R. FLEMING & C. A. B. HALVORSON, Jr.

ELECTRIC ARC LAMP.

APPLICATION FILED DEC. 26, 1903.

914,939.

Patented Mar. 9, 1909.

2 SHEETS—SHEET 1.

Fig. 1.

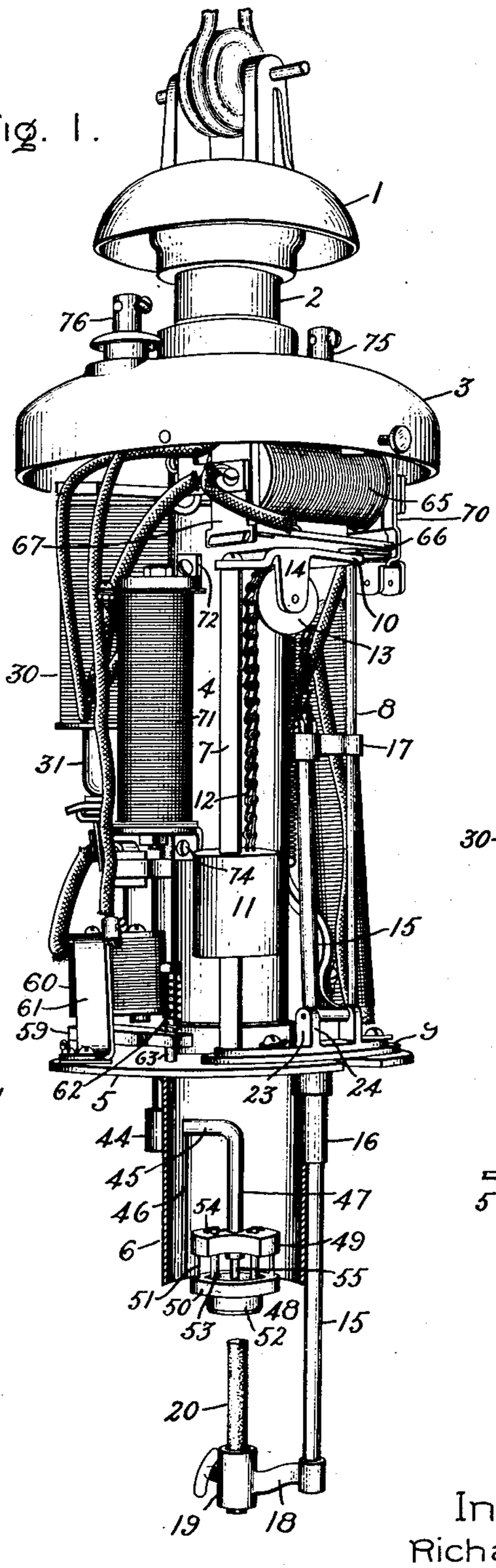

Fig. 2.

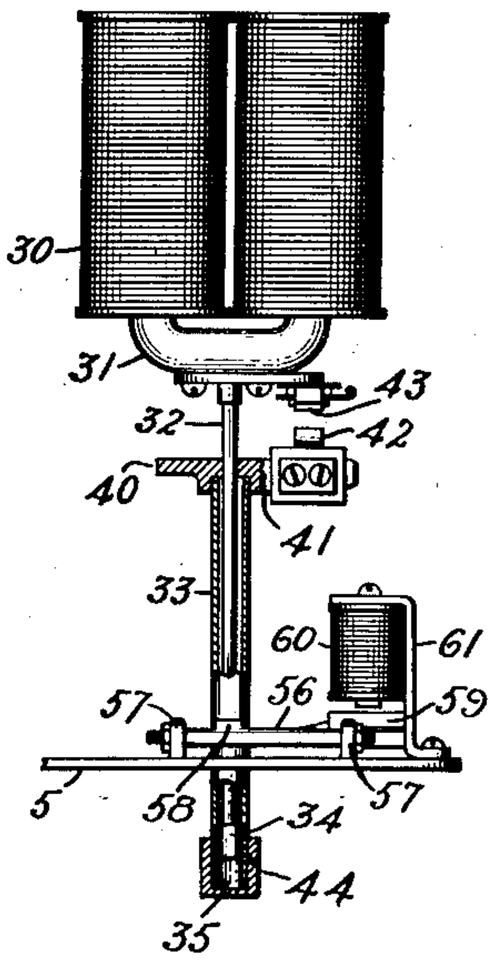

Fig. 3.

