(No Model.) 2 Sheets—Sheet 1.

F. W. STEINACKER & E. F. COWLEY.

ELECTRIC ARC LAMP.

No. 604,219. Patented May 17, 1898.

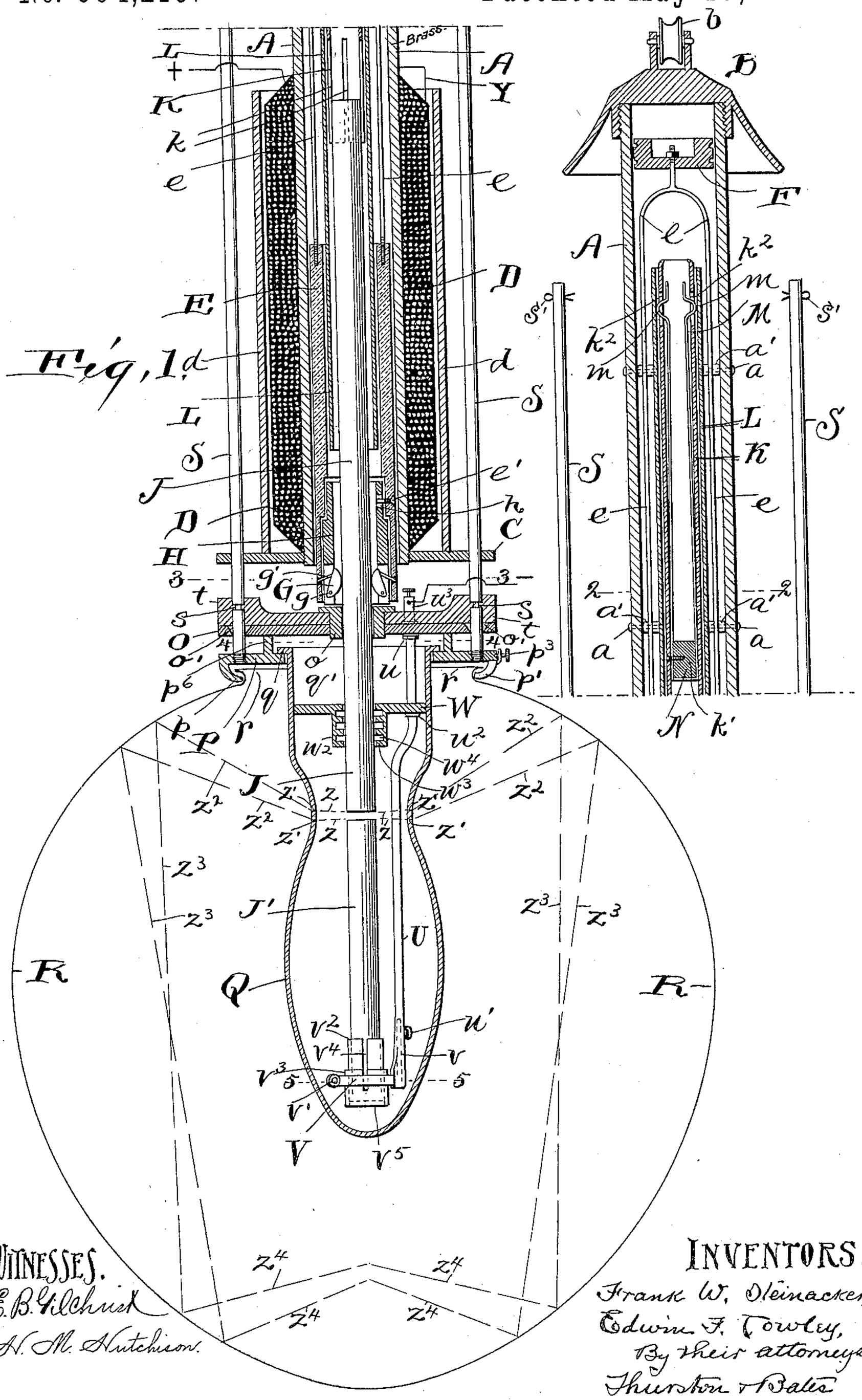

Fig. 1.

WITNESSES.
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(No Model.) 2 Sheets—Sheet 2.

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ELECTRIC ARC LAMP

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Fig. 3.

