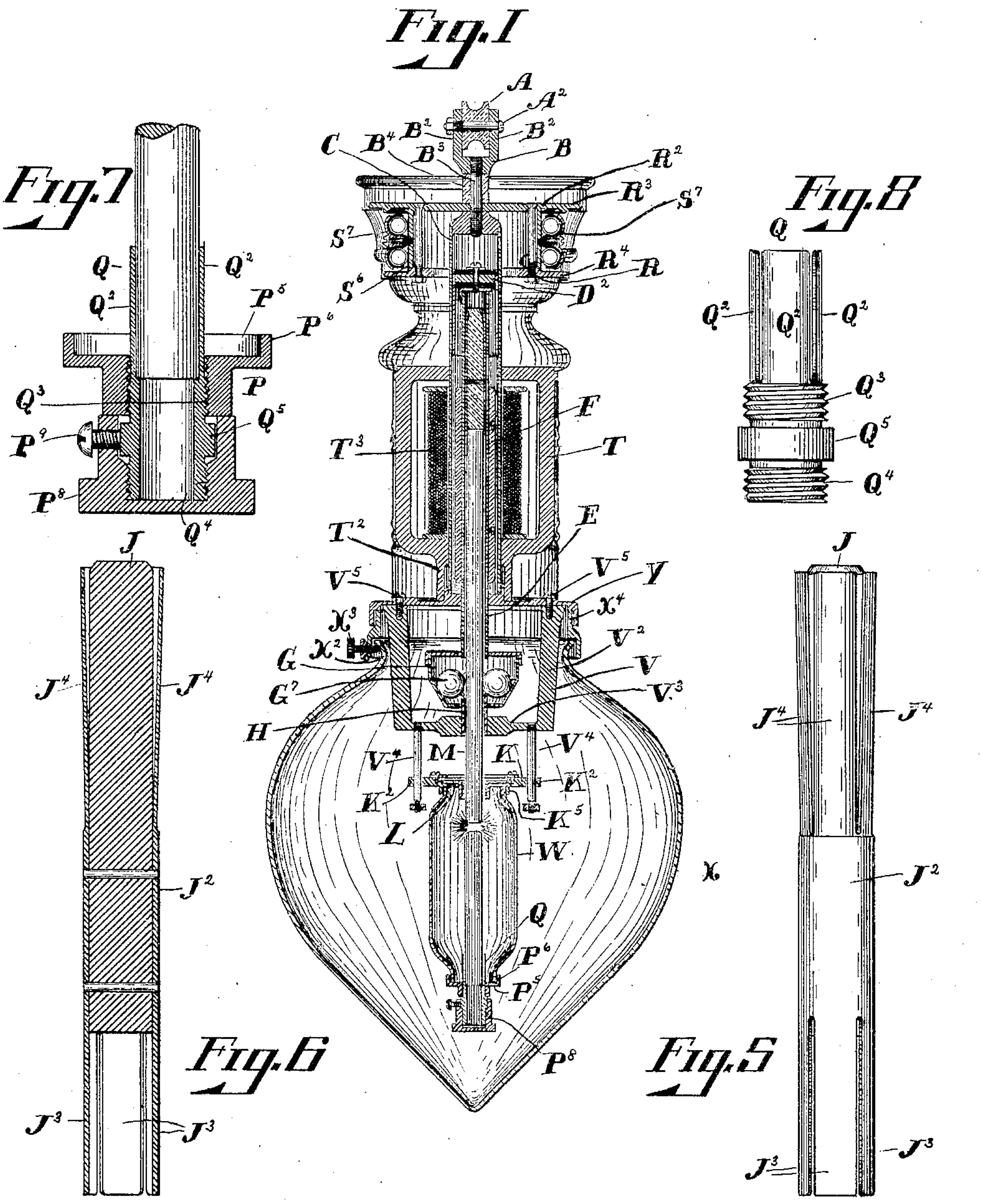
No. 705,122. Patented July 22, 1902.

J. S. NOWOTNY.

ELECTRIC ARC LAMP.

(Application filed June 28, 1897.)

(No Model.) 3 Sheets—Sheet 1.



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3 Sheets—Sheet 2.

