(No Model.) 2 Sheets—Sheet 1.

J. J. SKINNER.

ELECTRIC LAMP.

No. 370,423. Patented Sept. 27, 1887.

Fig. 1

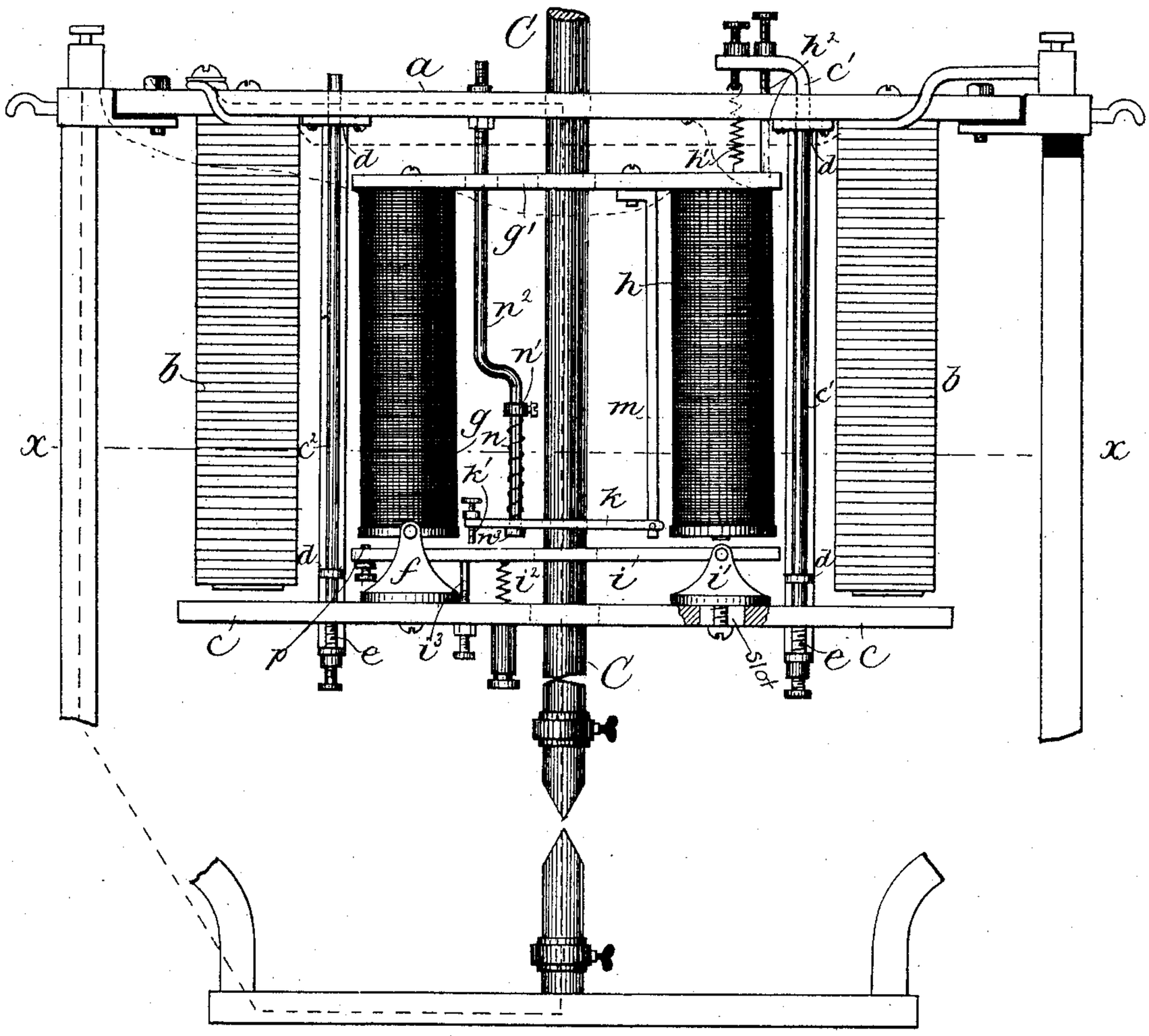
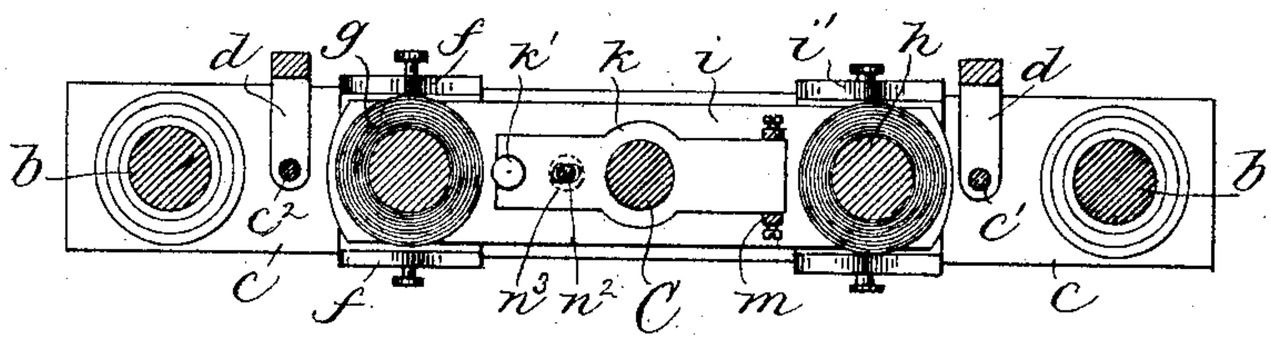


