(No Model.)

2 Sheets—Sheet 1.

J. J. SKINNER.

ELECTRIC ARC LAMP.

No. 297,022. Patented Apr. 15, 1884.

Fig: 4.

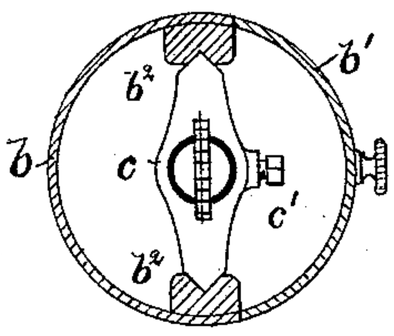

Fig: 1.

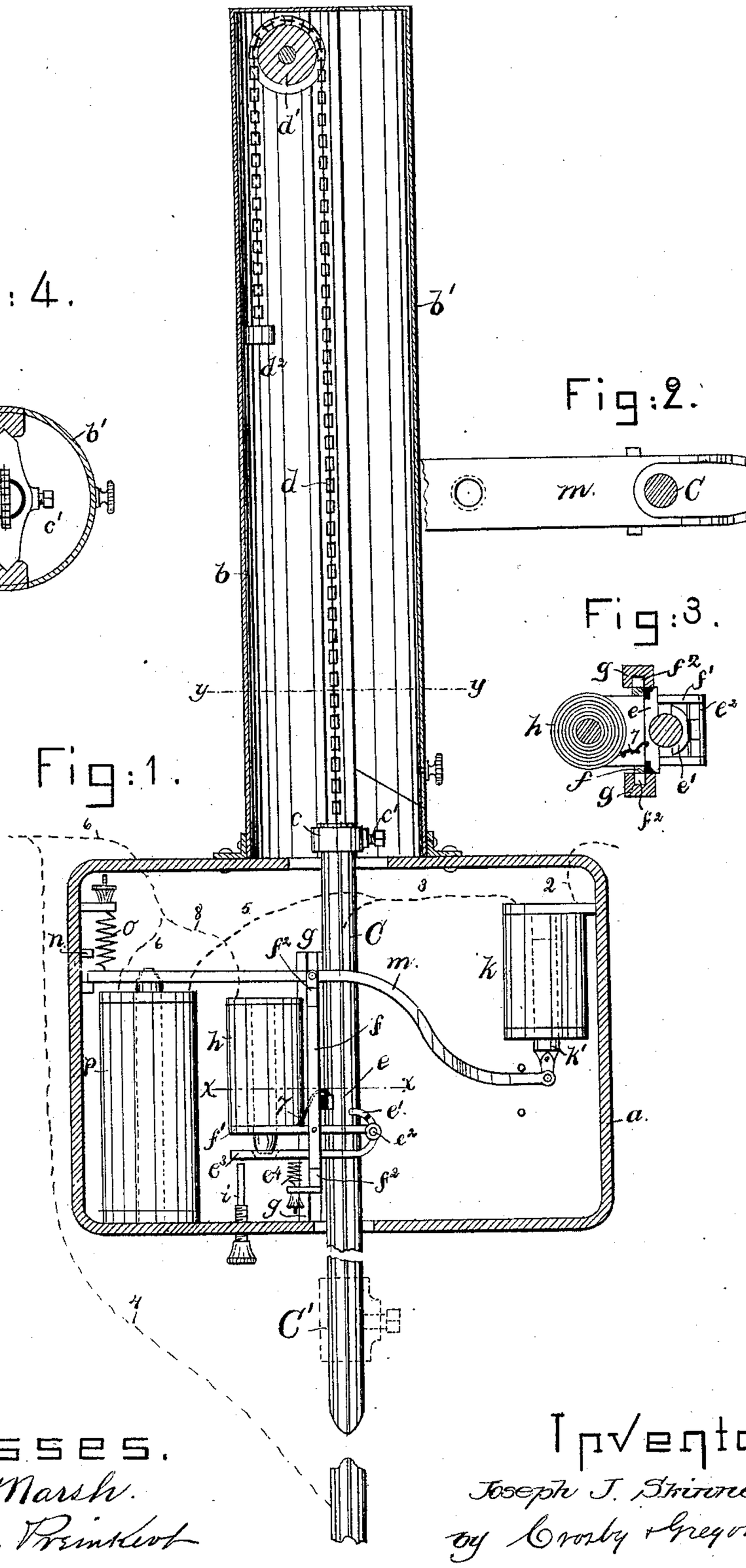

Fig: 2.

