(No Model.) 3 Sheets—Sheet 1.

G. R. LEAN.

ELECTRIC ARC LAMP.

No. 571,974. Patented Nov. 24, 1896.

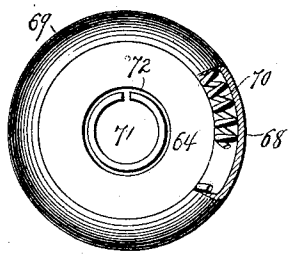


Fig. 2.

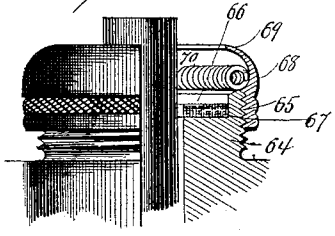


Fig. 3.

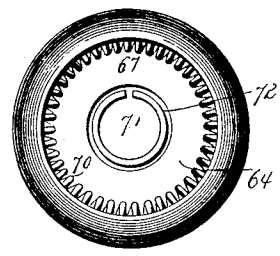


Fig. 4.

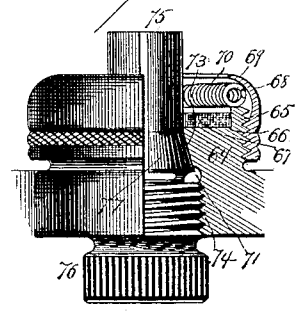


Fig. 5.

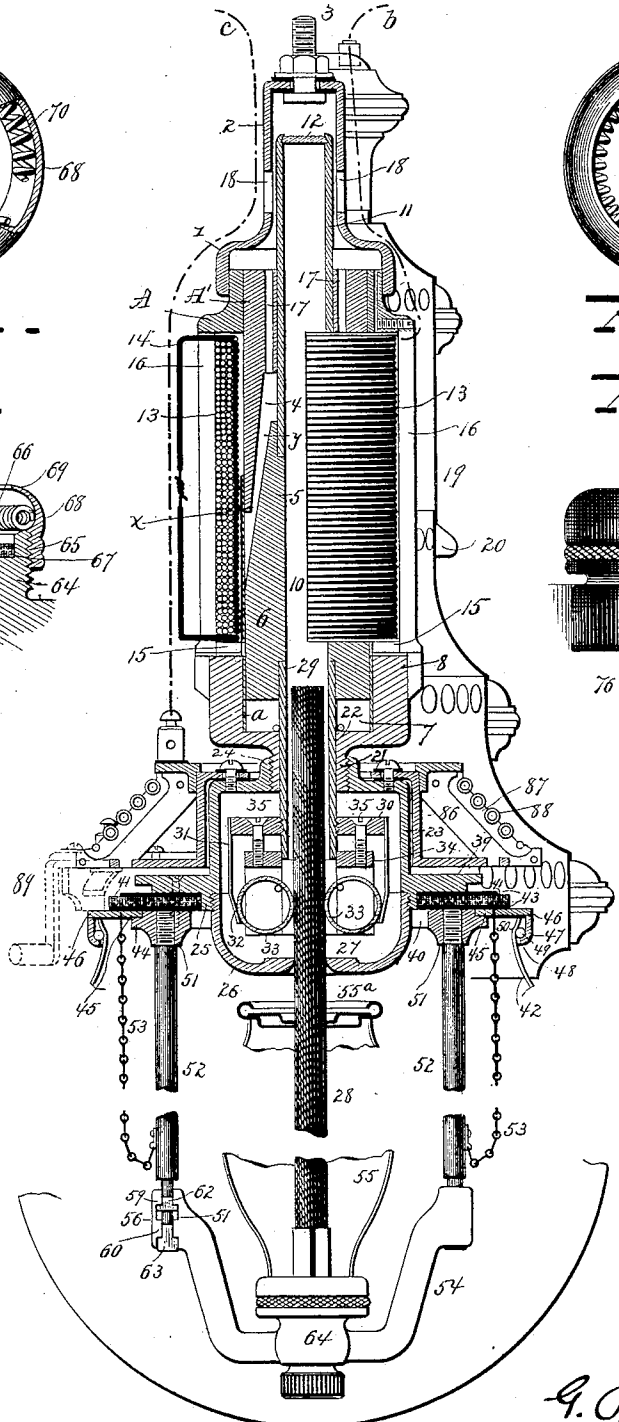


Fig. 1.

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(No Model.) 3 Sheets—Sheet 2.

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FIG. 6.