Fig. 2.



Witnesses,
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(No Model.) 2 Sheets—Sheet 2.

J. J. SKINNER.

ELECTRIC LAMP.

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Fig. 3.

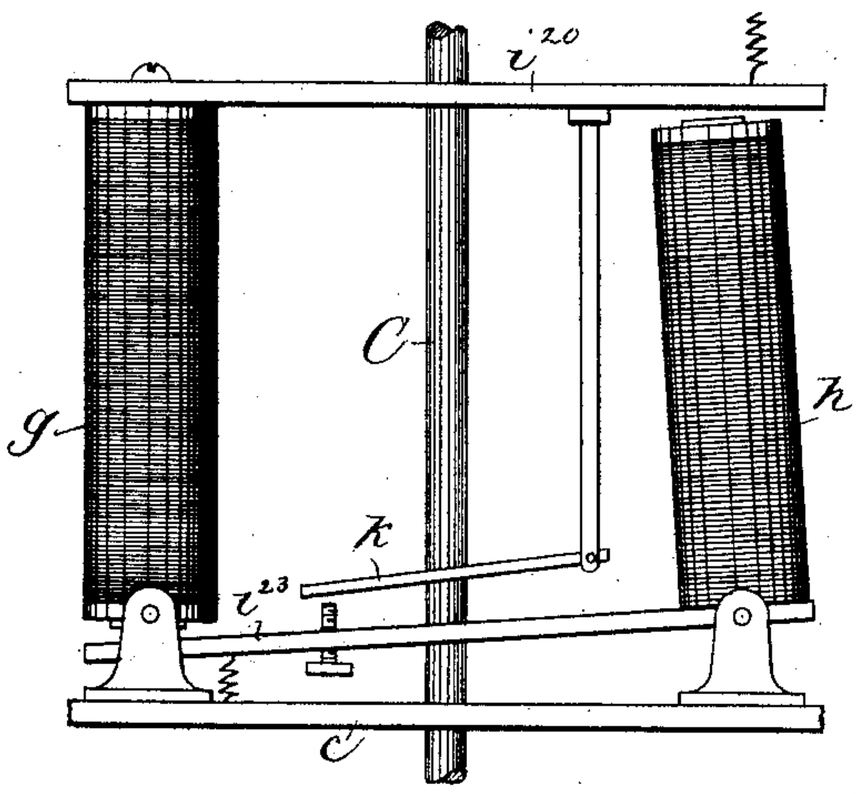


Fig. 5.