Fig: 3.

Witnesses.

Henry Marsh.

John F. C. Printkert

Inventor.

Joseph J. Skinner.

by Crosby & Gregory attys

(No Model.) 2 Sheets—Sheet 2.

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Fig. 5.

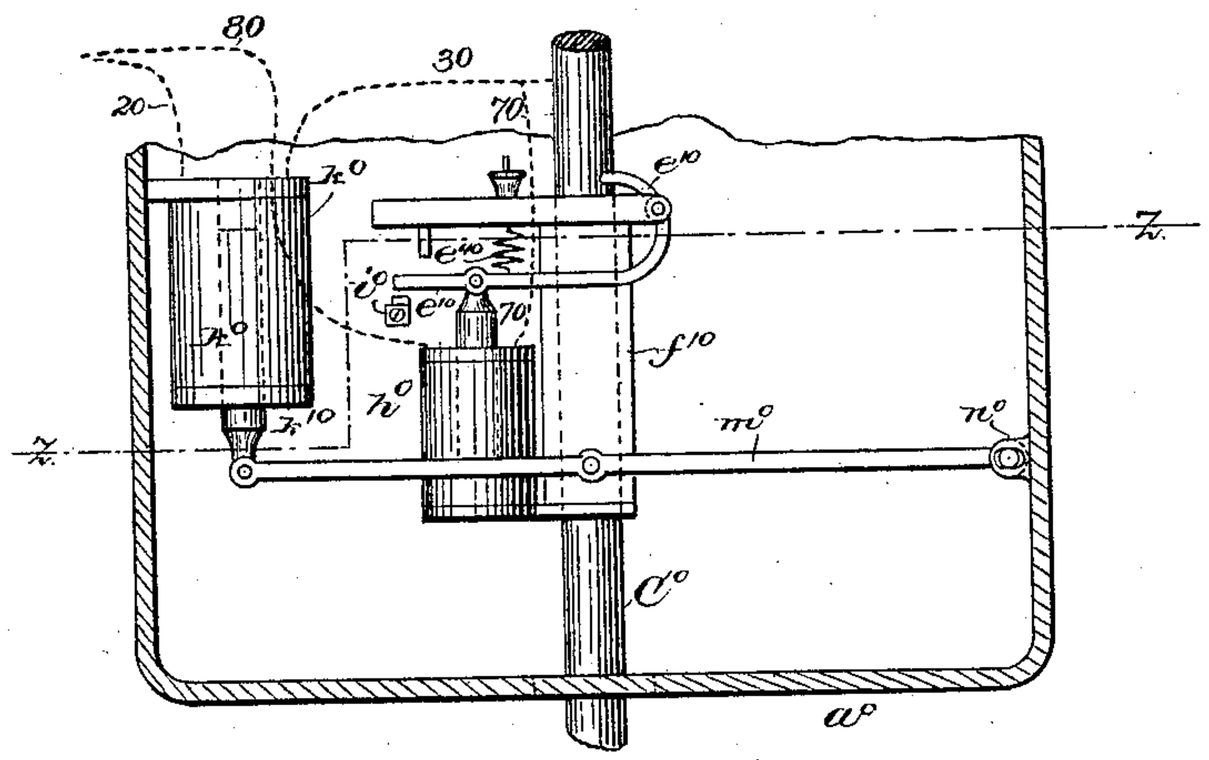


Fig. 6.

