No. 720,650. PATENTED FEB. 17, 1903.

A. WITTE.

ELECTRIC ARC LAMP.

APPLICATION FILED FEB. 26, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

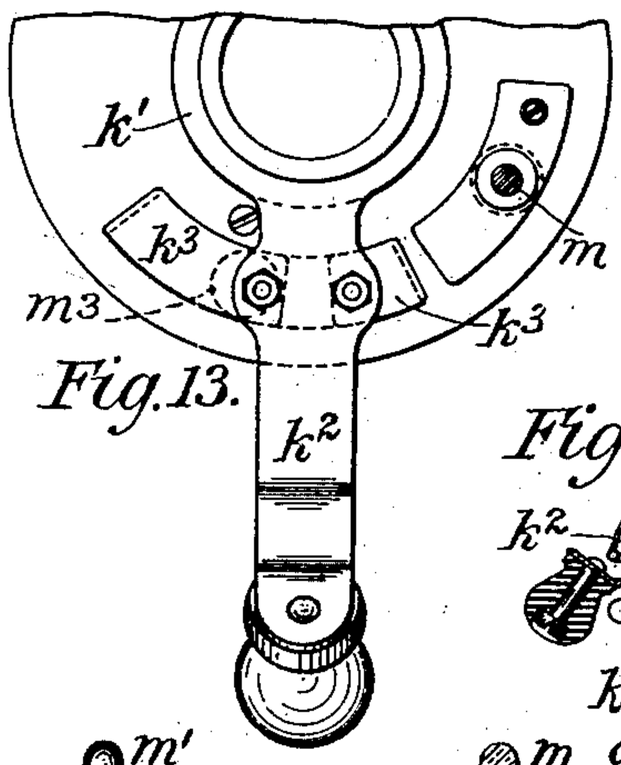

Fig. 13.

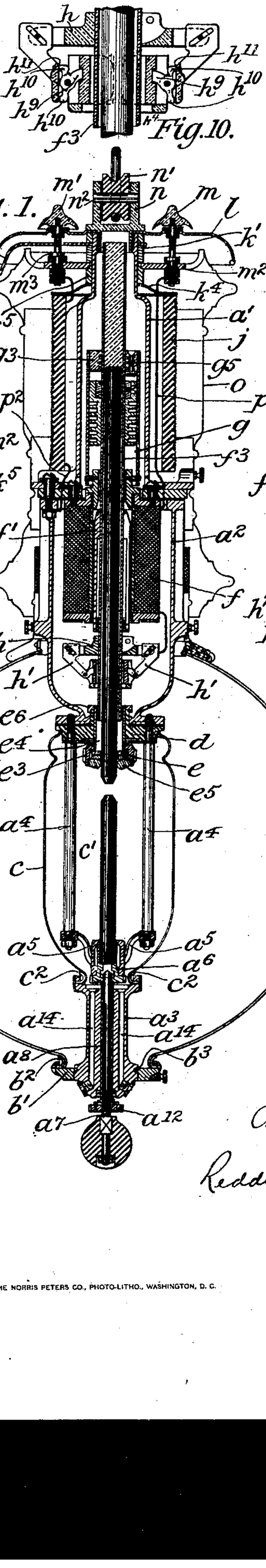

Fig. 1.

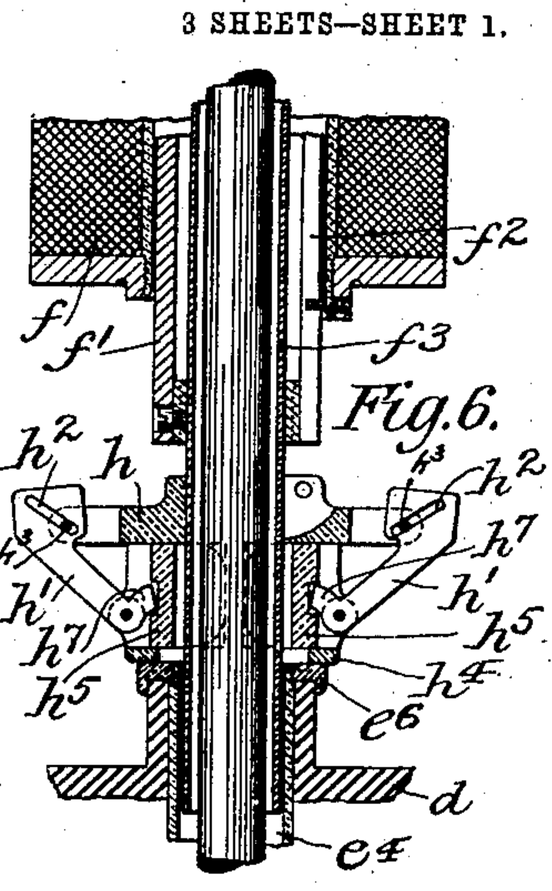

Fig. 6.

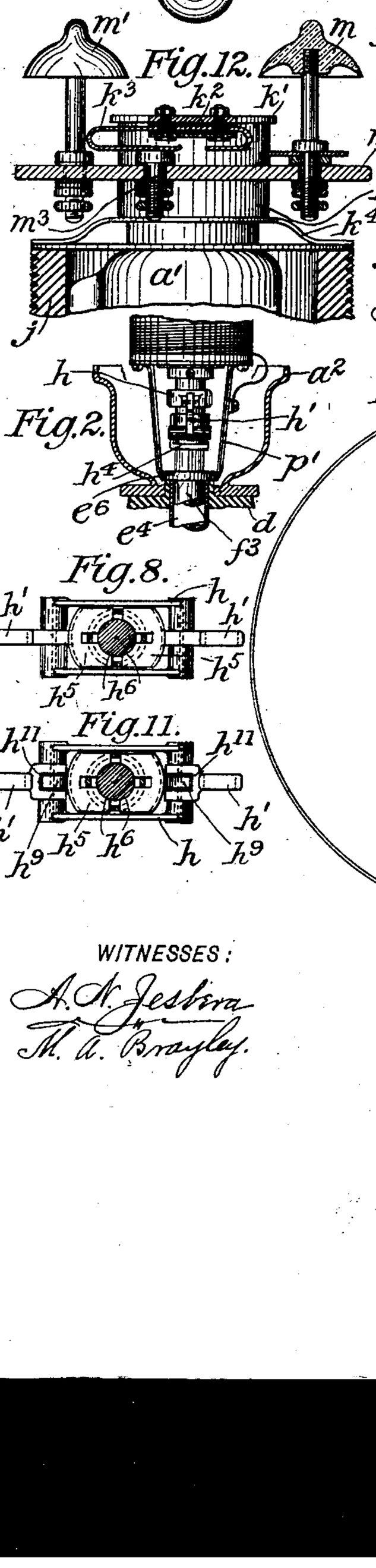

Fig. 12.

Fig. 2.