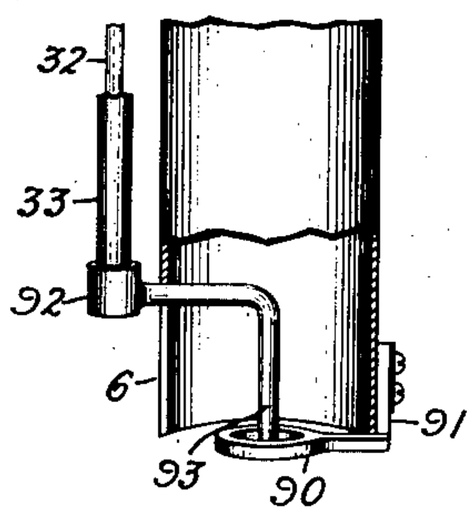

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Fig. 4

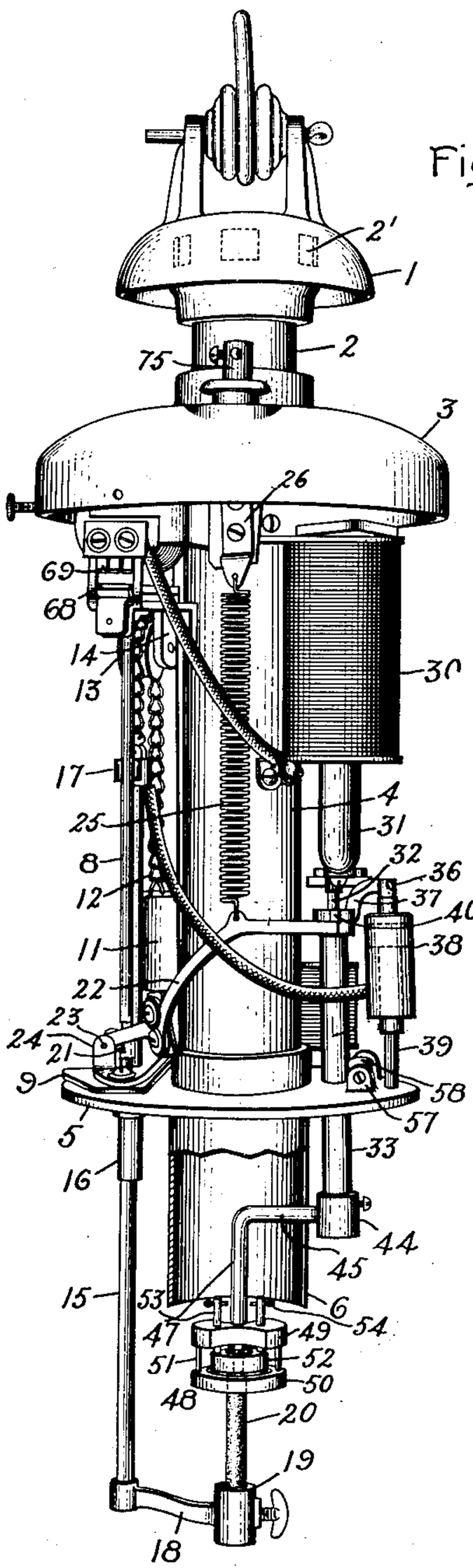
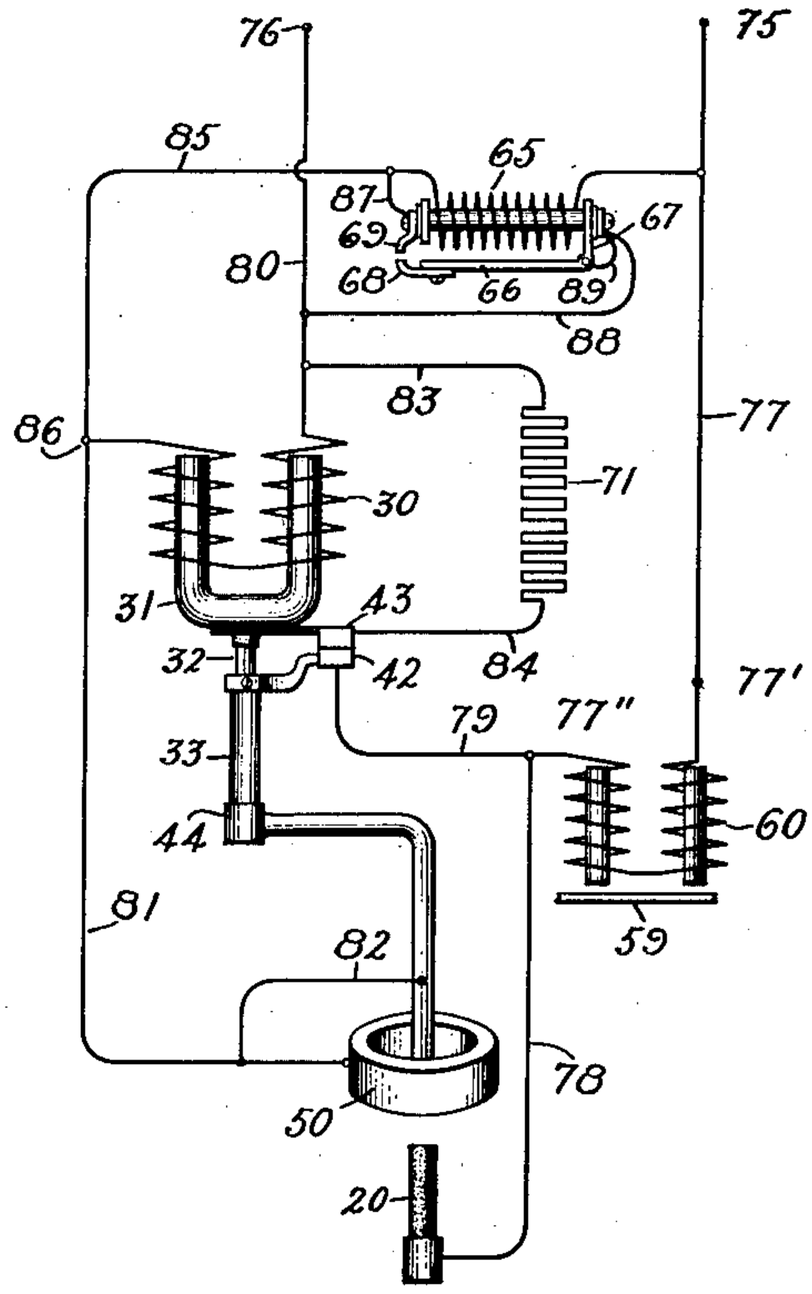


Fig. 5.



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UNITED STATES PATENT OFFICE.

RICHARD FLEMING AND CROMWELL A. B. HALVORSON, JR., OF LYNN, MASSACHUSETTS, ASSIGNORS TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC-ARC LAMP.

No. 914,939. Specification of Letters Patent. Patented March 9, 1909.

Application filed December 26, 1903. Serial No. 186,625.

To all whom it may concern:

Be it known that we, RICHARD FLEMING and CROMWELL A. B. HALVORSON, Jr., citizens of the United States, residing at Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Arc-Lamps, of which the following is a specification.

The object of our present invention is to improve the construction and operation of arc lamps.

