(No Model.)

3 Sheets—Sheet 1.

W. P. WIEMANN.

ELECTRIC ARC LAMP.

No. 492,650. Patented Feb. 28, 1893.

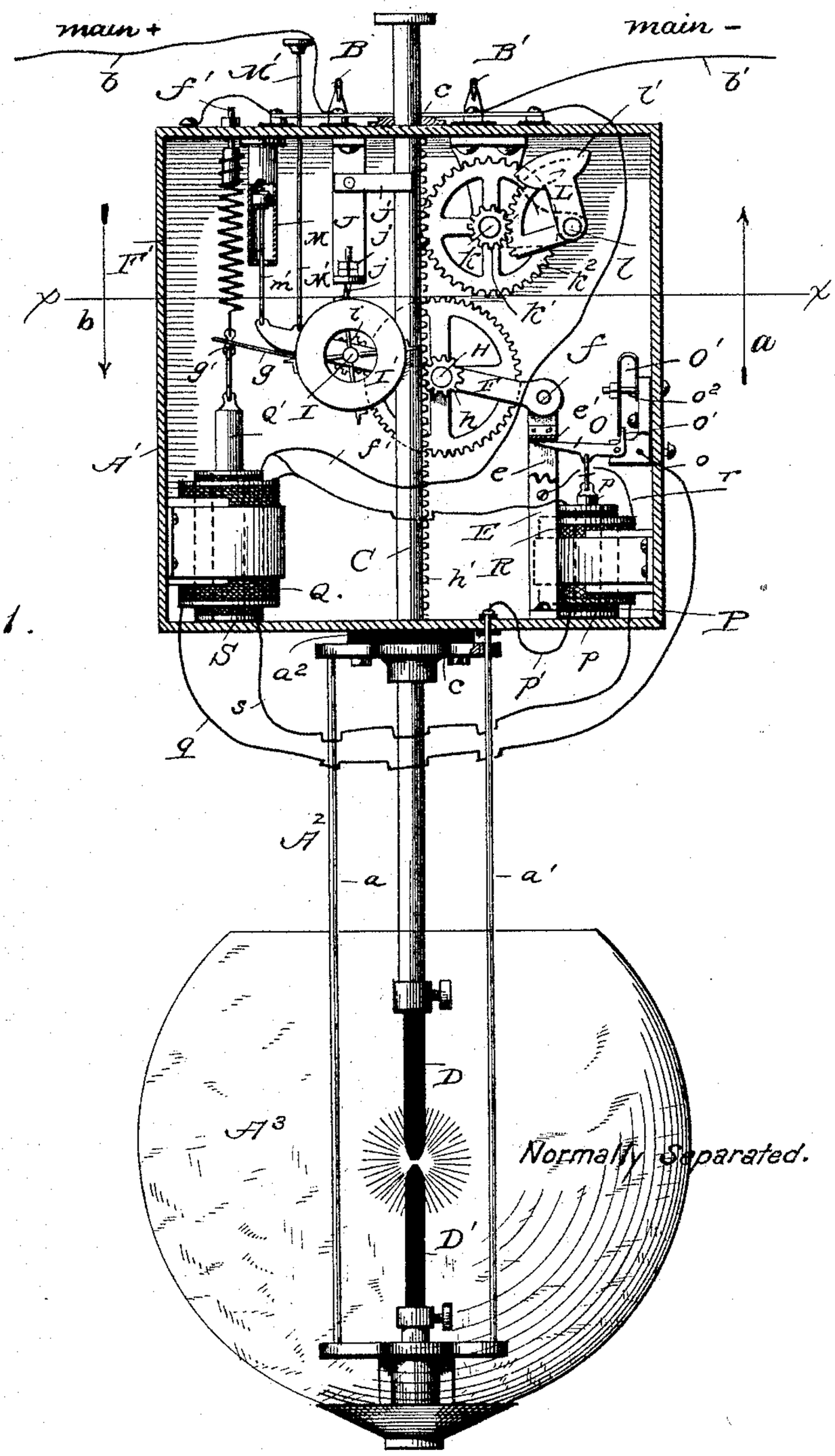

Fig. 1.

Witnesses
W. N. N. Knight-
W. F. Bernhard

Inventor
William P. Wiemann
By his Attorneys,
Edson Bros.

(No Model.) 3 Sheets—Sheet 2.

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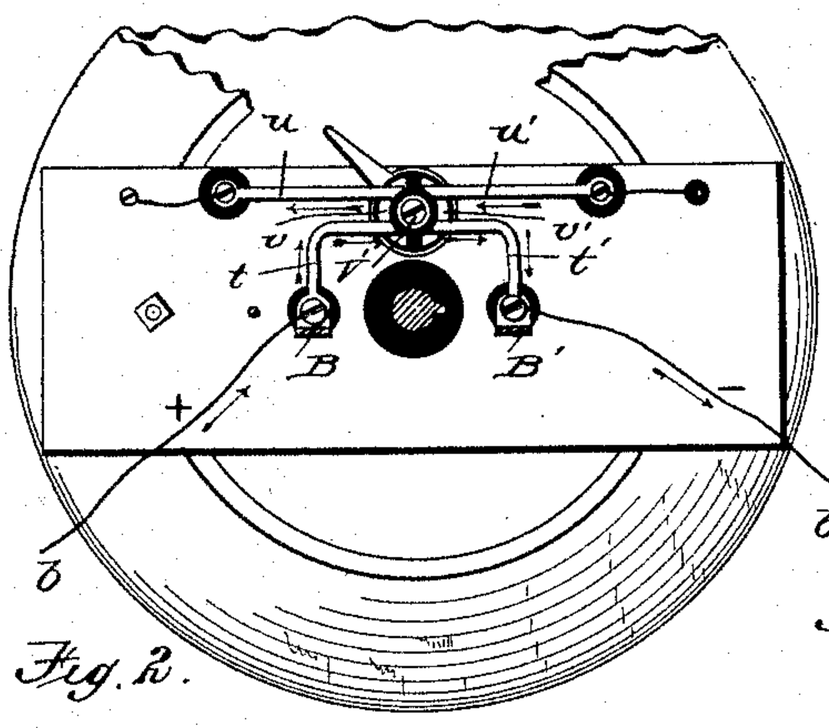


Fig. 2.

