No. 885,338. PATENTED APR. 21, 1908.

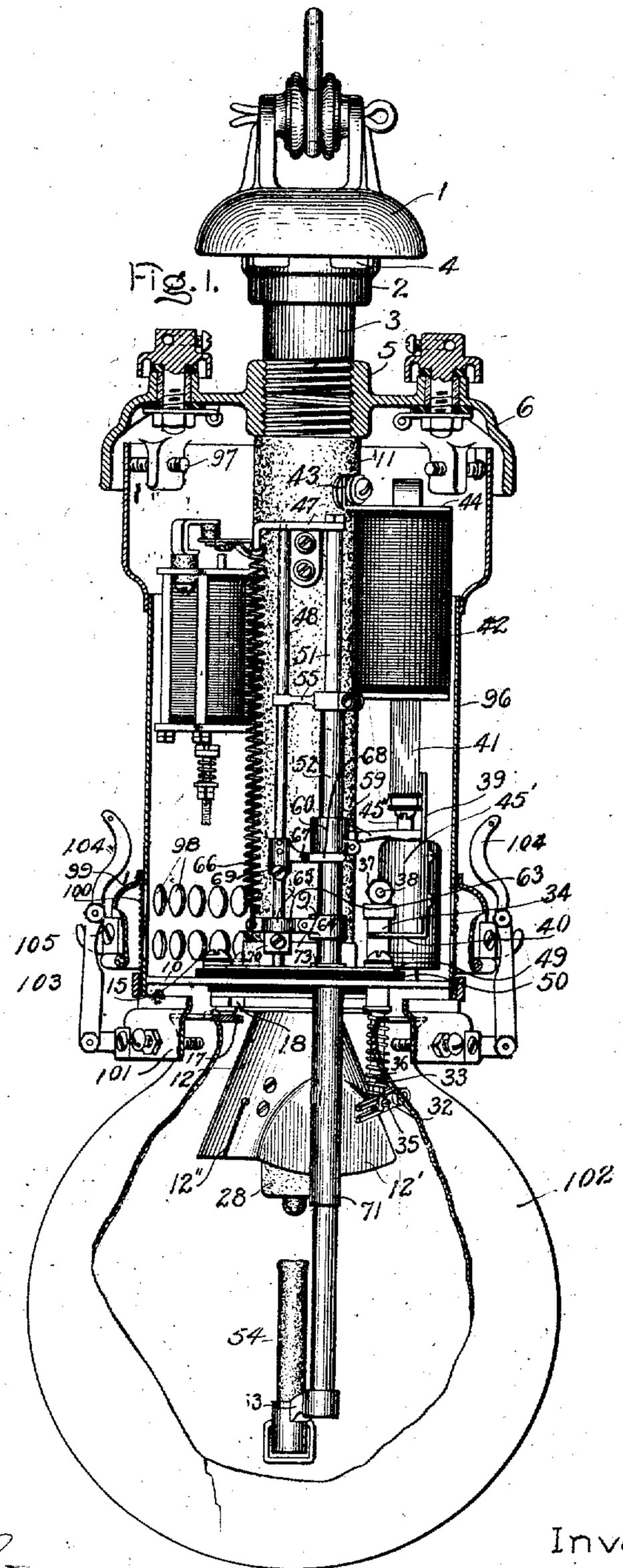
J. HÄRDÉN.

ARC LAMP.

APPLICATION FILED DEC. 12, 1903.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 2.