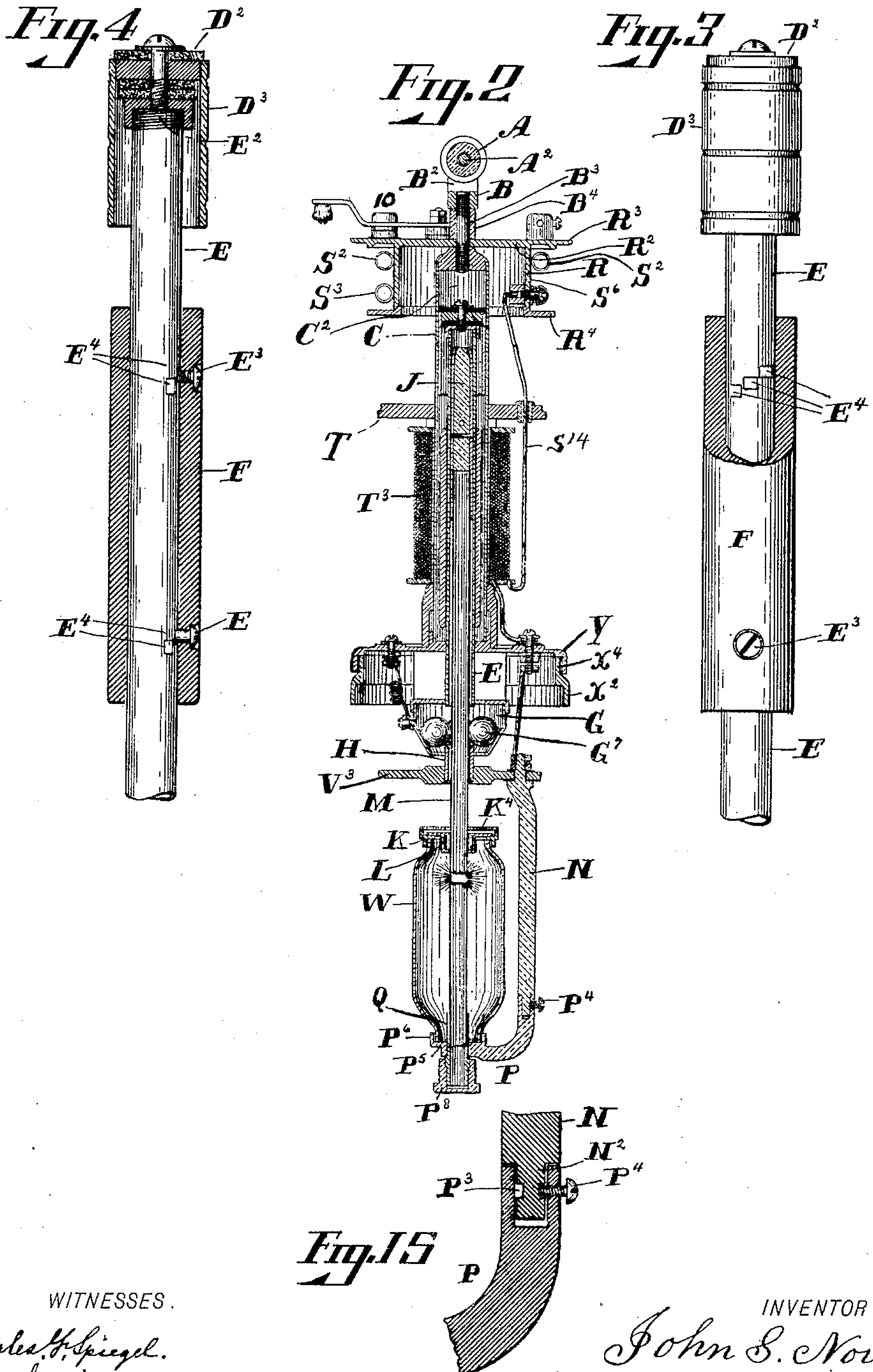

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Fig. 10

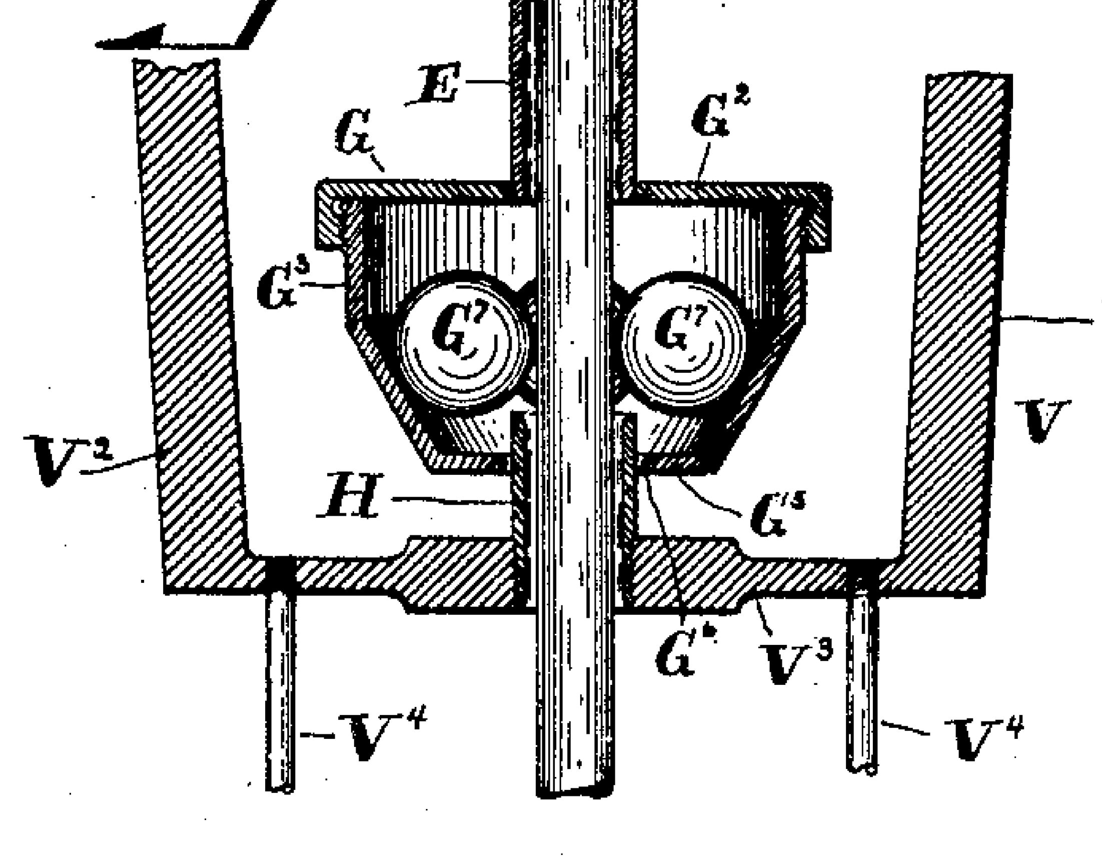