More particularly our invention relates to arc lamps in which the electrodes employed insure a luminous or flaming arc, which furnishes the major portion of the illumination, rather than to lamps in which one of the electrode tips heated to incandescence furnishes the bulk of the light, as is the case where carbon electrodes are employed. In such lamps it has been found that where in one of the electrodes some suitable material giving a luminous arc such as titanium carbid, titanium oxid, magnetic oxid or iron or certain other materials is employed, the opposite electrode can advantageously be made out of some metal such as copper or the like so constructed and arranged as to be practically non-consumable in the normal operation of the lamp. The arc products or fumes given by some of the materials which may be employed in the consuming electrode to give the luminous arc are apt to deposit more or less upon the exposed parts of the lamp such as the non-consuming electrode and interfere with the proper operation of the lamp unless suitable precautionary steps are taken. The lamp which we have hereinafter described and illustrated in detail is peculiarly adapted to take care of such fumes. The non-consuming electrode which we employ readily cleans itself from time to time of the bulk of any deposit which may be formed upon it. Moreover, as the arc products may form a film on the non-consuming electrode, which is more or less non-conductive when cold, we have provided means by which a cleaning member or part will be caused to engage the non-consuming electrode to start an arc at each feeding operation of the lamp.

Our invention also comprises many novel features in the construction of the feeding mechanism and other parts of the lamp.

The various features of novelty which characterize our invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

For a better understanding of our invention reference may be had to the accompanying drawings in which we have illustrated several embodiments of it.

Of the drawings, Figure 1 is a perspective view of the lamp with the casing and globe removed and the parts broken away; Fig. 2 is a partial elevation with parts broken away and showing certain details of construction; Fig. 3 is a partial elevation partly in section showing a modified construction; Fig. 4 is similar to Fig. 1 but taken from a different view point; and Fig. 5 is a diagram illustrating the circuit arrangements of the lamp.

Referring to the drawings, 1 represents a cap or hood from the lower end of which a chimney section 2 extends. The chimney section 2 is formed with discharge openings 2′ located within the hood. The lower end of the chimney section 2 carries a cup or hood member 3. A chimney section 4 in alinement and open communication with the chimney section 2 extends from the hood member 3 to a platfrom 5 which it carries at its lower end. A chimney section 6 extends some distance below the platform 5. The chimney section 6 is in alinement and open communication with the chimney section 4. In fact the chimney sections 2, 4 and 6 are connected together to form a rigid chimney structure and may indeed be integral with each other.

A pair of posts 7 and 8 extend upward from a member 9 which is carried on, but insulated from, the upper side of the platform 5. The upper ends of these posts are secured to a bracket 10 carried by, but insulated from, the chimney section 4. A weight 11 slides on the post 7 which may be rectangular in cross-section to fit a rectangular passage in the weight. To the upper side of weight 11 is secured one end of

a flexible member or chain 12. This chain passes over a pulley 13 journaled in arms 14 integrally formed on the bracket 10; the other end of the chain 12 is secured to the upper end of a rod or bar 15 which slides in a tubular guide 16 carried by the member 9. A cross-head or arm 17, carried by the upper end of the rod 15, has a sliding engagement with the post 8. The lower end of the rod 15 carries an arm 18 at the outer end of which a socket 19 is formed in which is held in line with the axis of the chimney the lower consuming negative electrode 20 which may be formed of or contain some material such as a compound of titanium, magnetite or the like which yields a luminous or flaming arc. The weight 11 which is heavier than the rod 15, arm 18, and electrode 20, tends to move the electrode 20 upward. The upward movement of the rod 15 is normally prevented, however, by the engagement with it of a dog 21 carried by a bent arm 22. One end of the arm 22 is journaled at 23 in arms 24 extending upward from the member 9. A spring 25, secured at one end to a bracket 26 carried by the tube section 4, and at the other end to the arm 22 intermediate its ends, normally holds the latter so that the dog 21 engages the rod or bar 15 to prevent its upward movement.

A pair of tubular magnet coils 30 are carried from the chimney section 4 with their axes parallel with the axis of the chimney section. The armature 31 coöperating with these coils is U-shaped, the legs of the U-shaped armature extending into the tubular coils. From the under side of the armature 31 extends a bar or rod 32 which passes axially into a movable tubular member 33. As is clearly shown in Fig. 2 the enlargement 34 carried at the lower end of the rod 32 plays in an enlarged recess 35 formed in the tubular member 33 so that the rod 32 has a limited movement relative to the member 33.

