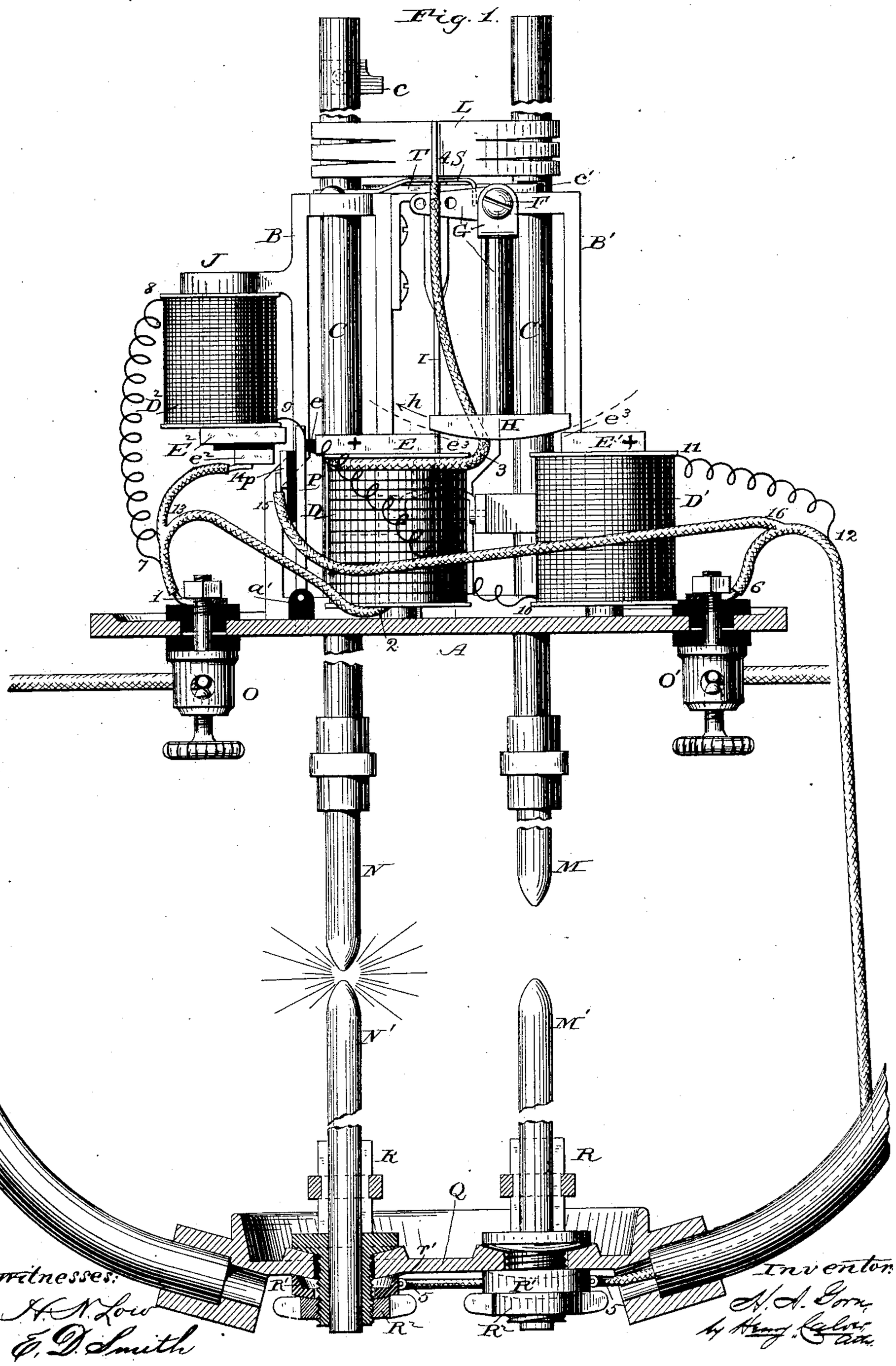
(No Model.) 3 Sheets—Sheet 1.

H. A. GORN.

ELECTRIC ARC LAMP.

No. 309,454. Patented Dec. 16, 1884.

Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 2.