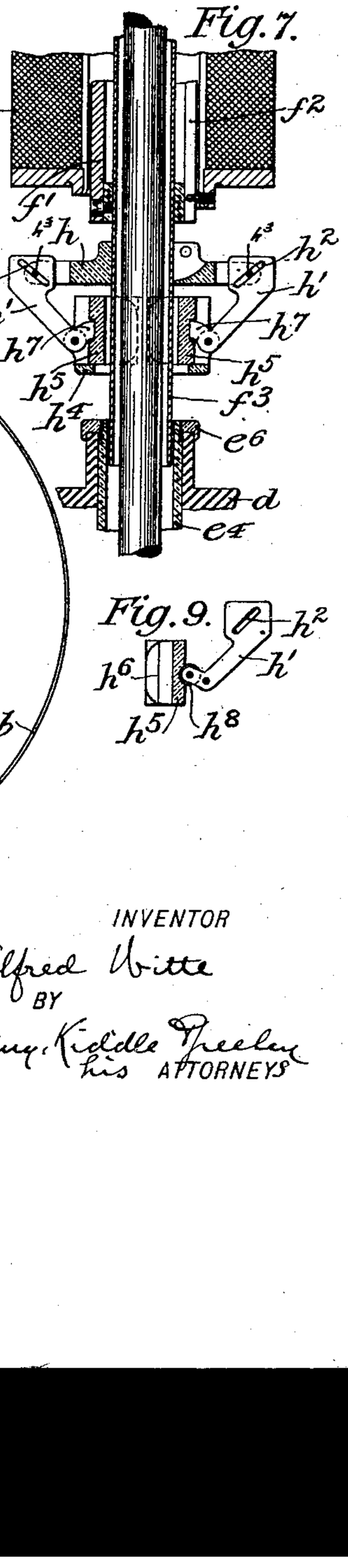

Fig. 7.

Fig. 8.

Fig. 11.

Fig. 9.

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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 26.

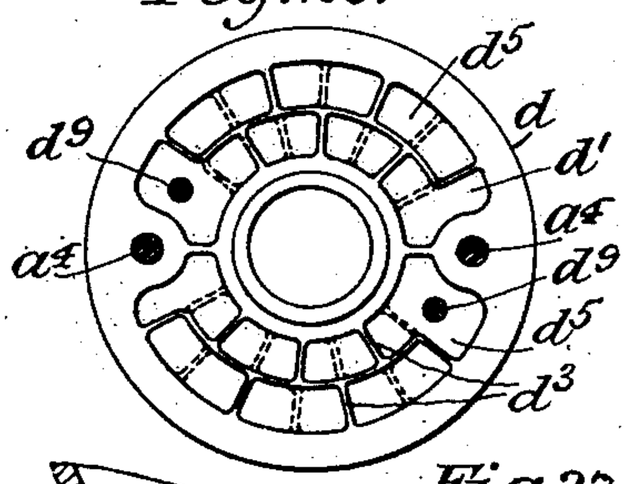
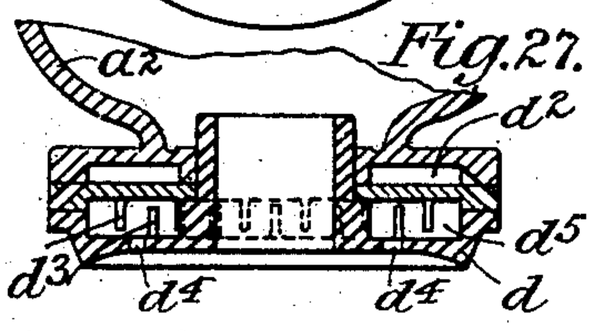


Fig. 27.



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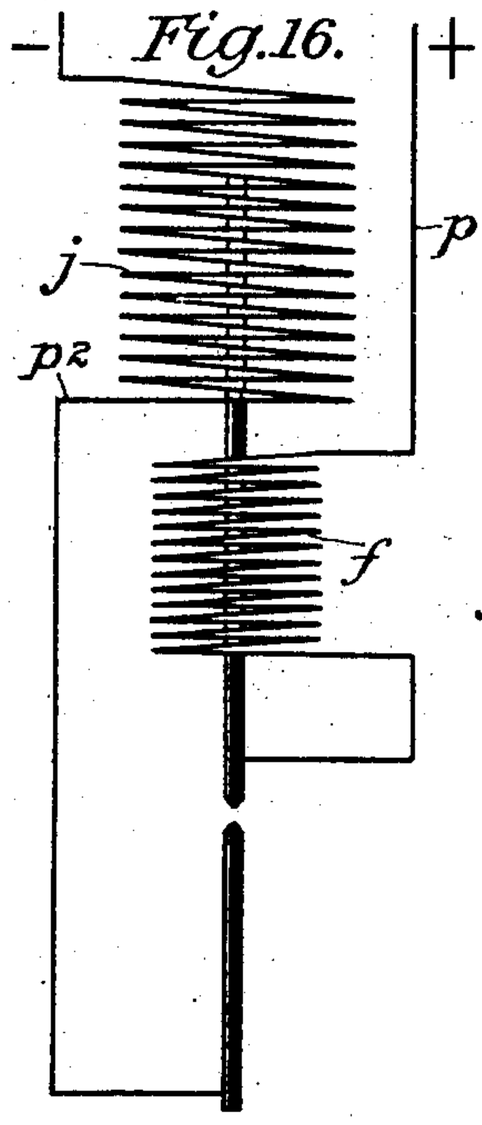


Fig. 3.