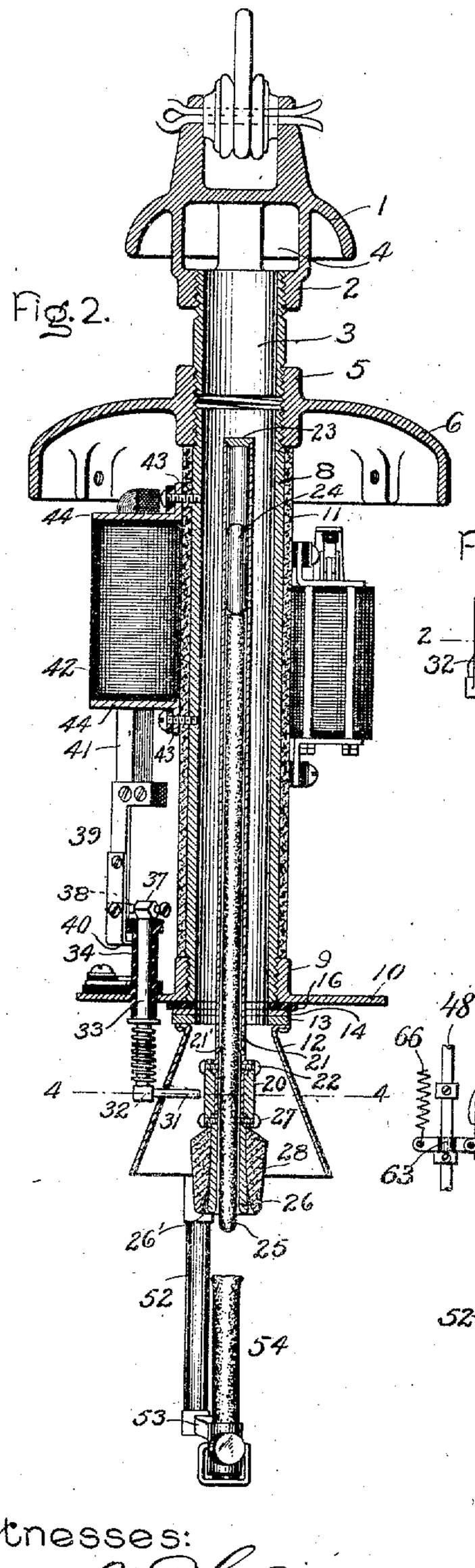

Fig. 3.

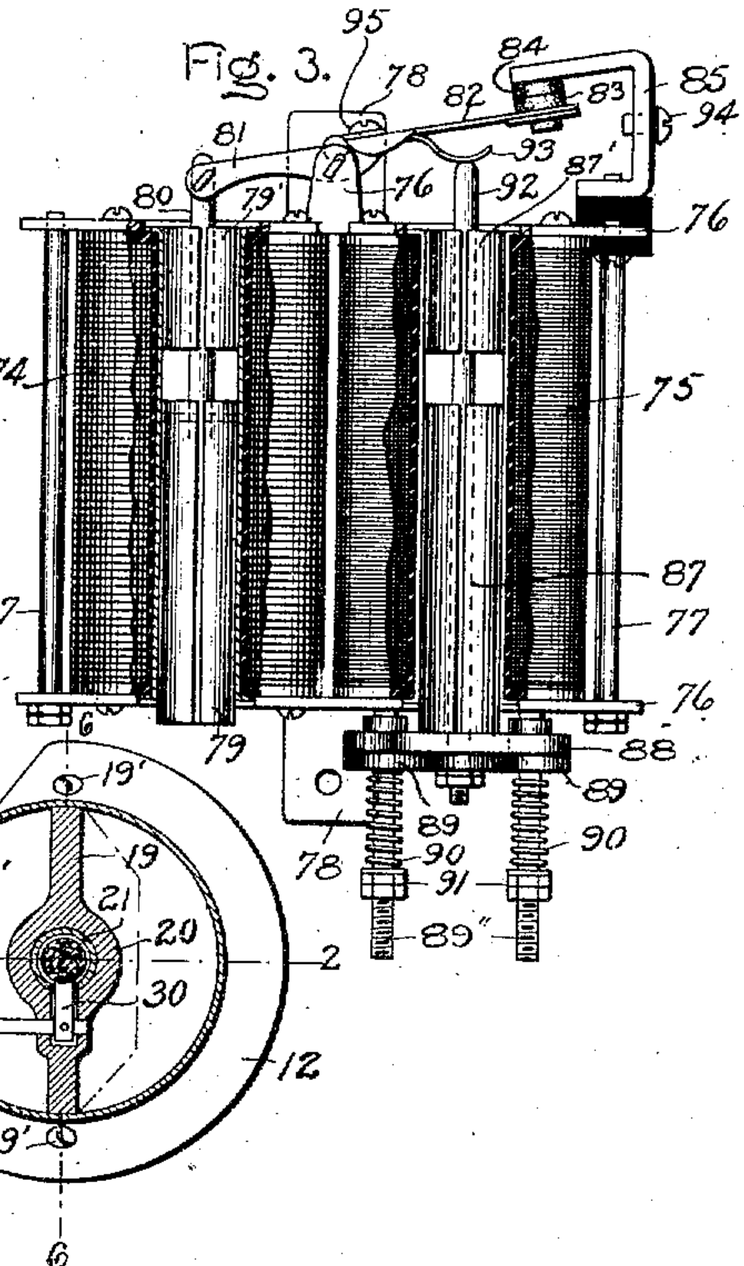

Fig. 4.