The tubular member 33 carries at its upper end a member 36. An arm 37 projecting to the left from the member 36, as seen in Fig. 4, is connected to the movable shell member 38 of a dash-pot, the fixed piston member 39 of the dash-pot being secured to the upper side of the platform 5. The engagement of the inner end wall of the shell member 38 with the end of the piston member 39 may be employed to limit the downward movement of the member 33. This lamp may be adjusted by adjusting these members. Another arm 40 projecting from the member 36 is adapted to engage the upper side of the free end of the arm 22 and thereby cause the rod 15 to be released when the armature approaches the lower limit of its movement. Another arm 41 extending to the right of the member 36, as seen in Fig. 2, supports an insulated contact member 42. A coöperating insulated contact member 43 is carried at the under side of the U-shaped armature 31. When the rod 32 and the tubular member 33 are at one limit of their relative movement in respect to each other; that is, when the enlargement 34 is in the upper portion of the recess 35, the contacts 42 and 43 are separated, but when the enlargement 34 is at the lower end of the recess 35, the contacts engage one another.

A cup or socket 44 detachably secured to the lower end of the tubular member 33 carries a bent arm which is formed with a horizontal portion 45 which extends into the tube section 6 through a slot 46 formed therein for the purpose, and a vertical portion 47 which is substantially in line with the axis of the section 6. In the form of our invention shown in Figs. 1 and 4 the arm 47 carries at its lower end the non-consuming positive electrode 48. The non-consuming electrode 48 comprises a cross-head member 49 which may be detachably secured to the member 47; an annular member 50 carried below the cross-head 49 and in fixed relation thereto by a pair of pins or posts 51; another annular member 52 of an external diameter somewhat less than the internal diameter of the annular member 50 carried from the cross-head 49 by a pair of pins 53, and an axial member 55. The pins 53 are secured at their lower ends to the annular member 52 but slide through apertures formed for the purpose in the cross-head 49. Cotter pins 54 or the like are employed to prevent the pins 53 from sliding entirely through the cross-head 49. The pins 53 are so proportioned that when the lamp mechanism is in the position shown in Fig. 1 the upper surface of the annular member 52 will be about on a level with the lower surface of the annular member 50. The axial member 55 is in line with the vertical portion 47 of the member 45 and extends downward from the cross-head 49 to a point slightly below the upper surface of the annular member 50. The bore of the annular member 52 is slightly less in diameter than the electrode 20. In consequence of this construction when the electrodes 48 and 20 move together in the manner hereinafter described the upper end of the electrode 20 engages the lower end of the annular member 52 and forces it up through the annular member 50 until the end of the electrode 20 contacts with the end of the axial member 55. As a result of this construction, material deposited upon the outer or inner surface of the annular member 52 will be removed by contact with the annular member 50 and the axial member 55 respectively. The various parts of the electrode 48 are formed of good conducting metal; preferably the annular member 52 is formed out of wrought copper and the axial member may advantageously be formed out of the same material though

it may be formed out of other materials such as carbon, graphite or the like.

A rock-shaft 56 journaled in brackets or arms 57 extending from the upper side of the platform 5 carries a locking member or pawl 58 which engages the tubular member 33 and normally prevents it from moving downward. An extension of the rock-shaft 56 carries a mass of magnetic material 59 which forms an armature coöperating with a pair of coils 60 which are supported from the underside of the upper off-set end of a bracket 61 which may be formed of magnetic material and is secured to the upper side of the platform 5. A helical spring 62 surrounds a bolt 63 which extends upward from the platform 5, the spring being located between the head of the bolt and the upper side of the armature 59 which is formed with an aperture through which the post 63 extends. The spring 62 assists gravity in holding the armature down, in which position the pawl or dog 58 engages the tubular member 33. When the coils 60 are energized, however, the armature is attracted and the tubular member 33 is then free to descend.