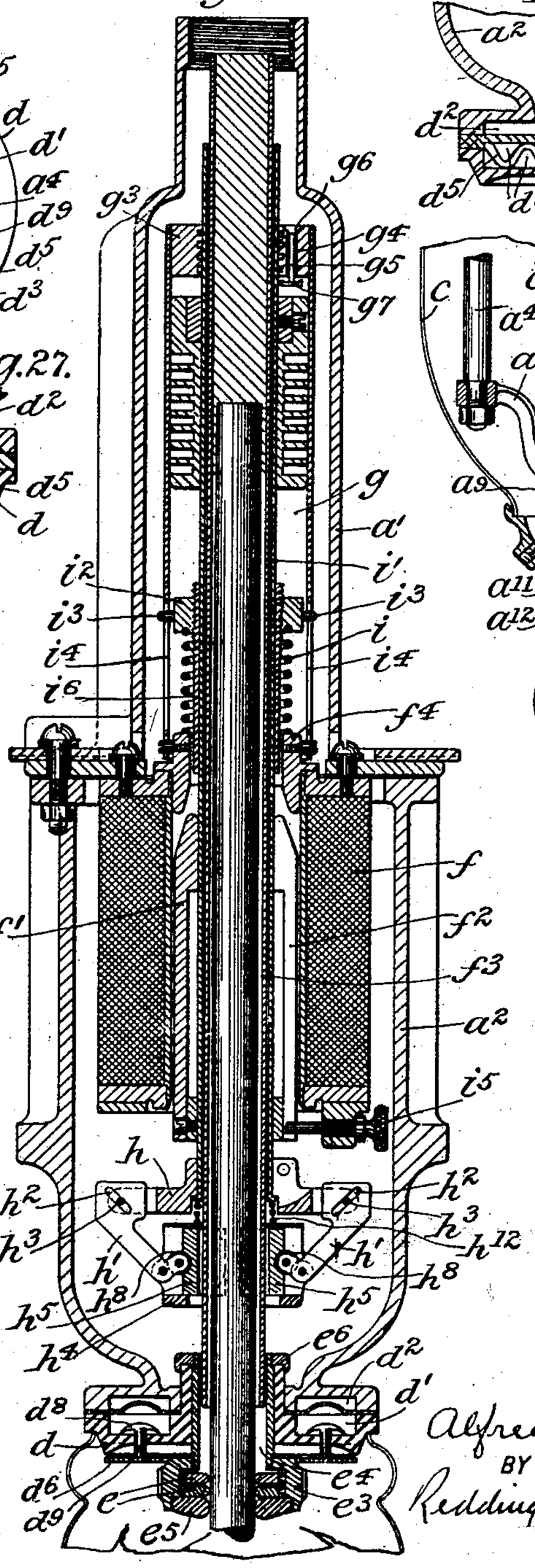


Fig. 28.

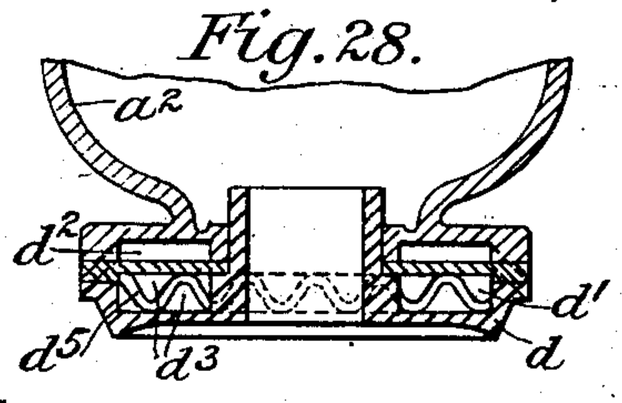


Fig. 5.

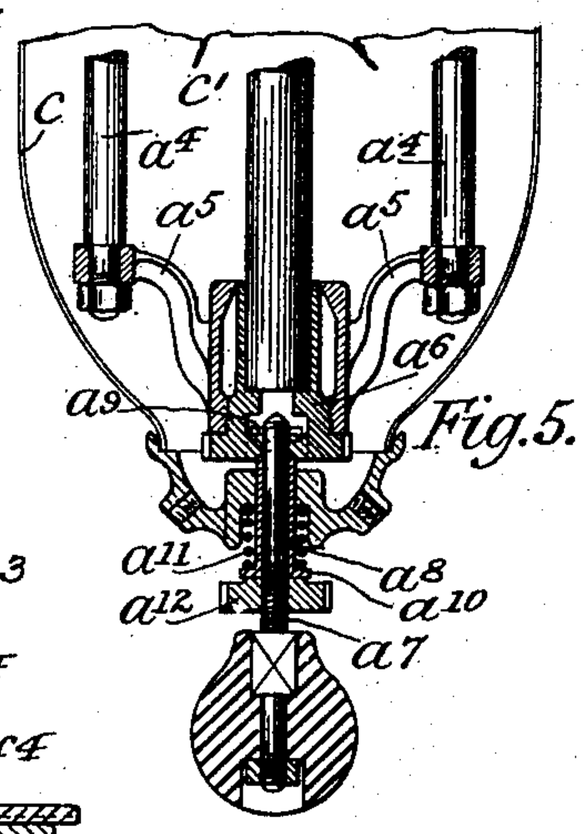


Fig. 14.

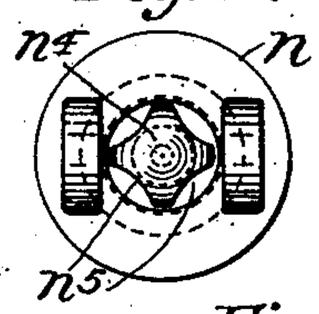
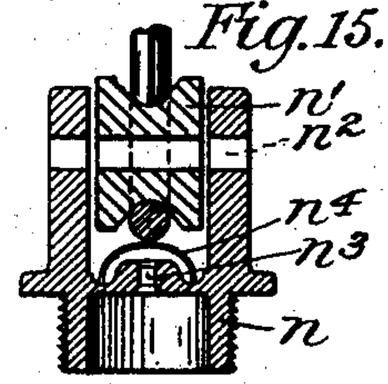


Fig. 15.



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NO MODEL. 3 SHEETS—SHEET 3.

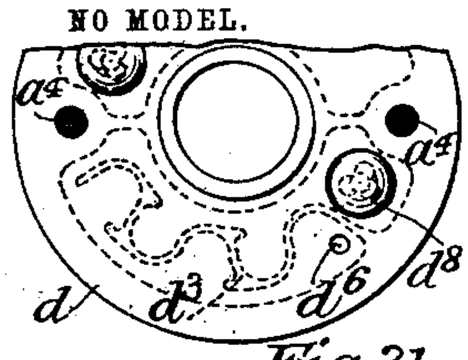


Fig. 31.

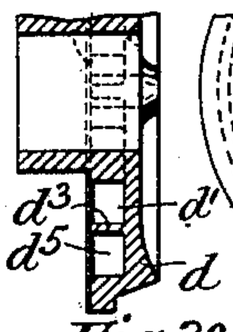


Fig. 30.

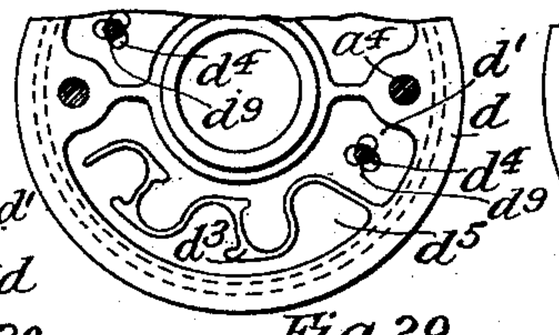


Fig. 29.

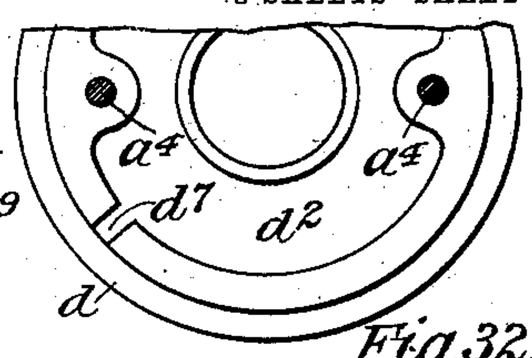
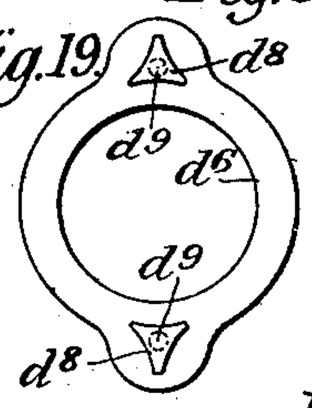


Fig. 32.