Fig. 11

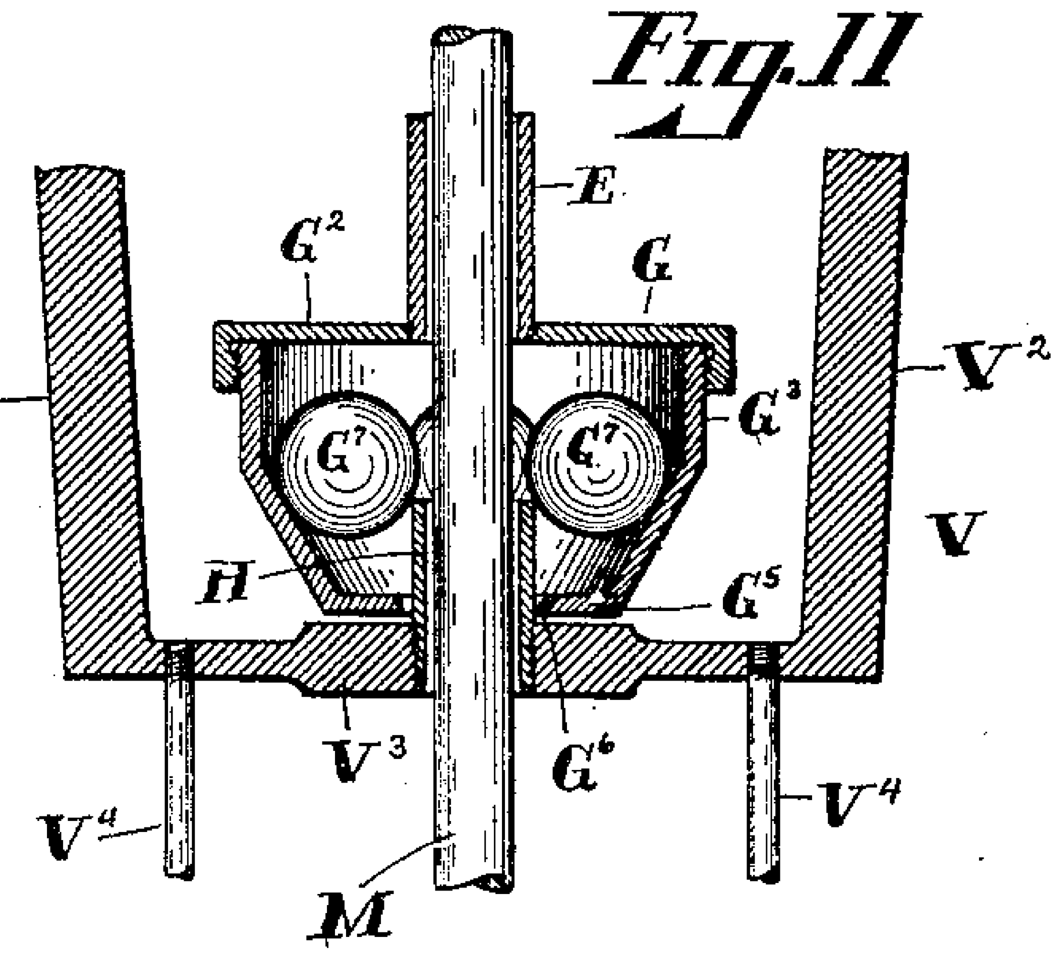


Fig. 12

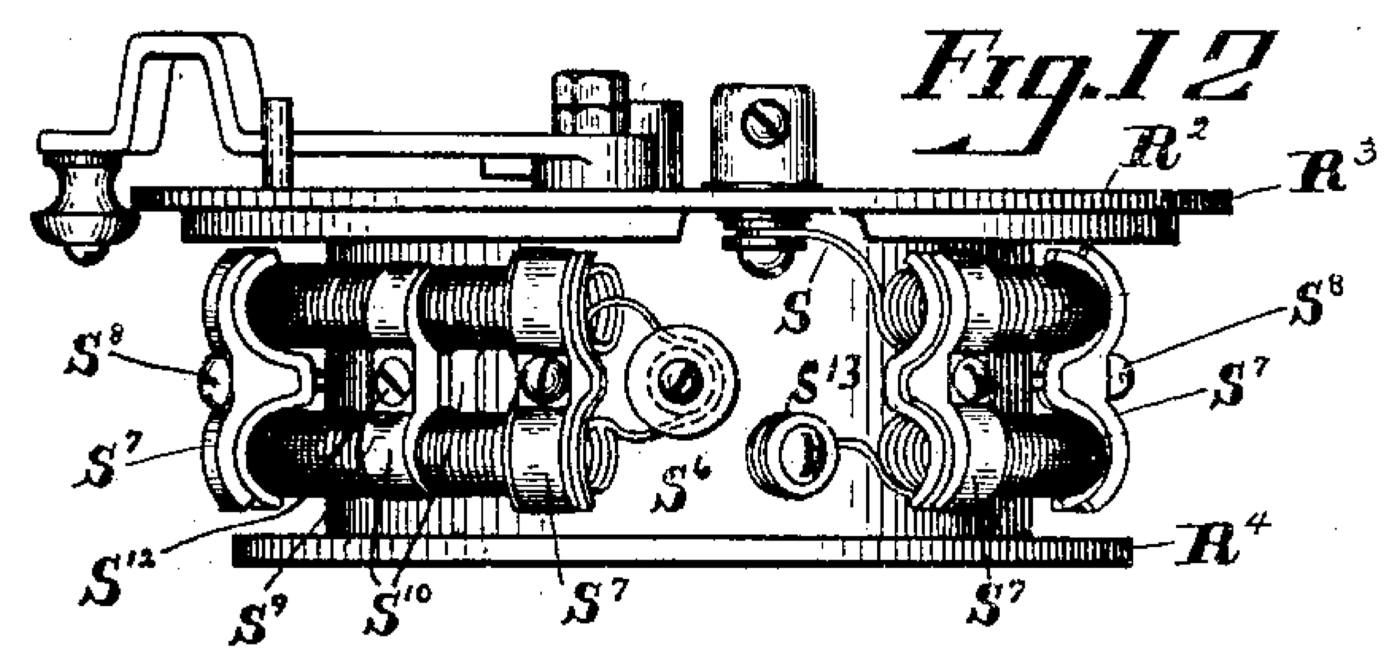
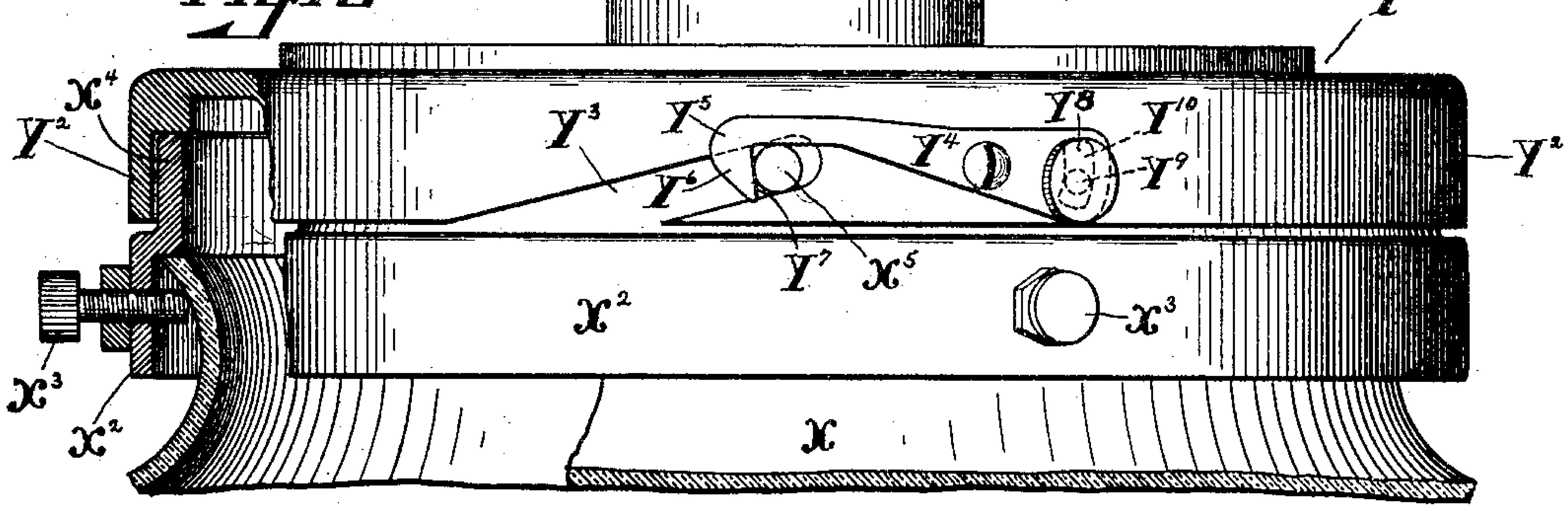


