(No Model.) 2 Sheets—Sheet 1.

J. McLAUGHLIN.

ELECTRIC ARC LAMP.

No. 560,421. Patented May 19, 1896.

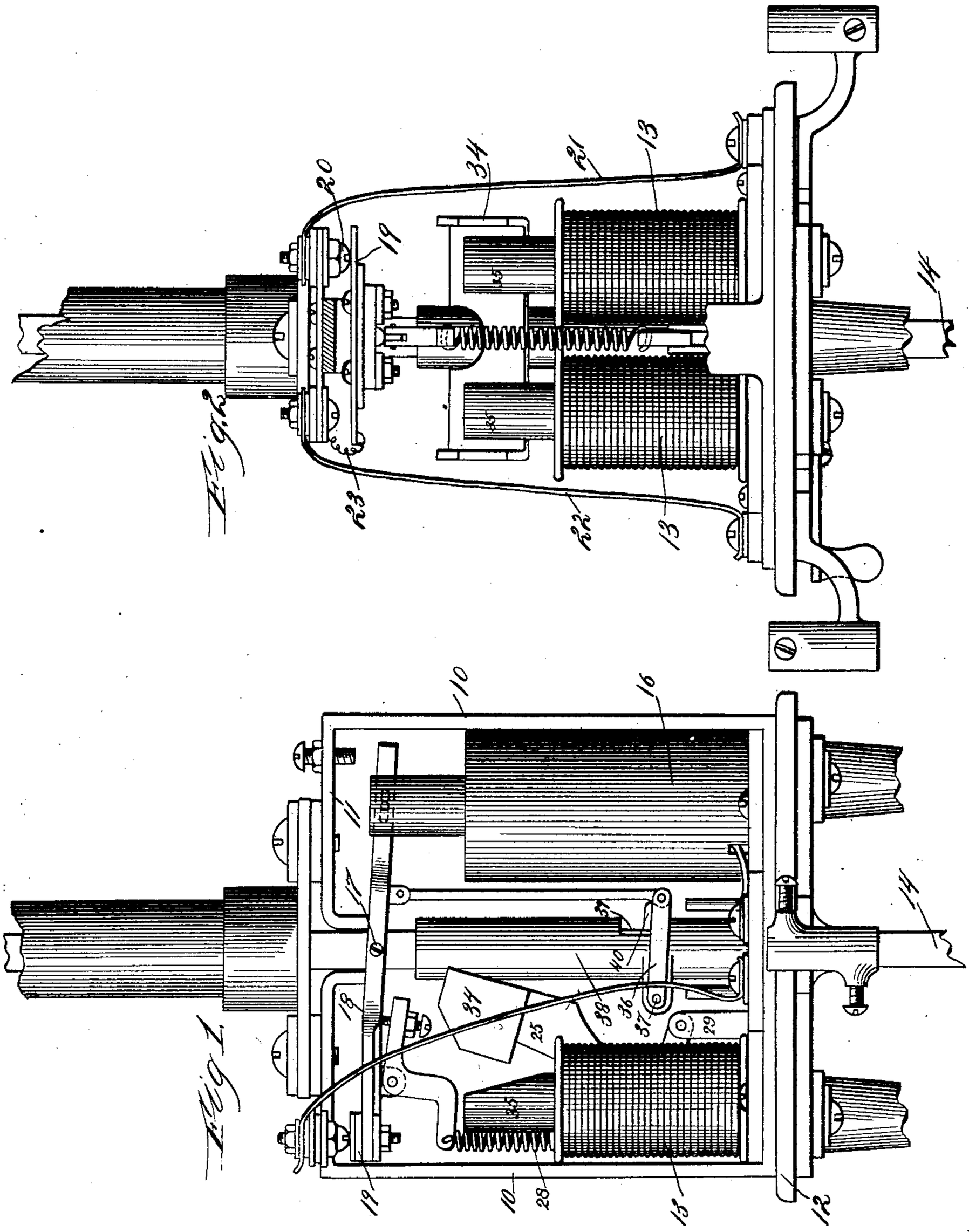

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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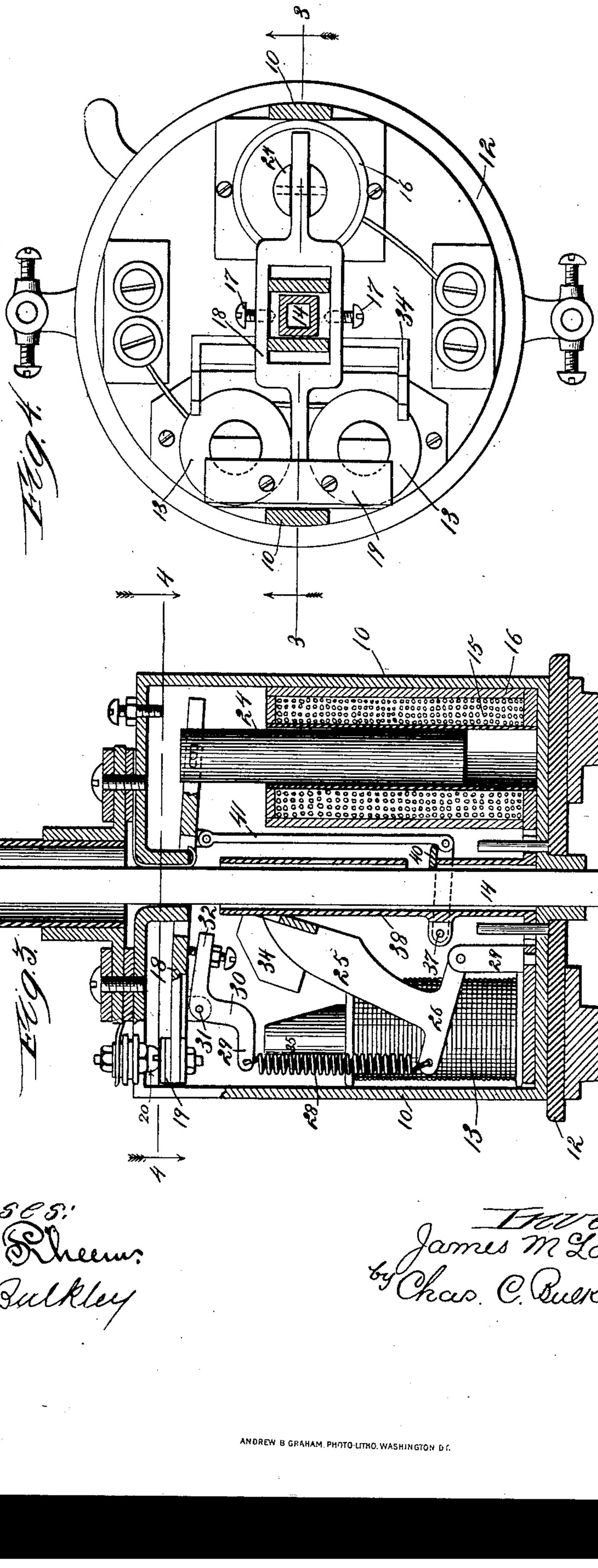

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UNITED STATES PATENT OFFICE.

JAMES McLAUGHLIN, OF CHICAGO, ILLINOIS, ASSIGNOR TO T. K. WEBSTER, OF SAME PLACE.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 560,421, dated May 19, 1896.

Application filed May 15, 1893. Serial No. 474,298. (No model.)

To all whom it may concern:

Be it known that I, JAMES MCLAUGHLIN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric-Arc Lamps, of which the following is a specification.

My invention relates to certain improvements in the means by which the arc of an electric-arc lamp is maintained constant and uniform in the normal operation of the lamp, the arc interval established, and the means by which the current from the line is cut out and directed about the arc of the lamp when from any cause a lamp so cut out has become inoperative.

My invention has several objects in view by which the construction of a lamp of this type is very materially simplified, the number of the parts employed reduced, and the lamp as an entirety rendered more compact and smaller in dimension, and the arc of which lamp may be positively and invariably established and maintained with a current of minimum ampere strength.