Fig. 19.



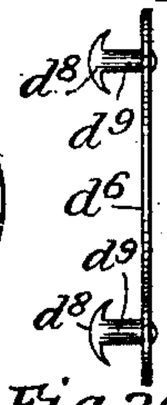


Fig. 20.

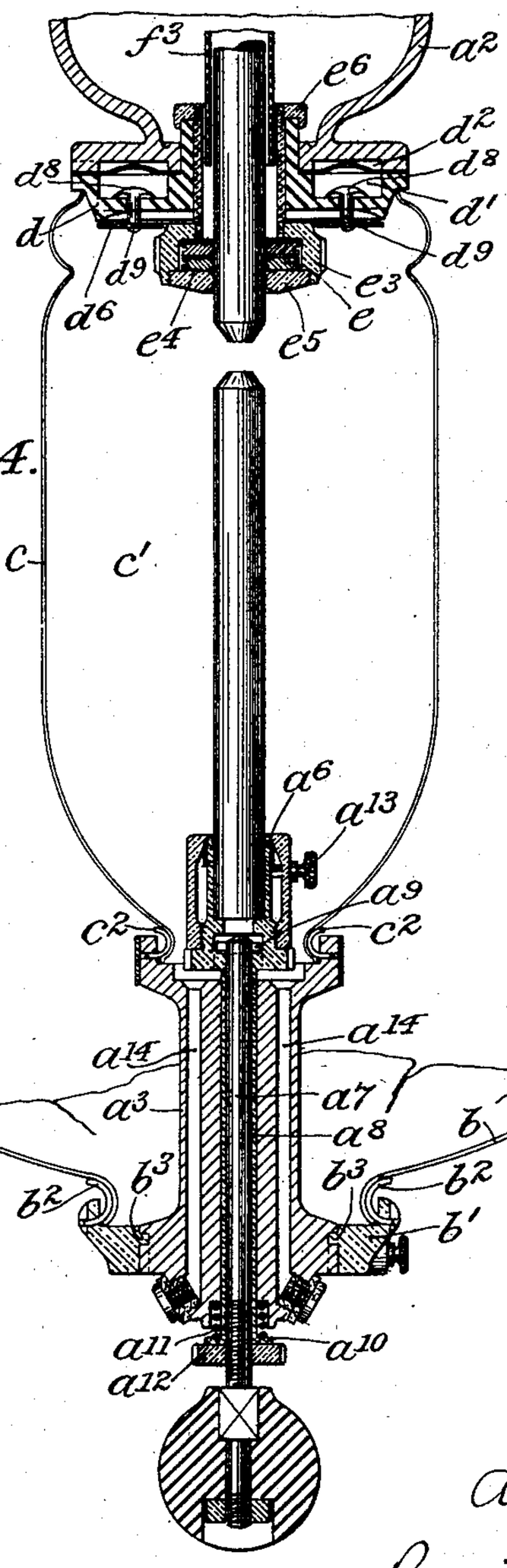


Fig. 4.

Fig. 17.

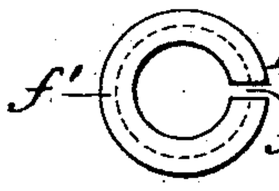


Fig. 18.

Fig. 21.

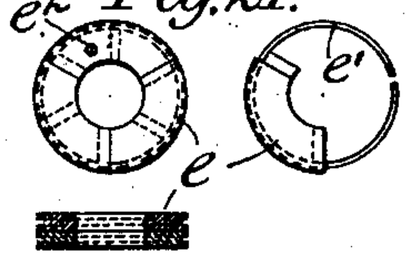


Fig. 22.

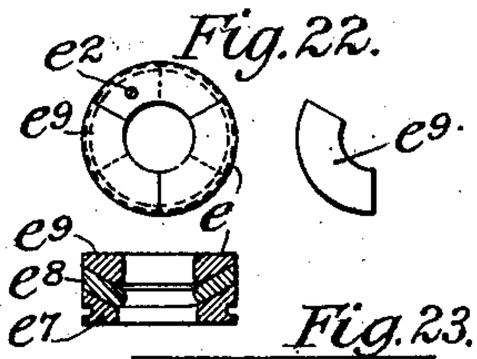


Fig. 23.

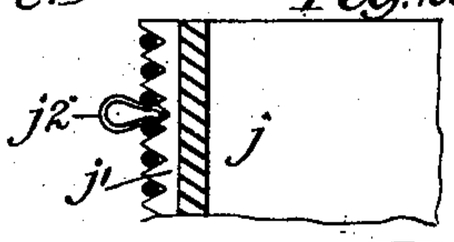
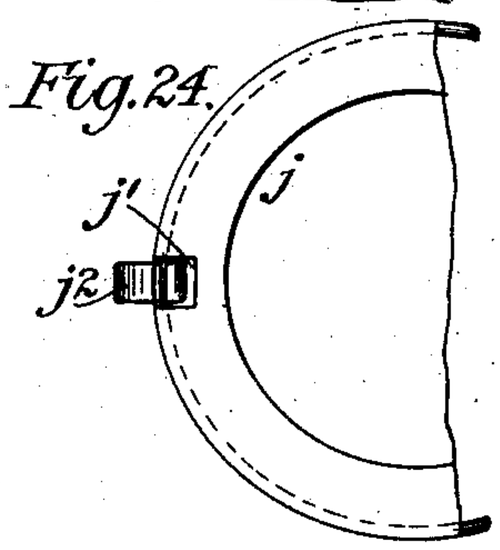


Fig. 24.



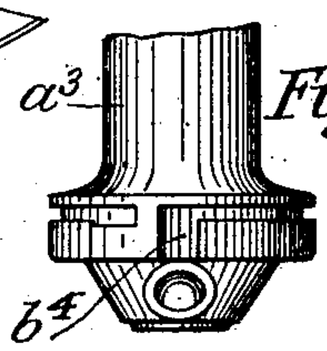


Fig. 25.

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UNITED STATES PATENT OFFICE.

ALFRED WITTE, OF NEW YORK, N. Y.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 720,650, dated February 17, 1903.

Application filed February 26, 1902. Serial No. 95,789. (No model.)

To all whom it may concern:

Be it known that I, ALFRED WITTE, a citizen of the United States, residing in the borough of Manhattan, city, county, and State of New York, have invented certain new and useful Improvements in Electric-Arc Lamps, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof.