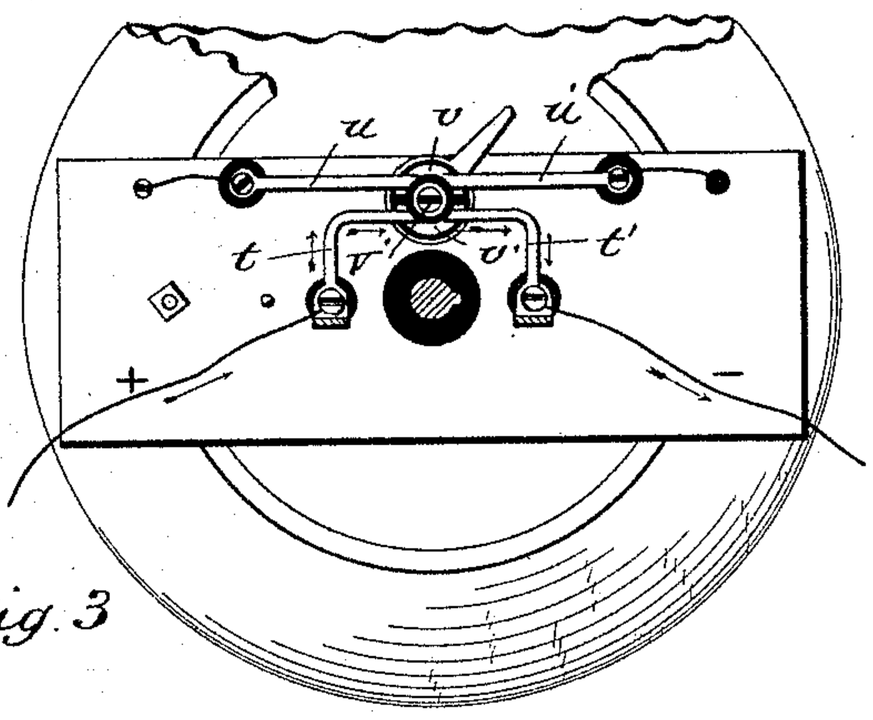


Fig. 3

Fig. 4.

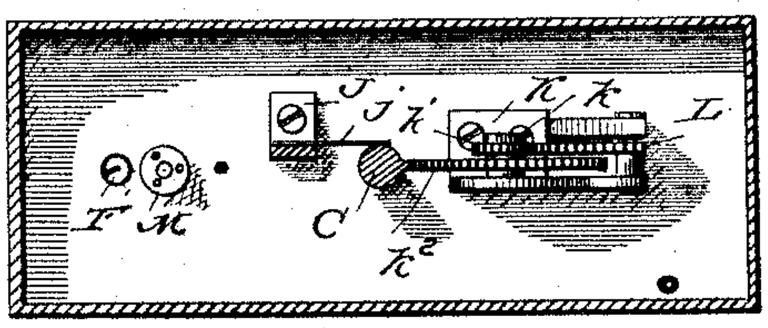


Fig. 5.

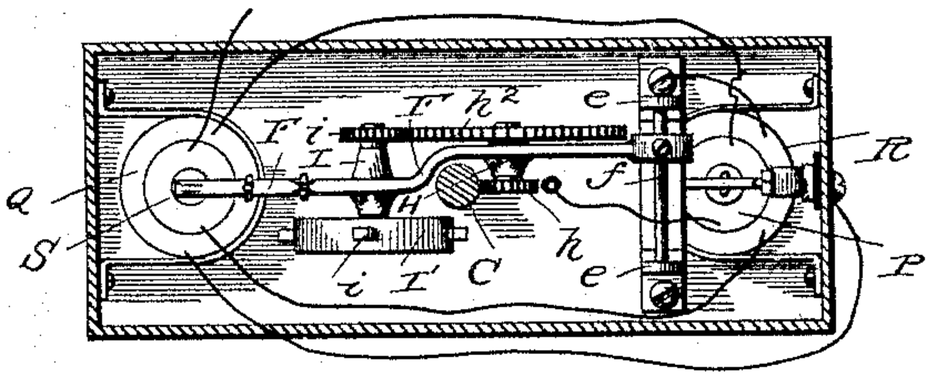


Fig 6.

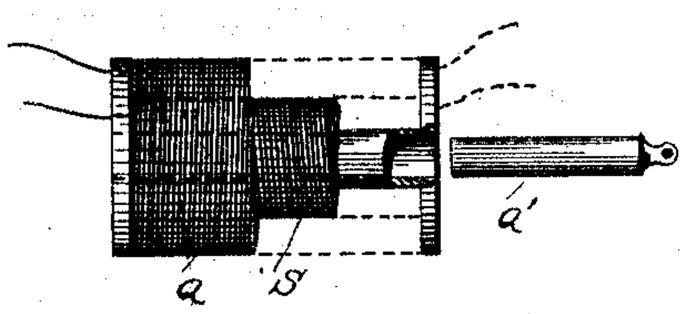


Fig. 7.