Fig. 13



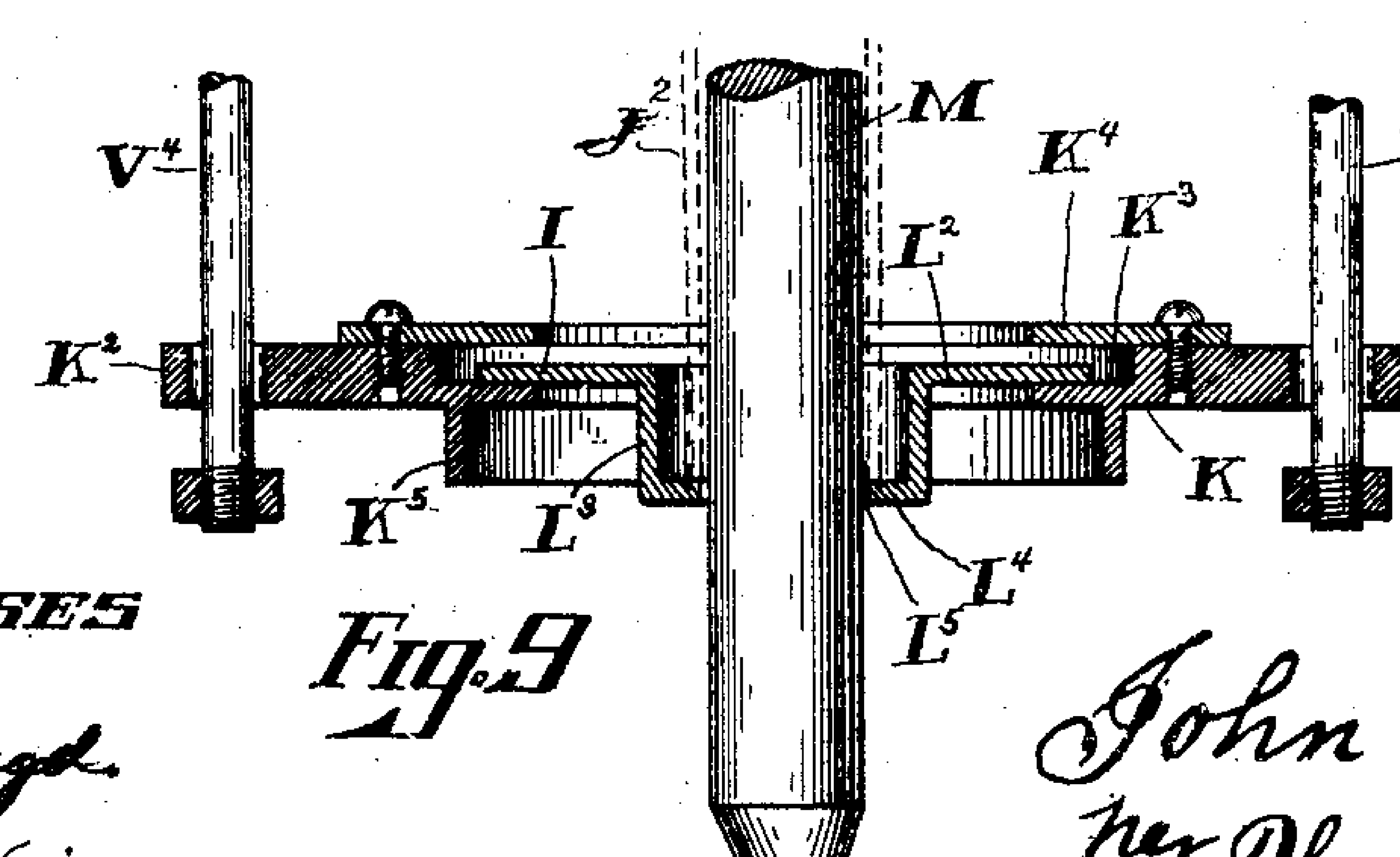


Fig. 9

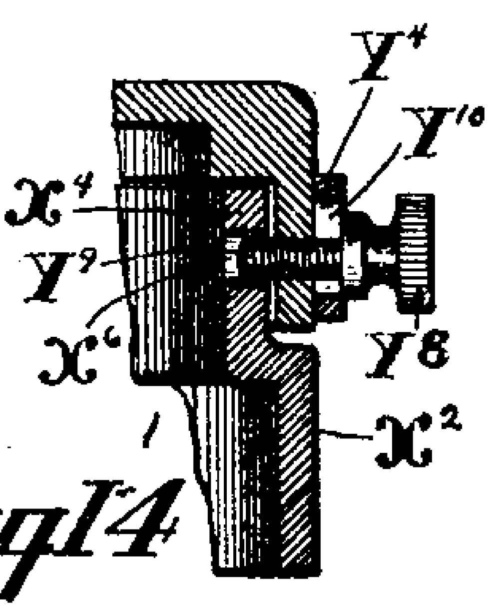


Fig. 14

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UNITED STATES PATENT OFFICE.

JOHN S. NOWOTNY, OF MADISONVILLE, OHIO, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 705,122, dated July 22, 1902.