This invention relates to electric-arc lamps, and while some of the features of the invention have to do particularly with arc-lamps wherein the carbons are inclosed in an inner globe this invention is not to be considered as limited to this special class of arc-lamps, except in so far as it concerns this feature alone. In arc-lamps provided with an inner globe great difficulty has been experienced in providing suitable conduits for the egress of the gases formed by the arc and at the same time preventing the ingress of atmospheric air to the carbons; and one object of this invention is to provide a gas-check whereby the incoming air may be heated and mixed with the outflowing gases, and thereby so thoroughly deoxidized that that part of it which may enter the inner globe or carbon-chamber shall not greatly promote the combustion of the carbons. In the consumption of the carbons the inner globe or carbon-chamber, especially at its lower end, receives a coacting of carbon dust or soot, and it is desirable to have some convenient means for relieving the inner globe of this soot without removing either the inner or outer globe. Accordingly two channels communicating with the outer air and inner globe are provided in the lower support of the lamp. Through one of these openings air may be forced to create a circulation of air in the inner globe, and thereby discharge the soot through the other channel.

In addition to the foregoing the invention comprises a feeding device which is simple in construction and operation and does not require the use of a shunt-coil, which generally involves considerable expense. In a modification of the improved lamp is a regulating device which can be adjusted to reinforce the feed-operating magnet when the lamp is run on a circuit of low potential.

The invention further comprises various details of construction, more particularly referred to hereinafter.

In the accompanying drawings, Figure 1 is a view in vertical central section of an electric-arc lamp embodying the improvements. Fig. 2 is a detail view, partly in side elevation, of the carbon-feeding devices, &c. Fig. 3 is a vertical central section, on a larger scale than Fig. 1, of the upper part of the lamp, some of the parts being slightly modified. Fig. 4 is a similar view of the lower part of the lamp, the outer globe being broken away. Fig. 5 is a detail view, in vertical central section on a plane at right angles to that of Fig. 3, of the lower part of a lamp without provisions for the support of an outer globe. Figs. 6 and 7 are detail views in vertical central section, illustrating the carbon-feeding devices in different positions. Fig. 8 is a detail plan view of the carbon-clutch shown in Figs. 6 and 7. Fig. 9 is a detail view of one of the clutch-jaws and its coöperating lever. Figs. 10 and 11 are detail views in vertical section and in plan, respectively, illustrating a slightly-different form of the carbon-clutch. Fig. 12 is a detail view, in vertical section, of the head of the lamp, illustrating particularly the arrangement of the cut-out switch. Fig. 13 is a detail plan view of the cut-out switch. Figs. 14 and 15 are detail views, in plan and vertical section, respectively, of the ventilating-suspender. Fig. 16 is a diagram of the lamp-circuit. Fig. 17 is a detail view, in vertical section, of the dash-pot and its coöperating devices as shown in Fig. 1, but on a larger scale. Fig. 18 is a top view of the armature or core of the magnet shown in Fig. 17. Figs. 19 and 20 are plan and edge views, respectively, of the device for closing the passage from the carbon-chamber to the gas-check during the cleaning out. Fig. 21 represents three detail views of the sectional carbon-rings. Fig. 22 represents three detail views of a modified form of the sectional carbon-ring. Figs. 23 and 24 are detail views of the resistance device. Fig. 25 is a detail view, in side elevation, of the devices for supporting the outer globe upon the frame of the lamp. Figs. 26 and 27 are detail views, in plan and vertical section, respectively, of a form of the gas-check different from that shown in Figs.

3 and 4. Fig. 28 is a view similar to Fig. 27, but showing a slightly-different form of the gas-check. Figs. 29 and 30 are views similar to Figs. 26 and 27, respectively, illustrating a further modification of the gas-check. Figs. 31 and 32 illustrate details of the gas-check.

As mentioned above, the invention is not wholly confined to inclosed-arc lamps; but inasmuch as some of the parts of the invention relate to the inclosed or carbon chamber an inclosed-arc lamp has been chosen for purposes of illustration. The feeding and regulating devices are supported by a frame, which is preferably composed of two castings a' and a^2, and from the casting a^2 the lower casting a^3 is supported by rods a^4, brackets a^5, and carbon-holder a^6. The brackets a^5 are preferably formed integral with the carbon-holder a^6, and the lower casting a^3 is secured to the carbon-holder a^6 by a locking-rod a^7 in a sleeve a^8. Said locking-rod has a pin a^9, adapted to fit in a corresponding slot or groove in said carbon-holder. Between the lower casting a^3 and an enlargement a^{10} on the end of the sleeve a^8 is a spring a^{11}. A nut a^{12}, threaded on the rod a^7, is adapted to be screwed against the enlargement a^{10} to compress said spring and lock the pin a^9 in its groove. By loosening said nut the rod a^7 may be lifted to disengage the pin a^9 from its groove, and by giving the rod a quarter-turn the same may be withdrawn from the carbon-holder a^6, which is provided with a recess, (not shown,) through which the pin passes as the rod is withdrawn, and in this way the lower casting may be removed from the lamp. The outer globe b is supported by a bracket b', being held thereon by spring-clamps b^2. Said support b' is provided with lugs or projections b^3, which fit in a circular groove or track in the casting a^3, and by turning the globe support or bracket b' until the lugs b^3 register with slots b^4 the outer globe may be removed. The inner globe c, which forms the inclosed or carbon chamber c', is mounted on the lower casting a^3 and held thereon by spring-clamps c^2.

In order to provide egress for the gases formed in the carbon-chamber c' and at the same time to prevent the atmospheric air from entering said chamber, a gas-check d is provided at the upper end of the chamber. The gas-check, which may be formed in the frame-casting a^2, is shown in the drawings to be and for reasons hereinafter specified is formed in a separate piece d, secured to the casting a^2 by the screw-rods a^4, comprises a lower chamber d', communicating with the carbon-chamber c', and an upper chamber d^2, the latter communicating with the lower chamber d' and the outer air. The precise form or shape of the chambers d' and d^2 is not essential to the present invention, except in so far as the shape or form conduces to the most effectional intermingling of the gases from the arc and the inflowing air. In the drawings various arrangements of the lower chamber d' are shown to accomplish the necessary intermingling of the atmospheric air and the carbon-gases. In Figs. 26 to 31 are shown lugs or projections d^3, forming partitions or obstructions in said lower chamber d', which give direction to the movement of the air and gases and also check the flow of the gases which enter this chamber from the carbon-chamber through the openings d^4. The chamber d' as disclosed in the drawings may comprise two distinct parts; but the number of distinct parts into which it may be divided is immaterial, provided the air and gases are properly mixed. In Figs. 26 to 28 is shown an arrangement of the partitions or obstructions d^3, which form sinuous conduits d^5 for the air and gases, the particular shape of the conduits causing the air and gases to circulate up and down, or, in other words, to have a substantially vertical movement. This vertical circulation effects a much more intimate mixture of the air and gases than is possible in a horizontal circulation of the same, inasmuch as the greater density of the gases prevents in a measure their thorough intermingling if they circulate substantially horizontally. The chamber d^2, which communicates with chamber d' through openings d^7, is preferably left unobstructed, and the free circulation of the inflowing air over the hot plates in this chamber heats said air before it passes into the chamber d'. In this way the gases formed by the action of the arc upon the carbon are largely confined to the carbon-chamber, and whatever air enters said chamber is considerably deoxidized by its contact with the hot gases in the gas-check, the life of the carbons being accordingly greatly prolonged.