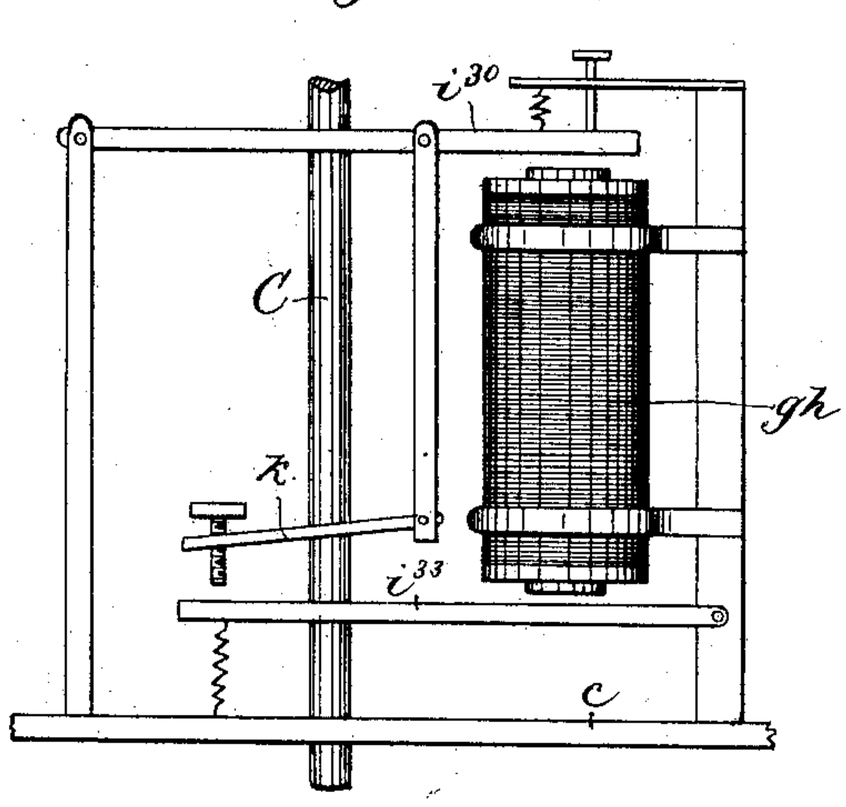


Fig. 4.

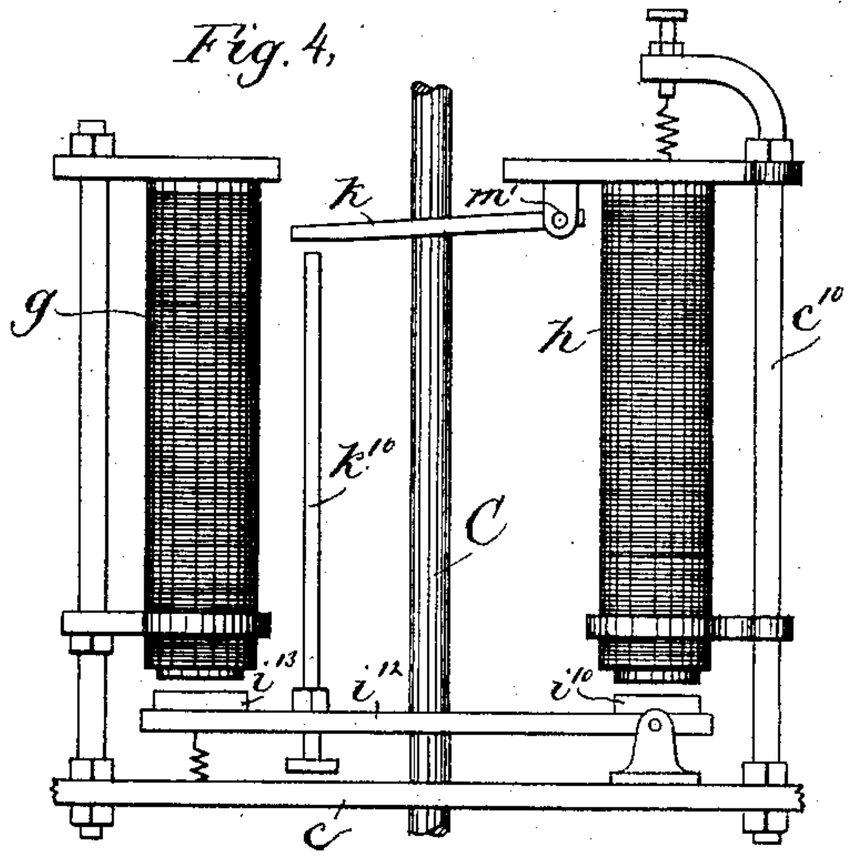
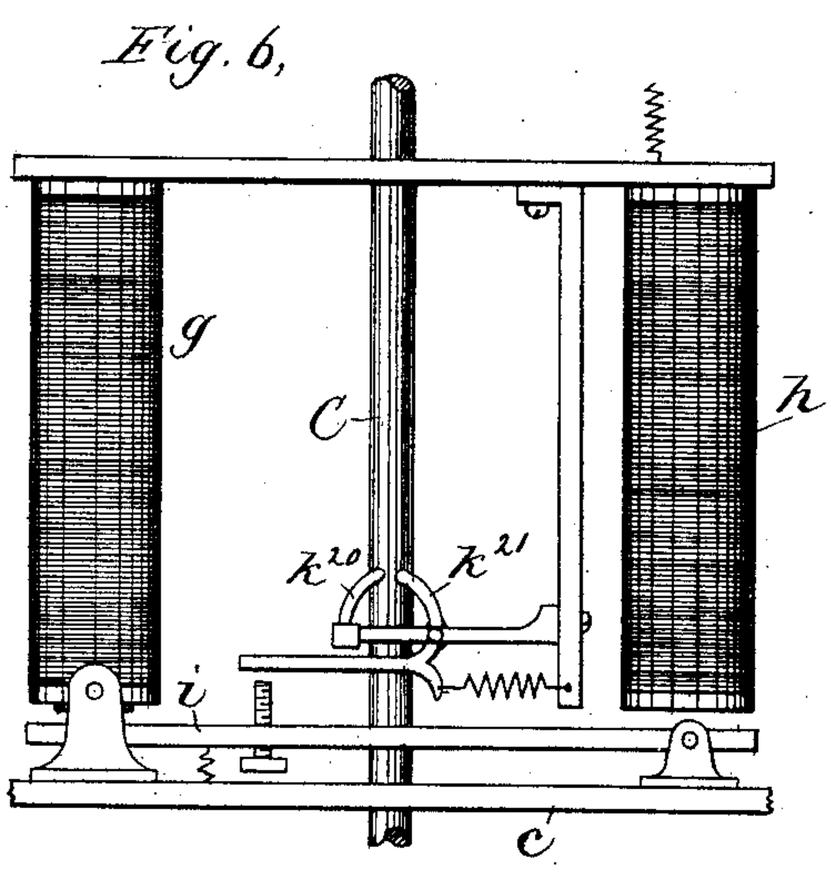