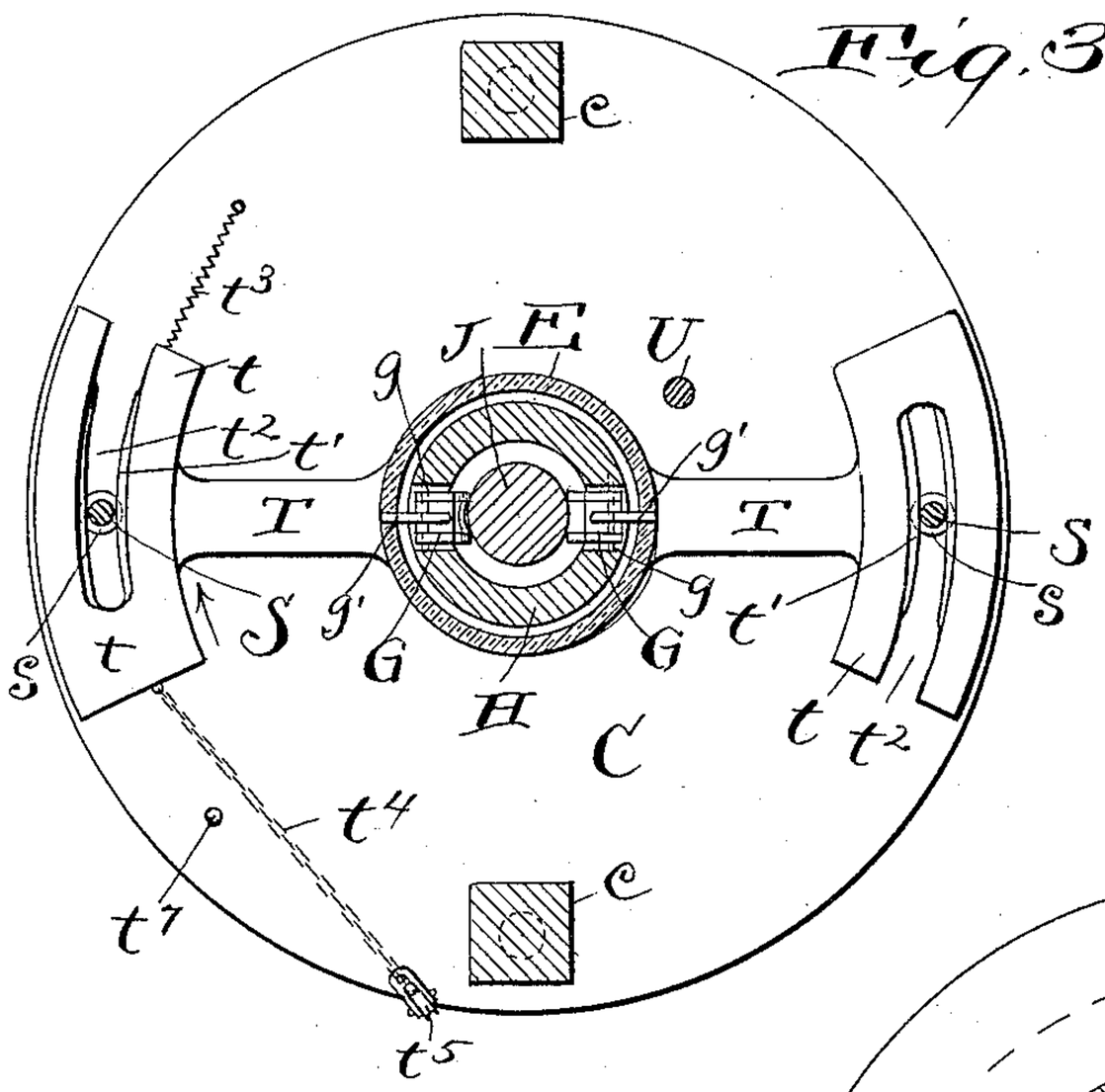


Fig. 2.

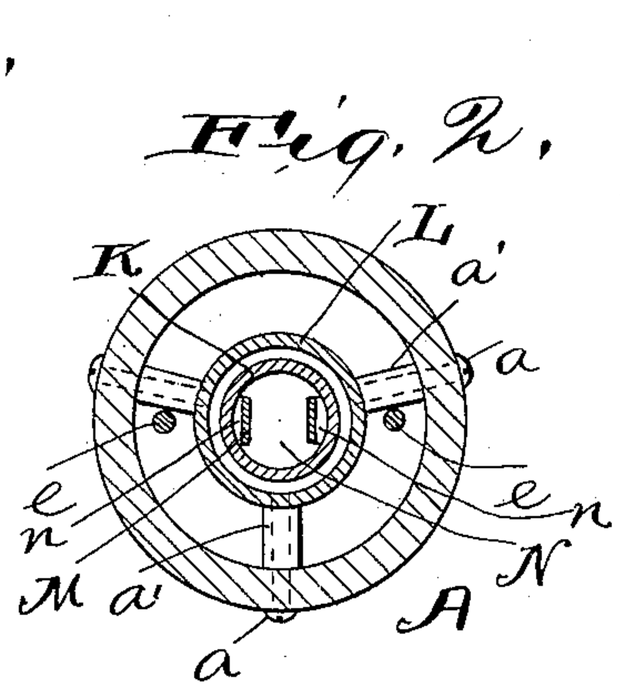


Fig. 4.