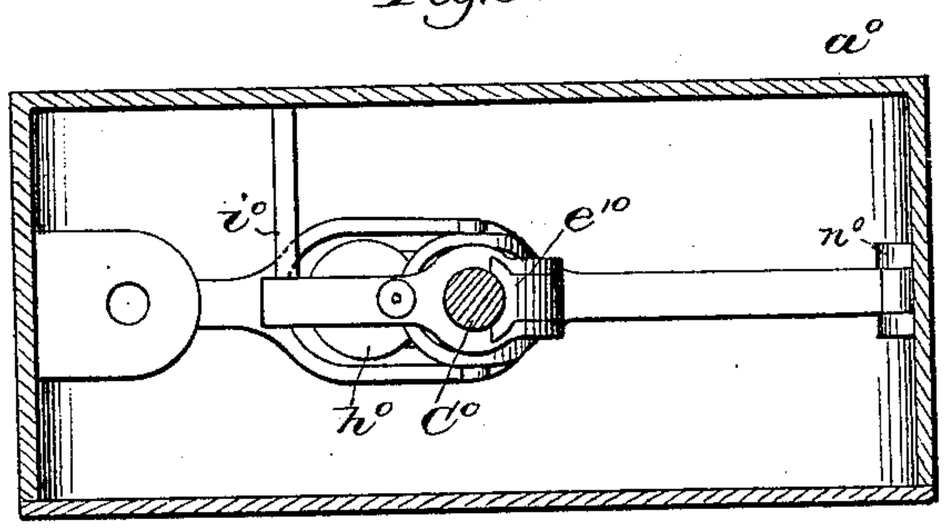
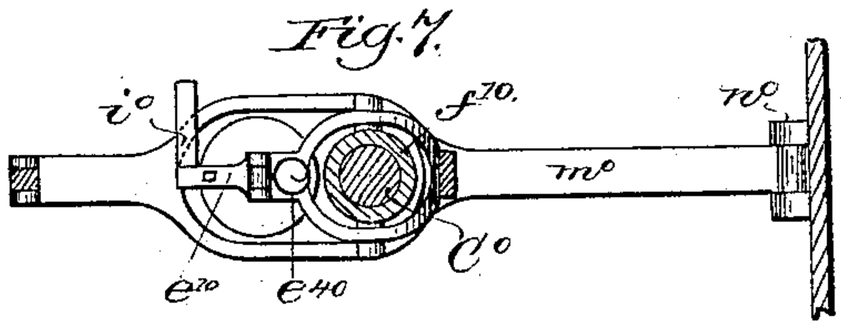


Fig. 7.



Witnesses.
John F. C. Prinkert
Henry Marsh.

Inventor.
Joseph J. Skinner.
by Crosby & Gregory attys

UNITED STATES PATENT OFFICE.

JOSEPH J. SKINNER, OF NEWTONVILLE, MASSACHUSETTS.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 297,022, dated April 15, 1884.

Application filed November 12, 1883. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH J. SKINNER, of Newtonville, county of Middlesex, 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, relating to electric lamps, has for its object to provide a simple, inexpensive, and effective mechanism for feeding the carbon, also enabling the lamp to be made shorter than those in general use. In one type of electric lamp now in general use, the upper carbon, or a rod having the upper carbon attached to it, is engaged by a clutch, which, in some cases, consists of a fixed and movable jaw, or their equivalents, the said clutch being mounted on a movable device that is raised and lowered by the attractive force of one or more electro-magnets actuated by the currents that produce the light, and which device, when moved toward a certain position—namely, its lowest position relative to the frame-work of the lamp—causes the jaws of the clutch to be separated, so as to permit the carbon or rod to slip under the action of gravity, and thereby feed the said carbon downward as its lower end burns away. The operation of the clutch-jaws, or the movement of one jaw from the other, is thus caused by and dependent upon the bodily movement of the entire clutch or clamp relative to the frame-work or main stationary portion of the lamp. In the so-called "washer," "clutch," or "ring-clamp," which may be employed in carrying out the present invention, the opposite sides of the ring constitute the two holding-jaws, and the tilting or inclination of the said ring causes the movement of the said jaws toward and from one another, (when considered with relation to their projection on a plane at right angles to the axis of the carbon,) by which movement the carbon is gripped when it is raised to establish the arc, or is released to feed the carbon, the gripping or releasing by the clutch being dependent upon the bodily movement of the said clutch or ring parallel with the axis of the carbon.