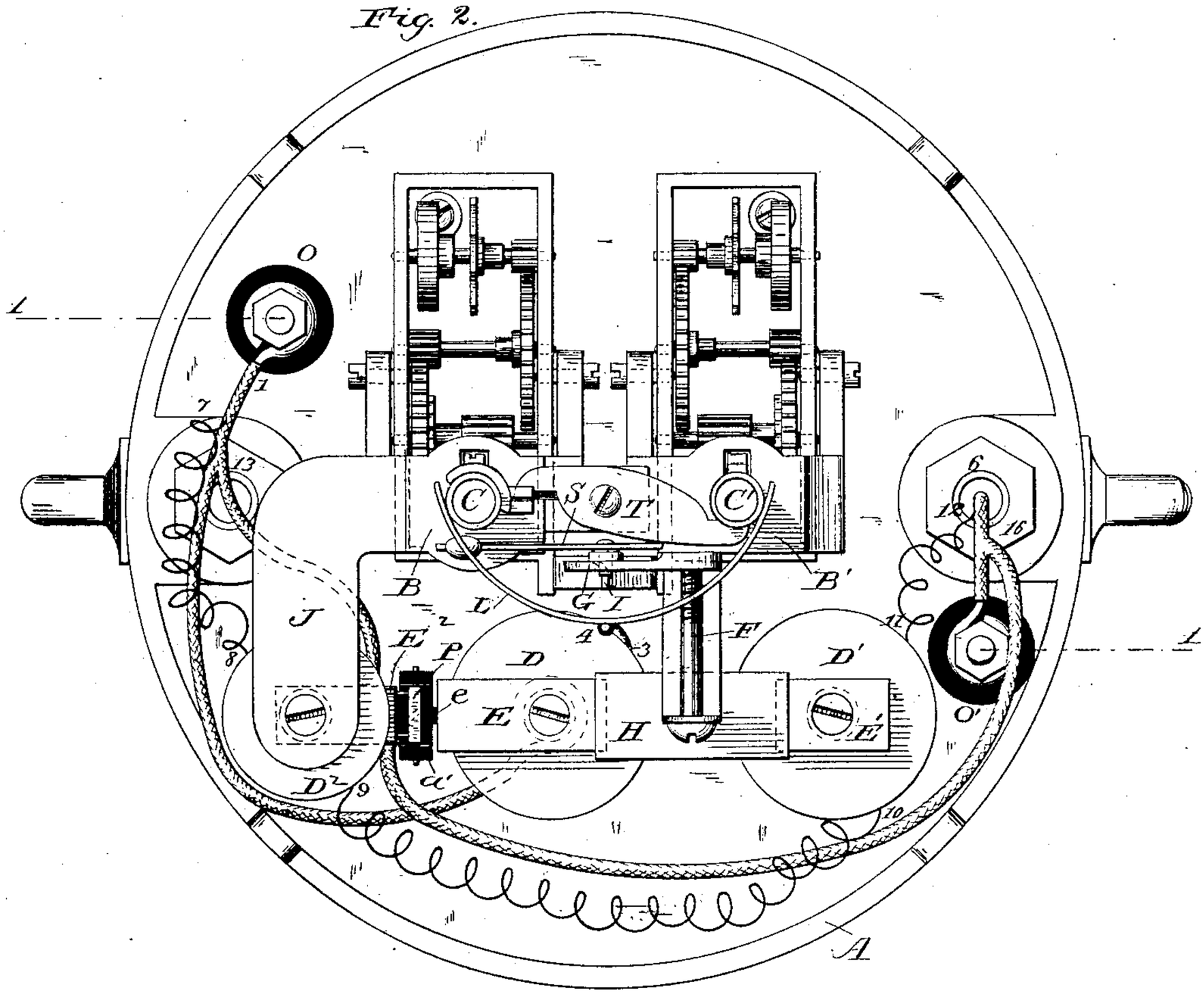
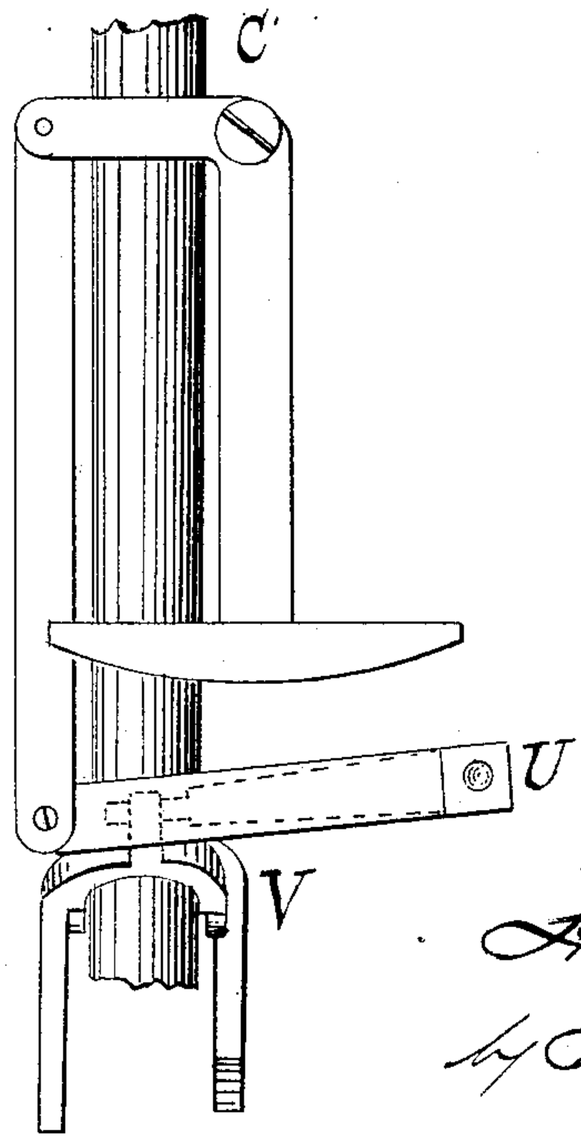