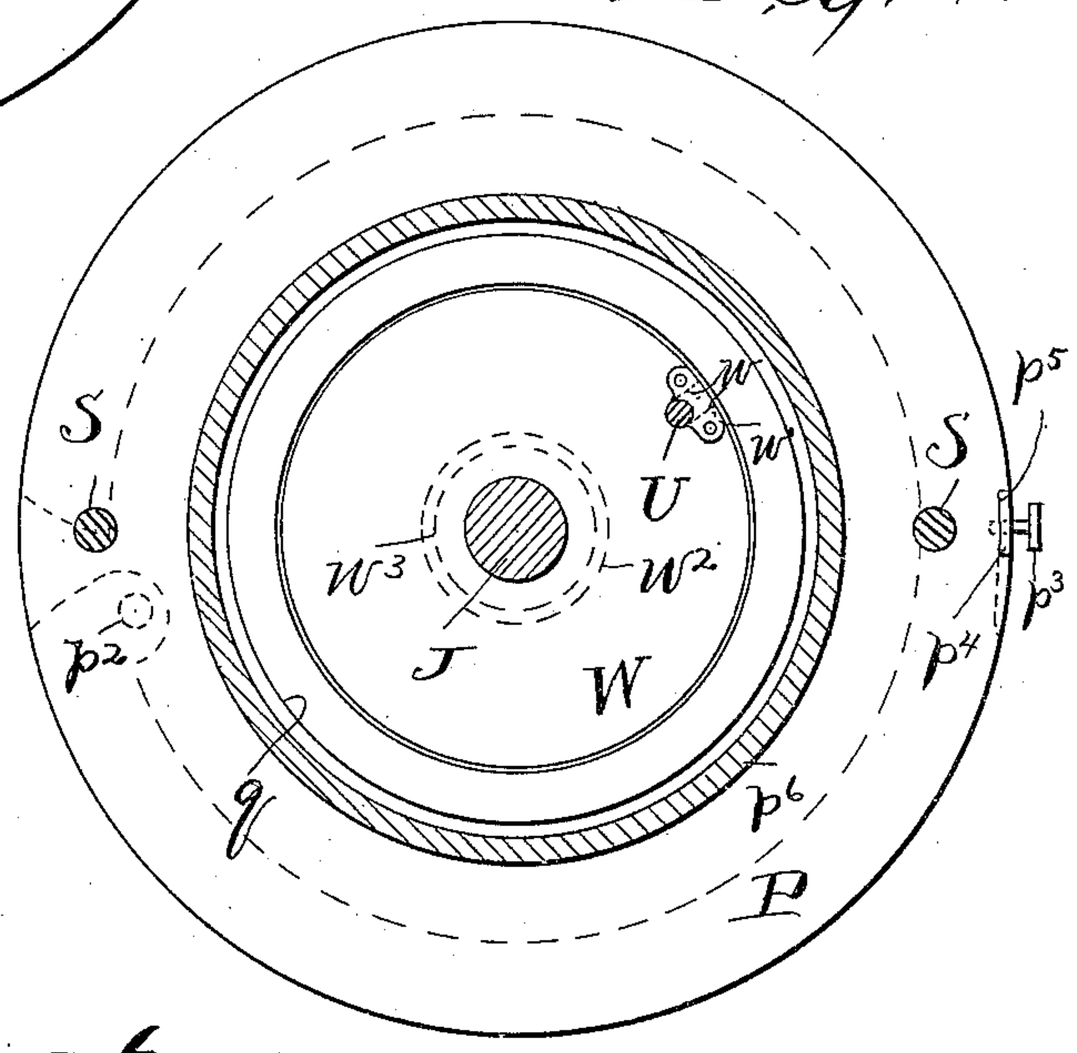


Fig. 5.

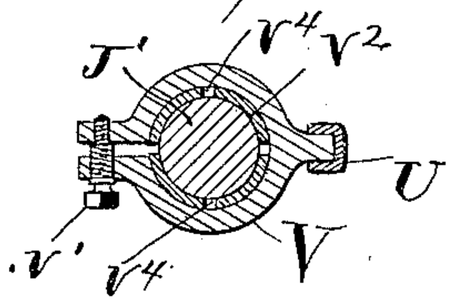


Fig. 7.