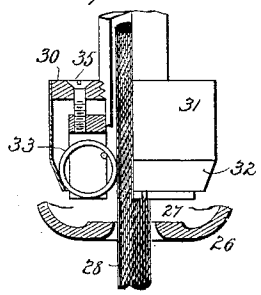


FIG. 10.

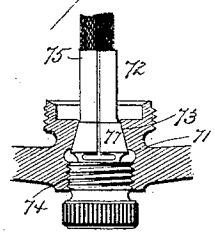


FIG. 8.

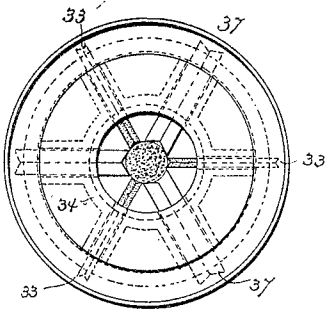


FIG. 11.

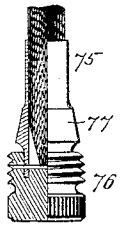


FIG. 7.

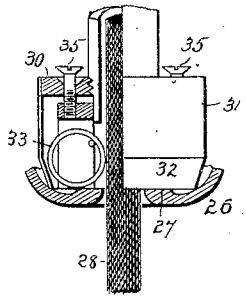


FIG. 9.

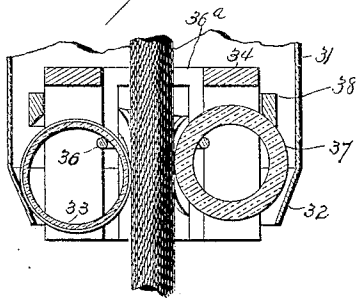


FIG. 12.

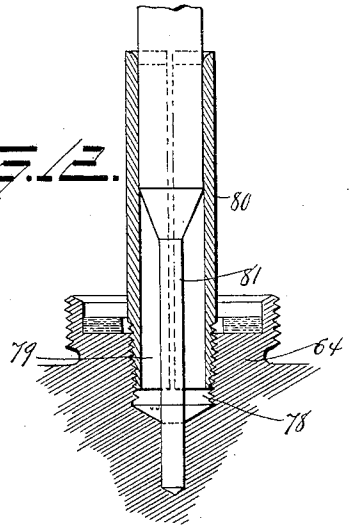
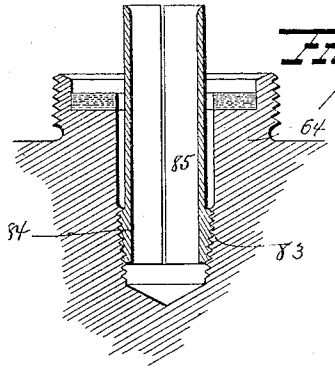


FIG. 13.



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Fig. 14.

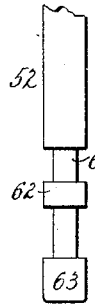


Fig. 15.

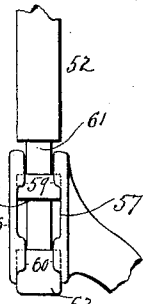


Fig. 16.



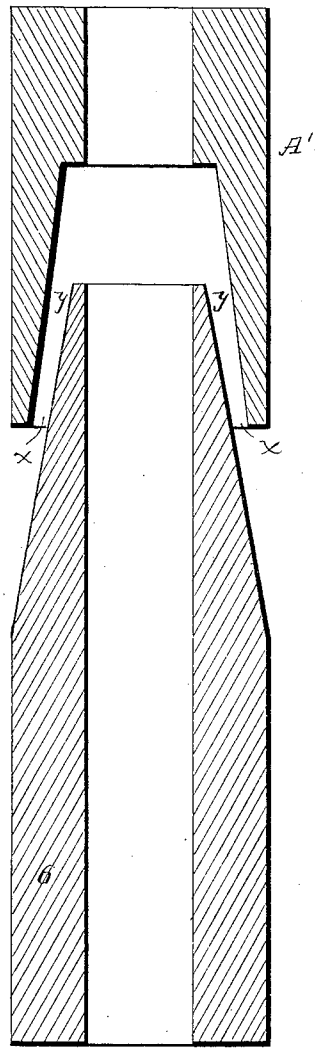
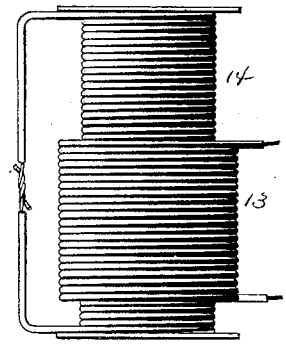


Fig. 18.