Fig 4



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(No Model.) 3 Sheets—Sheet 3.

H. A. GORN.

ELECTRIC ARC LAMP.

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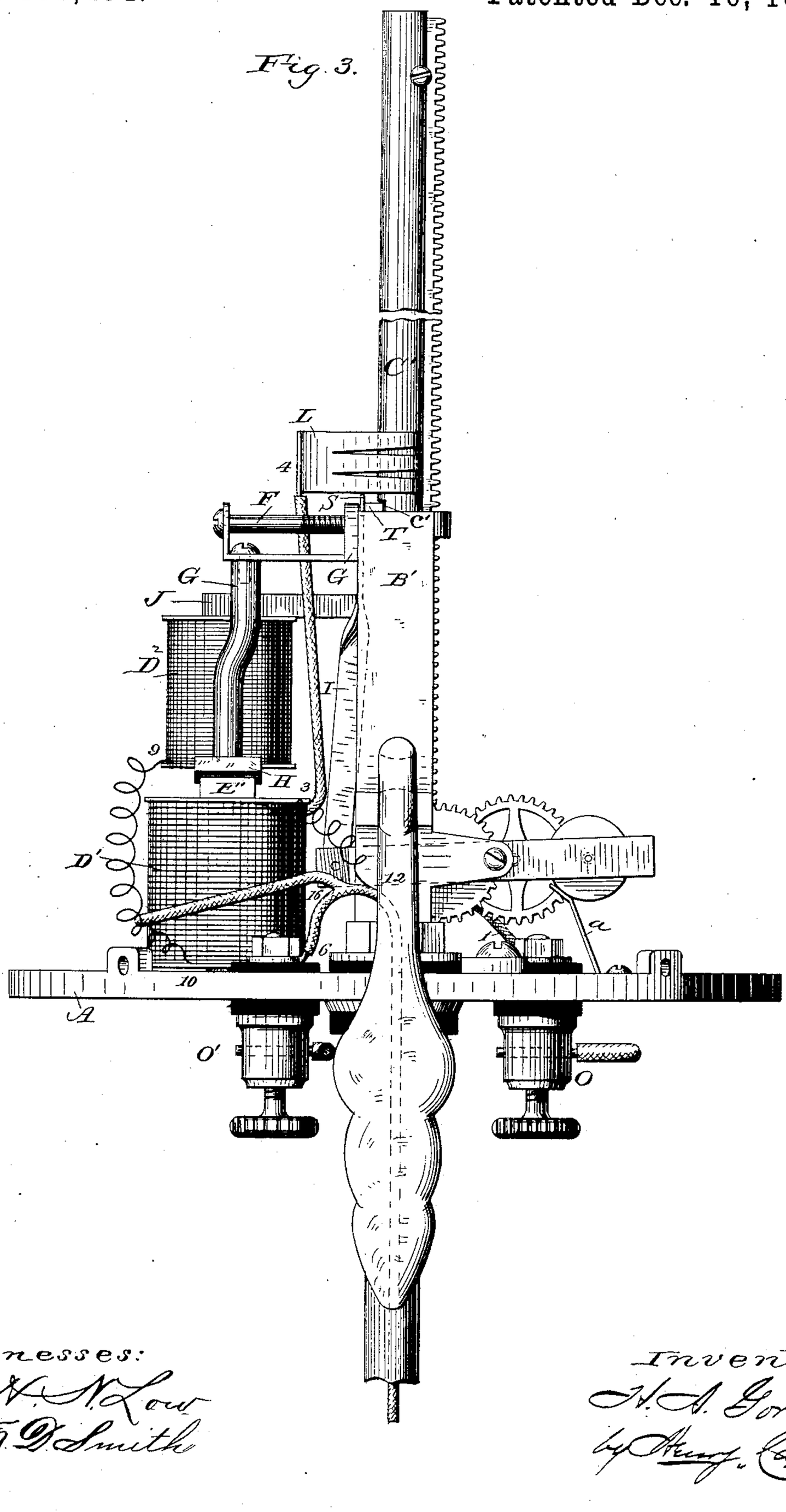
Fig. 3.