In addition to the gas-check another device is provided in the improved lamp to exclude atmospheric air from the carbon-chamber. The irregularity of the surface of the carbons ordinarily permits a great deal of atmospheric air to enter the carbon-chamber around the carbons. To prevent this entrance of air, sectional rings e, Figs. 21 and 22, are provided, each ring comprising a plurality of sections held together by a spring e' about the periphery thereof. Two such rings e may be placed together, so that the sections of one shall cover the ends of the sections of the other, and a screw e^2 may be employed to hold the two rings together. These rings are preferably mounted within a ring-nut e^3, threaded upon a tube e^4, and an externally-threaded nut e^5 may be screwed within the ring-nut e^3 to form with said nut e^3 a seat for the sectional rings e, which are held loosely therein. In this way the rings may be easily removed or adjusted by simply loosening nut e^5. The parts e^3 and e^4 are preferably formed of a good conducting material in order to transmit current to and through the rings e

to the upper carbon. Instead of two rings e with springs e' to hold their sections together one such ring e^7 may have its upper surface tapered to form a seat for another sectional ring e^8 with its surface cut to fit the taper on the ring e^7, but without the spring e'. As the carbon slides through these rings the sections of ring e^8 are held closely against the carbon by friction, but on account of the yielding of the sections of ring e^7 not so tightly as to prevent the proper feeding of the carbon. If desired, a ring e^9 may be fitted in like manner on the ring e^8. By means of a nut e^6 the tube e^4 may be secured within a bushing d of non-conducting material to insulate the parts e^3, e^4, and e^6 from the lamp-frame a^2. Though preferable it is not essential that the upper carbon receive its current through the rings e, and it will therefore be understood that the construction of the rings and adjacent parts may be varied accordingly both as to form and material.

The feeding device of the lamp comprises a magnet f, secured to and within the frame a^2, a hollow main core f', slotted at f^2 to prevent its becoming permanently magnetized, a feeding-tube f^3 for the upper carbon, loosely secured within the main core f', so as to be capable of longitudinal movement, and an auxiliary core f^4, secured to the upper end of the magnet. The upper end of the core f' is preferably tapered and fits a corresponding recess in the auxiliary core f^4. The latter serves to concentrate the magnetism, and accordingly a much smaller coil may be employed than otherwise.

Secured to the auxiliary core f^4 or otherwise secured within the upper part a' of the lamp-frame is a dash-pot g, concentrically arranged with respect to the feeding-tube f^3. In the head g^3 of said dash-pot is a port g^4, provided with a valve, which comprises a double-headed valve-stem g^5, slightly smaller in diameter than the bore of the port g^4, one head g^6 of the valve being tapered and adapted to fit in a corresponding recess in the head g^3, while the other head g^7 is disk-shaped and adapted to close the port from the inside. When the piston is moved violently up, as in starting the lamp, the valve-stem g^5 is lifted and the head g^7 closes the port, thereby establishing an air-cushion in the upper end of the dash-pot and retarding the further upward movement of the piston; but when the lamp is feeding normally, as is more fully explained hereinafter, the slight upward movements of the feeding-tube are not accompanied by the closing of the port by the head g^7, and therefore said upward movements of the feeding-tube are unrestrained.

In order to hold the upper carbon stationary within the feeding-tube f^3 as the latter moves slowly down in the act of feeding, a clutch is provided, and comprises a carrier h, secured in any desired manner to the feeding-tube f^3, lever-arms h', loosely engaging the carrier h, as by means of obliquely-arranged slots h^2 and pins h^3, a frame h^4 around the feeding-tube f^3 and pivotally supported by the ends of levers h'. The clutch further comprises jaws h^5, adapted to slide freely in the frame h^4 and having teeth h^6, which are adapted to move through corresponding slots in the feeding-tube f^3 to grip the upper carbon. Operatively connected with the jaws h^5 are the ends h^7 of the levers h', and when the lamp is in operation the weight of the carbon which is in frictional engagement with the teeth h^6 exerts a downward pull upon the frame h^4 sufficient to cause the ends of the levers to force the jaws h^5 to tightly engage the upper carbon. When the feeding-tube f^3 has reached the position shown in Fig. 6, the frame h^4 rests on top of the nut e^6, which acts as a stop. The levers h' then slide and turn on pins h^3 and the jaws release the carbon. As soon as the carbon drops, however, the resistance of the arc is diminished, thereby adding increased power to the magnet, and the feeding-tube and clutch are raised again. The levers h' at the same time cause the jaws to grip the carbon and the arc is reëstablished. In order to prevent any undue friction in the operation of the clutch device, which should be as delicate in operation as possible, a roller-bearing h^8, Fig. 9, may be provided in the ends of the end lever. Instead of making the levers h' to engage the jaws h^5 directly additional levers h^9, Figs. 10 and 11, may be employed. These additional levers are pivoted in the frame h^4, and each lever h^9 is provided with projections h^{10}, which bear against an abutting surface h^{11} on the levers h', thereby permitting the levers h^9 to have only a slight swiveling movement around their pivots. This construction of the clutch-operating mechanism renders the operation of the jaws more delicate, and there is less liability that the carbon will be released from its frictional engagement with said jaws. A spiral spring h^{12} may also be provided between the carrier h and the frame h^4 to prevent the jaws from loosening their grip on the carbon when the lamp is jarred or otherwise disturbed.

In Fig. 3 a modification of the feeding device is illustrated, which modification consists in the addition of a spiral spring i to assist the magnet f, or, in other words, to partially sustain the feeding-tube and its attachments when the lamp is run on a circuit of low potential. When this spring is used, it is preferable to employ an outer tube or sleeve i', which is fitted over the feeding-tube, and to mount the main core f' and clutch upon this outer tubing. The use of the outer tube or sleeve i', within which the feeding-tube f^3 has a slight relative longitudinal movement, is advantageous as a centering device for said feeding-tube, and hence may be used without the spring i. A nut i^2, having pins i^3 engaging slots i^4, is threaded upon the outer

tube i', or, as is shown in Fig. 3, on tube i^6, which tube is secured around tube i'. The lower end of the spring may be fixed in the core f^4, and its upper end may engage the nut i^2. To adjust the spring with reference to its carrying power, the tube i' is rotated to compress or release the spring, and a thumb-screw i^5 is provided and engages the slot f^2 in the main core f' to hold the tube i' from turning, and by withdrawing this screw the outer sleeve i' may be turned to screw said sleeve into the nut i^2, thereby compressing said spring until it possesses the required energy.