The present invention consists, partly, in a clamp or clutch the jaws of which are operated to grip or release the carbon without bodily movement of the said clamp by a suitable electro-magnet, preferably connected with and accompanying the clamp in its bodily movement, which movement of the clamp is produced by an electro-magnet in the usual manner, to separate the carbons and establish the arc in first setting the lamp in operation, the feed of the carbon thus being independent of its movement by which the arc was established, although both movements of the carbon are controlled by the same clutch or clamp. For convenience in distinguishing between the different functions of the clutch or clamp, it will hereinafter be called a "clutch" when referred to with relation to the movement of the jaws relative to one another, and as the "clamp" when its bodily movement is considered, as in all cases during such bodily movement, when of considerable amount, the jaws are closed and the carbon held or clamped by them. When several lamps are to be operated simultaneously in the same circuit in which the current is to be maintained substantially uniform, the magnet for producing the bodily movement of the clamp is included in the main circuit, while the feed or clutch controlling magnet, which causes the movement of the jaws of the clutch relative to one another, is included in a shunt-circuit around the arc, so that the strength of the current passing through it is proportional to the length of the arc, as usual. When no current is flowing, the clamp is in its lowest position with relation to the frame-work or box of the lamp, and the jaws of the clutch are at this time separated to permit the upper carbon to make contact with the lower carbon. As soon, however, as the current begins to flow, the lifting-magnet in the main circuit will raise the clamp bodily, the jaws of the clutch closing as it leaves its lowest position, and thus lifting the upper carbon with it and establishing the arc, after which the clamp will have no further bodily movement; but as the carbon burns away and the arc lengthens, the clutch-operating magnet will operate to separate the jaws of the clutch, permitting the upper carbon to slip downward or feed by the action of gravity. A depressing-magnet is

preferably also employed in a shunt-circuit, operating to move the clamp bodily downward, so that the separation of the carbon in establishing the arc is due to the difference of the bodily movements of the clamp that would be produced by the said lifting and depressing magnets. The said depressing-magnet is of such resistance, or so proportioned to the clutch-operating magnet, that it receives a maximum effect before the clutch-operating magnet begins to act, and consequently the clamp will come to rest under the opposing action of the said raising and depressing magnets before the feed takes place, and as long as the lamp remains in normal operation there will be no further action on the part of the raising and depressing magnets. The depressing-magnet is opposed by a retractor tending to raise the clamp bodily, and in case the carbon should slip too great a distance through the clutch while the lamp is in operation, and thus bring the carbons in contact, the force of the said depressing-magnet would be diminished and its retractor would come into operation, raising the carbon sufficiently to re-establish the arc and permit the carbon to burn away, so as to restore the lamp to its normal operative condition.

Figure 1 is a vertical section of the lamp embodying this invention; Fig. 2, a detail of the armature-lever of the clamp raising and lowering magnets; Fig. 3, a sectional detail in line *x x*, Fig. 1; Fig. 4, a sectional detail on line *y y*, Fig. 1; Fig. 5, a modification showing the invention embodied in a single lamp, or one intended to be operated in an electric circuit not containing other lamps; Fig. 6, a plan view of the apparatus shown in Fig. 5; and Fig. 7, a sectional detail thereof on line *z z*, Fig. 5.

The frame-work of the lamp, including the box or case *a*, inclosing the main operative parts, and surmounted by a tube, *b*, to contain the carbon or rod to which the carbon is fastened, may be of any suitable or usual construction, the said tube *b*, however, being shown as divided longitudinally into two parts, or provided with a movable side piece, *b'*, which may be removed or turned aside to permit carbons to be inserted from above the lamp-box, the invention being shown in this instance as embodied in a lamp in which the upper carbon, C, is held and operated directly by the clamp, instead of being attached to a rod controlled by the clamp, although the latter construction might be employed without departing from the main features of the invention, in which case the part marked C would be the usual carbon-rod, and would be provided at its lower end with a clamp or socket such as shown in dotted lines at C', in which the carbon would be fastened.