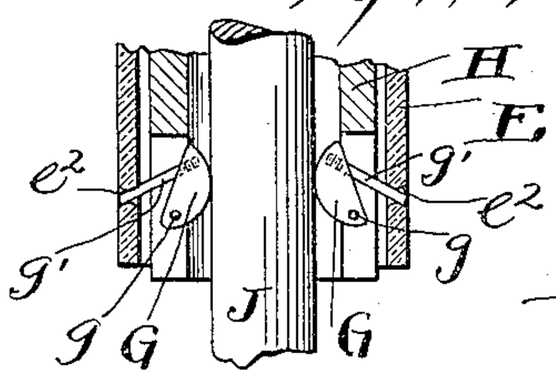
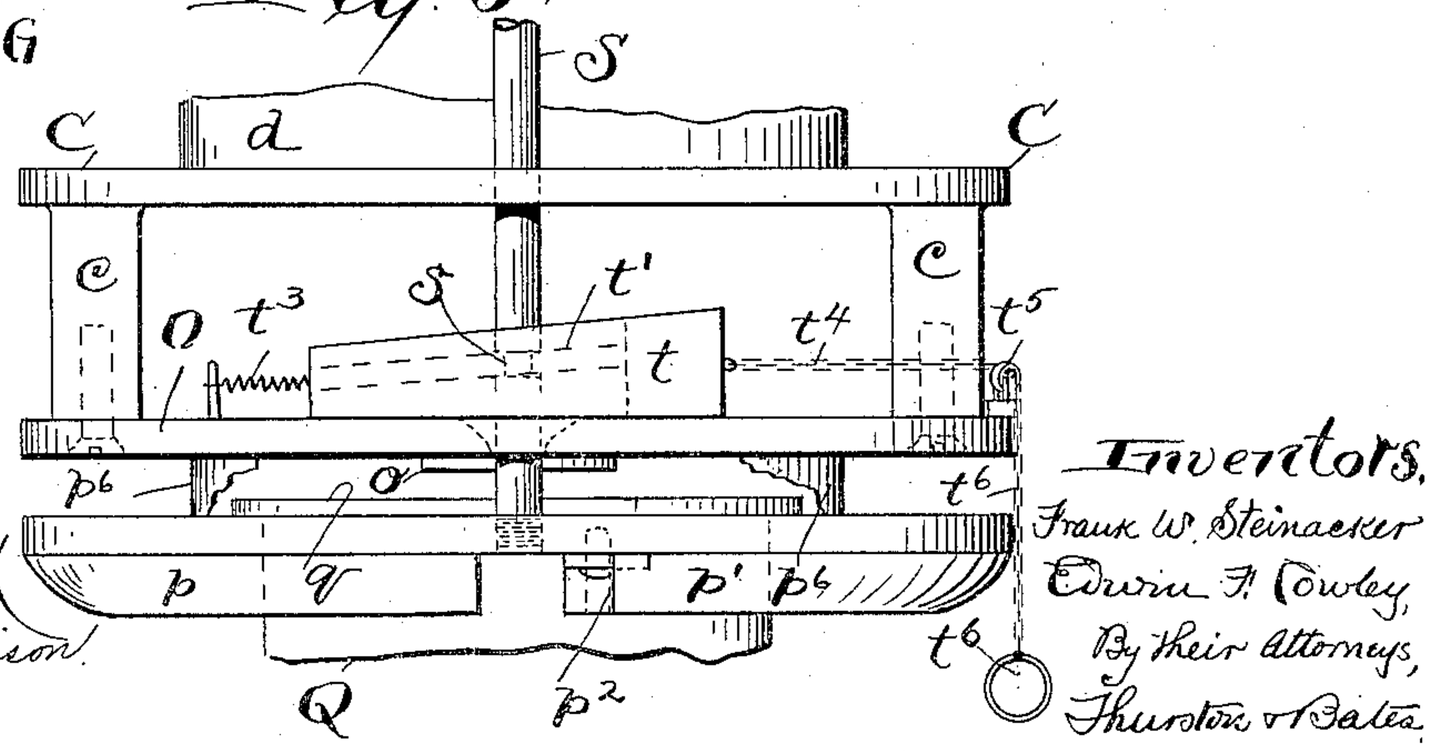


Fig. 6.



Witnesses.
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Inventors.
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By their Attorneys,
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UNITED STATES PATENT OFFICE.

FRANK W. STEINACKER AND EDWIN F. COWLEY, OF CLEVELAND, OHIO.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 604,219, dated May 17, 1898.

Application filed April 12, 1897. Serial No. 631,822. (No model.)

To all whom it may concern:

Be it known that we, FRANK W. STEINACKER and EDWIN F. COWLEY, citizens of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Electric-Arc Lamps; and we 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.

Our invention is for an arc-lamp, and is especially designed for a lamp of the incandescent arc type adapted for use on a constant-potential or incandescent-lamp circuit.

Our objects are to supply such a lamp which may be cheaply constructed and efficiently operated, which shall be compact and the length heretofore consequent upon the use of the ordinary carbon-rod materially reduced, which shall be conveniently accessible for replacing carbons and cleaning, which shall efficiently maintain the partial vacuum formed about the burning carbons, and in which the light reflections shall be concentrated at desirable points, and thus increase the luminosity.

Our invention consists in the various combinations of parts for accomplishing these objects and perhaps incidentally others, as hereinafter specified, and definitely enumerated in the claims; but we do not wish to be understood as limiting ourselves to the specific form shown, as various modifications and equivalents for many of the parts will readily suggest themselves to one acquainted with this art.

The drawings show the best embodiment of our invention at present known to us.

Figure 1 is a vertical central section of our improved lamp, the detached portion on the right showing the upper part of the lamp and being a continuation of the left-hand portion. Figs. 2, 3, 4, and 5 are horizontal sections, looking downward, ont he lines 2 2, 3 3, 4 4, and 5 5, respectively, of Fig. 1. Fig. 6 is an elevation of a portion of the lamp just above the globes looking from a position at right angles to that from which Fig. 1 is taken. Fig. 7 is a vertical central section showing the clutch and its attendant parts, being an enlarged view of these elements as shown in Fig. 1. Figs. 2 to 7, inclusive, are on the same scale, which is nearly twice the scale of Fig. 1.

Like letters of reference designate like parts in the several figures.