My object, further, is to provide means by which the arc is maintained at all times during the operation of the lamp with a maximum degree of steadiness as the carbons are consumed.

My object, still further, is to provide a cut-out for an arc-lamp adapted to establish a circuit about the arc of the lamp, which cut-out shall be of the simplest character of construction, and which dispenses with auxiliary magnets or differential or special magnetic helices heretofore employed for operating mechanism by which the cut-out circuit is established.

My object, further, is to provide certain features of mechanical construction and electrical connections by which maximum results in efficient operation are obtained.

In carrying out and effecting the objects aforesaid and also certain other desirable results my invention consists, generally stated, in the provision of a main actuating magnet or magnets, preferably located in series with the arc, an armature, which armature, when the main magnet is energized by introducing current from the line to the lamp, is attracted by said main magnet and held thereby as a keeper continuously and permanently for such a time as the current is passing through the arc, a mechanical resistance device, such as a spring or a weight, the resistance of which is established by the movement of the armature-lever acted upon by the main magnet and maintained established by said lever while the current is passing through the arc, intermediate mechanism, such as a pivoted lever connected with the mechanical resistance device aforesaid by which the carbons are separated and the arc established through the medium of carbon-separating devices, and a supplemental or auxiliary magnet or magnets, preferably located in a shunt or derived circuit, acting upon the intermediate mechanism against the influence of said mechanical resistance device in the feeding of the carbon or carbon rod and the regulation of the arc interval, a distinctive feature of my invention residing in the fact that the mechanical resistance device, which is approximately inactive when the current is not passing through the arc of the lamp, is established as such mechanical resistance and so maintained by the armature-lever moving through a long arc, which armature-lever is operated by the main magnet when the current is directed into the lamp and through the arc thereof, the mechanical resistance device acting then upon the carbon-separating devices to establish the arc, and the shunt-magnet in turn operating against the influence of the mechanical resistance device to permit the feed of the carbon and also regulate, vary, or determine the extent of the feed thereof in due proportion to the length of the arc interval and the consequent electrical resistance at this point.

My invention in this relation consists in certain further features of construction and arrangement which will be fully described hereinafter, and pointed out in my claims.

My invention as to the cut-out consists in a main magnet, a mechanical resistance device acted upon by said magnet to establish its resistance and maintain the same so established during the passage of the current

through the arc, intermediate mechanism between the mechanical resistance device and the carbon-separating devices, an auxiliary magnet in shunt-circuit acting upon the intermediate mechanism and against the influence of the mechanical resistance device, and a contact device carried by the intermediate mechanism, together with a cut-out circuit about the arc of the lamp, so that when the lamp becomes momentarily or permanently inoperative the main magnet is discharged and the influence of the mechanical resistance device relaxed, the intermediate mechanism and contact device then establishing automatically the cut-out circuit about the arc of the lamp.

Figure 1 is a side elevation of the carbon-regulating mechanism, also showing the cut-out. Fig. 2 is an end view of the same. Fig. 3 is a vertical section on the line $x\ x$ of Fig. 4. Fig. 4 is a horizontal section on the line $y\ y$ of Fig. 3.

The numeral 10 designates the side rods of the frame, 11 the cross-rod, and 12 the base-plate upon which the carbon-regulating mechanism is mounted. The main actuating-magnets 13, as shown, are wound with relatively coarse wire and are included in direct circuit with the line and the arc of the lamp. The course of the current is therefore from the positive binding-post through the main magnets 13, and from thence through the carbon rod 14 to the positive carbon and through the arc.

What may be termed the "shunt-magnet" or "solenoid" 15, Fig. 3, is located in a shunt-circuit about the arc and has the casing 16 for establishing the magnetic circuit.

Positioned above both the main and shunt magnets 13 and 15 and pivoted at 17 to the cross-bar 11 is a horizontal lever 18, on one end of which lever is secured the contact-plate 19, which latter is adapted to impinge against the contact-point 20 and establish a circuit through the cut-out leads 21 22 by the flexible conductor 23, Fig. 2, between said plate 19 and the lead 22. I provide one contact and the flexible connection instead of two points of contact, in order to avoid those difficulties arising from the unequal difference of contact between the two contacts; but, as is evident, this is a mere detail of construction.