Application filed June 28, 1897. Serial No. 642,620. (No model.)

To all whom it may concern:

Be it known that I, JOHN S. NOWOTNY, a citizen of the United States, and a resident of the town of Madisonville, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Arc-Lamps, of which the following is a specification.

The several features of my invention and the various advantages resulting from their use conjointly or otherwise, will be apparent from the following description and claims.

In the accompanying drawings, which illustrate an embodiment of my invention, Figure 1 is a vertical section of an arc-lamp. Fig. 2 is a vertical section of an arc-lamp, taken at right angles to the section in Fig. 1, the casing and outer globe having been removed. Fig. 3 is a detail view of the dash-pot piston and armature. Fig. 4 is a sectional detail of the dash-pot piston and armature. Fig. 5 is an elevation of the upper-carbon holder. Fig. 6 is a vertical section of the carbon-holder. Fig. 7 is a vertical section of the lower-carbon holder and its support. Fig. 8 is a view in elevation of the lower-carbon holder. Fig. 9 is a vertical section of the gas-cap for the arc-inclosing globe. Fig. 10 is a vertical section of the carbon-feeding clutch. Fig. 11 is a vertical section of the carbon-feeding clutch, showing the clutch-shoes in an inoperative position. Fig. 12 is a detail view in elevation of the resistance-supporting means. Fig. 13 is a side elevation, partly broken away, of the means employed to support the outer globe in place. Fig. 14 is a sectional detail of the globe-holder, and Fig. 15 is an enlarged sectional detail illustrating the pivotal support for the lower-carbon holder and arc-inclosing globe.

My invention is shown in connection with a lamp designed for constant-potential direct-current service; but certain of the features of novelty are applicable to constant-current lamps. I may also use my invention in connection with lamps designed for use on constant-potential or constant-current alternating circuits, and I aim to embrace such uses in the claims. The lamp is designed to be suspended from the ceiling or other suitable support, and the upper end thereof is provided with an insulator A, which is retained in the holder B by a pivot A^2. The main frame of the lamp consists of a central tube C, which is secured to the support B by the screw-threaded bolt B^3. The upper end of the tube is closed and forms the cylinder of the dash-pot, the dash-pot being arranged to check violent movements of the upper carbon. Mounted on the tube C is the core T of an electromagnet for controlling the feeding of the upper electrode. The core is provided with upper and lower heads, which are parallel with each other and are connected by side pieces formed integral therewith. The heads are perforated centrally to receive the frame-tube C, and the lower head is extended downwardly in the form of a sleeve, so as to distribute the magnetic lines of force in the magnet in a manner to give a long range of movement to the armature F. Surrounding the tube and located between the heads of the core is a coil of wire T^3, which forms a part of the lamp-circuit and in the present instance is connected directly to the negative electrode. Secured by screws V^5 to the under side of the sleeve or projection on the lower head of the core is a plate Y, which plate supports the outer globe X and also the U-shaped frame-piece V^2, the latter being arranged to support the gas-cap when the arc-inclosing globe is removed. The plate Y is provided with a downwardly-extending rim that incloses the globe-supporting ring X^4, the construction of which will be described in connection with Figs. 13 and 14. The lower ends of the arms V are connected by a plate V^3, and extending downward therefrom is an arm N, which supports the negative electrode and also the arc-inclosing globe. The arm is screw-threaded at its upper end and is retained in place by nuts. By making the arm thin in the direction of the rays of light very little shadow will be cast. Furthermore, by using only one arm instead of two the total shadow cast by the carbon and globe support is reduced to a minimum. The arm is connected in circuit with the electromagnet T^3, and the lower end thereof is provided with a shouldered portion N^2. The portion N^2 is grooved at P^3 to receive the retaining-screw P^4, which supports the arm P, the latter being curved at its end to bring it under the center of the lamp to form a support for the globe and lower carbon. The arrangement of parts is such that by loosening the screw P^4 the arm P may be revolved around the shouldered portion N^2, so as to bring the globe and lower holder out from under the upper carbon.

The lamp is provided with a resistance for steadying the supply of current to the arc and also for protecting the lamp from excessive flow of current. The rheostat which I prefer to use is one not only novel in construction, but very advantageous for the uses designed. At the upper end of the lamp is a drum or cylinder R, covered with insulation S^6—such as mica, for example—and this drum is provided with a top plate or disk R^2, which is secured to the tubular frame of the lamp by the bolt B^8. The plate R^2 projects outward beyond the cylinder and serves as a protector for the coils of resistance-wire. Secured to the bottom of the cylinder by screws and nuts is an annular plate having a flange R^4, which extends underneath the resistance-wires. These flanges located above and below the resistance-wires serve to protect them before the casing is applied to the lamp and also serve to hold the casing out of contact with the wire, and thus prevent short circuits. In order to ventilate the lamp, the upper and lower plates are perforated. The top plate R^2 carries the lamp-terminals and also the switch for opening and closing the circuit. Extending from one of the terminals, which terminal is insulated from the plate, is the resistance-wire S. This wire is wound in the form of a coiled spring, and the spring is wound around the cylindrical portion of the support. After the spring has made substantially a single turn—in an anticlockwise direction, for example—the wire of which it is composed is passed around an insulating-support, and the coiled spring of resistance-wire is passed around the cylinder in the opposite or clockwise direction, the wire finally terminating in a terminal S^{13}, the latter being insulated from the cylinder and connected to the wire of the magnet T^3 by a connection S^{14}, Fig. 2. The coil of resistance-wire is retained in place by clamps S^7, and these are in turn secured to the cylinder by screws S^8. Between the resistance-wire and the cylinder and between the clamps S^7 and the resistance-wire are pieces of insulation for preventing short circuits. By mounting the resistance-wire on the cylinder as illustrated—that is to say, by winding one half of the wire in one direction and then reversing it and winding the remaining half in the opposite direction, thus forming a loop at the end—a distinct advantage is obtained in the adjustment of the lamps. In other words, only a very small amount of resistance may be cut out or a large amount by a small change in position of the adjusting means. This adjustment is attained by means of a sliding clamp, which is supported entirely by the resistance and is composed of two members S^{10}, which are retained in place by the screw S^{12}. By changing the adjustment of the clamp on the resistance-wire the amount which is included in circuit can readily be changed, and this in a smooth and gradual manner. When the clamps are located in close proximity to the insulating-support S^6, very little resistance is cut out of circuit; but as the clamps are moved toward the left more and more of the resistance-wire is cut out. This gives a much greater range of adjustment than where the wire is wound around the cylinder in one direction only, as will readily be seen.