Fig. 6.



Witnesses,
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UNITED STATES PATENT OFFICE.

JOSEPH J. SKINNER, OF BOSTON, MASSACHUSETTS.

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 370,423, dated September 27, 1887.

Application filed April 5, 1886. Serial No. 197,846. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH J. SKINNER, of Boston, county of Suffolk, State of Massachusetts, have invented an Improvement in Electric Lamps, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention is shown embodied in an electric lamp of that class in which the feed of the carbon or its supporting-rod is controlled independently of the devices by which the carbons are originally separated to establish the arc when the lamp begins to burn.

In Patent No. 297,022, granted to me April 15, 1884, a lamp is shown having a carbon-controlling clamp that is operated to grip or release the carbon-rod independently of the bodily movement of the clamp by which the carbons are separated and independently of the position of the clamp with relation to the stationary frame-work of the lamp. In the lamp shown in the drawings of the said patent the clamp was lifted bodily while gripping the carbon-rod in order to separate the carbons and establish the arc by means of a magnet in the main circuit; and the clamp also had an additional movement controlled by a magnet, called a "depressing-magnet," in a shunt around the arc, by means of which an additional lifting movement of the clamp might be produced in order to establish or lengthen the arc if it happened to be shortened by an overfeed. As shown in the drawings of that patent, however, the depressing-magnet had no control over the gripping action of the clamp, which gripping action was controlled by a separate magnet.

One feature of the present invention consists in controlling the clamp by two electro-magnetic devices, each of which may operate to affect the gripping action of the clamp and also its bodily movement parallel with the axis of the carbon-rod, both devices normally cooperating to produce the feed and to control the position of the carbon-rod, although either one is capable of producing and controlling the feed when acting alone. The two electro-magnetic devices may either be two separate electro-magnets and armatures or two magnet-poles acting on a single armature and capable of producing independent movements or mechanical operations by the action of either pole relative to the adjacent part of the armature; or it may be a single magnet having two armatures, each capable of independent movement, the principal feature being that two movements are or may be produced by a variation in the current, due to a change in the length of the arc, each of which movements is imparted to a different part of the clamp, tending to increase or diminish its grip on the carbon-rod and contributing to raise or lower the clamp and carbon-rod, as the case may require. These various forms of electro-magnetic device are herein illustrated in separate details, showing the clamp and the parts that control its movement and in the illustration showing the entire operative parts of a lamp they are embodied in a form that gives excellent results in practical working. In this form the desired movements of the clamp are produced by two separate magnet coils and cores, which are shown as united, so as to form, magnetically considered, a single horseshoe-magnet, although, owing to their mechanical relations, they may be considered as separate magnets, and will, for convenience, be spoken of as such, since the attractive force in each one produces an entirely distinct and independent mechanical action and effect. The said magnets are shown rigidly connected and held by a pivot, so that they may oscillate about an axis near one pole and so that the variations in attraction of the other pole, acting on a relatively stationary part of the armature, tend to produce an oscillating movement of the magnets or to move the latter pole relatively to the armature, and the armature for the said magnets is pivoted near one end nearly opposite the said moving pole, while the free end of the armature is in the field of the other pole of the magnet, at or near the axis about which the magnets turn. By this arrangement a variation in the attraction of the last-mentioned magnet or core will tend to produce a movement of the free end of the armature, but will produce no movement of the magnets themselves, while the variations in the magnetic force of the other core will tend to produce a movement of the said core toward and from the armature, but will produce no movement of the armature itself.