Referring to the parts by letters, A represents a tube, preferably made of brass, which incloses the upper-carbon holder and a portion of the upper carbon and may be said to constitute the main frame of the lamp. Screwed onto the upper end of this tube is the cap or bell B, by which the lamp is supported. A pulley *b* is preferably carried on the top of this bell. To the lower end of the tube A is secured by screw-threads the plate C.

Around the tube A and above the plate C are wound wires constituting the solenoid D. A tube *d* preferably surrounds and protects the solenoid. In the interior of the tube A is the sleeve E, made of iron or soft steel, which constitutes the armature of the solenoid. The lower end of this sleeve operates the clutch for gripping the upper carbon, while from the upper end of the sleeve extend the rods *e*, which are secured to a piston-head F, which, with the tube A and the cap B, forms a dash-pot and prevents sudden movement of the said sleeve E. The clutch referred to is shown in Figs. 1, 2, and 7, and consists of two clutch members G, which have curved surfaces and are pivoted eccentrically at *g* to a sleeve H. This sleeve H, which we call the "clutch-sleeve," surrounds the upper carbon (designated J) and stands in the interior of the armature-sleeve E. A screw *e'* projects from the said armature-sleeve into a slot *h* in the said clutch-sleeve, whereby the latter is allowed a limited movement independent of the armature-sleeve, but may be compelled to move with it. Extending outward from the clutch members are the pins *g'*, which project into holes e^2 in the armature-sleeve. If now the armature-sleeve is raised, the pins *g'* tip the clutch members inward, and thus cause the clutch to grip the carbon. As soon as this takes place, any further upward movement of the sleeve E carries the sleeve H and the carbon with it.

The upper carbon J is clamped at its upper end by the cylindrical tube K, which telescopes into the tube L. The lower end of the

tube K is split by means of the slots *k*, whereby it securely grasps the carbon. Good electrical contact between the tubes K and L is insured by means of the contact-spring M, which is formed in approximately the U shape shown, and is secured to the tube K at the base of the U by means of the screw *k'*, which screws through the said tube K, the spring M, and into a weight N, which is provided, as shown, to insure the descension of the upper carbon. The spring M is flat in cross-section and notches *n* are formed in the cylindrical walls of the weight to accommodate it. Near the upper end of the spring M are formed the bends *m*, which project through slots k^2 in the tube K, and thus contact with the tube L. The contacting surface of the bends may be rounded to insure a good electrical connection.

It is thus apparent that whatever be the position of the inner tube K with reference to the outer tube L, forming the telescopes, the two will always be electrically connected together. The tubes K and L are preferably each made of brass and are of such size that one just slides easily within the other. The tube L is held rigidly in place by means of screw-bolts *a*, which screw through the tube A into the tube L, and are surrounded between said tubes by the spools *a'*, which prevent independent movement of the two tubes.

Depending from the lower side of the plate C are the studs *c*, to the lower ends of which is secured by screws the plate O. This plate has through its center a hole considerably larger than the cross-section of the carbon, and into this hole is screwed the thimble *o*, which closely surrounds the carbon, but does not contact with it. The upper surface of this thimble forms a stop, against which the clutch-sleeve continues to rest after the current has started until the rising of the armature causes the clutch members to grip the carbon.

Beneath the plate O is a plate P, which carries two lamp-globes. The inner globe Q projects through a central hole in this plate P and is supported by the flange *q*, which projects over the top of said plate P. The outer globe R is carried by means of the flanges *p* *p'*, extending downward and inward from the edge of said plate P, which flanges project into the groove formed by the flange *r* at the upper edge of the globe. The flange *p* is rigid with the plate P, being preferably formed integral therewith, while the flange *p'* is movable with reference to the plate P. This flange *p'* is pivoted to said plate by the pivot p^2, formed at one end of the flange, and is secured to the plate P at the other end by the thumb-screw p^3, which screws through an upwardly-extending lip p^4, formed on said flange, into the plate P. A notch p^5 is formed in the edge of the plate P at the place where this lip p^4 comes, so that the latter may enter it and have its outside flush with the periphery of the plate, whereby a neat appearance is obtained and whereby the thumb-screw p^3 is always brought in proper position to engage the threaded hole in the plate P. A cylindrical flange p^6, formed on the upper side of the plate P, surrounds and protects the flange *q* of the inner globe and also acts as a stop, limiting the upward movement of the plate P by contacting with the lower surface of the plate O. When this flange p^6 is in such contact, the open end of the globe Q is completely boxed in, except at the opening between the carbon J and the thimble *o*.