A potential coil 65 is carried by the tube section 4 near its upper end in any suitable manner. The armature 66 which coöperates with the potential coil 65 is pivotally connected to one end piece 67 of the potential coil. The other end of the armature carries a contact member 68 which engages a contact member 69 carried by the other end piece 70 of the potential coil. When the current passing through the potential coil does not exceed a certain predetermined strength the armature of the coil will remain in the position shown in Fig. 2, but when this current strength is exceeded the armature will be moved by the coil to cause the contacts 68 and 69 to engage for a purpose which we will hereinafter explain.

A resistance coil 71 is carried from the tube section 4 by means of brackets 72 which are secured to the tube section by screws 74. Binding posts 75 and 76 are carried by the member 3.

The circuit arrangements of the lamp hereinbefore described are illustrated in diagram in Fig. 5. A conductor 77 connects the binding post 75 with one terminal at the point 77′ of the coils 60. The other terminal 77″ of the coils 60 is connected to the lower electrode 20 by a conductor 78. A conductor 79 connects the line 78 to the contact member 42. A conductor 80 connects the binding post 76 to one terminal of the coils 30. The other terminal of the coils 30 is connected to both the axial member 55 and annular member 50 of the non-consuming electrode, as indicated in the diagram by lines 81 and 82. One terminal of the resistance coil 71 is connected to the line 80 by line 83. The other terminal of the resistance coil 71 is connected to the contact member 43 by a conductor 84. One terminal of the potential coil 65 is connected to the conductor 77. The other terminal of the potential coil 65 is connected by a line 85 to the line 81 at the point 86. A conductor 87 connects the line 85 with the contact 69. Conductors 88 and 89 connect the armature 66 to the line 80. It will be observed that when the contacts 69 and 68 engage, a low resistance connection will be established between the conductors 80 and 81 comprising the conductors 88 and 89, body of the armature 66, contact 68, contact 69, conductor 87 and conductor 85.

In the out-of-service condition of the lamp, shown in Fig. 1, the tubular member 33 will be held up by the dog 58 and armature 59. The electrode 20 will be held down by means of the engagement of the dog 21 with the bar 15. As the coils 30 are deënergized the member 32 will slide down in the tubular member 33 until the contacts 43 and 42 engage. Upon connecting the binding posts 75 and 76 in a suitable circuit current will begin to flow through the circuit comprising the conductor 80, conductor 83, resistance 71, conductor 84, contact 43, contact 42, conductor 79, winding of the coil 60 and conductor 77. The passage of this current will energize the coil 60 and cause the armature 59 to be attracted, whereupon the dog 58 will release the tubular member 33 which will begin to descend. As it reaches the lower limit of its movement which is controlled by the dash-pot and may be adjusted, the arm 36 will engage the outer end of the arm 22 which will cause the dog 21 to be moved out of engagement with the bar 15. This will allow the electrode 20 to move upward under the action of gravity on the counter-balance 11. As the electrodes 48 and 20 approach one another, the upper end of the electrode 20 will engage the under surface of the annular member 52 and force it through the annular member 50 taking off any deposit which may be formed on its outer surface. At the same time the axial member 55 will clean the inner surface of the member 52. When the axial member 55 engages the electrode 20 current will begin to flow through a circuit which includes the lines 76, windings for coil 30, line 81, line 82, axial conductor 55, electrode 20, line 78, windings for coil 60, and conductor 77. The passage of current through the coils 30 will cause the armature 31 to be attracted and moved upward. As the armature 31 begins to move upward the contacts 42 and 43 will be separated by reason of the relative movement occurring between member 33 and the bar 32. After the limit of this relative movement has been reached the tubular member 33 and the non-consuming electrode will begin to move upward. The initial upward movement of the