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UNITED STATES PATENT OFFICE.

HERMANN A. GORN, OF CLEVELAND, OHIO, ASSIGNOR TO W. H. GABRIEL, C. O. EVARTS, AND W. T. SELLERS, OF SAME PLACE.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 309,454, dated December 16, 1884.

Application filed April 3, 1884. (No model.)

To all whom it may concern:

Be it known that I, HERMANN A. GORN, a subject of the Emperor of Germany, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Electric-Arc Lamps, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to that class of electric lamps known as "arc" lamps, and more particularly to those having several sets of carbons, and usually denominated "duplex" or "multiplex" lamps.

The principal objects of my improvements are: first, to provide certain means by which the differential action of two electro-magnets may be utilized for automatically keeping the carbons in proper relative adjustment as they are consumed by feeding one toward the other; second, to provide an automatic cut-out by which, when any abnormal resistance occurs by reason of the exhaustion of the carbons, the failure of the carbon-feeding mechanism to operate properly or for any other cause the lamp will be cut out from the electric circuit, thereby avoiding danger of injury to the same; and, third, to provide means for automatically causing a set of carbons which has become exhausted to be succeeded in operation by another set. These objects are accomplished by the mechanism shown in the accompanying drawings, in which—

Figure 1 is a front elevation of a lamp embodying my invention, with the supporting-plate in section on line 1 1, Fig. 2. Fig. 2 is a plan view, and Fig. 3 a side view, of the upper portion of my lamp. Fig. 4 represents my swinging armature in connection with clutches for feeding a carbon rod or holder.

A is a plate, on which are mounted two housings or frames, B and B′, which afford support for the vertically-movable carbon rods or holders C and C′.

D is an electro-magnet supported upon plate A and electrically connected in the main circuit. The magnet D is provided at its upper end with a pole, E, the opposite faces of which are flat, said pole being thus of rectangular form in section both longitudinally and transversely. One of the ends of said pole is extended over one side of the magnet, said extended end being provided with a stud, *e*, of insulating material. Upon the plate A is also supported an electro-magnet, D′, of high resistance. This magnet is electrically connected in a shunt-circuit derived from the main circuit, and is provided with a flat pole, E′, which is extended somewhat in both directions from the center of the magnet.

G is an angle or bell-crank lever pivoted on a screw-stud, F, preferably secured to the frame B′. An armature, H, is secured to the longer downwardly-extending arm of the said lever, said armature being of rectangular form in cross-section. The lower face of the said armature is curved in the direction of its length, and its upper face straight.

To the shorter or horizontal arm of the lever G is pivoted a rod or link, I, which is connected with suitable mechanism for feeding the carbon-holders, such mechanism being herein illustrated as consisting of a train of gears carried by a frame pivoted near its center and connected with a rack on the carbon-holder. An escapement controlled by a stop, *a*, secured to the plate A, serves to regulate the movement of the gears in a well-known manner. It will be understood that there will be a train of gearing with an escapement for each of the carbon-holders. It will also be understood that clutches or gripping devices such as are well known in the art may be substituted for the gearing mechanism and be operated by suitable connections with the rod I—such, for example, as is shown in Fig. 4, in which U is an arm of a pivoted frame, by which gravitating clutches V, adapted to act on a carbon rod, C′, in a well-known manner, are carried.