Fig. 5.

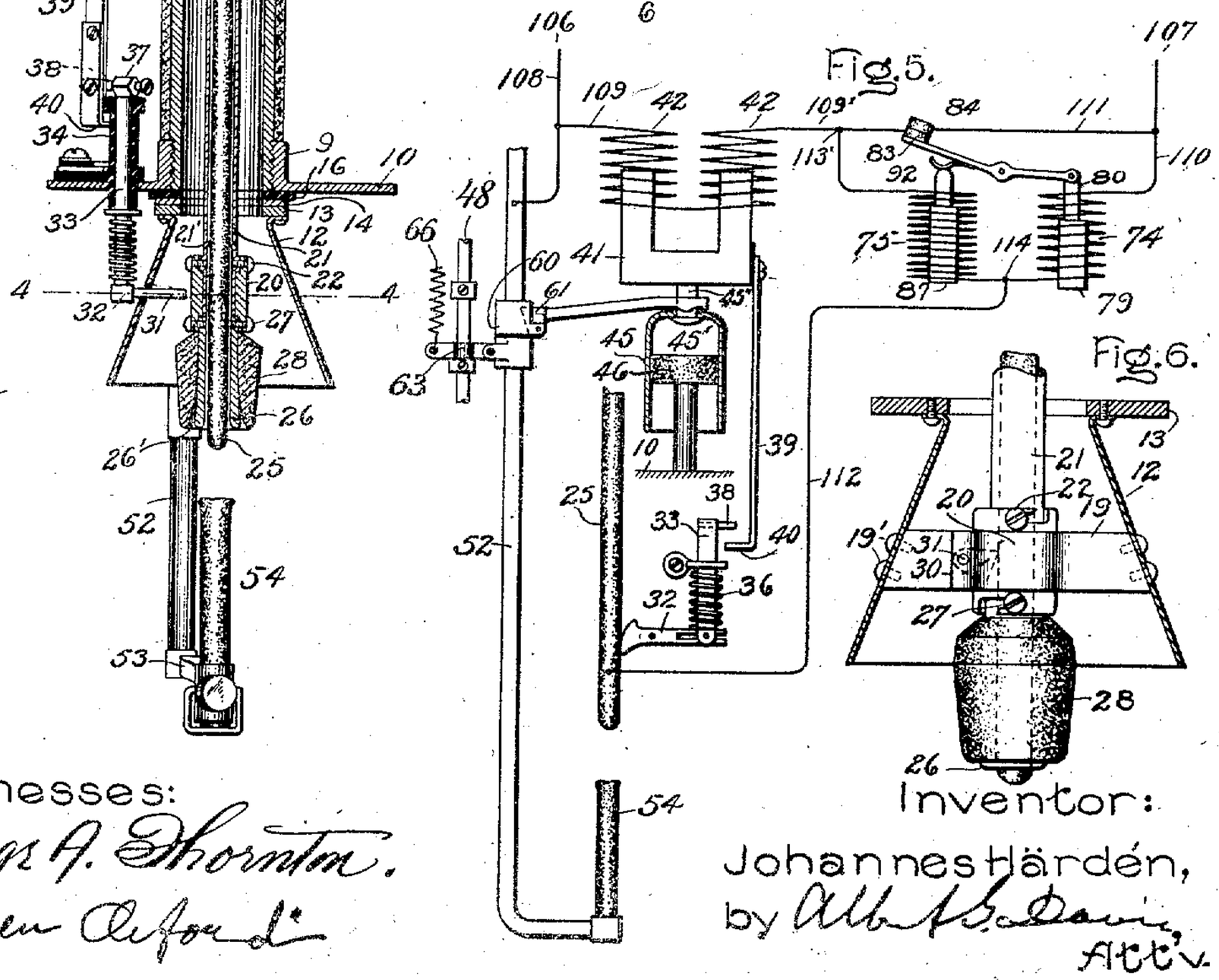

Fig. 6.

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UNITED STATES PATENT OFFICE.

JOHANNES HÄRDÉN, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ARC-LAMP.