Mounted within the upper part a' of the frame and secured thereto in any desired manner is a resistance-coil j, wound on a hollow cylinder of insulating material, said cylinder having a longitudinal slot j' extending the whole length of its surface. The winding may be accomplished by providing a spiral groove extending over the entire periphery or curved surface of the cylinder and winding the resistance-wire around the cylinder in said groove. A plug j^2 is provided to be inserted in said groove between any two consecutive convolutions of said wire to electrically connect said convolutions through said plug, and thus cut out from the resistance as many convolutions of wire as there are plugs inserted.

The lamp is also provided with a hand-switch having a sleeve k' mounted upon the upper part a' of the frame. Attached to said sleeve k' is an operating-lever k^2, carrying a contact-plate k^3. In order to maintain said switch secure in any desired position, a spring k^4 is provided, which rests on the top plate of the resistance j and through a collar k^5 presses against the sleeve k' of the switch, and thus holds it from any movement which might be imparted to it through jarring or other disturbance. A cap or cover l is provided to protect the top of the lamp, and through said cover the inleading and outleading binding-posts m and m' project and are insulated therefrom. The binding-posts are secured to a plate m^2, from which they are also insulated, said plate being secured to the collar k^5. A secondary binding-post m^3 is provided in and insulated from the plate m^2, this secondary binding-post being at one end of the lamp-circuit, while the inleading binding-port is at the other end of the lamp-circuit. The contact-plate k^3 on the operating-lever k^2 of the switch is adapted to electrically connect and disconnect the secondary binding-post m^3 with the inleading binding-post m, and the secondary binding-post is always electrically connected in any suitable manner with the outleading binding-post m'.

At the uppermost part of the lamp a thimble n is screwed or otherwise secured to the frame of the lamp. Said thimble is provided with a suspender or hanger comprising a button n', secured within the thimble by a rod or pin n^2. Beneath said button is a ventilating-flue n^3, having a cap or cover n^4, provided with recesses n^5 for the circulation of air, which is thus permitted to flow in and around the lamp-frame, the latter being considerably heated by the arc. The cap n^4 protects the interior of the lamp from dust particles and other foreign matter. A casing o is provided to inclose the frame of the lamp, and said casing may be of any design and may form any number of chambers around said frame for purposes of ventilation or covenience in construction.

When the lamp is in operation, the current enters the inleading binding-post m and passes through an insulated wire p to the magnet f, thence to braces or supports p', which connect the ring e^6 with the lower plate of the magnet. From the ring e^6 the current passes through the tube e^4 and ring e^3 to the sectional rings e, as hereinbefore described, and to the upper carbon. Returning the circuit passes from the lower carbon to the carbon-holder a^6 through bracket a^5 and rods a^4 to the frame a^2. From the frame a^2 the current passes through wire p^2 to the resistance j and thence to the secondary binding-post m^3 and through the switch to the outleading binding-post m'. As the current is turned on the magnet becomes energized and the upper carbon, which in its position of rest is supported on the lower carbon, is suddenly gripped by the clutch and is raised to form the arc. The resting position of the clutch mechanism is shown in Fig. 6, and after this mechanism has been raised and the jaws are in engagement with the carbon the feeding-tube f^3 gradually moves downward, such downward movement being restricted by the dash-pot g, as the port g^4 is closed during said downward movement by the valve-head g^6. As soon as the clutch-frame h^4 reaches the stop-nut e^6 in the downward movement of the feeding-tube the jaws h^5 release the carbon, which drops a very short distance and is again seized by the jaws and carried upward on account of the increasing power of the magnet as the carbons are brought together. This upward movement of the feeding-tube, however, is very slight, and the frame h^4 almost immediately strikes the stop e^6 again, and the operation is repeated until the carbon is exhausted. This slight upward movement of the feeding-tube and its attachments, as has been stated before, does not cause the valve-head g^7 in the dash-pot to close the port g^4, but only slightly raises the valve to permit the air in the upper part of the dash-pot to pass out.

To trim the lamp, the outer globe b and the inner globe c are removed, as hereinbefore described, by loosening the nut a^{12} and withdrawing the locking-rod a^9 from carbon-holder a^6. The lower carbon is held in said carbon-holder by a thumb-screw a^{13} and said carbon is readily adjusted. The upper carbon, which rests on the lower carbon, drops out as soon

as the lower carbon is removed, and a new carbon is easily inserted in the feeding-tube and is allowed to rest upon the lower carbon. In the interval between the changing of the carbons it is often desirable to remove soot and dust which collect in the inner globe from the consumption of the carbons, and this is easily effected without removing either the inner or the outer globe by introducing a current of air into the inner globe. To accomplish this, two openings a^{14} are provided in the lower casting a^3, which are ordinarily closed by cap-nuts a^{15}, screwed into said casting. By removing both of these cap-nuts and screwing in one opening an ordinary air-pump air may be injected through that opening to discharge soot or dust through the other opening. In order to close the openings d^4 from the carbon-chamber to the gas-check while air is being injected into the carbon-chamber, as above described, an aluminium plate d^6 is provided in the upper part of the carbon-chamber. Said plate has studs d^9, which extend through openings d^4, and these studs have enlarged heads d^8 to support said plate. The studs d^9 are smaller than the openings d^4, and their heads d^8 are recessed to permit the passage of the gases to the gas-check when the lamp is in operation. The force of the air which is pumped into the carbon-chamber is sufficient to cause the plate to be lifted and close the openings d^4.

I claim as my invention—

1. In an inclosed-arc lamp, a gas-check comprising a sinuous conduit for the air and gases, said conduit comprising a series of ducts leading upward, and a series of ducts leading downward through which the air and gases are adapted to circulate.

2. A gas-check for an inclosed-arc lamp, comprising a chamber for heating the inflowing air, a second chamber communicating with the first-named chamber and with the carbon-chamber for mixing the heated air and gases with the inflowing air, and partitions in the second chamber arranged to form substantially vertical conduits for the air and gases.

3. In an arc lamp, the combination of an inclosed carbon-chamber, a second chamber above said carbon-chamber and provided with substantially vertical conduits for air and gases said conduits communicating with the carbon-chamber, and a third chamber above the second-named chamber and communicating with said conduits and with the outer air.

4. The combination of an inclosed carbon-chamber, a second chamber above said carbon-chamber provided with conduits for inflowing air and outflowing gases arranged substantially vertically, said conduits communicating with the carbon-chamber, and a third chamber above the second-named chamber and communicating with said conduits and with the outer air.

5. In an inclosed-arc lamp, a sectional ring having a tapered upper surface and through which the carbon is to be fed into the carbon-chamber, a spring about the periphery of the ring to hold the sections of said ring closely against the carbon, and a second sectional ring fitted upon said tapered surface.

6. In an arc-lamp, the combination with a globe forming an inclosed chamber for the carbons, of a support for said globe having two openings whereby air may be injected through one opening into the said chamber to remove soot through the other, and means to keep the openings normally closed.