D^2 is an electro-magnet of high resistance supported by a bracket, J, projecting from the frame B, and electrically connected in the shunt or derived circuit with the magnet D′. The magnet D^2 is provided at its lower end with a pole, E^2, which is preferably flat, like the poles E and E′. One end of the pole E^2 is extended laterally, so as to project beyond its magnet toward the pole E of magnet D.

Attached to the pole E^2, but insulated therefrom, is a contact-piece, e^2.

P is an armature consisting, preferably, of a

soft-iron bar hinged to a lug, a', of insulating material attached to or supported upon the plate A, the upper end of the said bar being between the poles E and E^2.

Insulatingly attached to the bar P is a contact-piece, p, facing the piece e^2 of the pole E.

Pivoted to a projection preferably extended from the frame B' is a lever, T, one end of which is slightly beveled off, so as to be operated by a beveled lug, c, on the carbon-holder C, the opposite end of said lever entering a notch, c', in the carbon-holder C', where it is held by a spring, S, which bears against said lever.

L is a contact-brush pressing against the carbon rods or holders C and C', the latter carrying the positive carbons N and M, which are fastened to said holders in any suitable manner.

N' and M' are the negative carbons, arranged below, but in the same vertical plane with the positive carbons, said negative carbons being supported upon the globe-plate Q.

To provide for the universal adjustment of the negative carbons, so as to bring them in their proper positions relative to the positive carbons, the seats for the socketed holders R of the former on the globe-plate are rounded or convex on their lower sides and concave on their upper sides to form a partial ball-socket, as clearly shown in Fig. 1.

R' R' are binding-plates for the holders R, said binding-plates being formed with annular lips r', which form reduced bearings, admitting of a universal adjustment of the holders R when the set-nuts R^2 are loosened, the said holders fitting loosely in their seats, as shown in Fig. 1.

O and O' are binding-posts attached to plate A, but insulated therefrom.

The operation of my lamp is as follows: An electric current entering the lamp by the positive binding-post O will pass through cable 1 2 over the helix of magnet D, thence through cable 3 4 and brush L to the carbon-holders. When the lamp is first put in operation, the holder C' will be elevated far enough to permit one end of the lever T to enter the notch c' in said holder, so that the carbons M and M' will be held widely separated, and thus the current will pass through the holder C, carbons N and N', and cable 5 6 to the negative binding-post O', and then to the next lamp in the circuit or back to its source. The passage of the electric current over magnet D will cause the core of the latter to become energized, and its pole E, being thus magnetized, will attract the armature H on lever G, moving said armature in the direction indicated by arrow h. The movement of the lever G, communicated through the rod I to the train of gears or the clutching or gripping mechanism heretofore referred to, in a well-known manner, will cause the carbon-holder C to be raised slightly, thus separating the carbons N and N' and producing the voltaic arc. At the same time part of the electric current which has entered at the binding-post O, or, in other words, a derived current, will pass by way of wire 7 8, magnet D^2, wire 9 10, magnet D', and wire 11 12 to the negative binding-post O'. As the space between the carbons N and N' will be slowly increased by their combustion, the resistance offered to the passage of the main electric current from one carbon to the other will also be increased, and the said current will therefore be more and more diverted to the derived circuit. As a result, the magnet D will become weaker and the magnet D' stronger until the attractive power of the latter overbalances that of the former, and the swinging armature H is moved in the direction opposite to that indicated by arrow h. This latter movement of the armature H, communicated through the lever G and rod I to the mechanism for operating the carbon-holders, will cause the positive carbon which is in operation to be fed slightly downward, or toward the negative carbon. This shifting of the positive carbon will restore the normal strength of the main electric current passing through the magnet D, giving the latter sufficient power to move the swinging armature from the magnet D' to its normal position, and thereby suspend any further movement of the carbon-feeding mechanism. But should any abnormal resistance to the passage of the main electric current through the carbon-holders and carbons occur at any time, by reason of the failure of the carbon-holder operating mechanism to act properly, by the breaking of a carbon or from any other cause, the magnet D would become weakened, while the increased flow of the current in the derived circuit would strengthen the magnets D' and D^2. As soon as the attractive power of the magnet D^2 on the armature or bar P overbalances that of the magnet D, the said bar P will be moved toward the former magnet, bringing the contact-pieces e^2 and p together. With the pieces e^2 and p in contact a direct passage is afforded for the main current from the positive binding-post O, through the conductors 13 14 and 15 16, to the negative binding-post O', without going through the magnets or lamp, and the lamp will thus be cut out from the main circuit, leaving the main current free to pass to the next lamp or back to its source. As soon, however, as the carbons are again brought into contact the main current will re-energize the magnet D, which, becoming relatively stronger than the magnet D^2, will attract the bar P away from the latter and break the contact of the pieces e^2 and p, when the lamp will again be in working order. This cut-out mechanism, operating as just described, is obviously much better than the so-called cut-outs or safety-switches which work independently of the magnet which is in the main line.