No. 885,338. Specification of Letters Patent. Patented April 21, 1908.

Application filed December 12, 1903. Serial No. 184,876.

To all whom it may concern:

Be it known that I, JOHANNES HÄRDÉN, a subject of the King of Norway and Sweden, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Arc-Lamps, of which the following is a specification.

The object of my present invention is the improvement of arc lamps. More particularly my present invention relates to alternating current arc lamps in which the major portion of the illumination from the lamp is given by a flaming or luminous arc, as distinguished from those in which practically all of the illumination comes from electrodes heated to incandescence. With the electrodes employed in these lamps the products of combustion from the arc are not all permanent gases, as is substantially the case where carbon electrodes are employed, but contain matter which condenses to solid form. This necessitates a lamp arranged so that the solid matter cannot be deposited where it will clog up or otherwise hurt the operation of the lamp.

Satisfactory electrodes giving a flaming or luminous arc have been heretofore employed in direct current arc lamps, and are but very slowly consumed in air at the temperatures attained by them in operation. For use in alternating current lamps, however, it has been found desirable to employ in one of the electrodes, at least, a composition which rapidly wastes away in air at the temperature attained by it. I have devised means, therefore, for protecting this electrode of the lamp from combustion.

The lamp which I have hereinafter described and illustrated in detail is characterized by many novel features, all of which will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention reference may be had to the accompanying drawing, in which I have illustrated one embodiment of it.

Of the drawings, Figure 1 is an elevation with the casing and part of the mechanism in section and the globe broken away; Fig. 2 is a sectional elevation of the lamp on the line 2 2 of Fig. 4; Fig. 3 is an elevation showing the feeding coils; Fig. 4 is a section taken on the line 4 4 of Fig. 2; Fig. 5 is a diagram illustrating the circuits of the lamp; and Fig. 6 is a partial sectional elevation taken on the line 6 6 of Fig. 4.

Referring to the drawing, 1 represents a lamp cap or top on the upper side of which suitable means are provided by which the lamp may be suspended. From the under side of the cap or top 1 an integrally-formed tubular boss 2 depends. This boss is threaded interiorly to receive the threaded upper end of a short metal tube 3, as is clearly shown in Figs. 1 and 2 of the drawings. The boss 2 has a series of apertures 4 formed in it. The lower end of the tube 3 is also threaded to engage the upper end of the interiorly threaded cylinder 5 extending through and integrally connected to a circular member 6. The upper end of a section of metal tube 8 is threaded into the lower end of the cylinder 5. The section 8, which is similar to section 3 except that it is considerably longer, is also threaded at its lower ends to engage an interiorly threaded tubular boss 9, projecting upward from the disk-shaped platform 10. The section 8 is surrounded by a layer 11 of material which is an insulator both of heat and electricity.

A hollow member 12, in the form of the frustum of a cone, preferably formed of sheet copper, is secured to the under side of the platform 10 and extends in line and in open communication with the sections 3 and 8. In the construction shown in the drawings the upper and smaller end of the member 12 is secured to an annular member 13 which abuts against a metallic washer 14 secured to the platform 10 by a pair of screws 15. The screws 15 are insulated from the platform 10, in any suitable manner, and a layer 16 of insulating material is interposed between the washer 14 and the under side of the platform 10. Clamping nuts 17 on the end of the screws 15 are employed for holding the annular member 13 against the washer 14 and the platform 10. Preferably open-ended slots 18 are formed in the flange 13 through which the screws pass. This facilitates a ready removal of the member 12 from the platform 10 whenever it becomes desirable. With the construction employed it will be seen that the member 12 is secured to the platfrom 10 but is at the same time insulated therefrom. One side of the conical member 12 is flattened, as indicated at 12′, to obtain sufficient clearance for the elec-

trode - carrying mechanism. Slits 12'' are formed in the member 12 to prevent noisy vibration of the member which might otherwise be produced by the draft.