Adapted to reciprocate vertically by the influence of the shunt-magnet or solenoid 15 and gravity is a movable core 24, connected at its upper end with the lever 18, that end of the latter opposite the contact-plate 19.

The armature-lever 25 of the main magnets 13 is of peculiar form, Fig. 3, having at its lower end a bar 26, one end of which bar is pivoted to the standard 29 and the opposite extremity connected with the lower end of a spring 28, the upper end of which latter is connected with the arm 29 of a bell-crank lever 30, which lever is pivoted at 31 upon the horizontal lever 13, the arm 32 of the bell-crank lever 30 carrying an adjusting-screw 33, impinging against the lever 18.

The keeper-bar 34, Fig. 2, of the armature-lever 25 has two extension-pieces 34^a 34^a on either of its ends, and the contact-faces of the cores 35 of the magnets 13 are inclined from a vertical plane.

In the form shown in Fig. 5 I provide two additional extension-pieces 36 36, the upper end of the armature-lever 25 being secured between them.

The carbon-separating devices comprise a lifting-clutch 37, embracing the carbon rod 14 and pivoted at 38 to extensions from a sleeve 39. This sleeve is cut away so as to permit the gripping-bar 40 to frictionally engage the carbon rod 14. The clutch 37 is connected with the lever 18 by means of the vertical rod 42.

The operation of my device is as follows: In the type of lamp shown the carbons are normally together when no current is passing through the lamp. When the current from the line is directed into the lamp in any well-known way, it enters into and passes through the helices of the main actuating-magnets 13, energizing the cores 35 of said magnets, which latter then attract the armature 25, the upper portion of the armature moving through a horizontal arc, and upon the contact of the keeper-bar 34 with the inclined faces of the cores 35 the said bar and armature are held in this position during all of the time that said magnets are energized. By reference to Fig. 2 it will be observed that as the upper end of the armature 25 describes its horizontal arc the end of the cross-bar 26 opposite the pivot-point on the standard 27 describes a downward arc, which extends and establishes the tension of the spring 28, the latter in turn then exerting a downward pull upon that end of the lever 18 in proximity to the main magnets 13, causing that portion of said lever in proximity to the shunt-magnet 15 to ascend and raise the connecting-rod 41, and thus at the same time raise the pivoted clutch 37 and cause the gripping-bar 40 to engage the carbon rod 14, elevate the positive carbon, and establish the arc interval. It will be borne in mind, when the carbons are thus separated, that the counteracting influence or tension of the spring 28 is still maintained, since at all times during the continued operation of the lamp and the passage of the current through the main magnets 13 the keeper-bar 34 is constantly held against the core 35 of said magnets.

In order to approach or permit the approach of the carbons together upon abnormal length of arc and consequent increase in the resistance, the shunt-magnet 15 is energized by a proportional division of the current, said shunt-magnet then pulling downward upon its core 16. The latter then acts upon the lever 18 against the counteracting influence of the

spring 28, releasing the clutch 37, and permitting the feed of the positive carbon until the normal arc is reëstablished, when the shunt is demagnetized, and the clutch 37 again engages the carbon rod 14.

Since the feeding of the carbon is accomplished by the shunt-magnet only, that unsteadiness resulting from the connection of the series or main magnet directly with the clutch is avoided. So, also, as a result of my construction, a very serious defect in those types of lamp in which the carbons are together—namely, the failure to positively and invariably separate the carbons—is overcome.

As the tension of the spring is established and maintained by the main magnets, if from any cause the carbon rod should feed too far said rod will be instantly returned to its normal position by the tension of the spring acting on the lever controlling the clutch mechanism, this spring lifting the carbon until the influence of the shunt-coil and the tension of the spring balance, which is determined by the resistance of the arc.