In the cut-outs just referred to it frequently occurs that lamps in good working condition

are cut out of the circuit by reason of some disturbance in the current, as by the switching out of some lamps which are not working properly, or from other causes. As a result of such improper action of the cut-out a heavy spark is sometimes produced between the contact-pieces of the cut-out or switch, which is not only liable to destroy the electrical connections in the lamp, but, under certain circumstances, may melt out the whole lamp, and even become the source of a conflagration. This difficulty is avoided in my lamp by a cut-out or safety-switch that is kept open by a feed-controlling magnet in the main circuit, and is closed by a magnet in a derived circuit around the cut-out branch.

Another important feature of my cut-out is that the lamp will be automatically relighted when the separated carbons are again brought in contact with each other. When the carbons N and N' have become consumed, the lug *c* in the upper end of the carbon-holder C will come in contact with the beveled end of the lever T, moving the opposite end of the said lever against the stress of spring S out of the notch *c'* in the carbon-holder C'. The latter carbon-holder will then be free to descend, bringing the carbons M M' into contact, the carbon-holder C being prevented from descending farther by the contact of the lug *c* with the top of the frame B. As the consumed carbons will by this time have become sufficiently separated to offer such resistance to the passage of the current communicated by the brush L to the carbon-holders as will cause the current to flow by way of the carbons M M', the latter will immediately become lighted and the operation of the lamp will continue.

Although I have only shown two sets of carbons in my lamp, it will be understood that three or more sets of carbons automatically thrown into operation in the manner heretofore described may be used, if desired, and when all of the carbons have been consumed the lamp will be automatically cut out from the main circuit in the manner hereinbefore indicated.

As hereinbefore stated, the poles E and E' of the magnets D and D' are formed flat on both sides, so that they are rectangular in section both longitudinally and transversely, instead of having their faces which are adjacent to the swinging armature curved to correspond to the arc in which the armature moves, as with some poles heretofore employed in connection with swinging armatures.

It will be understood that the armature H, though moving in close proximity to, is never in actual contact with, the poles E and E', and by constructing my poles in the form shown it will be obvious, under the well-known law that magnetic attraction between two bodies varies inversely with their distances, that as the corners e^3 e^3 of the poles E and E' will be nearest to the swinging armature the attraction will be greatest at these corners. From this it follows that if the armature were uninfluenced by the magnet D' it would be moved by the magnet D until its center was adjacent to the corner e^3 of the pole E; while if the said pole were formed with an upper face curved to correspond to the arc in which the armature moves, it is clear that said armature, when uninfluenced by the magnet D', would move in the direction of arrow *h* in Fig. 1 until its center was over the center of the core of the magnet D. In other words, with the form of pole shown, the armature H, if uninfluenced by the magnet D', would be in a state of equilibrium relative to the magnet D when its center was adjacent to the corner e^3 of the magnet E, while under similar circumstances, but with a magnet having a curved face, the equilibrium-point of the armature would only be reached when the center thereof was over the center of the core of the magnet D; but as the armature will at all times be more or less attracted by the magnet D', it is clear that it will normally come to rest in a state of equilibrium with its center more or less to the right (Fig. 1) of the corner e^3 of the pole E. Thus it will be evident that the swinging armature, when acted upon by both of the magnets D and D', will be moved only through a very small arc, and as it will perform its function of operating the feeding mechanism of the carbons by such small movements, the feeding operations will be quickly effected, and the steady intensity of the light of the lamp will be but slightly interfered with. In other words, by the peculiar construction of the poles, as set forth, the attractive power of the magnets is concentrated at the angles which they present toward the armature, instead of being spread over a great surface, as where the faces of the poles adjacent to the armature are curved to be concentric with the curved face of the armature. As a consequence, while practically the same power may be exerted upon the armature by the two forms of poles referred to, this power, with the form of poles which I employ, is exerted within narrower limits, and the armature will be caused to move less in extent but more rapidly, and any slight variation of the current will be more quickly felt and responded to by the lamp. Moreover, as the armature will be nicely balanced with relation to its path of movement, so that it can swing easily, there will be no dead-weight in the armature to be overcome by the magnets, and its operation will thus obviously be very delicate, as it will be sensitive to comparatively slight variations in the differential attractions of the magnets due to the varying electric currents.