A bridge piece 19, which may be formed of copper, is diametrically located in the member 12, being secured thereto at opposite ends by screws 19'. The bridge member 19 is formed with a tubular enlargement 20 midway between its ends. A tube 21, which may be formed of copper, has its lower end inserted in the tubular enlargement 20 to which it is detachably connected by screws 22. The upper end of the tube 21 is closed by a plug or member 23. A follower block 24, which is preferably formed of copper and has a snug sliding fit in the tube 21, rests on the upper end of the upper electrode 25 of the lamp which projects into the tube 21. The electrode 25 is somewhat smaller in diameter than the body of the tube 21. Lugs 21' extend in from the tube 21 to prevent the follower 24 from passing out of the lower end of the tube. These lugs, however, do not prevent the movement of the electrode 25. A tubular member or bushing 26, which is preferably formed of copper, projects into the lower end of the tubular enlargement 20 to which it is detachably secured by screws 27. As is clearly shown in Fig. 2, the lower end of the tube 21 abuts against the upper end of the tubular member 26, so that the tubular enlargement 20 constitutes a coupling between the tubes 21 and 26. A tubular guard 28 formed of some infusible non-conducting material such as fire clay surrounds the tubular member 26. The outer surface of the tubular member 26 flares out at its lower end and the member 28 rests upon this surface. The lower end of the inner surface of the member 28 flares upward so that an annular space 26' exists between the lower ends of the members 26 and 28.

A pawl 30 is mounted in a chamber or recess formed for the purpose in the bridge member 19. Pawl 30 is carried by a shaft 31 which is journaled in the bridge member 19. The shaft 31 projects through the tubular member 12 and carries at its outer end an arm 32, the free end of which is bifurcated. A rod 33, which is slidingly mounted in an insulating bushing 34, passes transversely through the platform 10 and carries at its lower end a pin 35 which passes between the bifurcations of the arm 32. A helical spring 36 surrounds the lower end of the rod 33 extending between the bushing 34 and the arm 32. The rod 33 is prevented from dropping through the bushing 34 by a cross-head or nut 37 which is adjustably secured at the upper end of the rod. This cross-head or nut carries a projection 38, the purpose of which will be hereinafter explained at length. When the free end of the arm 32 is in the position shown in Fig. 1, as it normally is under the action of the spring 36, the pawl 30 is in position to engage the electrode 19, but when the rod 33 is moved up, as hereinafter described, the pawl 30 is oscillated into a position in which it no longer engages the carbon 19 which is then free to slide in the tube 15.

An arm 39 having a lower out-turned end 40 is secured to, but insulated from, the lower end of a U-shaped laminated armature 41. The legs of the U-shaped armature 41 pass axially into one each of a pair of tubular magnet coils 42. These magnet coils, which may be of ordinary construction, have lugs 43 projecting from their end pieces 44. Suitable screws passing through these lugs secure the magnet coils to the tube section 8. One member 45 of a dash pot 45' is secured to the under side of the armature 41. The other member 46 of the dash pot is secured to the platform 10. The two members of the dash pot are arranged to prevent a rapid downward movement of the armature 41 without retarding its upward movement. A bracket 47 is secured to, but insulated from, the upper end of the tube section. A rod 48 extends from the under side of the bracket 47 toward the platform 10. The lower end of the rod 48 is directly connected to a washer or plate 49 which is secured to, but insulated from, the platform 10, by a similar plate 50 of insulating material. A rod 51 also extends down from the bracket 47 parallel to the rod 48. The rod 51, which may be secured to the bracket in a suitable manner, as by a threaded connection, passes downward through apertures formed for the purpose in platform 10, and plates 49 and 50. A tube 52 surrounds the major portion of the rod 51 which forms a guide upon which the tube may be moved longitudinally. An arm 53 extending at right angles from the lower end of the tube 52 carries at its outer end a socket in which the consuming negative electrode 54, which is slightly larger than the electrode 25, is held in line with the electrode 25 and with the axis of the tube sections 3, 8 and 12.

An arm 55 is clamped to the upper end of the tube 52. The outer end of the arm 55 is bifurcated and the bifurcations straddle the rod 48. The arm 55 forms a means for preventing rotation of the tube 52 and consequent angular displacement of the electrode 54 about said tube.

A clutch 59 of ordinary construction connects the armature 41 and the tube 52. The tubular yoke 60 of the clutch 59 surrounds the rod 52, and the pawl 61 of the clutch is pivoted thereto. One end of the pawl is provided with an aperture through which the shank 45'' of the dash pot member 45 passes. The other end of the pawl is adapted to firmly engage and lift the rod 52 in the ordinary manner when the armature 41 is raised.