Fig. 17.



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UNITED STATES PATENT OFFICE.

GEORGE R. LEAN, OF CLEVELAND, OHIO, ASSIGNOR TO THE JANDUS ELECTRIC COMPANY, OF SAME PLACE.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 571,974, dated November 24, 1896.

Application filed May 23, 1896. Serial No. 592,787. (No model.)

To all whom it may concern:

Be it known that I, GEORGE R. LEAN, a resident of Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Electric-Arc Lamps; 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 an improvement in electric-arc lamps, one object of the invention being to provide efficient means whereby to prevent the "pounding" of the lamps at starting through an excessive flow of current and to "steady" the arc when the lamp is burning, in case the voltage should suddenly rise or fall, without the necessity for the use of wasteful resistance in series with the lamp, which resistance as heretofore used in lamps in multiple-arc circuits has absorbed from twenty-five to forty per cent. of the energy.

A further object is to provide simple and efficient globe-holding devices for electric-arc lamps.

A further object is to provide a carbon-holder which shall be simple in construction, easy to manipulate, and which shall operate accurately to hold the carbon in proper position.

A further object is to provide simple and efficient means whereby to facilitate the trimming of the lamp.

A further object is to improve various features of construction of an electric-arc lamp and to so construct the lamp that it shall be accurate and noiseless in operation and effectual in all respects in the performance of its functions.

With these objects in view the invention consists in the combination, in an electric-arc lamp, of a separating and feeding magnet, a holder connected with the armature of said magnet, clutch-rings carried by said holder and adapted to engage the carbon, and contact devices also carried by said holder and adapted to bear continuously against the carbon for the purpose of conducting current thereto.

The invention also consists in a separating and feeding magnet for arc-lamps, having a conical core or pole-piece and a conical armature, one adapted to enter the other, and the faces of the two cones arranged at an angle to each other; and the invention further consists in certain novel features of construction and combinations and arrangements of parts, as hereinafter set forth, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a sectional view of an electric-arc lamp embodying my improvements. Figs. 2, 3, 4, and 5 are views illustrating the holder for the inner or arc-inclosing globe. Figs. 6, 7, 8, and 9 are detail views illustrating the combined clutch and contact devices. Figs. 10 and 11 are detail views of the lower-carbon holder. Figs. 12 and 13 are views illustrating modifications of the lower-carbon holder. Figs. 14, 15, and 16 are detail views illustrating the connections of the inner-globe and lower-carbon holder with the depending arms or uprights of the lamp. Fig. 17 is an enlarged view showing the closed coil and a portion of the primary winding for the separating and feeding magnet. Fig. 18 is an enlarged detail view of the core and armature of the magnet.

A represents the iron frame or shell of the feeding and separating magnet, to the upper end of which a cap or casting 1 is fixed and terminates in an upwardly-projecting hollow shank 2. An insulated screw 3 is secured to the upper end of the shank 2 for the attachment of a suitable device by means of which to suspend the lamp.

Within the shell A the core or pole-piece A′ of the magnet is fixed and depends partially through the same, said core or pole-piece being made with a deep recess 4 in the form of a truncated cone for the reception of the similarly-shaped upper portion 5 of the armature 6 of said magnet. The core 6 is disposed within the shell A, and its lower end terminates within a chamber 7, formed by a cylindrical casting 8, of iron, fixed to the lower end of the shell A and forming, in effect, a part thereof. The chamber 7 is lined with sheet-brass or other suitable non-magnetic material *a*, and against this lining the armature 6 has a neat but sliding contact, said lining extending somewhat above the lower end of the core A′ and inclosing the same. The cylinder or casting 8 thus constitutes a dash-pot for the armature 6 and in which said armature acts as a plunger. The armature 6 is made with

a longitudinal opening 10, in the upper end of which a tube 11 is secured, said tube extending up through the center of the core or pole-piece A′ and terminating within the tubular shank 2 of casting 1, its upper end being closed air-tight by means of a cap 12. The helix 13 of the magnet is located within the shell, and also located within said shell is a closed coil or conductor 14. This closed coil may be placed within the helix 13, or it may be wound around it, or the magnet may be provided with sectional windings, one constituting the working helix and another forming the constantly-closed conductor. The armature of the magnet will be connected with the upper carbon of the lamp in a manner which will be hereinafter explained in detail.