The clamp is in most of the modifications

illustrated shown as the usual ring-clamp, which, when at right angles to the carbon or its holding-rod, or nearly so, permits the latter to slip through it to feed the carbon, and which, when inclined to the axis of the carbon-rod, grips or binds the said rod, so that if the clamp when in this position is moved parallel with the axis of the carbon-rod it will carry the said rod with it, causing the carbon to approach or recede from the opposite carbon. An upward or downward movement from the horizontal position of either end of the clamp with relation to the other end will tend to thus incline it and cause it to grip the rod. In my invention one end of the clamp is connected with one of the electro-magnetic devices—as, for instance, with the movable magnet—this being normally the higher end of the clamp, and the other or lower end of the clamp is acted upon by the other electro-magnetic device—as, for instance, the armature of the magnets—which armature when lifted tends to raise the said lower end of the clamp or bring it to the level of the other end, and the movement of either end from any given position that the clamp may occupy while the lamp is in operation may be sufficient to cause the feed to take place without a corresponding movement of the other end, although in the normal operation both ends will move simultaneously in such a way as to cause the feed to take place or to check the feed.

Some of the mechanical and electrical combinations embodied in the present invention are applicable to other apparatus than an electric lamp, and the invention, so far as relates to such combinations, is not limited to their use in an electric lamp.

Figure 1 is a front elevation of an electric lamp embodying this invention; Fig. 2, a horizontal section thereof on line *x x;* and Figs. 3, 4, 5, and 6 are details showing various modifications in the construction of the electro-magnetic device and clamp.

The entire operative parts of the lamp may be supported on a cross-bar, *a*, which may be of iron and form the back strap for two magnet-cores, which are provided with the usual coils and which constitute the lifting-magnet *b*, by which the carbons are separated to establish the arc in starting the lamp. The said magnet *b* acts on an armature, *c*, provided with guide-rods c' c^2, working in guides *d*, connected with the main frame or back strap, *a*, the said rod c' being shown as passing through the frame *a*, and having its upper end parallel therewith. The downward or retractive movement of the armature *c* is produced by gravity and is limited by adjustable stops *e*. (Shown as connected with the ends of the stationary guide-pieces *d*.)

The armature *c* is provided with an upright or bracket, *f*, in which is pivoted an electro-magnet, *g*, consisting of a straight core and coil wound thereon, the said core being shown as connected by an iron bar, g', with a similar magnet, *h*, which is preferably connected in the same circuit with and affected by the same current as the magnet *g*, so that, magnetically considered, the said magnets *g* and *h* form a single horseshoe-magnet, although they will be, for convenience, spoken of as separate magnets, as they produce different mechanical effects and have different functions, and they might, if desired, be entirely separate magnets, the connecting-piece *g* then being of non-magnetic material; or the magnet *h* might be supported independently of the magnet *g*, and so as to have an up-and-down movement with relation to the armature *c*, which constitutes the frame-work upon which the said magnets are supported, as shown in Fig. 4, in which the magnet *h* is shown as mounted on guides longitudinally movable on the rod c^{10}, connected with the armature *c*, toward and from the armature i^{10} on an armature-lever, i^{12}, pivoted opposite the pole of the said magnet *h*. In this modification (represented in Fig. 4) the frame of the magnet *h* is directly connected with one end of the clamp *k*, as represented at m', and the magnet *g* is stationary and co-operates with an armature, i^{13}, on the lever i^{12}, which is provided with a projection, k^{10}, that engages the end of the clamp *k*.

The magnets *g* and *h*, as shown in Fig. 1, both co-operate with an armature, *i*, pivoted in a bracket, i', on the armature *c* of the lifting-magnet, the said pivot i' being about opposite the pole of the magnet *h*, so that the latter can produce no movement of the armature *i*, but is itself movable toward and from the said armature by the oscillation of the magnets *g* and *h* about their pivot in the bracket *f*. The free end of the armature *i* is opposite the pole of the magnet *g*, and is movable toward and from the pole of the said magnet, which pole is itself practically motionless, as its slight oscillation on the pivot produces no mechanical effect and is immaterial to the operation.

A retractor, h', tends to raise the magnet *h* or withdraw it from the armature *i*, and a retractor, i^2, tends to draw down the armature *i* from the pole of the magnet *g*, the said retractors being adjustable in any usual manner. An adjustable stop, h^2, in the end of the rod c' limits the upward movement of the magnet *h* by the retractor h', and another adjustable stop, i^3, limits the downward movement of the armature *i* by the retractor i^2.