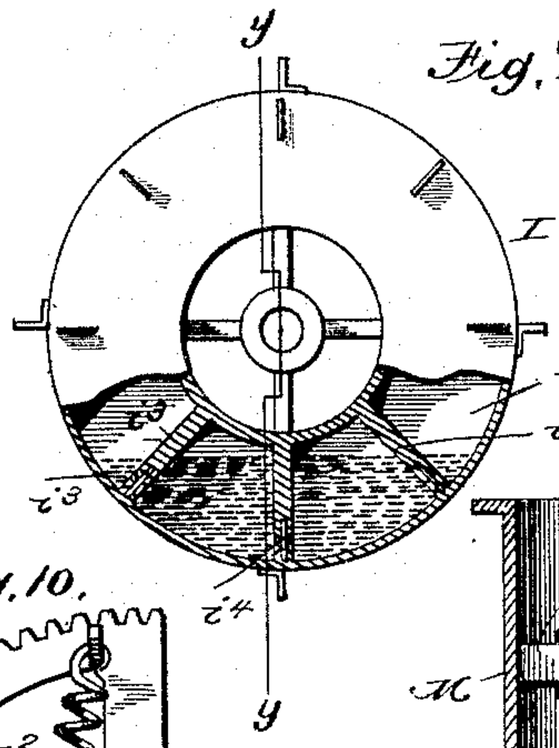


Fig. 8.

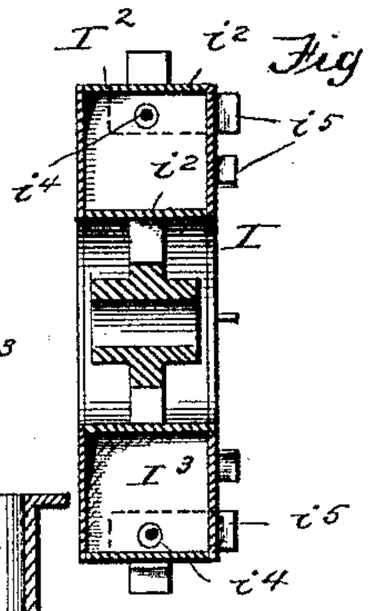


Fig. 9.

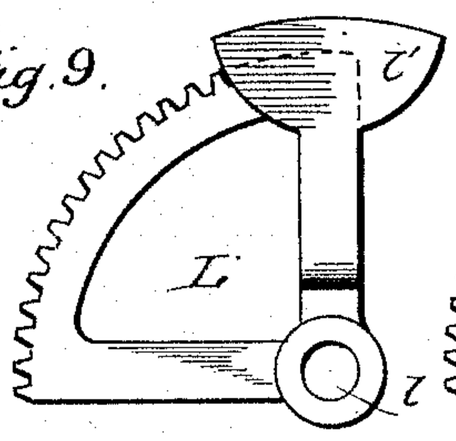
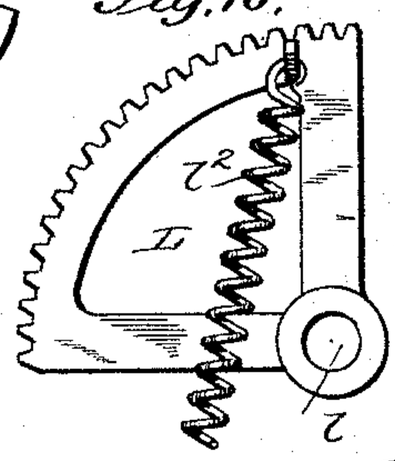


Fig. 10.



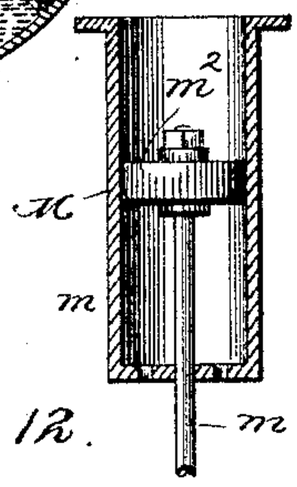
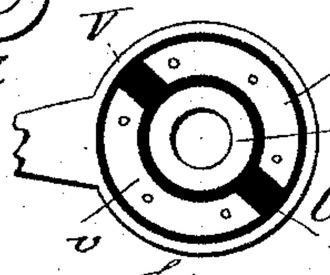


Fig. 11.

Fig. 12.