With the constantly-closed coil or winding on the magnet, when the circuit is closed through the lamp, current will be induced momentarily in the closed or secondary winding in a reverse direction to the direction of current through the working or primary coil or helix. The current thus induced in the closed or secondary coil will tend to weaken the lifting-magnet and cause the arc to be drawn slowly, the secondary current becoming gradually weakened until it ceases altogether and the arc shall have been drawn to its full length. When the current is cut out of the lamp, there will be a secondary current induced in the closed or secondary coil in the same direction as the current through the working helix. This will increase, for an instant, the strength of the then-weakening magnet and thus cause the lamp to cease slowly instead of abruptly. These same actions will occur in a less degree with any change of voltage in the circuit or in case the arc should be momentarily interrupted from any cause, and thus maintain a constant and regular flow of current at the arc. The secondary circuit being only momentary does not affect the magnet nor the light of the lamp when the current is steady, but only when there is a fluctuation in the circuit, and thus has the advantage of steadying the arc and causing the lamp to burn very steadily without much external resistance, resulting in greatly increasing the efficiency of the lamp without loss through a resistance such as heretofore used.

By the use of the closed secondary winding arc-lamps can be burned on circuits of but little higher voltage than the voltage of the arc, instead of wasting a large amount of energy through a resistance, and greater steadiness in the burning of the lamp can be attained than is possible when such resistance is employed. The use of the closed secondary coil or winding enables lamps to be started and stopped smoothly without jumping and is particularly advantageous when a number of lamps are burned in series on high-potential circuits. The reactive effect produced by the closed secondary coil or winding can be used to advantage on the shunt-magnets of lamps burning on constant-current circuits, the result being to prevent too sudden changes in strength of the shunt-magnet due to changes in the length of the arc or abnormal fluctuations in the current.

The core of the separating and feeding magnet and its armature comprises, as above mentioned, two cones, one adapted to enter the other. It will be observed that the wall of the conical recess 4 in the core of the magnet is not parallel with the conical face of the armature, but at an angle thereto. This is a matter of importance in adjusting lamps to operate under certain conditions. By changing the angle of the recessed cone to that of the entering cone the pull of the magnet can be changed to any desired range, so that when an arc is drawn too long the armature will be drawn into a weaker portion of the magnetic circuit and thus cause the arc to be corrected. By the arrangement of the cones above described the pull of the magnet can be made to remain constant throughout a predetermined range of movement of the armature by making the relative angles of the faces of the two cones such that the air-gap at the points x y will remain constant through this range. This can be accomplished by having the sum of the distance at the points x y average the same throughout the range, other fluctuations in the strength of the magnet, such as the magnetic gap at the entering-point of the armature, having been corrected. If the angle of the entering cone is less than the angle of the recessed cone, the pull of the magnet will constantly grow weaker as the armature is drawn into the recess, while the reverse of these angles will produce the opposite result. Thus it will be seen that by careful arrangement of the two cones a variety of results can be attained, such as a strong pull of the magnet for a portion of the range of movement of the armature and a gradual decline at the finish, or vice versa. I have found it to be of advantage in lamps burning in series on high-potential circuits to have the pull of the magnet constantly decreasing as the armature rises. This is exactly opposite to the pull of an ordinary solenoid as is commonly used in arc-lamps. I have found that for arc-lamps for use on one-hundred-and-ten-volt circuits it is of advantage to have the magnet produce a uniform pull on the armature throughout the ordinary lift of the carbon and from that point rapidly weaken, so that in case the lamp receives an abnormally high potential the armature will not rise in proportion to the increased voltage of the circuit and draw arc so long that it will break and cause the lamp to flicker. In this case the angles of the faces of the two cones would be such that a lamp burning at one hundred and ten volts would draw an eighty-volt arc, while the increase of ten per cent. in the potential of the lamp would not increase the arc over five per cent.

It is desirable to provide proper ventilation

for the windings 13 14, and for this purpose openings 15 are made in the armature-casing and through the lining *a*. For the same purpose the shell A is made with elongated slots 16 and the core or pole-piece is made with holes 17, which communicate at one end with the conical recess 4 and at the other end with the interior of the casting 1, the shank 2 of the latter being made with slots or openings 18. The sheet-metal casing 19, which incloses the operating mechanism of the lamp, is provided with air-vents 20. A free circulation of air will thus be permitted to keep the inside parts of the magnets and the windings cool without allowing a current of air in the inclosed chamber 7, as the armature 6 constitutes a seal for said chamber below the openings 15.