The plate P is held in its upward position by the rods S, which are screwed into it at their lower ends and extend upward through the plates O and C. Notches *s* are formed in these rods S, and ribs *t'*, formed on the walls of a pair of forked blocks *t* above the plate O, take into these notches and prevent the rods descending. These forked blocks are formed as shown in Figs. 1, 2, and 6, and are the heads of a lever T, pivoted at its center about the thimble *o*. The notches t^2, which cause the forks in the blocks *t*, extend from one end of those blocks in a circumferential direction well toward the other end and are of a width just a trifle greater than the diameter of the rods S. The ribs *t'* extend diagonally upward and also taper inward, whereby when the lever T swings about its pivot in the direction indicated by the arrow in Fig. 3 the rods S, and with them the plate P and the globes, are drawn upward until the flange p^6 contacts with the bottom of the plate O. A spring t^3, secured to the lever T at some convenient point, holds it in this engaging position. If the lever T is swung about its pivot in the opposite direction, a portion of the notch where the tapering ribs merge with the walls of the notch and where the distance between the ribs is hence as great as the diameter of the rod S comes opposite that rod, and then the said rods descend and with them the parts carried thereby. In order that the notches *s* may be effectually prevented from catching on the plate O, we make the holes *o'* in the plate O, through which these rods pass, tapered, as shown, and we also for this reason cause the lever T to release its hold on the rods before coming out of actual contact with those rods, so that the sides of the notches t^2 guide the rods S in their descent and prevent their catching.

For the easy operation of the lever T we provide a chain or cord t^4, running over a pulley t^5 and having a depending end t^6. If the end t^6 of this cord is pulled, each block *t* is caused to swing about the pivot *o* until the notches of the rod S are released, when those rods and the globes descend. A pin t^7, projecting upward from the plate O or other satisfactory means, limits the movement of the lever T. When these blocks *t* have thus become disengaged from the notches *s*, both globes descend until the pins *s'*, projecting through the upper ends of the rods S, contact with the upper surface of the plate C. When the outer

globe is shoved upward, the rods are shoved also, and as soon as the notches *s* come opposite the ribs *t'* the blocks *t*, which have been bearing against the sides of the rods S, swing around under the action of the spring t^3 and the ribs *t'* automatically enter and travel in the notches *s*, and thus lock the globes tightly in their elevated position.

The lower carbon J' is supported in suitable relation to the upper carbon by the rod U, which passes through an insulating-bushing *u* in the plate O, and is held to that bushing and therefore to the plate O by nuts above and below the bushing. In the lower end of this rod U is a recess into which an upwardly-extending tongue *v* of the lower-carbon clamp V takes. A thumb-screw *u'* locks this tongue *v* to the rod U. The carbon-clamp V consists of the split yoke shown, the thumb-screw *v'*, and the thimble v^2. This thimble is split by the slots v^4 in several places from its upper end well toward its lower and surrounds and clasps the lower end of the carbon. Formed on its outer cylindrical surface is the horizontal flange v^3, intercepted by the slots v^4. The yoke surrounds the lower part of the thimble and the flange prevents its descending. Projecting from the lower side of the yoke is the cylindrical flange v^3, which forms a guide for the thimble. The yoke and flange being split, as shown, at the end opposite the tongue *v* may be caused to grasp the thimble and carbon with more or less tightness by means of the thumb-screw *v'*, which connects these split ends. This thumb-screw is made in the form of a right and left hand screw, so that by turning in one direction it will cause the clamp to compress the thimble, and thereby tightly clamp the carbon in place, while by turning it in the other direction the clamp is loosened, the heat from the lamp taking the temper out of a spring-yoke should it be attempted to use such.

As has been stated, the lamp shown is of the incandescent-arc type. The inner globe Q and the flange p^6 and plate O very materially confine the air about the carbons, and the heat from the carbons expands that air and drives it out of the globe through the passage between the thimble *o* and the carbon and produces a very considerable vacuum. As a protection against return of the expanded air we provide a head W, which closely fits within the globe Q and loosely surrounds the upper carbon. Thus a passage is left between the said head and the carbon by which the air may travel out as it becomes heated, while the return of the air around the surface of the globe, which is cooler, is prevented by the head W. This head is supported by the lower-carbon rod U, which passes through a notch *w* in said head, the remaining portion of which notch is afterward filled by the block *w'*. A flange u^2, formed on the rod U, prevents the head W from descending. Around the central hole through this head the head is extended in the form of a sleeve w^2, which has inwardly-projecting annular flanges w^3, which flanges thus leave chambers w^4 between them. These chambers w^4 form an air-packing, which prevents the rapid return of air from the outside when the heat of the arc decreases. The air coming in between the upper part of the head and the rod would expand when it reached the first chamber, and hence only a portion of this air would pass beyond the next flange. This portion would likewise expand, and only a portion of it would pass into the next chamber, and so on, the result being that when the heat of the arc diminishes time is allowed for it to regain its normal strength before the air can pass from outside into the inner globe Q. It will be noticed that this head W is not at the upper end of the globe, but stands some distance lower down in the globe, and thus a chamber *q'* is provided at the upper end of the globe. This chamber is filled with air which has become heated by the head W below it, and it also operates to retard a return of the outside air.

The current comes into the lamp from some conveniently-located binding-post and passes along the conductor marked + to the solenoid. After passing through the solenoid it goes to the outer tube A, the conductor for that purpose being indicated at Y. From the tube A the current passes through the pins *a* and spools *a'* to the outer tube L, and from thence to the inner tube K, which conducts it to the upper carbon. From the lower carbon the circuit continues via the rod U to the binding-post u^3, formed at the upper end of this rod. From u^3 a suitable conductor (indicated by the minus sign) conducts the current to the other outside binding-post.