Witnesses

W. N. Knight-

H. G. Burchard

Inventor

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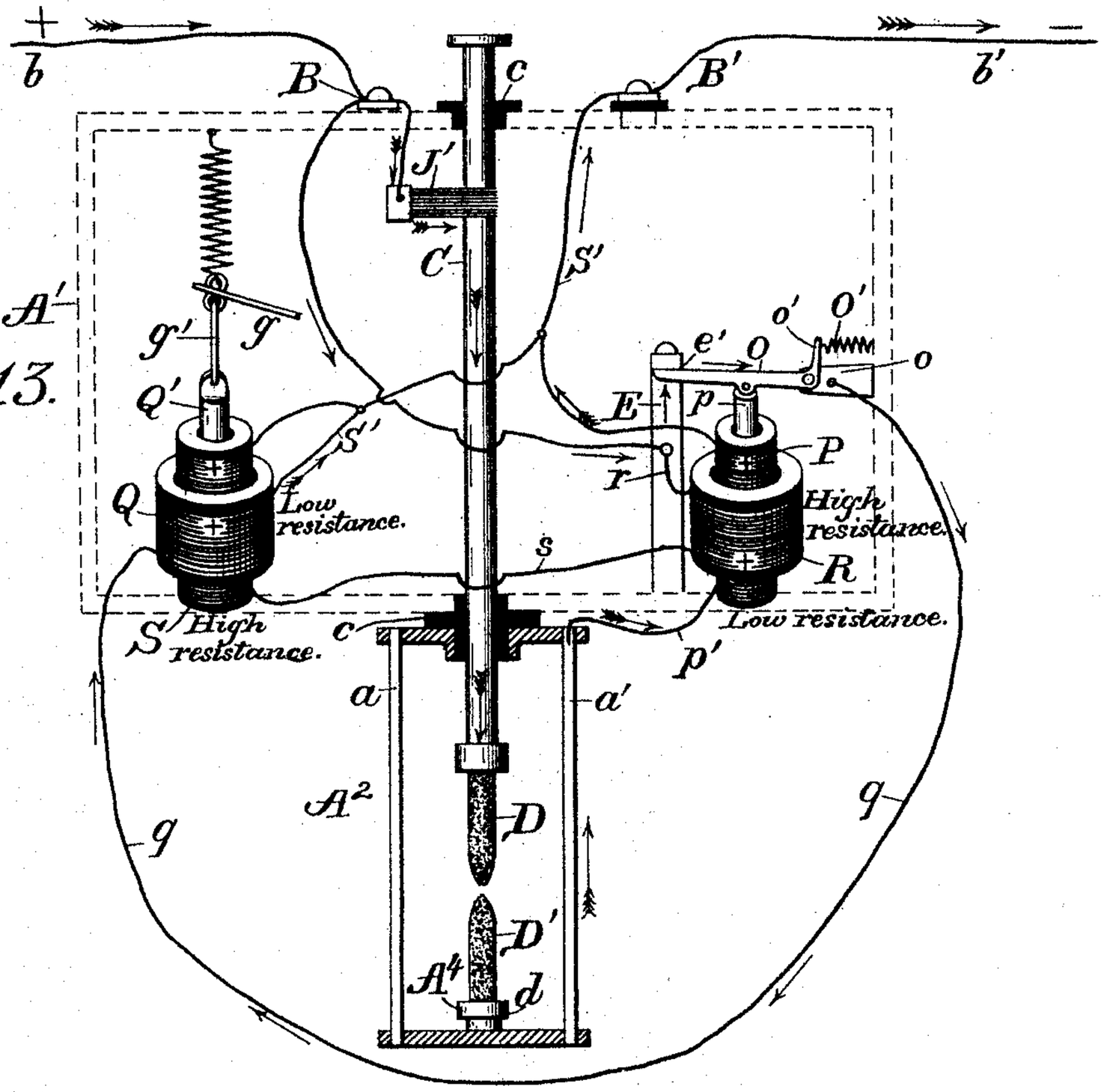
Fig. 13.



Witnesses;
Percy C. Bowen.
W. L. Berukart

Inventor;
William P. Wiemann,
By Edson Bros,
Attorneys.

UNITED STATES PATENT OFFICE.

WILLIAM P. WIEMANN, OF ALLEGHENY, PENNSYLVANIA.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 492,650, dated February 28, 1893.

Application filed April 18, 1892. Serial No. 429,602. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM P. WIEMANN, a citizen of the United States, residing at Allegheny, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Arc-Lighting Systems; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to arc lighting systems in which are combined a lamp of very low resistance (or one without any standard of resistance which would tend to uniformity or steadiness of the current).

In my improved lamp I aim to reduce the resistance to the passage of the current to the lowest possible limit and to automatically and promptly regulate the feed of the positive carbon, the weight of which is counterbalanced by suitable devices operating automatically with the feed-controlling mechanism and any sudden feed or movement of the carbon is checked by a pneumatic or liquid checking mechanism also contained within the lamp and operating in combination with the feed-mechanism.

The invention further consists in the combination of mechanisms, and the construction and arrangement of the parts of each mechanism, as will be hereinafter fully described and more particularly defined in the claims.

In the accompanying drawings, which illustrate my invention—Figure 1 is an elevation of the lamp showing the casing in section to illustrate the feed regulating, weight compensating and speed controlling mechanisms for the movable carbon. Fig. 2 is a plan view showing the two-pole switch adjusted for the current to pass into and through the lamp. Fig. 3 is a similar view but with the switch adjusted to cut the lamp out of the main circuit. Fig. 4 is a transverse horizontal sectional view through the lamp casing in the plane indicated by the dotted line *x*—*x* of Fig. 1, and looking upward in the direction indicated by the arrow *a*, Fig. 1. Fig. 5 is a similar transverse sectional view on the same line, *x*—*x*, but looking downward in the direction indicated by the arrow *b*, Fig. 1. Fig. 6 is a detail view, partly in side elevation and partly in section, of the short circuit or starting coil and its armature to bring the feed-mechanism into play, and also showing one of the shunt coils. Fig. 7 is a side elevation, partly in section, of one form of wheel, for controlling the speed of the carbon, and Fig. 8 is a sectional view thereof on the line *y*—*y* of Fig. 7. Figs. 9 and 10 are side elevations of two forms of devices for balancing the weight of the movable carbon. Fig. 11 is a detail view, partly in section, of the means for checking the too rapid upward movement of the feed-mechanism. Fig. 12 is a detail face view of a part of the two-pole switch. Fig. 13 is a diagram view illustrating the circuits in the lamp.

Like letters of reference denote corresponding parts in the several figures of the drawings.

I will first proceed to a detailed description of my improved arc lamp embracing therein the mechanisms for feeding the carbon, for controlling the speed of the feed of the carbon, and for counterbalancing the weight of the same; after which the cut-out switch, will be described in the order named.