An internally-screw-threaded collar 21 depends from the cylindrical casting 8 in line with an opening 22 in the bottom of said casting. An annular box or casing 23, having an opening in its top, is disposed below the casting 8 and provided with an internally-screw-threaded collar 24 for the reception of the collar 21, depending from the casting 8. The box or casing 23 is provided at its bottom edge with an internally-screw-threaded annular flange 25 for the reception of screw-threads on the periphery of a dish-shaped casting 26, which constitutes the bottom of said box or casing 23. The parts 23 and 26 thus constitute a receptacle or casing for inclosing the clutch and contact devices for the upper carbon, and the said casting or bottom 26 is provided centrally with a flattened enlargement 27, in which a hole is made for the passage of the upper carbon 28. A tube 29 is secured at its upper end to the lower end of the armature 6, so that its bore will aline with the bore of said armature. The tube is adapted to loosely receive the upper carbon 28 and passes freely through the collar 21, terminating in the box or receptacle 23, preferably at or near its center, and carrying the clutch and contact devices for the upper carbon. In constructing these clutch and contact devices a horizontally-disposed plate 30 is secured to the tube 29 at a point near the lower end of the same, and from the periphery of this plate a circular casing 31 depends, the lower end of which is contracted or made with an inwardly-projecting flange 32, said casing forming an open-bottom clutch-pan, the rings 33, constituting said clutch, being adapted to rest on the inclined flange 32 of the clutch-pan and against the carbon-rod when the lamp is in operation, as shown in Figs. 1, 6, and 9. The clutch-rings 33 are made with roughened peripheral grooves whereby to cause them to properly engage the carbon-rod without danger of slipping, and said clutch-rings are disposed within a slotted carrier 34, supported from the plate 30 by means of screws 35, the upper ends of which pass loosely through said plate, and the carrier is provided in its top with a hole 36^a for the reception of the lower extremity of the tube 29. In Fig. 8 of the drawings three clutch-rings are shown, and they are maintained in proper position by means of a horizontally-disposed ring 36 passing through them. A series of contact-rings 37, constituting the contact-brush for conducting current to the upper carbon, are mounted in the slotted carrier 34 and alternate with the clutch-rings 33, the horizontal ring 36 also passing through said contact-rings and serving to constantly support the same in contact with the carbon. The contact-rings 37 have smooth peripheral grooves to conform to the contour of the carbon and are made equal in diameter to that of the clutch-rings, but with thicker or wider walls, so that they will be supported by the ring 36 somewhat higher than the clutch-rings.

When current is passing through the lamp, the position of the clutch devices will be as shown in Figs. 1, 6, and 9, the clutch-pan and slotted carrier being elevated above the bottom 26 of the casing which incloses them, and the clutch-rings being clamped or wedged between the carbon-rod and the inclined flange 32. The rings 37 bear against the carbon-rod and are maintained in proper contact therewith by means of a weight 38, placed upon them.

It is obvious that when the feeding of the upper carbon becomes necessary the clutch-pan and slotted carrier will move downwardly until the carrier engages the enlargement 27 of the casting 26, when it will be caused to move upwardly on the tube 29, as shown in Fig. 7. The clutch-rings will at the same time engage the enlargement 27 of casting 26 and be thus caused to rise slightly, so as to loosen their grip on the carbon-rod and permit the latter to feed. The contact-rings 37, being more elevated in the carrier 34 than the clutch-rings 33, as above explained, they will not come in contact with the casting 26 when the clutch-pan and carrier are lowered, and hence the engagement of the contact-rings with the upper carbon will be constant under all conditions.

The box or casing 23, which incloses the clutch and contact devices, is made with a laterally-projecting annular flange 39, beneath which a ring 40 is disposed and insulated therefrom, a spring-cushion 41, for the outer globe 42, and sheets 43, of insulating material, being located between said flange 39 and ring 40. The ring 40 is made with peripheral segmental flanges 44, adapted to receive and support similar segmental flanges 45, projecting inwardly from an annular plate or ring 46, the upper face of which has an air-tight bearing against the spring-cushion 41, or, more strictly speaking, against the lower insulating-sheet 43, on which said cushion rests. The plate or ring 46 is provided with a depending peripheral flange 47, the lower edge of which is curved inwardly, as at 48, and forms a seat for packing-ring 49, on which the shoulder 50 at the upper edge of

the outer globe 42 rests, the extreme upper edge of said globe having a close fit against the under face of the annular plate or ring 46.