The magnet *h* is operatively connected with one end of the clamp *k*, which is shown as pivotally connected with an arm, *m*, fixed on the bar g', the pivotal connection being about opposite the pole of the magnet *h*, so that it has an up-and-down movement with the said magnet-pole, turning about the pivot of the magnet *g* in the bracket *f* as a center. The other end of the clamp *k* is in position to be acted upon by the armature *i* as it is attracted by the magnet *g*, the said armature striking against an adjustable contact-piece, k', connected with the clamp, the adjacent end of which is acted upon by a spring, *n*, tending to press it downward with relation to its piv-

otal point on the arm *m*. The frame *a*, connecting-piece *g'*, for magnets *g* and *h*, and armatures *i* and *c* are each provided with an opening of sufficient size to permit the carbon-rod C to move through them without contact, except that either the frame *a* or the armature *c*, but not both of them, may have its opening small enough to serve as a guide of the carbon-rod. If the armature *c* is thus used as a guide, the clamp *k* may be located near the upper ends of the magnets *g* and *h*, as represented in Fig. 4. The clamp *k* is provided with an opening slightly larger than the carbon-rod, so that when the said clamp is at right angles to the rod the carbon will move freely downward until arrested by the carbons coming in contact; but when the said clamp is slightly inclined it will grip the rod and prevent it from moving lengthwise through the clamp. The clamp serves also as a second guide for the carbon-rod, and the rod needs no other guide than the clamp and the opening in *a* or *c*, as stated. The spring *n*, referring to Fig. 1, bears against a collar, *n'*, on a rod, n^2, adjustably connected with the frame *a* and passing freely through a hole in the bar *g'*, so that when the parts supported by the armature *c* rise the said spring tends to hold the adjacent end of the clamp down, and the raising of the other end by the arm *m* and its connections with the armature *c* first tilts the clamp so as to grip the rod C, and then its further movement carries the rod C bodily upward with it, compressing the spring *n*.

The end of the rod n^2 is enlarged or provided with a head that forms a stop, n^3, limiting the downward movement of the adjacent end of the clamp, so that when the armature *c* falls, when the current ceases to flow, the stop n^3 will arrest the downward movement of the adjacent end of the clamp and cause it to take nearly a horizontal position, so that it will release the carbon-rod C and permit the carbons to come in contact to complete the circuit in the usual manner.

When no current is flowing, the armature *c* will be in its lowest position, the magnet *h* in the highest position with relation to the said armature *c*, and the armature *i* in the lowest position with relation to the said armature *c* and some distance from the contact-piece *k'* of the clamp, and the stop n^3 is about opposite the pivoted connection of the clamp *k* with the arm *m* when the parts are in this position, so that the said clamp is about horizontal and the carbon-rod released, as before mentioned.

When the lamp is intended to be used as one of a series, the magnet *b* will be connected in the direct circuit with the carbons, and the magnets *g h* will be preferably connected *seriatim* in a shunt around the carbons and arc when established. With the parts in this condition, when the current begins to flow the magnet *b* is strongly energized, while the magnets *g h* are only slightly energized, and the attraction of the magnet *b* raises the armature *c* and all the parts connected therewith, thus raising the arm *m* and connected end of the clamp, while the spring *n* tends to prevent the other end of the clamp from rising, so that the clamp tilts, engages the carbon-rod and raises it bodily, separating the carbons and establishing the arc, and the armature *c* has no further movement in the subsequent operation of the lamp, and forms a stationary frame-work for the feeding devices supported on it. As the arc approaches its normal length, more current is caused to pass through the magnets *g h*, energizing them, so that as the arc arrives at its normal length the magnet *h* is drawn down by its attraction toward the armature *i*, and the opposite end of the armature *i* is drawn upward to the contact-piece *k'* by the attraction of the magnet *g*. The downward movement of the magnet *h* tends to draw down the adjacent end of the clamp *k*, which movement, provided that the other end has no movement, tends to release the carbon-rod and permit it to feed. At the same time the upward movement of the armature *i* acts on the opposite end of the clamp, tending to raise it, which movement alone might be sufficient to cause the clamp to relax its hold on the rod and permit the latter to feed, and the feed is normally effected by the combined action of the two electro-magnetic devices on the opposite parts of the clamp.