The tube *b'* is provided with guides b^2, (best shown in Fig. 4,) in which a carriage or cross-head, *c*, is free to travel vertically, the said cross-head being adapted to have the upper carbon secured to it, as by the set-screw c'. The said cross-head *c* has connected with it an automatically varying counter-balance, (shown as a chain, *d*,) passing over a pulley, *d'*, at the upper end of the tube *b*, the said chain being drawn over the said pulley as the carbon descends, and being of such weight per unit of length that as it is drawn over the pulley by the descent of the carbon while burning away the resultant weight or downward force upon the carbon remains constant. For instance, if the carbon moves downward, as is usually the case, one-half faster than it is consumed, or descends, for example, one and one-half inch while one inch is being removed from its lower end, the chain *d* should be of one-third the weight per unit of length that the carbon is, since the descent of the cross-head *c* through one and one-half inch adds three inches to the difference between the lengths of the parts of the chain on the opposite sides of the pulley, which is three times the length (namely one inch) of the upper carbon burned in such descent of the cross-head *c*. A weight, d^2, at the extremity of the chain overbalances the weight of the portion between the carbon and pulley, preventing it from drawing the remainder over the pulley. It is obvious that a variable counterbalance insuring a substantially uniform resultant downward force upon the carbon may be effected by other means or arrangements, which are, however, considered by me to be the equivalent of the one described. The carbon is thus caused to descend uniformly during the entire operation of the lamp, and the openings in the lamp-box *a*, through which the carbon passes, are made larger than the carbon, so that the latter does not touch the box, but is guided only by the cross-head *c* and the clutch-jaws, thus reducing friction and rendering the operation much more uniform. The clutch or clamp by which the carbon C is held and is raised to establish the arc, and by which the feed of the said carbon is subsequently controlled, is shown in this instance as consisting of a jaw, *e*, fixed upon a frame, *f f'*, provided with projections f^2, adapted to slide vertically in guides *g*, fixed upon the lamp-box, the other member of the said clamp consisting of a jaw, *e'*, pivoted at e^2 upon the portion *f''* of the clamp-frame, and provided with an operating-lever, e^3, acted upon by a spring, e^4, which, in the construction shown in Fig. 1, tends to close the jaws of the clutch and hold the carbon C fast. The said lever e^3 constitutes or is provided with an armature operated by the clutch-controlling magnet *h*, shown as having its pole shaped to produce a substantially uniform attractive effect upon the armature during a considerable range of movement of the said armature to and from the said pole. The attraction of the magnet *h*, when sufficient to overcome the spring e^4 or other retractor acting on the arm e^3, reduces the pressure of the jaws upon the carbon, thus permitting the latter to slip downward or feed

until, by its downward movement, the strength of the magnet *h* is reduced, causing the clamp to hold the carbon and check the feed until its lower end is further consumed, the operation being like that of clutches heretofore in use, except that the movement of the jaws is not produced by and not accompanied by a bodily movement of the said jaws or clamp-frame; and, furthermore, the feed takes place while the clamp is in its highest position instead of in its lowest position, as has usually been the case. The fixed jaw *e* is preferably located slightly higher than the jaw *e'*, as shown, thus enabling the carbons to be more easily inserted through the open jaws when applied from above through the opening made in the tube *b* by removing its side *b'*. The carbon, when of full length, may thus be pushed down in a slightly-inclined position through the clutch-jaws, and then connected at its upper end with the cross-head *c*, then at the upper end of the tube *b*, and the entire lamp is thus much shorter vertically than when a carbon-holding rod of at least the length of the part of the carbon consumed is used. By providing guides for the clamp-frame, the clutch is enabled to operate as one of the guides for the upper carbon, instead of the latter operating as the guide for the clutch or clamp, as is usually the case when the carbon or its rod is guided by bushings at the top and bottom of the lamp-box.