The ring 40 is made with internally-screw-threaded bosses or enlargements 51 for the reception of the screw-threaded upper ends of depending rods or uprights 52. Chains 53 are secured at one end to the annular plate or ring 46 and at their other ends to the rods or uprights 52 at points in proximity to the lower ends of the latter. When it is desired to remove the outer globe 42 for the purpose of trimming the lamp, it is simply necessary to give the globe a one-sixth turn, so as to bring the segmental flanges of the annular plate or ring 46 in line with the spaces between the segmental flanges 44 of the ring 40. The globe 42 can then be lowered and will be supported by the chains 53.

The rods 52 support at their lower ends a yoke or bracket 54, and the latter carries the holder for the inner or arc-inclosing globe 55 and the holder for the lower carbon of the lamp. In order that the arc-inclosing globe and the lower-carbon holder can be readily removed, the yoke or bracket 54, which carries them, is connected with the rods or uprights 52 in the following manner: Each end of the yoke or bracket 54 is made with a hollow boss or enlargement 56, open at one side, as at 57, and having an internal shoulder 58 at its upper end and lugs 59 60, projecting toward each other in the opening 57. The lower end of each rod or upright 52 is provided with a shank 61, having two enlargements 62 63, adapted to enter the hollow bosses 56 and be prevented from escape therefrom by the lugs 59 60, the enlargement 62 on the shank 61 being adapted to receive the shoulder 58 at the upper end of the boss. The yoke or bracket 54 is connected in the same manner to both rods or arms 52, except that the lateral opening 57 of one boss or enlargement 56 is at opposite side thereof from the lateral opening 57 of the other boss or enlargement. Thus it will be seen that by raising the yoke or bracket 54 and then turning it slightly it can be readily detached from the rods or standards 52.

The yoke or bracket 54 is provided centrally between its ends with a circular enlargement or base 64, having external screw-threads 65 and an annular recess 66, in which latter a packing-ring 67, of asbestos or other suitable material, is placed and adapted to receive the lower flanged edge of the inner or arc-inclosing globe 55, the latter being provided with a valved cover 55ª, through which the upper carbon passes. A collar or cap 68 is adapted to screw on the enlargement or base 64, and is made with an inwardly-projecting curved flange or lip 69, within which and above the upper edge of the recessed portion of the enlargement or base 64 an annular coiled spring 70 is disposed. The lower flanged end of the inner globe 55 having been seated in the recessed base 64, the cap or collar 68 will be screwed down until the annular coiled spring 70 holds the flange of the globe tightly against its seat in the base 64 of the holder, the spring being forced down toward said base as well as being contracted, as shown in Figs. 4 and 5. It is apparent that by unscrewing the cap or collar 68 the annular coiled spring 7 will be permitted to expand, as shown in Figs. 2 and 3, and thus permit the removal of the inner globe.

The base of the inner-globe holder is made with an opening 71 for the accommodation of the lower-carbon holder 72, the upper portion of said opening being made tapering, as at 73, and the lower portion 74 being made cylindrical and provided with screw-threads. The carbon-holder 72 comprises a split sleeve 75, of spring metal, to receive the lower carbon, and a nut 76, to which the lower end of said sleeve is secured. The nut 76 is adapted to screw into the lower portion 74 of the opening 71, and the sleeve 75 is made with a tapering enlargement 77, adapted to engage the tapering wall of the upper portion 73 of the opening 71. From this construction it will be seen that when the nut is screwed up the lower carbon will be tightly clamped within the split sleeve 75.

Instead of the construction of holder for the lower carbon above described, that shown in Fig. 12 might be employed. In this form the inner-globe holder is made with a tapering screw-threaded socket 78 for the reception of the tapering screw-threaded lower end 79 of the split sleeve or socket-piece 80. A post 81 is inserted in a socket in the base 64 and projects upwardly within the sleeve or socket-piece 80, terminating at its upper end in a head 82, which serves as a support for the lower carbon.

In the form of carbon-holder shown in Fig. 13 the base 64 is made with a deep socket 83, having a tapering screw-threaded portion at its lower end for the tapering screw-threaded portion 84 of the split sleeve or socket-piece 85, the diameter of the socket 83 above the screw-threaded portion being sufficiently greater than the external diameter of the sleeve or socket-piece 85 to permit the expansion of the latter for the insertion of the carbon. A recessed frame 86 encircles the box or casing 23 and is provided with strips 87 of mica, on which a wire of low resistance 88 is wound. The positive leading-in wire *b* of the lamp is connected with the magnet frame or shell, from which it passes to the clutch-pan and carrier and contact-rings to the upper carbon, then to the lower carbon, and then through the yoke or bracket 54 and rods 52 to the ring 40. The segmental flanges of the ring 40 being in electrical contact with the segmental flanges of the ring or plate 46, current will pass from the former to the latter and then through a switch 89, then through the low resistance 88, and finally out through the minus-wire *c*. Thus it will be seen that when the outer globe is lowered, as above ex-

plained, the circuit will be opened on account of the disengagement of the rings 40 and 46, and it will therefore be impossible for the trimmer to receive a shock while trimming the lamp, even though he should forget to turn the switch.