In case the feed should be too great and the arc abnormally shortened, the attraction of the magnets *g* and *h* would be weakened, so that the retractor *h'* of the latter would tend to raise it, and at the same time the magnet *g* would tend to permit the armature *i* to be retracted, thus increasing the grip of the clamp, and at the same time permitting it to be moved bodily upward by the retractor *h'*, and thus bringing the arc to its normal length.

The parts should be so adjusted that in the normal operation the magnet *h* is drawn down and its retractor *h'* strained sufficiently to be able to raise the upper carbon from the lower in case they come together by the slipping of the rod through the clamp, so that the arc will be again established, and will cause the carbons to burn away until the arc becomes of normal length, when the feeding action will go on again, as before described.

The armature *i* may be provided with an adjustable stop, *p*, (shown as engaging the end of the magnet *g*,) so as to prevent the said armature from engaging the clamp when its opposite end is in the highest position, or with the magnet *h* retracted against its back-stop h^2, and this insures that the feed shall not take place until the magnet *h* is drawn down a certain distance from its back-stop, moving the clamp downward bodily from the highest position that it can assume under the action of the retractor *h'*. In practice the position that the clamp assumes in the normal operation of the lamp will be determined by the adjustment of the retractors *h'* and i^2, which should preferably be so adjusted that the magnet *h* and the armature *i* shall each take an intermediate

position with relation to their back-stops and their co-operating armature or magnet-pole, and be thus free to move in either direction, as may be required, for the proper operation of the feed. As soon as the arc is established, the weight of the upper carbon with its holding-rod, if one is used, is borne on the clamp, and is thus divided between the force of the retractor h' and the upward pull of the magnet g on the armature i; and it will be seen that the clamp may be in equilibrium in positions at different heights with relation to the armature c, or frame-work of the lamp, according as the weight supported on it varies by the consumption of the carbon—a result not attained by the usual feed mechanism, in which the clamp is acted upon at one point by the force of one or more electro magnets and engaged at another point by a stationary stop on the frame-work of the lamp.

The bracket i', that supports the armature i, is adjustably connected with the armature c, being shown as fastened thereon by a screw passing through a slot, as indicated in Fig. 1. By this means it may be adjusted so that the attraction of the magnet h acts either at one or the other side of the pivotal axis of the armature i or directly over the said axis, so that the attraction of the magnet h may be made to assist or oppose that of the magnet g in its tendency to move the armature i or to produce absolutely no tendency to move the said armature, as the case may require.

It is obvious that the magnet h might co-operate with a separate armature from that of the magnet g, in order to produce the desired movement of the end of the clamp controlled by it, as represented in Figs. 3, 4, and 5, and that its movement might be produced either by the magnet h moving with relation to its armature, as shown in Figs. 1, 4, and 6, or by moving the armature with relation to it in the more usual manner, as shown in Figs. 4 and 5, and there are numerous modifications in the mechanical construction and arrangement of the said magnets and their connections with the clamp, the principal feature being that there are two electro-magnetic devices responding to similar changes in electric condition, but each acting upon a different part of the clamp and being capable of producing an independent effect thereon. Some of these modifications are illustrated in Figs. 3, 5, and 4, the latter of which has been already sufficiently described. In the modification shown in Fig. 3 each of the magnets g and h is a straight magnet provided at one end with an extended pole-piece, i^{20} i^{23}, which pole-piece for each magnet serves as the armature for the other magnet, the two magnets and pole-pieces or armatures thus forming a magnetic circuit. Each magnet is shown as pivoted near one end in such manner that the attraction of its pole-piece by the other magnet produces a rocking movement, and the mode of operation on the clamp k will be apparent without further explanation, being substantially the same as already described in connection with Fig. 1—that is, the attraction of the magnet h on the part i^{20} tends to lower the pivoted end of the clamp k, and the attraction of the magnet g on the armature i^{23} tends to raise the other end of the clamp. In the modification shown in Fig. 5 a single-bar magnet, gh, performs the function of the two separate magnets shown in the other figures, one pole—namely, the upper one—corresponding to the magnet h and the lower pole corresponding to the magnet g of the other figures, and these two poles, which may be considered as two separate magnets, so far as their mechanical effect is concerned, co-operate with the two separate armatures i^{30} i^{33}, which affect the clamp in a manner that will be readily understood from the drawings. In this construction the magnets are stationary and the movement is confined wholly to the armatures.

The mechanical construction illustrated in Fig. 1, in which two magnets are rigidly connected and are pivoted near the pole of one, is a convenient one, and it is preferable to have the two magnet-cores magnetically connected and acting on a single armature, so that together they form a magnetic circuit, and each one tends to strengthen or increase the action of the other; but the invention is not limited to this construction, as shown by the various modifications herein illustrated, all of which comprise substantially the same combination of parts—namely, the clamp or equivalent device and two electro-magnetic devices, each comprising a magnet-pole and corresponding armature, constituting two members, one of which is movable with relation to the other, and the movable member of each of which acts upon the clamp at a different point from the other to control it, in the manner set forth.