When the clamp-frame *f f'* is in its extreme lowest position, as when no current is flowing, the clamp-arm e^3 is engaged by a projection, *i*, on the lamp-box, thus separating the clamp-jaws and permitting the upper carbon to drop into contact with the lower carbon, so as to complete the circuit. The upper carbon is raised in order to establish the arc when the lamp first begins to operate by means of a lifting magnet or solenoid, *k*, the armature or core *k'* of which is connected with one arm of a lever, *m*, pivoted upon the frame *f f'*. Before the current begins to flow the other end of the said lever *m* is held by a spring, *o*, against the projection *n* on the lamp-box, which projection operates as a fulcrum for the lever while the magnet *k* is drawing on its other end to raise the carbon. The spring *o* operates on the lever *n* as a retractor from a depressing-magnet, *p*, in a shunt or branch circuit around the arc, the said magnet not being highly charged until the arc is of considerable length, although it is charged sufficiently to overcome the retracting-spring *o* before the arc arrives at its normal length, at which it is to be retained by the consumption and feeding of the carbon. The magnet *k*, when the circuit is first charged, by attracting its armature or core, lifts the clamp-frame and carbon C, which is gripped by the clamp immediately when its arm rises from the projection *i*, and thus forms the arc, and as the arc is lengthened by the further movement of the lifting-magnet, but before it reaches its normal length, the magnet *p* operates to draw the clamp downward or lower the fulcrum end of the lever *m* when considered with relation to the clamp and lifting-magnet, and the combined operation of the two magnets *k* and *p* will thus place and retain the upper carbon, C, at about the position of normal length of the arc, there being no further movement of the clamp-frame or bodily raising or lowering of the clamp. After the arc is thus established, suitable stops limit the movement of the lever *m* at either end, caused by the attraction of the magnets *k* and *p*. As the carbon burns away and the arc increases beyond its normal length, the clutch-controlling magnet *h* will be charged sufficiently to release the carbon held by the clutch and permit it to feed, and the feeding movement will diminish the strength of the magnet *h*, permitting the clutch-jaws to close again before the arc is shortened sufficiently to cause the magnet *p* to operate, so that the feed will go on, controlled by the movement of the clutch-jaws relative to one another, without any bodily movement of the clamp relative to the lamp-box. If, however, the clutch should fail to catch the carbon quickly enough, and the latter should drop so as to connect the carbons, and thereby prevent their consumption, the magnet *p* will have its strength reduced, so that the retractor *o* will raise the clamp and carbon sufficiently to establish an arc, and thus cause the carbons to burn away until the proper length of the arc is again reached, after which the normal operation of the lamp will continue as before described.

The means for making electrical connections and insulating the parts from one another may be of any usual character, the circuit arrangement preferred being indicated by dotted lines in Fig. 1, in which the line or circuit, entering by the wire 2, passes through the magnet *k*, and then by wire 3 to a suitable brush or contact spring bearing on the carbon C, through which the main circuit continues, traverses the arc, and passes from the lower carbon by the conductor represented at 4. Branching from the wire 3, a conductor, 5, passes to one terminal of the magnet *p*, the other terminal of which is connected by wire 6 with the wire 4, the said magnet *p* thus being in a shunt or derived circuit around the arc. The magnet *h* might be included in the same branch as the magnet *p*, if desired; but it is preferred to connect one member, as *e*, of the clamp, by wire 7, with one terminal of the said magnet, the other terminal of which is connected by wire 8 with the wires 6 and 4, the current thus being transmitted from the upper carbon through the clamp to the said magnet *h*, and thus tending to weaken the current passing through the said magnet as the clutch relaxes its pressure on the carbon, thereby reducing the tendency of the carbon to slip a great distance at a time. The upper carbon is preferably insulated from the cross-head *c*, and the jaws of the clutch and other conductors insulated from the lamp-box, which latter is thus wholly disconnected

from the circuit and cannot be brought into circuit by any accidental connection or metallic contact. When one lamp only is to be used in a circuit, the feed may be regulated by the variation in strength of the current in the said circuit produced by the burning away of the carbons and lengthening of the arc. In this construction (illustrated in Figs. 5, 6, 7) the feed-controlling magnet h^0, which may be either in the same circuit with the lifting-magnet k^0 or in a branch or shunt around the said magnet, operates by its attractive force to tighten or increase the pressure of the clamp-jaws, while its retractor e^{40} tends to release the carbon. In this construction the frame upon which the clutch and its controlling-magnet k^0 are supported consists, mainly, of a sleeve, f^{10}, surrounding the carbon, and having suitable projections, upon which the clutch-jaw e^{10} is pivoted and its retractor and magnet are supported. The circuit-wire 20 enters the lifting-magnet k^0, and is continued from such magnet, by wire 30, to the upper carbon, and thence to the arc. A branch, 80, of the wire 20 passes to the magnet h^0, the other terminal of which is connected by wire 10 with wire 30 and the upper carbons.