The arc lamp of the present invention relates to that class which employ a movable lever or swinging frame carrying a positive feed device which engages with the carbon carrier to feed the latter, and this lever or frame is normally elevated by a spring and is adapted to be drawn down by the action of an electro-magnet included in a shunt circuit in which the current is varied by the resistance of the arc as the carbon pencils are consumed. The swinging frame or lever that forms a part of the feed mechanism is pivoted at one extremity to a suitable support, and the elevating spring is connected to the other free end of said swinging frame, by which arrangement I am enabled to secure better leverage and an easy free movement of the said swinging frame.

In the main line or circuit is arranged the main line or starting coil of low resistance, and within this main line coil is arranged the high resistance coil of a pair of series-connected shunt coils which are included in a derived shunt circuit, said high resistance shunt coil having its core mechanically connected to the swinging frame of the feed

mechanism, whereby the center of attraction of the low resistance main-line coil and the high resistance shunt coil is practically at the same point, which is not possible when said two coils are arranged one above the other, an example of which is shown in the regulator of the Thomson-Rice patent No. 449,715, dated April 7, 1891.

Referring now more particularly to Figs. 1 and 13 and Figs. 4 to 11, inclusive, A designates the general frame of the lamp consisting of the upper casing A′ and the lower part A^2. The two parts of the lamp frame are suitably connected in the usual rigid or any preferred manner, the lower part A^2 being formed by the usual vertical rods a, a', which are insulated at a^2 from the upper casing A′ and said rods sustaining the usual means for supporting the globe A^3 and the lower carbon holder A^4, as shown.

The upper part or casing A′ is of the general rectangular form shown in Figs. 1 to 5 inclusive, and on its upper side said casing A′ has the positive and negative terminals B, B′, of the working circuit, the conductors of which are designated as b, b', respectively, the positive terminal B being in electrical connection with the insulated upper casing A′ as will presently appear, so that said casing forms part of the path for the current supplied to the lamp while the negative terminal B′ is insulated from and out of electrical connection with said frame or casing A′.

In the middle of the top and bottom of the casing A′ are provided the bushings c, c, which are arranged in vertical alignment with each other, and through these bushings passes the vertical rod C constituting the upper carbon carrier, said carrier being movable freely through said bushings and being in electrical connection therewith. The lower end of the carbon carrier has the usual clamp or socket at its lower end to retain the upper carbon D which is adapted to be adjusted in axial alignment with the lower carbon D′ and to be separated the proper distance therefrom to strike the arc in the usual manner, said lower carbon and its holder d being in electrical connection with the lower part A^2 of the lamp frame A, one of the rods a^2 of which frame A^2 is connected in the manner presently described to form a path for the current to the low resistance cut out coil and thence to the negative terminal B′.

Within the casing A′ is erected a vertical support E consisting preferably of two upright pieces e, e, which are secured at their lower ends to the casing and are in electrical connection therewith, and near their upper ends said uprights are joined and braced by a transverse bridge e', which forms the contact for the lever or movable piece of the cut-out presently referred to. To the upper extremities of the uprights is pivoted, by a transverse rod or shaft f, a movable lever or swinging frame F which extends nearly across the casing and serves as the support for the feed mechanism of the carrier rod C of the upper carbon, and this frame is held normally in an elevated position by means of a coiled tension spring F′, the upper end of which is connected to a tension adjusting screw f' that works in a suitable bearing in the top of the casing A′ and by turning which screw the tension of the spring can be increased or diminished. This tension spring of the swinging frame is not connected directly to said frame, but the connection is effected through an intermediate leaf spring g which serves to prevent undue jarring on the frame F when the lamp is swayed in the wind or jarred by other causes, and one end of said leaf spring is fastened rigidly to the frame and the other end is connected to the link g' at the lower part of the coiled tension spring, said link being also connected to the armature of the high resistance shunt coil and the low resistance starting coil included respectively in a derived shunt circuit and the main line.

The swinging frame F carries a shaft H which is suitably journaled on the frame, and at one end the shaft has a gear pinion h, which meshes with the gear teeth on a rack h' on the carbon carrier C in order to feed or lower said carrier; and the other end of the shaft H has a larger gear wheel h^2 which in turn meshes with a gear i on one end of a shaft I also journaled on the frame F, the shafts H, I, being arranged on the frame on opposite sides of the vertical carbon carrier C. This shaft I carries an escapement I′ that controls the descent of the carbon carrier, and this escapement is in the form of a disk or wheel having a series of spaced prongs or teeth i' around its periphery, one of said teeth being in engagement with a fixed detent j when the lamp is not burning and the swinging frame is raised by the tension spring F′ to the inclined position shown in Fig. 1. The detent is in the form of a vertical threaded pin which works in an arm of a pendant J, and on this threaded pin is fitted a jam nut j' which serves to rigidly and firmly hold the detent in place but which permits of the desired vertical adjustment of said detent relative to the path of the prongs on the rotating escapement. The pendant J is rigidly secured to the top of the casing A′, in electrical connection therewith, and this pendant also carries a lateral brush J′ which contacts at all times with the carbon carrier C and which serves as the path for the current to the carbons when the carrier is lowered to strike the arc and when the lamp is burning.