In operation before the current is turned on the upper carbon stands in contact with the lower carbon and sleeves E and H rest on the thimble *o*. When the current is turned on, it energizes the solenoid, which lifts the sleeve E. This rises independently a short distance and then, by means of the pins *g'*, projecting from the clutch members G, causes the latter to engage the upper carbon J. When these clutch members have so engaged the carbon, any further upward movement of the armature E under the action of the current raises both the armature and the clutch-sleeve H, and thus draws up the upper carbon and separates it from the lower, thereby forming an arc between them. As the carbons burn away the resistance of the arc becomes greater, and the current's strength through the solenoid is thereby decreased. This decrease of the current's strength weakens the action of the solenoid and allows the armature to descend, bringing the upper carbon down. When the carbon has burned away enough so that the armature in descending causes the clutch-sleeve H to contact with the thimble *o*, the clutch members release their hold slightly and the carbon descends. If this descent should be more than required, the solenoid is immediately strengthened, and its armature

raises the upper carbon to the proper elevation.

When it is desired to replace the carbons by fresh ones, the two globes are lowered by pulling on the end t^6 of the cord t^4 and allowing the globes to descend out of the way. The lower carbon and its clamp are then removed and the upper carbon and its tube allowed to descend until the tube can be conveniently grasped by the hand and the old carbon removed and a new one inserted. The lower-carbon clamp is then replaced and a fresh carbon secured in it.

To clean the globes, the outer one may be removed downward when held at any position by turning out the thumb-screw p^3 and swinging the flange p' about its pivot and then slipping the flange r of the outer globe off of the flange p, while the removal of the inner globe is easily effected when the globes are lowered. Then the plate P is below the bottom of the lower-carbon holder a distance substantially equal to the length of the inner globe, and hence the inner globe may be easily shoved upward by the hand and removed from the upper side of the plate P.

It will be noticed that the main portion of the inner globe Q is not cylindrical, but from the bottom up it is first concave to the carbons and then convex to them. The purpose of this is that the rays of light, which do not flare much, but pass in approximately horizontal lines from the carbons, will not strike the globe perpendicularly to its surface, but at an angle, and hence will be refracted. This refraction causes the rays to strike the outer globe at such place that they will be concentrated at points directly beneath the inner globe and within the outer globe. In operation these refractions and reflections result in the production of one, two, or three balls of light below the globe Q, the number of balls depending upon the position of the carbons. Four of the rays are indicated by broken lines in Fig. 1. These rays are composed of the following portions: The portion Z from the carbons to the globe Q, the portion Z′ where the rays pass through the globe, the refracted portion Z^2 to the outer globe, and the reflected portions Z^3 and Z^4. All of the portions Z^4 of those rays which emanate from similar points of the arc meet at a point beneath the globe Q. This result is dependent upon the formation of the inner globe, which must continue up around the arc far enough to form a reflecting-surface. When the carbons are burned lower than the position shown in the drawings, the rays will strike the globe R at points farther down and will be reflected to the opposite side of the globe R and then back to points beneath the globe Q.

Having described our invention, we claim—

1. In an electric-arc lamp, a telescoping holder composed of an outer stationary tube, and an inner movable tube in contact therewith, said inner tube being adapted to hold the movable carbon, and being adapted to slide up and down within the stationary tube, and, while the lamp is burning, being adapted to have its upper portion in the lower portion of the outer tube, said outer tube thereby acting as an extension of the inner tube, substantially as described.

2. In an electric-arc lamp, a telescoping holder composed of a stationary tube and a movable tube slidable within the stationary tube and contacting with it and receiving current from it and connected with the movable carbon, said movable tube being adapted to descend so that the upper end thereof is below the upper end of said stationary tube, whereby said stationary tube lengthens said holder, substantially as described.

3. In an electric-arc lamp, in combination, a stationary tube, a clutch below the same, a movable tube adapted to stand within said stationary tube and adapted to project downward beyond said clutch while in engagement with said stationary tube, said movable tube contacting with said stationary tube and receiving current from it and a movable carbon carried by said movable tube, substantially as described.

4. In an electric-arc lamp, in combination, the solenoid D, the sleeve E constituting its armature, the sleeve H, substantially within said sleeve E, clutch members G pivoted to said sleeve H and having outward projections adapted to be engaged by said sleeve, substantially as described.

5. In an electric-arc lamp, in combination, the sleeve H, clutch members G pivoted to said sleeve and adapted to engage a carbon extending through said sleeve, the sleeve E having holes e^2, the pins g' projecting from said clutch members into said holes whereby movement of the sleeve E causes the clutch to assume engaging position, substantially as described.

6. In an electric-arc lamp, in combination, the sleeve H, clutch members G pivoted to said sleeve and adapted to engage a carbon extending through said sleeve, the sleeve E capable of movement independent of the sleeve H, means connecting said sleeve and clutch members whereby a movement of said sleeve causes the clutch members to assume engaging position, and a pin in one of said sleeves projecting into a slot in the other, whereby independent movement of the two sleeves is limited, substantially as described.