member 33 will allow the arm 22 to move the dog 21 into engagement with the bar or rod 15, thus locking the latter against further upward movement. After this occurs the further upward movement of the member 33 will cause an arc to be drawn between the electrode 20 and the axial member 55. The upward movement of the member 33, which is continued until the electrode 48 moves into the position shown in Fig. 1, is delayed by the action of the dash-pot members 38 and 39. The arc originally drawn between the electrode 20 and the axial member 55 will now extend between the electrode 20 and the annular member 52. When by reason of the consumption of the electrode 20 the voltage of the arc rises beyond a predetermined value, current will flow through the windings of the coil 65 in amounts sufficient to attract its armature causing an engagement between the contacts 68 and 69. This closes a low resistance shunt about the winding of the coils 30, as before explained, whereupon the electrodes 48 and 20 will again move into contact with each other after which they will again be separated in the manner hereinbefore described by reason of the reënergizing of the coils 30 occurring when the contacts 68 and 69 separate owing to the diminution of the current flowing through the coil 65.

In the modified form of our invention shown in Fig. 3 an annular member 90 carried at the end of a bent arm 91 is located at the lower end of the chimney section 6 with its axis in line with the axis of the chimney section. Screws passing through the upturned end of the arm 91 serve to rigidly secure it to the chimney section. A bent member 92, of the same general shape as the bent member shown in Figs. 1 and 2, is carried at the lower end of the member 33. When the lamp is in the running or operative position the lower end of the axial portion 93 of the member 92 is located above the under surface of the annular member 90, as is shown in Fig. 3. The operation of this form of our invention may be substantially identical with that of the first form described with the exception that the annular member 90, which corresponds in function to the annular member 52 of the electrode 48, is fixed. In each feeding operation the lower part of the axial portion 93 corresponding to the member 55 in the other construction passes through the annular member 90 until its lower end projects below the annular member 90 a distance equal to the arc length, whereupon it is engaged by the lower electrode of the lamp. Thereupon current will begin to flow between the electrode 20 and the axial portion 93. This will cause an arc to be drawn between the electrode 20 and the axial portion 93, which will afterward be maintained between the electrode 20 and the annular member 90.

It will be seen that after each feeding operation with either form of our invention an arc of predetermined length is struck. This arc length will not be varied until the succeeding feeding operation except by the elongation occurring as the electrode 20 wastes away in the operation of the arc. The non-consuming electrode in neither form of our invention impedes the flow of suitable draft through the chimney formed by the sections 2, 4 and 6. As in both forms of our invention the axial conductor, which may be regarded as an auxiliary electrode as it engages the electrode 20 to start the arc, is not in direct contact with the arc in the normal operation of the lamp, it remains comparatively clean, thus insuring a good contact between it and the electrode 20 in starting the arc. With both forms of the electrodes employed the axial conductor cleans the axial passage through the annular conducting body which may be regarded as the main electrode as it forms the main portion from which the arc extends in the normal operation of the lamp. In the form of our invention shown in Figs. 1 and 2 the outer surface of this member is also cleaned at each feeding operation.

It will be observed that in both forms of our invention an annular member, formed of good conducting material, forms the operative portion of the positive electrode during the normal operation of the lamp. This configuration of the member from which the positive end of the arc extends has been found advantageous as with it there is little tendency of the arc to wander. This is especially true as the air or gas currents set up by the arc flow partly through the annular member and partly along its outer periphery, and these currents assist in steadying the arc. This, of course, adds to the stability of operation of the lamp.

It will, of course, be understood that any suitable casing may be employed to protect the lamp mechanism located between the hood 3 and platform 5. This casing may support a globe which incloses the lamp mechanism located below the platform 5. Suitable air passages may be provided in the globe or between the globe and the casing to allow the admission of the proper amount of air to furnish draft through the chimney of the lamp necessary to carry off the arc products and to steady the arc.

The circuit arrangements which we employ insure a lamp mechanism in which energy is expended in the regulating mechanism. The coil 65 which is in shunt to the arc is of comparatively high resistance and absorbs but little energy. The coils 30 and 60, which are in series with the lamp, are of compara-

tively low resistance and consequently they also absorb but little energy. Instead of employing the construction shown in the diagram the conductor 78 may be connected to the terminal 77′ of the coil 60 in which case the coil 60 will not be in series with the arc but on the contrary will be out of circuit when the contacts 43 and 42 are separated as in the normal operation of the lamp.