A second clutch 63 comprises a yoke 64 which surrounds the tube 52 and a pawl 65

pivoted to the yoke. The inner end of this pawl is adapted to engage the tube 52 whenever the outer end of the pawl is elevated. One end of a long helical spring 66 is secured to the outer end of the pawl 65. The other end of the spring 66 is secured to a lug which depends from the bracket 47. The spring 66 normally holds the pawl 65 in such position that its inner end engages the tube 52. The pawl 65 is preferably formed with an aperture through which the rod 48 passes. This prevents angular displacement of the clutch.

A member 67 is adjustably secured to the rod 48. This member is provided with a bifurcated extension 68 which straddles the tube 52. The upper surface of the extension 68 forms a stop, against which the yoke 60 of the clutch 59 rests when the armature 41 is at the lower limit of its movement. The member 67 is provided at its under side with a lug 69 which forms a stop against which the outer end of the pawl 65 impinges when the tube 52 is given a sufficient upward movement. This impingement causes the clutch to release the tube 52. An adjustable collar 70 is mounted upon the rod 48 against the upper side of which the outer end of the pawl 65 normally rests. A tube 71 surrounds the tube 52. The upper end of the tube 71 is provided with an out-turned flange 73 which prevents the tube from dropping through the washer 49 and the platform 10. The tube 71, which is arranged to telescope or slide on the tube 52, may be forced upward against the under side of the yoke 64 to cause the clutch 63 to release the tube 52 whenever it may be desirable, as in trimming the lamp.

A pair of magnet coils 74 and 75 which are clamped between end plates 76 by bolts 77 are secured to, but insulated from, the tube section 8 near its upper end by means of screws passing through projections 78 from the end pieces. A movable core or plunger 79 of magnetic material is located near the lower end of the coil 74. A bar or rod 80 is secured to the upper end of the core 79, and the other end of the rod 80 is pivotally connected to a member 81 which is pivoted in lugs or projections from the upper end member 76. The opposite end of the member 81 comprises a strip 82 of flexible material at the outer end of which a contact member 83, which may consist of a block of carbon, is carried. A coöperating contact member 84, which may also be formed of a block of carbon, is secured to the under side of a bent arm 85 carried by the upper end piece 76.

A movable core 87, which is located in the tubular coil 75, is secured at its lower end to a cross head 88 which carries bushings 89 through which bolts 89″ projecting downward from the lower end plate 76 pass. Helical springs 90 surround the bolts 89″. The lower ends of these springs rest on nuts on nuts 91 which may be adjusted along the length of the bolts. The heads of the bushings 89 rest on the upper end of the spring 90, and the weight of the cross head 88 and the core 87 is yieldingly sustained by these springs. The core 87 carries an upwardly-extending rod or plunger 92, which under some circumstances engages the under side of a spring projection 93 from the member 81 which extends beneath the flexible member 82.

The cores 79 and 87 are formed of magnetic material which may be shaped in any suitable manner for use in alternating current, as by laminating it. In order to improve the action of the coils 74 and 75 tubular blocks or cores 79′ and 87′ of magnetic material may be secured in the upper ends of the coils 74 and 75 respectively. The rods or bars 80 and 92 slide in the bores of the blocks 79′ and 87′ respectively. When the coil 74 is energized the core 79, located in the lower portion of the coil, is urged upward. The upward movement of the core rocks the member 81 and separates the contacts 84 and 83. When the coil 75 is energized, its core, which is also located in the lower portion of the coil 75, is urged upward. The engagement between the plunger 92 and the spring member 93 tends to oscillate the member 81 in the direction which will again bring the contacts 83 and 84 together. Clamping screws 94 and 95 carried by the arm 85 and the member 81 respectively secure to the member 81 and arm 85 the ends of conductors, a circuit through which may be controlled by the contacts 83 and 84. A casing 96 extends between the platform 10 and the hood 6 to which it is secured by suitable screws or bolts 97. Near the lower end of the casing 96 suitable apertures 98 are formed in the casing for the purpose of ventilating the lamp mechanism. A hood 99 prevents dust and moisture from entering these apertures. The casing 96 may be surrounded at the portion where these apertures are located by a screen 100. The connection between the casing and the hood 6 is such that suitable passages exist there through which the air heated by the mechanism of the lamp may pass out of the casing.

An annular member 101 located beneath the platform 10 carries a globe 102 which surrounds the electrode. The annular member 101 is secured to the casing 96 in any suitable manner as by the pivoted members 103 and 104 connected to the member 101, and lugs 105 carried by the hood 99.