If from any cause the carbon rod should fail to feed, the influence of the shunt-magnet is thereby intensified, owing to the abnormal increase of resistance at the arc, causing the core of the shunt-magnet to operate the horizontal lever to such an extent as to bring the contact-plate 19 against the contact-point 20, thus establishing the circuit through the cut-out leads 21 and 22, when the current is then nearly all cut out or diverted from the main magnets, releasing the armature and relaxing the tension of the spring, and as the end of the horizontal lever near the shunt-magnet is the heavier maintaining the cut-out contact established. When this is accomplished, the carbon rod is permitted a free movement by the clutch to establish a contact between the carbons, and upon this occurring the current is directed through the main magnets, which then attract the armature and exert a pull upon the horizontal lever, breaking the cut-out circuit and establishing at the same time the arc interval.

In my lamp a greater range of operating ampere capacity is provided than in other lamps, since the main magnets establish the arc interval and the shunt alone performs the office of feeding or permitting a feed of the carbon rod, and, further, as the armature acting upon the spring at its upper end describes and travels through a relatively longer arc of a circle and the lower end thereof through a much shorter arc a very considerable leverage is obtained and a minimum degree of ampere current is sufficient to actuate the armature and establish the resistance of the spring and separate the carbons. So, also, it is evident that a less number of turns of wire upon the coils of the main magnets are necessary and that the cross-section of the wire employed may be increased, thus reducing the liability of the magnets to burn out.

In the type of keeper-bar 34 I provide projected inductive points 34^a, advanced beyond the plane of the armature 25, so that the attractive influence of the magnets is first exerted on these advanced points and upon the keeper-bar until the latter is brought and held against the faces of the cores 35, by this means increasing the length of arc through which the upper end of the armature 25 passes.

In the form shown in Fig. 5 I provide four projected inductive points, so that each of the magnets has two advanced points upon which to act. These features all tend to materially increase the attractive influence of the magnets 13 and reduce to a minimum the amperes necessary to set the spring and thus separate the carbons.

Whenever throughout the specification reference is made to the term "mechanical resistance device" or "yielding pressure device" I desire to be understood as comprehending within the same the spring 28, the tension of which is established and maintained by the armature-lever 25 when the latter is acted upon by the main magnet in series with the arc.

It is evident that many forms of devices other than a spring may be used as a mechanical resistance device, and I therefore do not desire to be understood as limiting myself to any specific device for this purpose.

Referring to the inductive points 34^a, which are extended from the keeper-bar 34 of the armature 25, it will be observed that extensions are provided always within the same inductive area and influence of the magnets, so that the latter may be acted upon at all times notwithstanding the position of the keeper-bar and armature. When, for instance, the armature is away from the electromagnets, which latter are not energized and which are not therefore acting on the armature, it will be observed that the inductive projections or points 34^a are still at the same relative distance from the magnets, so that the armature will be immediately under the influence of the magnets and is yet given a long arc of movement to exert a good leverage.

I am aware that inverted-V-shaped points have been provided, formed by cutting into the armature and used conjunctively with V-shaped magnets; but it is evident with this construction as the armature is released and recedes from the magnets that the distance between the points and the V-shaped magnets increases in proportion to the receding movement of the armature and the distance between the points and the magnets, whereas in my form of magnets and points the distance is always the same. In the former when the armature is released the points are away from the magnets and in the latter the points are at the same relative distance from the magnets.

Referring to the cut-out device, it will be perceived that the intermediate mechanism

is adapted to establish the cut-out circuit over which the current is then directed. When this occurs, it is apparent that the armature acted upon by the main magnet is released, at the same time releasing the tension of the mechanical resistance device, and the horizontal lever, by reason of its weighted end or by other means, then relaxes the hold of the clutch, and thus permits any free movement of the carbon.

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

1. In an arc-lamp, a main actuating magnet or solenoid a mechanical resistance device, a pivoted armature acted upon by the main magnet which armature is attracted and held by said main magnet when the current is passing through the arc and by which operation the counteracting influence of the mechanical resistance device is established, said pivoted armature being connected with the mechanical resistance device and moving through the arc of a circle in the establishment of the counteracting influence thereof, a shunt-magnet and intermediate connecting mechanism between the mechanical resistance device and the carbon separating and releasing devices upon which intermediate mechanism the shunt-magnet acts against the counteracting influence of the mechanical resistance device.