The magnets D and D' are preferably so wound and connected that the poles E and E' thereof, which are presented to the armature H, are both of the same direction or polarity.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In an electric-arc lamp, the combination,

with the carbon-feeding mechanism, of a swinging armature and two electro-magnets, one in the main circuit and the other in a derived circuit, said magnets being both provided with flat rectangular poles, and said armature being arranged to swing in proximity to the corners of said poles, substantially as set forth.

2. In an electric-arc lamp, the combination, with the carbon-feeding mechanism, of a swinging armature having a curved face and two electro-magnets having flat poles, one of the said magnets being arranged in the main circuit and the other in a derived circuit, substantially as set forth.

3. In an electric-arc lamp, the combination, with the carbon-feeding mechanism and a swinging armature for operating the same, of two electro-magnets, one in the main and the other in a derived circuit, the arrangement being such that both magnets present like poles to the said armature, substantially as set forth.

4. In an electric-arc lamp, the combination, with an armature for operating the carbon-feeding mechanism, and a switch or cut-out, of main and shunt electro-magnets, the former arranged to serve the double purpose of assisting the operation of the said feeding mechanism and of keeping open the circuit closed by said switch or cut-out, and the latter serving to close said circuit, substantially as set forth.

5. In an electric-arc lamp, the combination, with the carbon-feeding mechanism and an armature for operating the same, of an electro-magnet for operating said armature arranged in the main circuit, a non-carbon-feeding electro-magnet arranged in a shunt or derived circuit, and a switch or cut-out placed between said magnets and controlled by their differential action, substantially as set forth.

6. In an electric-arc lamp, the combination, with an electro-magnet arranged in the main circuit, and having a pole provided with an insulating-stud, of an electro-magnet arranged in a derived circuit, and having a pole to which is insulatingly attached a contact-piece, and a movable cut-out or armature arranged adjacent to the said magnetic poles, and having an insulatingly-attached contact-piece, substantially as set forth.

7. In an electric-arc lamp, the combination, with the plate A and frame or housing B, of a magnet, D, supported by said plate and connected in the main circuit, the pole E, having the insulating-stud e, the magnet D^2, supported by said frame and arranged in a derived circuit, the pole E^2, having the insulatingly-attached contact-piece e^2, and the cut-out bar or armature P, insulatingly hinged to the plate A, and having the insulatingly-attached contact-piece p, substantially as set forth.

8. In an electric-arc lamp, the combination, with a main circuit containing one electro-magnet, of a shunt or derived circuit containing two electro-magnets, a cut-out device, and a carbon-feed-operating device, the said cut-out device being controlled by the magnet in the main circuit and one of the magnets in the derived circuit, and the feed-operating device by the magnet in the main circuit and the other magnet in the derived circuit, substantially as set forth.

9. In an electric-arc lamp, the combination, with two carbon-holders and their supporting-frames, one of the said holders being provided with a beveled lug, and the other with a notch, of a lever pivoted to one of the said frames and having a beveled end adapted to be engaged by said lug, and a spring for holding the said lever in engagement with said notch until released therefrom by said lug, substantialiy as set forth.

10. In an electric-arc lamp, the combination, with a globe-plate formed with a concavo-convex seat, a carbon-holder fitting loosely in said seat, a binding-plate for said holder having an annular lip, and a set-nut for securing said binding-plate, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

HERMANN A. GORN.

Witnesses:
L. E. MEACHAM,
CHAS. O. EVARTS.