Mounted within the main tubular frame C of the lamp is a second tube E, which carries the clutch for feeding the upper electrode. The clutch G is illustrated in Figs. 10 and 11 on an enlarged scale, wherein E represents the vertically-moving tube which is under the control of the electromagnet. To the lower end of this tube is secured a flat horizontal plate G^2, having a downwardly-extending rim which is screw-threaded to receive the tubular clutch member G^3. The clutch member G^3 is provided with a tapered lower end, which is so arranged that the balls G^7 are forced against the electrode M when the tube E is raised. The number of balls used may be varied; but I have found that four work very satisfactorily. The lower end of the clutch member G^3 is closed by a plate G^5, having a central perforation to receive the short tube H. The tube H is screw-threaded at its lower end and is mounted in a plate V^3 in such manner that it is concentric with the tube E. This tube releases the electrode M by engaging with the clutch balls or members G^7 and forcing them out of contact as the tube E moves downward to the position illustrated in Fig. 11, thus permitting the upper electrode to feed. When the tube is again raised, the conical portion of the clutch member G^3 again forces the balls into engagement with the electrode and either strikes the arc or adjusts the length thereof, as the case may be. The diameter of the upper-carbon holder is such that the holder can pass down through the tube E and clutch when the balls G^7 are in the position shown in Fig. 11. The holder is prevented from dropping out of the tube E and breaking the globe or globes by the plate L^2, as will be described hereinafter. The upper end of the tube E is screw-threaded to receive a nut that also closes the end. Situated above the nut and separated therefrom by washers of asbestos is the dash-pot piston-head D^3. The piston is secured to the tube E by means of a screw, and between the screw and the head is an asbestos washer D^2. These washers give a certain flexibility to the parts—in other words, form a flexible connection—so as to compensate for any irregularities in alinement and prevent the parts from binding. This is a very important feature. The periphery of the cylinder is grooved in the ordinary manner to increase the effectiveness of the dash-pot and also to permit of using relatively loose-fitting parts.

Mounted on the tube E and vertically adjustable thereon is a core F, which is arranged to move within the influence of the electromagnet. In order to simplify the adjustments, a number of steps E^4, Figs. 3 and 4, are provided, with which the screws E^3 are adapted to engage. By manipulating the screws and also sliding the core up or down on the tube and resetting the screws it may be adjusted to any desired position, thus changing its relation with respect to the magnet-coil T^3. Changing the position of the core on the tube changes the electromotive force at the arc, and consequently the amount of light given by the lamp. It will readily be seen that the shifting of the core on the tube brings it into a position of greater or less magnetic influence. For illustration, when the core is lowered on the tube and the set-screws are placed in the lowest step the length of the magnetic air-gap between the top of the core F and the upper plate of the magnetic yoke is the greatest. Hence the magnetic influence exerted on the core is the weakest, and the length of the arc established is relatively short, therefore allowing a relatively large amount of current to flow between the electrodes owing to the decreased resistance. It is to be assumed, of course, that the length of arc is such and the admission of air to the arc inclosure great enough to prevent excessive deposit of unconsumed carbon particles within the inclosure. By shifting the core to the second step the magnetic influence exerted by the core is greater, due to the core entering a denser magnetic field, and necessarily a longer arc is drawn and the resistance at the arc increased, so that a less amount of current will flow. By raising the core so that the screws will enter the third step the core enters a magnetic field of still greater intensity and in like proportion diminishes the flow of current through the arc. The candle-power of the lamp and also the consumption of energy necessarily vary somewhat as the relative positions of the core and electromagnet are changed.

The holder for the upper electrode is best shown in Figs. 5 and 6. It consists of a thin metal sleeve J^2, which is slotted at its lower end to form a holder for the upper carbon, as indicated at J^3. The slots give the necessary flexibility to the holder to cause it to retain the electrode in place when the lamp is in service, but permit the carbon to be removed by the trimmer. The upper end of the tube is reduced somewhat in size, so as to make a yielding contact device, and is also slotted to form fingers J^4. These fingers are bent outward slightly to engage with the inner wall of the tube E, and thus convey current from one terminal of the lamp to the upper electrode. The center of the holder is provided with a weight J, which tends at all times to force the upper electrode downward against the action of the electromagnet. This weight also tends to prevent the parts from sticking, due to any cause. The weight and carbon-holder are secured together by pins, which extend transversely through them.

The holder for the lower electrode is best shown in Figs. 7 and 8, wherein P represents a part of the lamp-frame having a central screw-threaded opening for receiving the carbon-holder Q. The holder consists of a slotted tube Q^2, having a screw-threaded portion Q^3, that engages with the thread in the part P, and an enlarged portion or band Q^5. It is also provided with a screw-threaded portion Q^4 for receiving the nut P^8. The nut is retained in place by a set-screw P^9, which engages with the band Q^5. Under ordinary conditions the carbon-holder and the part P^8 are secured together, so that by unscrewing them the lower carbon can be removed and a new one substituted without in any manner disturbing the arc-inclosing globe. It sometimes happens that the holder for the lower carbon is injured by maintaining the arc too near it, thus necessitating a new holder. With the construction described a new split tube Q^2 can be substituted at a small expense, and this with very little work on the part of the station operators. The frame-piece P is cupped out, as indicated at P^5, to receive the arc-inclosing globe or chamber W, which is preferably made out of glass and is provided with a straight end, which makes a fairly snug fit with the sides of the cup-like portion of the frame. It is desirable to make the ends of the globe straight in order to simplify and reduce the cost of manufacture. The globe rests on the frame-piece at the lower end and is retained in place by suitable means located at the top.