To counterbalance the weight of the carbon and thus poise the same so that it will move freely on the descent of the swinging frame, I employ either of the devices shown in detail in Figs. 9 and 10 and one of which devices is shown in Fig. 1. Above the swinging frame and its train of transmitting gearing, is arranged a bracket K which is rigidly secured to the top of the casing and depends there-

from; and in the lower part of this bracket is journaled a shaft *k* which carries two concentric gears *k'*, *k²*, the larger gear meshing with the teeth or rack of the vertical carbon carrier and the smaller gear meshing with the teeth of a balanced segment L. This segment is fulcrumed at the juncture of its right angled arms to the pendent bracket K, as at *l*, and it may be normally depressed by the ponderosity of a weight *l'* at its upper end, as in Figs. 1 to 9, or by the tension of a coiled spring *l²*, one end of which is connected to the upper or outer end of the segment and the other end adapted to be connected to the pendent bracket K. When the carrier C is raised and a new carbon placed therein, the weighted or spring controlled end of the counterpoise segment is in a substantially horizontal position, but as the carbon is consumed and the carrier C fed downward by the action of the feed mechanism thereon, the weighted end of the segment is gradually raised, whereby as the weight of the carbon is lessened the tension or ponderosity of the segment gradually decreases, thus causing the counterpoise to act in proportion to the decrease in weight of the carbon on the carrier rod C.

Any tendency of the swinging frame to move suddenly and effect the rapid movement of the carbon carrier is checked by a dash-pot M acting in conjunction with the tension spring F'. This dash-pot has its cylinder *m* secured rigidly to the top of the casing A' and its lower end perforated with two or more holes, one of which admits of the passage of the rod *m'* of the piston head *m²* and the other hole or holes admit air to the cylinder. This piston rod *m'* is connected directly to the swinging frame, and should the latter be moved suddenly in either direction, the air between the head of the cylinder and the piston head will be compressed to an extent sufficient to check the rapid movement of the pivoted frame.

The swinging frame can be adjusted manually without opening the casing A' by means of an operating stem M' which passes through a suitable opening in the top of the casing and is connected to the swinging frame at or near its free or non-pivoted end.

O is an automatic cut-out to short circuit the current when the lamp is not burning or when the arc is too long, which cut out is in the form of a horizontal arm or lever fulcrumed at one side in a fixed support *o* which is secured rigidly to one side of the casing A' and is insulated therefrom, and said cut out lever has a vertical lip *o'* against which bears a pressure spring O' having one end secured to the insulated support *o* and adapted to have the tension of its operating arm, in contact with the lip *o'*, varied by means of an adjusting bolt and nut *o²* which works through the support *o*. This spring normally elevates the free end of the cut-out lever into contact with the transverse bridge *e'* of the vertical support for the swinging frame; and to said cut-out lever, at an intermediate point of its length, is connected a vertically movable core *p* of the cut-out coil P which is suitably supported within the casing and which is connected by a wire or conductor *p'* in circuit with one of the vertical rods *a'* of the lower part of the lamp frame.

When the current enters the lamp it is divided into two branches, one branch constituting the starting branch and having the low resistance coil Q placed therein with the contact or cut-out O, and the other branch forming a shunt circuit and including the high resistance coils R, S.

Within the low resistance coil Q of the starting branch is placed the high resistance coil S of the shunt circuit, and in said coil S is fitted the endwise movable core Q' which is connected at its upper end by the link *g'* and the spring *g* to the non-pivoted end of the swinging frame F that carries the feed mechanism. The shunt coils R, S, are connected in series with each other so as to be in parallel to the low resistance coil Q of the starting branch when the lamp is not burning, and it is parallel to the arc and the operating coil P provided for holding the cut-out open when the lamp is burning. The shunt coil S is of greater resistance than the other shunt coil R, and within the latter is arranged the cut-out controlling coil P, whereby one coil S of the derived or shunt circuit is adapted to regulate the feed mechanism when the resistance of the arc is increased and the other coil R holds the cut-out open and interrupts the starting branch so that the current will flow when the lamp is burning through the cut out coil P and through the shunt or derived circuit and coils R, S.

In practice, the concentric coils Q, S, are arranged on one side of the lamp casing while the concentric coils P, R, are on the opposite side of the lamp casing; and I prefer to make the high resistance coil S that controls the arc regulating feed mechanism of about two hundred ohms, and the other high resistance coil R about one hundred ohms' resistance while the coil Q in the starting branch and the cut-out coil P are of very low resistance, about one-half ohm, and the arc resistance about four and one half ohms, to a current of ten ampères and fifty volts per lamp; but these proportions are not essential but merely illustrative, and I do not confine myself to the use thereof. The coils P, R, are so arranged that their ends are of reverse polarity, thus the north pole of the cut-out coil P is contiguous to the south pole of the shunt coil R. The other shunt coil S is arranged concentric within the starting coil Q instead of outside of and around the same as in the manner of the shunt coil R relative to the cut-out coil P.

The connections are as follows:—The shunt coil S is connected in series with the shunt coil R by means of a conductor S and the coil R is also connected to the frame E by a con-

ductor *r;* the starting coil Q is connected to the cut-out O by the conductor *q;* and the coils P, Q, R, are connected to a conductor which leads to the negative terminal of the lamp; and the positive terminal B of the circuit is connected to the casing A′ of the lamp. When the lamp is not burning, the shunt coils R, S, are in parallel with the short circuit or starting coil Q, and the cut-out lever O is in contact with the bridge *e′* of the vertical frame-support E so that the current from the positive terminal B passes into the casing A^8, thence through the support E and its bridge *e′*, thence through the cut-out lever O and its support *o*, to the conductor *q*, the short circuit coil Q and thence through the conductor S′ to the negative terminal B′. As the starting or short circuit coil Q has very small resistance, a very limited quantity of the current is forced through the shunt coils R, S, and the latter coil does not energize the cut-out coil P sufficiently to draw the core *p* downward to break the contact between the cut out and the bridge *e′* of the vertical frame support E. When the lamp is burning, the current passes from the positive terminal B into and through the casing A′, thence to the pendant J, its brush J′, the carbon carrier C, to and across the arc to the lower carbon D′, up the bar a^2 of the lower part of the lamp frame; thence across the connection *p;* to and through the cut out coil P, thence to the conductor S′ and finally to the negative terminal.