2. In an arc-lamp a main actuating magnet or solenoid, a mechanical resistance device, an armature acted upon by the main magnet which armature is attracted and held by said magnet when the current is passing through the arc and by which operation the counteracting influence of the mechanical resistance device is established, a pivoted lever operated by said armature, a shunt-magnet and intermediate connecting mechanism between the mechanical resistance device and the carbon separating and releasing devices upon which intermediate mechanism the shunt-magnet acts against the counteracting influence of the mechanical resistance device.

3. In an arc-lamp, a main actuating magnet or solenoid in series with the arc, a mechanical resistance device, an armature with which said mechanical resistance device is connected and which armature is attracted by said main magnet and held against the latter during such times as the current is passing through said main magnet and by which operation the counteracting influence of the mechanical resistance device is established and maintained, a pivoted armature-lever carrying said armature, a shunt-magnet and intermediate connecting mechanism between the mechanical resistance device and the carbon-separating devices upon which intermediate mechanism the shunt-magnet acts against the counteracting influence of the mechanical resistance device.

4. In an arc-lamp, the combination of a main magnet in series with the arc, a mechanical resistance device inactive when no current is passing through the arc, a pivoted keeper-armature connected with the mechanical resistance device, and adapted at its upper end to move through an extended arc of a circle acted upon by said main magnet to establish and maintain established the influence of the said mechanical resistance device during the passage of the current through the arc, carbon-separating devices, intermediate connecting mechanism between said devices and an auxiliary or supplemental magnet or solenoid adapted to operate to feed, or permit the feed of, the carbon against the counteracting influence of the mechanical resistance device.

5. In an arc-lamp the combination of a main magnet in series with the arc, a mechanical resistance device inactive when no current is passing through the arc, a pivoted keeper-armature lever acted upon by said main magnet, a mechanical resistance device connected with said armature-lever, the resisting influence of the former being established by the latter carbon separating and releasing devices, intermediate mechanism connected with the mechanical resistance device and the carbon separating and releasing devices and auxiliary or supplemental magnet or solenoid acting upon the intermediate mechanism to permit the feed of the carbon against the counteracting influence of the mechanical resistance device.

6. In an electric-arc lamp, the combination of a pivoted armature-lever, an electromagnet in main circuit with the arc, a keeper-bar carried by said armature-lever and attracted and held by said main magnet during the operation of the lamp, a mechanical resistance device connected with said pivoted armature-lever, a shunt-magnet and an intermediate pivoted lever between said mechanical resistance device and the shunt-magnet together with carbon-separating devices connected with the intermediate and releasing lever.

7. In an electric-arc lamp, the combination of a main magnet, a mechanical resistance device, a keeper-armature acted upon by said main magnet to establish and maintain established the influence of the mechanical resistance device during the normal operation of the lamp, a shunt-magnet, intermediate mechanism between said shunt-magnet and the said mechanical resistance device, carbon-separating devices, a cut-out circuit and contact device carried by said intermediate mechanism which contact device, when the arc is abnormal establishes the cut-out circuit thereby releasing the mechanical resistance device and the carbon separating and releasing devices to permit a free movement of the carbon.

8. In an arc-lamp, the combination of a main magnet or magnets in circuit with the arc, a pivoted armature having a keeper-bar, inductive points carried by and extended in advance of the plane of the keeper-bar, a me-

chanical resistance device connected with said armature, a pivoted intermediate lever connected with said mechanical resistance device, a cut-out circuit, a cut-out contact or contacts carried by said intermediate lever, a shunt-magnet or solenoid and an armature or movable core therefor also connected with the intermediate lever together with feeding mechanism also operated by said intermediate mechanism.

In testimony whereof I have hereunto set my hand this 21st day of March, 1893.

JAMES McLAUGHLIN.

Witnesses:

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PAUL PAULSON.