Referring to Figs. 1 and 9, K represents the gas-cap and also the means for holding the globe in place. The cap itself is loosely mounted on two vertically-extending guides V^4, which are secured to the frame-piece V at their upper ends and are provided with nuts at their lower ends to prevent the gas-cap from dropping out of the lamp when the arc-inclosing globe is removed. This suspension of the gas-cap is an important feature, since it obviates the necessity of handling the cap when it is hot. It also reduces the liability of globe breakage. The gas-cap consists of the flat plate K^2, having a downwardly-extending flange K^5, that encircles the upper end of the arc-inclosing globe W and retains the same against lateral displacement, the weight of the same holding the globe against the lower seat. When the globe is being mounted in position, the lower end is inserted in the cup-like holder P^6 and the gas-cap is forced downward, so that the flange K^5, surrounds the upper end of the globe. The weight of the gas-cap is sufficient to hold the globe against its seat, and the rods V^4 and flange prevent lateral movement of the upper end. The means employed for supporting the inner globe constitute an important feature of my invention. By reason of the improved construction I am enabled to do away with the holding devices which exert pressure on the side walls of the globe. Where such pressure-exerting devices are used, the globes are commonly made thicker at the clamping end instead of with a uniform thickness, as in the present instance, the latter construction obviating to a large extent the trouble due to breakage in manufacture. The upper face of the gas-cap is bored out at K^3 to receive the sliding plate L. This plate is provided with a central depression L^3, having an opening which makes a snug fit with the carbon. The object of this plate, which is relatively light, is to prevent the parts from binding and to simplify the question of alinement. It also acts as a stop for the upper-carbon holder when for any reason it passes downward through the clutch. The holder is relatively thin, so that it can pass down through the clutch, as is illustrated in dotted lines, Fig. 9. By reason of this arrangement I am enabled to utilize the greater portion of the upper carbon, thereby reducing the total length of the lamp. When the holder strikes the sliding plate L, it stops further movement, and therefore cuts the lamp out of circuit as soon as the carbons are burned away to a point where the voltage will no longer maintain the arc. The central depression in the sliding plate allows the holder to descend farther than would be the case if it were straight. Consequently the effective length of the carbon is somewhat greater. The disk L is retained in place on the gas-cap by means of a ring K^4, and the parts are so arranged that the cap as a whole is free to move up and down as well as laterally to a slight extent, the plate L compensating for curves and other irregularities in the upper carbon, thereby preventing it from binding.

Referring to Figs. 13 and 14, the support for the closed-bottom outer globe X will be described. Secured to the lower end of the actuating or feeding magnet is a plate Y, having a hub-like extension Y^{12}, that enters the extension T^2 of the magnet. The plate is provided with a downwardly-extended flange Y^2, which is bored out to receive the globe-supporting ring X^4, the latter being permanently secured to the curved neck of the globe by set-screws X^3. The ring is also provided with two or more outwardly-projecting pins X^5, (I have found three to be very satisfactory,) that enter slots Y^3, formed in the downwardly-extending flange of the plate Y. Mounted on the periphery of the flange are pivoted levers or latches Y^4, one for each pin, having hook-like ends Y^6, which are arranged to engage with the pins and hold the outer globe in place. The opposite end of each lever is slotted, as indicated at Y^{10}, and passing through the slot is a set-screw Y^9. Situated in the ring X^2, in such position that they will be opposite the set-screws Y^9 when the outer globe is in position, are holes X^6. When the set-screws are seated in a manner to hold the pivoted levers or latches Y^4 in place, the ends thereof will enter the holes in the ring and retain the globe in place even though the latches themselves be accidentally displaced. In other words, these pins form an auxiliary globe-locking device. When it is desired to remove the outer globe, the set-screws are released, permitting the arms Y^4 to be swung upward, after which the globe can be rotated slightly in a direction to remove the pins X^5 from the slots Y^3. After the lamp has been trimmed or inspected, as the case may be, the outer globe may be returned by reversing the operation above described. By using a closed-bottom outer globe all danger from shocks is prevented, as the parts carrying current are protected.

The lamp as a whole is inclosed in a metallic casing which is insulated from the current-carrying parts, so that danger from shocks is also eliminated at this point. The casing closely fits over the working parts of the lamp, thus preventing the entrance of bugs and dirt. The same is also true of the outer closed-bottom globe. To facilitate trimming, a chain or other connection may be employed, which is connected to the plate Y and to the ring X^2.

The action of the lamp is as follows: Current enters at the positive binding-post or terminal and passes through the switch-lever to the top plate R^3, thence through the various metallic parts to the carbon-tube and electrode, thence through the arc to the lower electrode. From here the current flows through the side arm N to the magnet-coil, thence by wire S^{14} to the resistance, through the resistance and bridging-clamp S^9 to the negative terminal or binding-post. It will readily be seen by the drawings that the current entering the lamp will find a number of paths to the upper electrode, as all of the main working parts of the lamp are in circuit therewith, while the negative side of the lamp starting from the arc is suitably insulated. As the adjacent ends of the electrodes are consumed the core F moves down, carrying with it the clutch. As the latter descends to the feeding-point the stationary tube H enters the chamber and shoves the balls G^7 away from the electrode, thus allowing the latter to descend and compensate for the carbon consumption. As the tube E rises the balls reëngage with the electrode and lift it to the proper point. Changes in the position of the armature with respect to the magnet will of course vary the amount of "pick up" or movement of the upper electrode.

In the drawings and specification I have shown a type of lamp designed to operate on constant-potential direct-current circuits, and the electromagnetic coil is composed of one continuous wire, which is directly in circuit with the arc and the rheostat of the lamp and is so constructed that a requisite proportion of wire or turns accurately balance and maintain the proper voltage at the arc. By the use of what is known as a "differential coil" this same construction may be utilized for lamps that are intended to be operated in series on direct constant-current circuits.

What I claim as new and of my invention, and desire to secure by Letters Patent, is—

1. In an electric-arc lamp, the combination of a carbon-holder, a tube which incloses the holder, an armature, a solenoid-magnet, a core which incloses the magnet, an extension on the core, and means for adjusting the armature so that its position with respect to the extension may be varied to compensate for different lengths of arc.

2. In an electric-arc lamp, the combination of a tube, steps formed thereon, a core embracing the tube, means engaging with the steps for adjusting the core, and a solenoid-magnet surrounding the core, the parts being so arranged that altering the position of the core on the tube varies the intensity of the magnetic field by changing the magnetic reluctance.

3. In an electric-arc lamp, the combination of a frame-tube which surrounds the carbon and passes through the solenoid, a solenoid, a core for the solenoid which engages with the tube, an armature located within the tube, a piston secured to the armature and arranged to work in the tube, the said piston and tube constituting a dash-pot, and a flexible connection between the armature and piston for compensating for inaccuracies in alinement.