The operation of the lamp may be briefly described as follows:—It will be understood that the carbons will be separated when the current is not flowing as the swinging frame is elevated by the tension spring F′ and the cut-out O is closed by the tension of its controlling spring. When the current enters the lamp, it is divided into two branches, finding least resistance through the starting branch so that the greater proportion of the current flows through the starting branch, the cut out and the low resistance coil Q therein, and thence to the negative terminal B′, while very little of the current passes into the shunt or derived circuit and the coils R, S, therein because of the high resistance of said coils to the passage of the current. This passage of the current through the coil Q of the starting branches attracts the movable core Q′ and thereby draws the swinging frame F downward, overcoming the tension of the spring F′, which movement of the frame releases the escapement I′ from the detent *j* and permits the feed mechanism to lower the carrier C so that the carbons come together, and the current passes through the carbons, and the lower part of the frame A^2. When the carbons come together the contact of the cut-out at the bridge *e′* is broken, and there is very little resistance in the arc now and consequently very little current in the shunt circuit in which the coils R, S, are included, the spring F′ lifts the frame and parts the carbons striking the arc. As the carbons part, the resistance of the arc is increased and more current is forced through the high resistance coils R, S, which energizes the coil S sufficiently to again attract the core Q′ and checks the further upward movement of the carbon carrier and consequently any further parting of the carbon pencils, whereby the pull of the spring F′ is counterbalanced by the attraction of the coil S and its core Q′. When the arc becomes too long, or greater than that for which the lamp is adjusted, the resistance of the arc is increased, and the flow of the current consequently increases in the coils R, S, effecting the attraction of the core Q′ and feeding the positive carbon pencil and lessening the length of the arc and decreasing the resistance thereof. Should the carbon pencils be fed too close, the resistance of the arc is less than the lamp is adjusted for and sufficient current will not pass through the coil S of the shunt circuit to attract the core Q′ and thus fail to feed the carbon, whereupon the pull of the elevating spring F′ lifts the frame to raise the carrier C and the attracted carbon, thus increasing the length of the arc and the arc resistance, and thereby cause increased quantity of the current to flow through the coil S until the attraction of the magnet S is sufficient to counterbalance the spring. When the lamp is in action, and the arc is of the proper length and resistance, sufficient current passes through the shunt coil R of the derived circuit to allow the coil P to hold the cut-out open, thus holding the starting branch open; but when the resistance of the arc is too great (as by consumption of the carbon pencils or failure of the carrier C to feed) the increased current in the coil R of the shunt circuit weakens the poles of the cut-out coil P sufficient to release the core *p*, whereupon the tension of the spring O′ elevates the lever O into contact with the bridge *e′*, thus restoring the starting branch and diverting the current from the carbon pencils through the starting branch and the low resistance coil Q, whereby the lamp is cut-out.

The escapement I′ may have a solid rim connected to the hub thereof by radial spokes as indicated in Fig. 1, but I prefer to make the escapement as indicated in Figs. 7 and 8 to adapt the same to reduce the speed of the carbon carrier. This speed reducing and controlling escapement is provided with a hollow closed rim I^2 formed by the concentric bands or rings i^2, i^2, and the annular chamber thus formed is divided into a series of compartments I^3 by means of fixed radial partitions i^3 which extend from the inner band to the outer band of the wheel. In each of these radial walls i^3, is formed a transverse port i^4, and over each port is fitted a plate i^5 having a hole of certain size formed therein through which the liquid can pass.

The escapement wheel has within its lower chambers a working fluid indicated in Fig. 7, which is adapted to shift from the chambers

through the ports in the walls when the escapement is released from the detent *j* and turned or rotated on its axis during the descent of the carbon carrier. In practice I prefer to make the escapement and its radial walls from hard rubber because of its imperviousness to the action of acids, and as a working fluid I employ mercury because of its weight, but this is not essential. It is evident that the weight of the working fluid and the slow progress it makes in passing through the contracted ports in the radial walls, will serve to retard any sudden or quick rotation of the escapement on its axis and thus assist the feed mechanism in preventing any sudden rapid movement of the carbon carrier C.

I will now proceed to describe in detail the switch for cutting the lamp out of the circuit, to enable the attendant to change or adjust the carbons or parts of the lamp without danger from the current. The lamp hanger and switch are more clearly shown in Figs. 2 and 3 of the drawings and also indicated in Fig. 1. The suspending hooks B, B′, form the positive and negative terminals for the circuit, and said terminals have the contacts *t*, *t*′, arranged as shown, the circuit terminals and the switch contacts thereof being insulated from the lamp casing A′. The contacts for the terminals of the lamp are indicated at *u*, *u*′, the contact *u* being positive and the other contact *u*′, being negative; and all of said contacts have their free ends bent or arranged close together to engage with the segmental conductor plates *v*, *v*′, forming the two poles of the manual cut-out switch. The switch *v*, preferably, is made of wood or any suitable insulating material, with a central hub v^2 through which passes a pivot or fulcrum V′ around which the switch can be turned, and the segmental pole plates are arranged within the switch, concentric with its hub, said plates *v*, *v*′, being insulated from each other and the switch hub by means of a suitable insulating material v^3 which partly fills the interior of the switch and in which the pole plates are embedded. When the lamp is in circuit, the positive contacts *t*, *u*, of the circuit and lamp terminals bear on one of the segmental pole plates *v*, of the switch, while the negative contacts *t*′, *u*′, of the circuit and lamp terminals are on the other pole plate *v*′ of the switch, so that the current will pass from B, the contact *t* thereof, the pole plate *v* of the switch, the positive lamp terminal *u*, the lamp casing A′, through the operative parts of the lamp, thence to the negative terminal contact *u*′, the other pole plate *v*′ of the switch, the other negative circuit terminal contact *t*′, and thence to the negative terminal B′ off to the negative conductor *b*′, see Fig. 2. When the switch is reversed, the pole plate *v* contacts with the two contacts *t*, *t*′, of the lamp terminals and the other pole plate *v*′ contacts with the terminals *u*, *u*′, of the circuit terminals B, B′, so that the current will pass from the positive circuit conductor *b* directly through the contacts *u*, *u*′, and the pole plate *v*′ to the negative conductor *b*′ of the circuit and will not pass through the lamp at all.