While we have hereinbefore described in detail particular embodiments of our invention it will be readily understood by those skilled in the art that many changes can be made in the form of these embodiments without departing from the spirit of our invention.

What we claim as new and desire to secure by Letters Patent of the United States, is,

1. In an arc lamp, a frame work, an electrode comprising an annular member, means for securing said member as a whole in a position relative to the frame work which is independent of the duration of an arc therefrom, an axial member, and means for causing relative movement between said members whereby the arc is started from one of said members and transferred to the other of said members.

2. In an arc lamp, a non-consuming electrode comprising two relatively movable parts, the relative positions of which are unaffected by the duration of an arc from the electrode, and means for causing an arc to start from one of said parts and to be maintained from the other of said parts.

3. In an arc lamp, a non-consuming electrode comprising an axial member, an annular member, and means for causing movement of one of said members with respect to the other whereby the axial member will remove material deposited on the inner periphery of the annular member by the arc.

4. In an arc lamp, a non-consuming electrode comprising an annular member from which the arc extends in the normal operation of the lamp, and means for removing from the interior periphery of said member material deposited thereon by the arc.

5. In an arc lamp, an electrode comprising an annular member from which the arc extends in the normal operation of the lamp, and means for removing material deposited on the peripheral surfaces of said member from the arc.

6. In an arc lamp, a non-consuming electrode comprising a bridge member, an annular member in fixed relation thereto, a member located axially with respect to said annular member and a second annular member concentric with respect to the first annular member and relatively movable with respect to said axially located member.

7. In an arc lamp, a non-consuming electrode, a consuming electrode, means for moving the non-consuming electrode toward the consuming electrode at each feeding operation a distance equal to the arc length, and means for moving the non-consuming electrode the distance necessary to compensate for its consumption since the previous feeding operation.

8. In an arc lamp, an armature and a member connected thereto by means allowing a limited relative movement between the two, a contact carried by the armature, a second contact carried by said member, said contacts engaging only at one limit of the relative movement between the armature and the member, and a lamp regulating circuit controlled by said contacts.

9. In an arc lamp, a non-consuming electrode, a consuming electrode, an auxiliary electrode, means for starting an arc between the consuming electrode and the auxiliary electrode, and means for thereafter causing the arc to be maintained between the consuming electrode and the non-consuming electrode.

10. In an arc lamp, a tubular non-consuming electrode, a consuming electrode, the position of which as a whole is not directly affected by the duration of an arc therefrom, and an auxiliary electrode which moves through the tubular non-consuming electrode into contact with the consuming electrode.

11. In an arc lamp, a consuming electrode normally tending to move in one direction, a clutch member for preventing such movement, a non-consuming electrode tending to move in the opposite direction, a clutch member for preventing such movement, means for releasing one of said clutch members, and automatic means controlled by the resulting movement of the released electrode for thereafter releasing the other of said clutch members.

12. In an arc lamp, an electrode normally tending to move in one direction, a clutch member for preventing such movement, a second electrode tending to move in the opposite direction, a clutch member for preventing such movement, means for releasing the first mentioned clutch member, and automatic means controlled by the resulting movement of the released electrode for thereafter releasing the other of said clutch members.

13. In an arc lamp, a non-consuming electrode comprising an axial member and a member having a passage formed in it, said passage being normally open, and means for causing movement of one of said members relative to the other of said members whereby said axial member moves into said passage and removes material deposited on the wall thereof by the arc.

14. In an arc lamp, a non-consuming electrode comprising a member having a passage in it from which member the arc extends in the normal operation of the lamp, and through the passage in which arc products flow, and means for cleaning the wall surrounding said passage.

In witness whereof we have hereunto set our hands this twenty-fourth day of December 1903.

RICHARD FLEMING.
CROMWELL A. B. HALVORSON, JR.

Witnesses:
DUGALD MCK. MCKILLOP,
JOHN A. MCMANUS.