4. In an arc-lamp, the combination of a drum composed of a main body and a detachable flange, bolts for securing the flange to the body, coils of resistance-wire encircling the drum and presenting parallel surfaces, means for connecting the coils at one end, means for connecting the opposite ends to terminals, and a connector which is circumferentially adjustable on the coils for varying the amount of resistance in circuit.

5. In combination with an arc striking and feeding mechanism, a rheostat comprising a support covered with insulating material, a body of resistance material, insulated clamps for securing the resistance-body to the support which are provided with curved inner faces, a two-part connector which engages with the resistance-body for cutting portions of it into and out of circuit, and means for clamping the two parts of the connector around the resistance material.

6. In an arc-lamp resistance, the combination of a cylindrical support, a body of resistance material mounted thereon, and a pair of flanges forming a part of the support and located above and below the said body for the purpose of protecting it.

7. In an arc-lamp, the combination of a cylinder-support, a flange formed integral therewith, a body of resistance material surrounding the support, a detachable flange located at one end of the support, and means for securing the flange to said support.

8. In an electric-arc lamp, the combination of a tubular frame, a resistance-supporting device secured to the frame, means for suspending the lamp, and a single means for securing the supporting device to the frame and also retaining the resistance-supporting device in place.

9. In combination, a support, a resistance-wire coiled around the support, means for securing the wire to the support, and means for cutting out more or less of the wire, which means is supported entirely by the said resistance-wire.

10. In an arc-lamp, the combination of a support, coiled resistance-wire wound thereon, the arrangement being such that one part of the wire is wound in a clockwise direction, the balance in an anticlockwise direction, means for holding the wire at the point of turning, means for holding the ends of the wire, and a contact arranged to bridge more or less of two turns.

11. In connection with an arc-lamp, a rheostat in the form of a drum composed of metal and carrying on its surface insulated coils of high-resistance material and attached thereto by means of clips with insulating material between the clips and coils, the said clips being attached to the drum by suitable means, the resistance spiral coils on the drum lying parallel to one another and encircling the drum, and a short-circuit strap attached to the spiral, and circumferentially adjustable thereon.

12. In an electric-arc lamp, the combination of a fixed frame-tube carrying a solenoid, a tube carrying the armature or core and located within the frame-tube, and movable therein under the influence of the current in the solenoid, a carbon-holder movable in the tube carrying the core, and a plate capable of moving edgewise to compensate for changes in alinement of the feeding carbon, which also acts as a stop for the carbon-holder.

13. In an electric-arc lamp, the combination of a fixed frame-tube carrying a solenoid-coil, an armature or core, a tube carrying the core and movable with it under the action of the current in the solenoid, a carbon-holder, a plate which is perforated to receive the feeding electrode and is free to move edgewise, the said plate also acting as a stop for the carbon-holder, a globe, and a support common to the plate and upper end of the globe.

14. In an electric-arc lamp, the combination of the fixed tube carrying a solenoid-coil, a core, a tube carrying the latter, and slidable with the core within the fixed tube, in accordance with changes in the strength of the current through the coil, a frictional carbon-holder slidable in said tube, a carbon-guide consisting of the depressed plate free to move edgewise thus permitting the carbon to re-

main in its straight line of descent, and also operating to duly stop the carbon-holder, and a disk supporting the guide, and having a depending flange within which is received the upper edge of the inner globe for holding the same in place.

15. In an electric-arc lamp, the combination of a slidable carbon, a frame, guide-rods secured thereto, a disk capable of moving on said rods, and having a flange for receiving the upper end of the arc-inclosing globe, a lower holder having a flange for receiving the globe, and a lower-carbon holder, both of said holders being mounted on the frame of the lamp.

16. In an electric-arc lamp, the combination of an arc-inclosing globe, a lower holder therefor having a screw-threaded portion and a flange for retaining the globe, a frame which is formed integral with the holder, means for holding the lower carbon which fits into the screw-threaded opening, and means for pressing the globe against the holder.

17. In an electric-arc lamp, the combination of an arc-inclosing globe, a holder in which the lower end of the globe rests, a frame for supporting the lower holder, a holder which engages the upper end of the globe and retains it in place by pressing it downward, and rods which limit the downward movement of the upper holder, and suspend the same when the globe is removed.

18. In an electric-arc lamp, the combination of an arc-inclosing globe, a support for the lower end in which the globe rests freely, a frame to which the support is secured, a support for the upper end which retains the globe in place, a gas-cap for restricting the admission of air to the globe and the exit of gas, and a pair of rods for limiting the downward movement of the gas-cap.

19. In an electric-arc lamp, the combination of an arc-inclosing globe, a support for the lower end thereof, a frame to which the support is secured, a support which engages with the upper end and retains the globe in place, and a guide for the upper support which permits it to be raised or lowered at will.

20. In an electric-arc lamp, the combination of an arc-inclosing globe, a support for the lower end thereof, a frame to which the support is secured, a support which has a flange that surrounds and engages the upper end of the globe, guide-rods on which the support is free to slide, and means for limiting the downward movement of the support.

21. In an electric-arc lamp, the combination of a frame having a slotted flange, a globe, a ring permanently secured to the globe, projections on the ring which enter the slots in the flange, swivel-hooks for retaining the pins within the slots, and means for limiting the angular movement of the hooks.

22. In an electric-arc lamp, the combination of a frame having a slotted flange, a globe, a ring permanently secured to the globe, projections on the ring which enter the slots in the flange, means for retaining the pins in the slots, and means for holding the globe in place when the retaining means are displaced.

23. In an electric-arc lamp, the combination of a frame having a downturned slotted flange, a ring having projections which enter the slots, pivoted latches arranged to engage with the projections, and set-screws which hold the latches in place and also enter holes in the ring and support it when the latches are displaced.

24. In an electric-arc lamp, the combination of a globe or cylinder which incloses the carbons, a cap which rests loosely on the top of the cylinder and prevents the free entrance of air into the cylinder, and means for retaining the cap within the lamp at or near its normal position when the cylinder is removed.

25. In an electric-arc lamp, the combination of a globe or cylinder which incloses the carbons, a cap which is arranged to close one end of the cylinder and rests loosely on the cylinder, and means for retaining the cap in place after the cylinder is removed.

JOHN S. NOWOTNY.

Attest:
WM. E. JONES,
A. GOSIGER.