For the purpose of securing the best contact between the pole plates of the manual cut-out switch, I arrange the same so that the pole plates face downward and bear directly upon the lamp and circuit terminals, whereby the dust and dirt are prevented from accumulating on the contacts and pole plates and they are always clean, which is highly desirable.

Each of the contact plates *u*, *u*′, and *t*, *t*′, is rigidly secured at one end to the top side of the hanger-board as seen in Figs. 2 and 3, while the other end of said contact plate is free or unconfined; and each of said contact plates is thus free to yield or give at its free unconfined end so that good electrical contact is made by all of said contact-plates with the pole pieces of the switch. The terminal contact plates *t*, *t*′, of the circuit are each arranged at one end parallel with the lamp contact plates *u*, *u*′, as seen in Figs. 1 and 2, so that the contact plates of the lamp and line circuit are substantially parallel with each other, which arrangement is important as it enables me to locate the contact plates *u*, *u*′, and *t*, *t*′, near one edge of the hanger-board and thus the pivoted switch can be placed on said hanger board so that its handle extends beyond the side of the hanger-board, whereby the operator standing on the ground can turn the switch without liability of having the hand touch the contact plates and thus obviate being shocked by the current.

From the description heretofore given of my improved lamp, it will be seen that I do not provide any coils for holding the carbons apart when the lamp is in action, nor is there any practical cut out resistance when the lamp is not burning, nor in fact any other element of standard resistance tending to insure uniformity and steadiness of the current. I have therefore found that it is necessary in a lamp devoid of standard resistance, to provide a novel current regulator operating promptly to regulate the current exactly at the dynamo and compensate for unsteadiness of the current and the resistance on the arc caused by drafts of air on the arc, jarring and swaying of the lamp, and by switching lamps in and out of the working circuit.

I am aware that changes and alterations in the form and proportion of parts and details of construction of the mechanism herein shown and described as an embodiment of my invention may be made without departing from the spirit or sacrificing the advantages thereof, and I therefore reserve the right to make such changes and alterations as fairly fall within the scope of the same.

What I claim as new is—

1. In an arc lamp, the combination with a carbon carrier, and a feed mechanism supported by a movable frame, of a starting coil in a starting branch and having its core con-

nected with said movable frame, an automatic cut-out in circuit with said coil, and the independent shunt coils included in a shunt circuit and arranged relatively to the starting and cut-out coils to control the same, substantially as and for the purpose described.

2. In an arc lamp, the combination with a carbon carrier and a movable frame carrying the feed mechanism for said carrier, of an automatic cut-out embracing a movable contact having a core connected thereto and adapted to be moved by a cut-out coil, a starting coil in circuit with the cut-out and having its core connected to the movable frame, and the shunt coils connected in series with each other, substantially as described.

3. In a low resistance arc lamp, the combination with a carrier, of a movable frame having the feed-mechanism, an escapement on said frame connected to the feed mechanism, a detent in the path of the escapement to hold the latter and feed mechanism at rest, a starting coil having its core connected to said frame to depress the same, a spring to elevate said frame, an automatic cut-out mechanism in circuit with the starting coil, and the shunt coils, substantially as described.

4. In an arc lamp, the combination with a carbon-carrier having a rack, and means for feeding and controlling the same, of a pivoted balanced counterpoise geared directly with the rack of said carbon-carrier, substantially as described, for the purpose specified.

5. In a low resistance arc lamp, the combination with a carbon carrier, of a swinging frame having the feed-mechanism and an escapement controlling the same, an elevating spring, a detent in engagement with said escapement, the starting coil having an interior shunt coil and a core, the latter being connected to the swinging frame, a cut-out embracing a movable contact connected to the starting coil, and a shunt coil around the cut-out coil and connected in series with the shunt coil within the starting coil, substantially as described.

6. In an arc lamp, a counterpoise for the carbon carrier comprising a shaft adapted to be geared to said carrier, and an overbalanced segment pivoted to gear with the shaft, substantially as described.

7. In an arc lamp, a speed arresting escapement for the feed-mechanism and carbon-carrier, comprising a revoluble drum provided with the interior radial walls, each having a transverse port, and a slide or gate adapted to vary the size of said ports, the radial walls in the drum forming a series of compartments in which the working fluid is contained, as and for the purpose described.

8. In an arc lamp, the combination with a carrier and a feed mechanism therefor, of a starting coil having its core adapted to release the feed mechanism, a cut-out connected to the starting coil and its spring-controlled contact connected to the movable core of said cut-out coil, and the shunt coils arranged within and without the starting and cut-out coils respectively, and connected in series with each other, substantially as described.

9. In an arc lamp, the combination with a carbon-carrier, a swinging frame, and feed mechanism carried by the frame and connected with the carbon-carrier, of a revoluble drum connected with the feed-mechanism and having on its exterior a series of radial projections and with its interior divided into compartments by radial walls having valved ports, and a detent fixed on the lamp frame in the path of the radial projections on the drum, substantially as described.

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

WM. P. WIEMANN.

Witnesses:

FRED WALDSCHMIDT,

BERNARD WIEMANN.