Various changes might be made in the details of construction of my invention without departing from the spirit thereof or limiting its scope, and hence I do not wish to limit myself to the precise details herein set forth.

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

1. In an arc-lamp, the combination with a magnet-core and armature, of a helix encircling said core and included in series with the carbons of the lamp, a constantly-closed conductor also encircling said core, whereby to effect the gradual starting and stopping of the lamp, and a clutch supported by said armature, substantially as set forth.

2. In an arc-lamp, the combination with the pole-piece of a magnet, an armature arc-starting mechanism and connections between the arc-starting mechanism and the magnet, of a helix encircling said pole-piece and armature and included in the lamp-circuit, and a constantly-closed conductor also encircling the pole-piece and armature, whereby to effect the gradual starting and stopping of the lamp, substantially as set forth.

3. A separating and feeding magnet for an electric-arc lamp having a conical pole-piece and a conical armature, the adjacent conical faces of said pole-piece and armature being disposed at an angle to each other, substantially as set forth.

4. A separating and feeding magnet for an electric-arc lamp having a conical pole-piece, and a conical armature, one adapted to enter the other and the faces of the two cones arranged at an angle to each other, substantially as set forth.

5. In an electric-arc lamp, the combination with suitable framework and a clutch, of a separating and feeding magnet having a conical recess in its pole-piece or core, an armature having a conical end to enter said conical recess, the conical face of the armature being disposed at an angle to the face of the conical recess in the pole-piece or core and connections between said armature and clutch, substantially as set forth.

6. In an arc-lamp, the combination with the separating and feeding magnet having a hollow core and a hollow armature, of a tube attached to and communicating with the armature and passing loosely through said hollow core, a tube depending from the armature and clutch devices connected with the last-mentioned tube, substantially as set forth.

7. In an electric-arc lamp, the combination with a magnet-shell, of a hollow cap or casting fixed to the upper end thereof, a pole-piece secured within said shell, a hollow armature also disposed within the shell and constituting the plunger of a dash-pot formed at the lower end of the shell, a tube connected with the upper end of the armature and terminating within said hollow cap or casting, a cap closing the upper end of said tube, a tube depending from said armature, and clutch devices connected with said last-mentioned tube, substantially as set forth.

8. In an electric-arc lamp, the combination with a magnet-shell and a cylindrical casting secured within the lower end thereof, of a core depending within said shell, a helix within the shell, a lining in said cylindrical casting said lining inclosing the lower end of the core, an armature disposed within the shell and helix and having a sliding fit in the cylindrical casting, a tube depending from the armature and clutch devices carried by said tube, substantially as set forth.

9. In an arc-lamp, the combination with a carrier, of clutch-rings for the upper carbon, mounted therein, contact-rings also mounted in said carrier, and means for operating the clutch-rings without moving the contact-rings from the carbon, substantially as set forth.

10. In an arc-lamp, the combination with a clutch-pan and a carrier mounted therein, of a set of clutch-rings mounted in the carrier and adapted to engage the upper carbon, means for moving said clutch-rings to release the carbon, and contact-rings also mounted in said carrier and disposed in a higher plane than the clutch-rings so that they will not be affected by the operation of said clutch-rings, substantially as set forth.

11. In an arc-lamp, the combination with a slotted carrier adapted to permit the passage of the upper carbon through it, of a series of clutch-rings having roughened peripheral grooves, mounted in said carrier, a series of contact-rings mounted in said carrier and alternating with the clutch-rings, said contact-rings being of the same diameter as the clutch-rings but having thicker or wider walls and a supporting-ring passing through all of said clutch and contact rings, substantially as set forth.

12. In an arc-lamp, the combination with the armature of the separating and feeding magnet, of a clutch pan or receptacle connected therewith, a vertically-movable slotted carrier supported in said pan or receptacle, clutch-rings mounted in said carrier, a horizontal ring passing through said clutch-rings, and a device adapted to be engaged by said carrier and clutch-rings, whereby to cause them to move upwardly and the carbon to feed, substantially as set forth.