7. In an arc-lamp, the combination of a globe forming an inclosed carbon-chamber and having an outlet to permit the outflow of gases, a support for said globe having two openings whereby air may be injected through one opening into said chamber to discharge soot through the other, and means to close said outlet when air is injected into the chamber.

8. In an arc-lamp, the combination of a globe forming an inclosed carbon-chamber and having an outlet to permit the outflow of gases, a support for said globe having two openings whereby air may be injected through one opening into said chamber to discharge soot through the other, and a movable plate adapted to close said outlet when air is injected into the chamber.

9. In an arc-lamp, a feeding device comprising a magnet fixed in the frame of the lamp, a tube within which the carbon is adapted to be fed, a core mounted on said tube, a device carried by said tube to engage the carbon, and means operatively connected with said second tube to partially sustain the weight of said tube and carbon.

10. In an arc-lamp, a feeding device comprising a magnet fixed in the frame of the lamp, a tube within which the carbon is adapted to be fed, a core mounted on said tube, a device carried by said tube to engage the carbon, and a spring one end of which is fixed and the other end of which operatively engages said second tube and is thereby adapted to partially sustain the weight of said tube and carbon.

11. In an arc-lamp, a feeding device comprising a magnet fixed in the frame of the lamp, a tube within which the carbon is adapted to be fed, a core mounted on said tube, a device carried by said tube to engage the carbon, a spring one end of which is fixed and the other end of which operatively engages said second tube and is thereby adapted to partially sustain the weight of said tube and carbon, and means to adjust said spring.

12. In an arc-lamp, a feeding device comprising a magnet fixed in the frame of the lamp, a tube within which the carbon is adapted to be fed, a core mounted on said tube, a device carried by said tube to engage the carbon, a spiral spring surrounding said tube

one end of said spring being fixed, and a collar secured to said tube and which the upper end of said spring operatively engages.

13. In an arc-lamp, a feeding device comprising a magnet fixed in the frame of the lamp, a tube within which the carbon is adapted to be fed, a core mounted on said tube, a device carried by said tube to engage the carbon, a spiral spring surrounding said tube one end of said spring being fixed, and a collar screw-threaded upon said tube and which said spring operatively engages, said tube being adapted to be screwed into said collar to compress said spring.

14. In an arc-lamp, a feeding device comprising a magnet fixed in the frame of the lamp, a feeding-tube capable of longitudinal movement within which the carbon is adapted to be fed, a second tube surrounding the feeding-tube, a core mounted on said second tube, a device carried by said second tube to engage the carbon and means to partially sustain the weight of said second tube and its attachments.

15. In an arc-lamp, a feeding device comprising a magnet fixed in the frame of the lamp, a feeding-tube capable of longitudinal movement within which the carbon is adapted to be fed, a second tube surrounding the feeding-tube, a core mounted on said second tube, a device carried by said second tube to engage the carbon, and a spring adapted to partially sustain the weight of said second tube and its attachments.

16. In an arc-lamp, a feeding device comprising a magnet fixed in the frame of the lamp, a feeding-tube capable of longitudinal movement within which the carbon is adapted to be fed, a second tube surrounding the feeding-tube, a core mounted on said second tube, a device carried by said second tube to engage the carbon, a spring adapted to partially sustain the weight of said second tube and its attachments, and means to adjust said spring.

17. In an arc-lamp, a feeding device comprising a magnet fixed in the frame of the lamp, a feeding-tube capable of longitudinal movement within which the carbon is adapted to be fed, a second tube surrounding the feeding-tube, a core mounted on said second tube, a device carried by said second tube to engage the carbon, a spiral spring surrounding said second tube one end of said spring being fixed, and a collar secured to said second tube and which the upper end of said spring operatively engages.

18. In an arc-lamp, a feeding device comprising a magnet fixed in the frame of the lamp, a feeding-tube capable of longitudinal movement within which the carbon is adapted to be fed, a second tube surrounding the feeding-tube, a core mounted on said second tube, and a device carried by said second tube to engage the carbon.

19. In an electric-arc lamp, the combination with a magnet and armature, of a clutch carried by said armature and comprising a carrier, jaws for engagement with the carbon, a frame in which said jaws are mounted, levers operatively connected with said jaws and supporting the frame, said levers having loose engagement with said carrier, a stop for engagement with said frame, and a spring in operative relation with said frame and carrier.

20. In an electric-arc lamp, the combination with a magnet and armature, of a clutch carried by said armature and comprising a carrier, jaws for engagement with the carbon, a frame in which the jaws are mounted, obliquely-slotted levers operatively connected with said jaws and supporting the frame, pins secured to said carrier and which are engaged by the slots on said levers, and a stop for engagement with said frame.

21. In an electric-arc lamp, the combination with a magnet and armature, of a clutch carried by said armature and comprising a carrier, jaws for engaging with the carbon, a frame in which the jaws are mounted, levers operatively connected with said jaws, a second set of levers operatively engaging the first-named levers and supporting the frame, said second set of levers having loose engagement with said carrier, and a stop for engagement with said frame.

22. In an electric-arc lamp, a resistance-coil, comprising an insulating-cylinder, having a longitudinal slot in the surface thereof, a spiral groove in the periphery of said cylinder, a resistance-wire wound in said groove, and a plug adapted to be inserted in said groove between consecutive convolutions of said coil.

23. In an arc-lamp, the combination with an inleading and an outleading binding-post, of an electric switch comprising a sleeve on the lamp-frame, a lever secured to said sleeve, a contact-plate secured to said lever, and a secondary binding-post at one end of the lamp-circuit the other end of said circuit being connected with the inleading binding-post, said contact-plate being adapted to electrically connect and disconnect the secondary and outleading binding-posts.

24. In an arc-lamp, the combination with an inleading and an outleading binding-post, of an electric switch comprising a sleeve on the lamp-frame, a lever secured to said sleeve, a contact-plate secured to said lever, a secondary binding-post at one end of the lamp-circuit the other end of said circuit being connected with the inleading binding-post, said contact-plate being adapted to electrically connect and disconnect the secondary and outleading binding-posts and a spring in operative relation with said lever to guard the same from accidental movement.

25. In an electric-arc lamp, the combination of a feeding-tube, a magnet, an armature or core for said magnet mounted on said tube, a device carried by said tube for engaging the carbon, and a dash-pot, said dash-pot having

a port and a double-headed valve-stem to open and close said port.

26. In an electric-arc lamp, the combination with the feeding device of a dash-pot having a port, a valve-stem in said port, a head on one end of said valve-stem and adapted to permit the egress and prevent the ingress of air to and from said dash-pot, and a head on the other end of said valve-stem and adapted to permit the ingress and prevent the forcible egress of air to and from said dash-pot.

This specification signed and witnessed this 18th day of February, A D. 1902.

ALFRED WITTE.

In presence of—
ANTHONY N. JESBERA,
JOHN M. SCOBLE.