I hereby reserve the right to claim the specific construction represented in Figs. 3, 4, and 5 in other applications for Letters Patent, as the specific construction of the two electro-magnetic devices employed in the cases represented in each of these figures is not claimed in the present application, but is merely shown for the purpose of illustrating different ways in which said devices may be constructed and arranged with relation to the clamp. The specific arrangement of the magnets and their armature pivoted with relation to one another, as herein shown, is applicable to other apparatus besides electric lamps, and I do not desire to be limited to the application of these devices to the clamp of an electric lamp, as herein shown.

The herein-described feed mechanism is applicable to a lamp operating alone or singly in an electric circuit by placing the magnets g and h in the main circuit, using wire of proper conductivity and arranging the relation of attractive and retractive forces acting on the clamp, so that the feed will be produced upon a decrease in the strength of the magnets g and h, instead of upon an increase thereof, as herein described, as will be apparent to any one fa-

miliar with the construction of electric lamps. The clamp is herein shown as acting upon a rod to which the upper carbon is attached; but it is obvious that it might act upon the upper carbon directly, the holding-rod being omitted.

The feed mechanism is shown as applied to and acting on a ring-clamp; but it is obvious that it is equally applicable to other kinds of clamps in which the gripping action depends on the movement of a point or portion of the clamp at one side of the carbon-rod relative to a point or portion at the other side of the carbon-rod.

Fig. 6 illustrates the invention applied to another form of clamp consisting of a rigid jaw, k^{20}, and a pivoted jaw, k^{21}, the said rigid jaw, together with the pivot of the other jaw, being moved by one of the magnetic devices, while the pivoted jaw is turned on its pivot by the other of the said magnetic devices, and the combined action of the two magnetic devices tends to increase or decrease the grip of the clamp, as when the ring-clamp is used.

I claim—

1. The combination, with the clamp, of two electro-magnetic devices, each comprising an electro-magnet pole and armature, constituting two members, one of which members in each device is movable with relation to the other members of the same device, the said devices having coils included in one circuit, the movable member of one of said devices engaging with the clamp at one place and the movable member of the other of said devices engaging with said clamp at another place, substantially as and for the purpose described.

2. The combination of two electro-magnets and an armature pivoted opposite the pole of one of the said magnets, which magnet is movable toward and from the said armature, whereby changes in magnetic condition of one of the said magnets tend to produce a movement of the magnet relative to the armature and changes in the magnetic condition of the other tend to produce a movement of the armature relative to the magnet, substantially as described.

3. The two magnet-cores and coils thereon, and a bar connecting the said cores, the said connected magnets being pivoted near the axis of one, combined with an armature pivoted near the axis of the other magnet, substantially as described.

4. The combination of the lifting-magnet and its armature with a clamp and two electro-magnetic devices, each comprising two members, one of which members of each device is movable with relation to the other members of the same device, and both of which devices are supported on and movable with the said armature of the lifting-magnet, the movable member of each of said electro-magnetic devices engaging with the clamp at a different point from the other, substantially as and for the purpose described.

5. The combination, with a clamp, of two electro-magnetic devices, each comprising a magnet-pole and corresponding armature, constituting two members, one of which members of each device is movable with relation to the other members of the same device, the said poles being in one magnetic circuit and the movable member of each device engaging the clamp at a different point from the other, substantially as and for the purpose described.

6. The two magnet-cores and coils thereon and bar connecting the said cores, the said connected magnets being pivoted near the axis of one, combined with an armature pivoted near the axis of the other and means to adjust the pivot of the said armature, substantially as described.

7. The combination, with a clamp, of an electro-magnetic device connected with one portion thereof, and an electro-magnetic device acting on a different portion thereof, each of said devices acting on the clamp and controlling the gripping action thereof, and a stop limiting the action of one of the said devices, whereby it is prevented from operating on the clamp until the other device has been brought into operative position, substantially as described.

8. The combination of two electro-magnet poles with an armature pivoted opposite one of the said poles, in the field thereof, and having its free end in the field of the other of the said poles, and means for adjusting the position of the armature-pivot with relation to the adjacent magnet-pole, as described, whereby the attractive force at the pivoted end of the armature may be caused to act in conjunction with or in opposition to that acting on the other end of the armature, substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOSEPH J. SKINNER.

Witnesses:
JOS. P. LIVERMORE,
H. P. BATES.