The form of lamp which I have described in detail is intended to operate in a constant alternating current circuit. In the diagram shown in Fig. 5, 106 and 107 represent the lamp terminals. A conductor 108 extends from the terminal 106 to the tube 52 which supports the lower electrode of the lamp. A conductor 109 extends from the line 108 to

one terminal of the magnet coils 42 which are in series with each other; the other terminal of the magnet coils 42 is connected to the contact 83 by a conductor 109′. The contact 84 is connected to a conductor 110 by means of a conductor 111. The conductor 110 extends between the terminal 107 and one terminal of the coil 74; the other terminal of the coil 74 is connected to the upper electrode of the lamp by a conductor 112. One terminal of the coil 75 is connected to the line 109′ at the point 113, and the other terminal of the coil is connected to the line 112 at the point 114.

The lamp mechanism shown in the various figures is in the out-of-service position. When the lamp is connected in circuit current will pass between the terminals 106 and 107 through the conductors 108 and 109, windings of the feed magnet coils, conductor 109′, contacts 83 and 84, and conductor 111. The passage of current through the magnet coils 42 will cause the armature to be attracted which will thus through the clutch 59 raise the tube 52 and thereby the lower electrode 54 until the upper end of the electrode engages the stop formed by the lower end of the bushing 26, the bore in which the electrode is too large to enter. Before the upper end of the lower electrode has reached the upward limit of its movement the arm 39 carried by the armature 41 will engage the projection 38 of the plunger 33. The continued upward movement of the arm 39 will cause an oscillation of the arm 32 and pawl 30 which will disengage the latter from the upper electrode 25 which will drop into engagement with the lower electrode. As soon as current in an appreciable amount begins to flow between the electrodes of the lamp the coil 74 which is in series with the electrodes will raise its armature and separate the contacts 83 and 84. The magnet coils 42 will then be deënergized and the tube 52 will drop backward a distance equal to the movement of the pawl 63 between the stops 69 and 70 on the rod 48, thus striking an arc of a predetermined length. As the pawl 30 will not be forced into engagement with the upper electrode 25 by its controlling spring 36 until the electrode 54 has moved downward a certain distance, the electrode 25 which, impelled by gravity, will follow it downward, projects from the bushing 26 at the end of each feeding operation about as far as shown in Fig. 2.

After the contacts 83 and 84 are separated a circuit will still exist through the windings of the magnet coils 42 and the winding of the coil 75 between the points 108 and 114; this circuit, it will be observed, is in shunt to the arc. As the winding of the coil 75 has a high resistance, current passing through the coils 42 under these circumstances will not be sufficient to attract the armature 40. When, for any reason, the voltage of the arc rises above a predetermined amount the current flowing through the winding 75 will be great enough, however, to raise the armature 87 by means of the plunger or rod 92 and, overbalancing the action of the armature 79, force the contacts 83 and 84 together, whereupon the lamp will again feed. This will cause a new arc of predetermined length to be formed and compensate for the electrode portions which have been consumed. By adjusting the nuts 91 the tension of the springs 90 can be adjusted and thereby the arc voltage, which will cause the core 87 to move the contacts 83 and 84 together against the action of the core 79, can be regulated. When, in consequence of a predetermined rise in the arc voltage the coil 75 is operatively energized, the armature 87 is raised until it is brought into an equilibrated position by the flow of the alternating current through the coils against the counter-acting force of gravity supplemented by the force exerted upon the armature by the spring member 93. As the body of the armature 87 approaches the block 87′ the magnetic resistance in the magnetic circuit energized by the coil 75 is reduced. The spring member 93 forms a yielding or resilient abutment against which the upper end of the rod 92 bears and serves when the coil 75 is operatively energized to take up the vibrations of the armature due to the current alternations in said coil. When the armature 87 has moved the contact 83 into engagement with the contact 85, the flexible or resilient member 82 assists somewhat in taking up such vibrations. The provision of a yielding resilient support against which the upper end of the rod 92 may impinge possesses the advantages among others, of doing away with the chattering noise otherwise experienced. The springs 90 also aid in rendering the action of the core 87 noiseless.