13. In an arc-lamp, the combination with the separating and feeding magnet and its armature, of a tube depending from said armature, a plate secured to said tube near its lower end, a casing depending from said plate and having an inclined flange at its lower end, a vertically-movable carrier within said casing and having a hole to receive the lower

end of said tube, clutch-rings mounted on said carrier and adapted to bear against said inclined flange and the carbon-rod, a horizontal ring passing through the clutch-rings, and a device to be engaged by said clutch-rings and carrier, substantially as set forth.

14. In an arc-lamp, the combination with a magnet-shell, a cylindrical casting secured thereto and an armature within said shell, of a box or casing secured to said cylindrical casting, a removable bottom for said box or casing and having an opening for the passage of the carbon, a tube secured to the armature and passing into said box or casing, a clutch-pan secured to said tube, a carrier in said clutch-pan, clutch-rings in said carrier and pan and adapted to engage the bottom of the box or casing to permit the carbon to feed, and a horizontal ring passing through said clutch-rings, substantially as set forth.

15. In an arc-lamp, the combination with the framework, of a ring removably attached to said framework, having a flange adapted to receive and support a globe and a cushion against which said ring bears, substantially as set forth.

16. In an arc-lamp the combination with the framework of a ring supported thereby, a spring-cushion above said ring, an annular plate adapted to be removably secured to said ring and bear against said spring-cushion, a curved flange depending from said annular plate, a globe, and a packing-ring between the peripheral flange of the globe and said curved flange on the annular plate, substantially as set forth.

17. In an arc-lamp, the combination with the framework, of a ring secured thereto and insulated therefrom, a globe-holder removably connected with said ring, a lower-carbon holder, electrical connections between said carbon-holder and said ring, said ring and globe-holder constituting part of the circuit through the lamp, so that when the globe and its holder are removed, the lamp will be open-circuited, substantially as set forth.

18. In an arc-lamp, the combination with the framework, and an insulated ring supported thereby, of rods depending from said ring, a yoke or bracket removably secured to the lower ends of said rods, and an inner-globe holder and lower-carbon holder supported by said yoke or bracket, substantially as set forth.

19. In an arc-lamp, the combination with the framework, of two depending rods supported thereby and insulated therefrom, buttons or enlargements on the lower ends of said rods, a yoke or bracket, hollow bosses at the ends of said yoke or bracket, lugs projecting into said openings, and internal shoulders at the upper ends of said bosses for the reception of the buttons or enlargements on the depending rods, substantially as set forth.

20. A globe-holder comprising a base, an adjustable cap thereon and a spring-ring within said cap and adapted to be forced against the flange of the globe by said cap, substantially as set forth.

21. A globe-holder comprising a base, an adjustable cap thereon, and an annular coiled spring adapted to be forced by said cap, against the flange of the globe whereby to force the latter against its seat, substantially as set forth.

22. A globe-holder comprising a base, an adjustable cap thereon, said cap having an inwardly-curved flange, and an elastic ring adapted to be forced against the flange or shoulder on the globe by said curved flange on the cap, substantially as set forth.

23. A globe-holder comprising a base having external screw-threads, a cap adapted to screw on said base, said cap having an inwardly-curved annular flange at its upper edge, and an annular coiled spring within said curved annular flange, substantially as set forth.

24. A globe-holder comprising a recessed base, a packing-disk thereon, a screw-cap on said base, said cap having a curved flange at its edge, and an elastic ring adapted to be pressed against the shoulder on the globe whereby to force the edge of the globe against said packing-disk, substantially as set forth.

25. In an arc-lamp, the combination with a base having an externally-screw-threaded projection and having a hole, a portion of said hole being made with a tapering wall and a portion being made with a screw-threaded wall, of a cap adapted to screw on the screw-threaded projection, a device within said cap adapted to be forced by the cap against the flange of a globe whereby to clamp the latter to the base, and a split sleeve passing through the hole in the base and adapted to receive a carbon, said sleeve having a tapering portion to bear against the tapering wall of the hole in the base and a nut to screw in the screw-threaded portion of said hole in the base, substantially as set forth.

26. The combination in an arc-lamp, of a separating and feeding magnet and the carbons, a frame, strips of insulating material supported by said frame, and a low resistance wound on said bridges and included in circuit with the separating and feeding magnet and the carbons, substantially as set forth.

27. In an arc-lamp, the combination with the framework and a low resistance, of an insulated ring supported by the framework, a globe-holder removably attached to said ring, a lower-carbon holder included in circuit with the said ring and globe-holder, and a switch between said globe-holder and resistance, substantially as set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

GEORGE R. LEAN.

Witnesses:
D. W. ROCKWELL,
J. M. SEE.