The operation of the lamp will be readily understood, it being substantially the same as that previously described, the corresponding parts having the same reference-letters, but having zero (0) appended to their index-marks. When the clamp is in its lowest position, the operating-arms e^{30} of the clutch-jaw e^{10} are engaged by a projection, i^0, separating the jaws of the clutch and permitting the carbons to rest in contact. When the current begins to flow, the magnets k^0 h^0 are both strongly charged, the former raising the clamp and the latter closing the jaws of the clutch as soon as it rises from the projection i^0, thus lifting the carbon and establishing the arc. As the carbon burns away, increasing the length of the arc, the current is weakened by the resistance, so that the magnet h^0 relaxes its holding-power on the clutch, permitting the carbon to feed until the power of the magnet h^0 is increased sufficiently to cause the clutch to hold the carbon. The magnets are so adjusted that the magnet h^0 will operate the clutch with a smaller change in current strength than is requisite to permit the magnet k^0 to lower the clamp, so that the feed takes place with the clamp in its highest position. A depressing-magnet may be used in a shunt around the arc to reestablish the arc in case the carbons come together while the clamp is raised, as previously described; but this will not be generally necessary, as the power of the magnet h^0 increases so greatly as the carbons approach one another that it will hardly be possible for the upper carbon to slip sufficiently to come in contact with the lower one.

I claim—

1. In an electric lamp, a clamp and lifting mechanism therefor, combined with a magnet controlling the jaws or carbon-gripping portions of the clamp independently of the position or movement of the clamp, whereby the said gripping portions are operated without bodily movement of the said clamp parallel with the carbon, substantially as described.

2. In an electric lamp, a clamp and lifting mechanism therefor, combined with an electromagnet rigidly connected with the said clamp and movable therewith, substantially as described.

3. In an electric lamp, a clamp and lifting mechanism therefor, combined with an independent magnet included in a shunt around the arc, and operatively connected with the jaws or gripping portion of the clamp, whereby the said gripping portion is operated to feed the carbon independently of the bodily movement of the clamp relative to the lamp-box, substantially as described.

4. In an electric lamp, a clamp and lifting-magnet therefor, combined with a depressing-magnet in a shunt-circuit around the arc, a retractor for said depressing-magnet, and an independent magnet operatively connected with the jaws or gripping portion of the clamp, and controlling the said gripping portion independently of the position of the clamp relative to the lamp box or frame, substantially as described.

5. The clamp and its lifting-magnet and a depressing-magnet in a shunt-circuit around the arc, the said magnets tending to move the clamp in opposite directions, and each operating independently of the other to produce its raising or lowering effect upon the clamp, combined with an independent controlling-magnet for the jaws or the gripping portion of the clamp, substantially as described.

6. In an electric lamp, the lamp-box containing the feed-controlling devices of the lamp, and tube surmounting the said box, having one side movable for the purpose of introducing the carbons from above the lamp-box, the carbon being engaged directly by the clamp, substantially as described.

7. The lamp-box and clamp and its operating mechanism therein, combined with the tube surmounting the box, provided with guides, and the cross-head movable therein, the said cross-head and clamp constituting the guides for the carbon, substantially as described.

8. The clamp and lifting mechanism therefor, combined with a magnet operatively connected with the jaw or gripping portion of the clamp, the said magnet being in a shunt-circuit around the arc, and the said shunt-circuit including the carbon and clamp-jaw, substantially as described.

9. The clamp-frame having a jaw or gripping member fixed upon it adapted to engage the carbon at one side only, and a co-operating jaw or gripping member pivoted on the said frame and adapted to engage the carbon at the opposite side, one of the said jaws be-

ing higher than the other, and the said jaws permitting a free movement of the carbon between them when the said carbon is in an inclined position, substantially as described.

10. In an electric lamp, the clamp-frame having carbon-gripping devices or jaws, combined with guides fixed with relation to the lamp box or frame-work, the said guides controlling the movement of the said clamp-frame, substantially as described.

11. In an electric lamp, a clamp and lifting mechanism therefor, combined with an independent magnet operatively connected with the jaws or gripping portion of the clamp, and controlling the said gripping portion independently of the position of the clamp relative to the frame-work of the lamp, and a stop whereby the grip of the clamp upon the carbon is relaxed when the clamp is in its lowest position with relation to the frame-work, substantially as described.

12. The lamp box or frame and guides b^2, and the cross-head C, movable therein, combined with the clamp-frame and clamp and guides therefor, the said cross-head and clutch determining the position of or guiding the carbon in its feeding movement, substantially as described.

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,
W. H. SIGSTON.