The combustion products of the arc pass upward through the chimney formed by the sections 2, 8 and 12 and are discharged through the openings formed in the hood or cap 1. Suitable space exists between the upper end of the globe 102 and member 101 to allow the admission of the air necessary to create a proper draft. The lower electrode may be composed principally of titanium carbid or some other substance yielding a luminous arc which is not readily oxidized and is slowly consumed. It has been found desirable, however, to employ in the upper electrode a considerable amount of carbon.

I make no claim in my present application to such electrodes for use in alternating current arc lamps, as I have claimed them in another application, Serial No. 184,564, filed December 10, 1903.

As is well known, unless means are taken to protect the upper electrode from the action of the air, it will be rapidly consumed.

With the construction shown the upper end of the electrode 25 is surrounded by a casing or shield, which comprises the tube 21, tubular enlargement 20 and shell 26, and as the portion of the electrode 25 which projects below the bushing 26 is, in the operation of the lamp, surrounded by a practically non-oxidizing atmosphere created by the arc, this electrode will also be slowly consumed. When the electrode 25 becomes so short that the upper end of the electrode passes below the pawl 33, the electrode will drop down and form a low-resistance connection between the lower electrode and the bushing 26, which is in electrical connection with one terminal of the lamp, thus obviating the necessity for an automatic cut-out to protect the lamp when the upper electrode is consumed.

The guard or shield 28 formed of fire clay, or other insulating material, prevents a tendency of the arc to wander up the side of the bushing 26. The connection of the bridge member 19 to the thin shell 12 very largely increases the heat-dissipating capacity of the tubular member 20 and bushing 26. This prevents them from reaching temperatures at which they would be readily oxidized. With the construction shown the bushing 26 and guard 28 may be readily renewed when necessary.

While the lamp which I have hereinbefore described is particularly adapted for use on constant alternating current circuits, it will be readily understood that the minor changes which may be necessary to adapt it for use on direct current circuits and on constant potential circuits, can readily be accomplished by those skilled in the art.

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

1. In an arc lamp, a tube or casing in which the upper electrode of the lamp is located, said tube or casing being formed in detachable sections, a coupling for the sections the section adjacent the arc being formed of some good conducting metal, and a guard or shield of refractory non-conducting material which surrounds said section.

2. In an arc lamp, an upper electrode, means for locking it in place, a stop, a lower electrode and means for moving it against the stop, and means for causing the locking means to release the upper electrode as the lower electrode strikes the stop.

3. In an arc lamp, a tubular member, an upper electrode located therein, means for locking the upper electrode in fixed relation to said member, a lower electrode, means for moving said electrode against the member, said means releasing the upper electrode, and means for causing said locking means to engage the upper electrode again only after the lower electrode has separated a predetermined distance from said member.

4. In an arc lamp, a pair of electrodes, a solenoid and means actuated thereby for positively feeding the lower electrode when energized and releasing the upper electrode to feed by gravity, a switch controlling the energization of said solenoid, a series coil opening said switch, and a shunt coil for closing said switch.

5. In an arc lamp, a central chimney member for carrying off arc products forming the backbone of the lamp, a casing centrally located in said chimney, and an electrode movably located in said casing.

6. In an arc lamp, a series coil and a shunt coil arranged side by side, armatures for each of the coils, a pivoted member and a circuit controlled thereby, means connecting the armature of the series coil and the pivoted member whereby the series coil when energized will normally maintain said circuit open, and a flexible connection between the armature of the shunt coil and the pivoted member whereby when the shunt coil is energized by a predetermined current the circuit will be closed.

7. In a luminous arc lamp, a long centrally located draft tube or chimney constituting the backbone of the lamp, a tube or casing located therein, and an electrode projecting from the lower end of the tube or casing.

8. In a luminous arc lamp, a long centrally located draft tube constituting the backbone of the lamp, a consuming electrode in said tube with its lower and arcing end adjacent the lower end of the draft tube or chimney, and means for protecting the body of the electrode from the action of the gases in said tube.

9. In an arc lamp, feeding mechanism including a pair of contacts, means for holding said contacts in engagement with each other when the lamp is out of service, a coil in series with the arc normally acting to separate said contacts when current is flowing through the lamp, and a coil in shunt to the arc for bringing about an engagement between said contacts regardless of the energization of the series coil whenever the voltage of the arc rises above a predetermined amount.

In witness whereof, I have hereunto set my hand this 7th day of December, 1903.

JOHANNES HÄRDÉN

Witnesses:

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JAMES S. ANTHONY.