7. In an electric-arc lamp, in combination, the sleeve H, clutch members G pivoted to said sleeve and adapted to engage a carbon extending through said sleeve, the sleeve E capable of movement independent of the sleeve H, means connecting said sleeve and clutch members whereby a movement of said sleeve causes the clutch members to assume engaging position, and a stop limiting the absolute movement of both sleeves in the downward direction, substantially as described.

8. In an electric-arc lamp, in combination, a stationary plate, a pair of rods supporting

a globe and passing through said plate, shoulders on said rods and a latch movable horizontally but held against vertical movement, said latch being adapted to engage with the shoulders on the rods and thereby hold the globe in its elevated position and being adapted to be withdrawn from such engagement and thereby allow the globe to descend, substantially as described.

9. In an electric-arc lamp, in combination, the plate O, the pivoted lever T above said plate and having diametrically-opposed forked ends *t*, the rods S supporting a globe and passing through said plate O, there being formed notches in said rods into which the said forked ends are adapted to take, and means for turning said lever about its pivot and thereby releasing said rods S, substantially as described.

10. In an electric-arc lamp, in combination, the plate O, the pivoted lever T above said plate and having diametrically-opposed forked ends *t*, the rods S supporting a globe and passing through said plate O, there being formed notches in said rods into which the said forked ends are adapted to take, the spring t^3 forcing said forked ends in the direction to engage said notches, and the cord or chain t^4 furnishing means for withdrawing said ends from engagement with said notches, substantially as described.

11. In an electric-arc lamp, in combination, the rods S S supporting a globe, notches *s s* formed in said rods, a pair of latching members substantially immovable vertically but movable horizontally and adapted to take into said notches, and means for insuring a community of motion or rest between said two latching members, substantially as described.

12. In an electric-arc lamp, in combination, a pair of rods on either side of the upper carbon of the lamp, notches formed in said rods, a latch-lever T pivoted about an axis coincident with that of said carbon and having ends with circumferentially-disposed notches t^2 which are adapted to take around said rods, there being formed on the walls of said notches the ribs t' which incline outwardly as they approach the entrance to the notch whereby they release their hold on said rods before the latter are clear of the notches, substantially as described.

13. In an electric-arc lamp, in combination, a pair of rods on either side of the upper carbon of the lamp, notches formed in said rods, a latch-lever T pivoted about an axis coincident with that of said carbon and having ends with circumferentially-disposed notches t^2 which are adapted to take around said rods, there being formed on the walls of said notches the ribs t' which incline upwardly as they recede from the entrance to the notch, a stop limiting the upward movement of the rods at a point which causes the notches *s* to occupy a position intermediate of the position occupied by the lowest portion and the highest portion of said ribs, whereby the latch-lever is adapted to draw said rods tightly up to their highest position, substantially as described.

14. In an electric-arc lamp, in combination, the plate O, the thimble *o*, the lever T pivoted about said thimble and supported by said plate, the rods S S passing through said plate, forks on said lever adapted to take around said rods, there being notches in the rods and corresponding ribs on said forks, substantially as described.

15. In an electric-arc lamp, the plate P having a depending flange *p* and having a hole through its center, in combination with the outer globe R supported by said flange and the inner globe Q extending through said hole and having the outwardly-turned flange *q* by which it is supported, substantially as described.

16. In an incandescent arc electric lamp, an inner globe surrounding the arc and adapted to inclose a more or less perfect vacuum, and a relatively large outer globe, said globes being each closed at their lower ends and being supported only at their upper ends, in combination with means for simultaneously raising or lowering both globes, substantially as described.

17. In an electric-arc lamp, in combination, the stationary plate O, the plate P, supported by rods passing through said plate O, a hole through the center of the plate P, a lamp-globe Q extending through said hole and having a flange *q* which extends over onto the plate P and means for holding said two plates apart, substantially as described.

18. In an electric-arc lamp, in combination, the stationary plate O, the plate P having a hole through its center, the lamp-globe Q extending through said hole and having a flange *q* projecting over onto the upper surface of the plate P, and the flange p^6 on the upper surface of the plate P surrounding the said flange *q*, and adapted to contact with said plate O, substantially as described.

19. In an electric-arc lamp, the combination, with the plate P and means for holding the same in place, of the depending inwardly-extending pivoted flange p', said flange p' being pivoted at p^2 near one end, and having near the other end an upwardly-extending spring-lip p^4 adapted to take into a notch p^5 in the edge of said plate P and means for locking said lip to said plate and thereby holding the flange p' in place, substantially as described.

20. In an electric-arc lamp, in combination, the plate O supported by the frame of the lamp, the plate P supported beneath said plate O, the globe Q supported by said plate P, the rod U for supporting the lower carbon, said rod being supported by said plate O and a head W substantially closing the upper end of the globe Q, said rod U passing through said head, substantially as described.

21. In an electric-arc lamp, in combination, a lower-carbon holder consisting of a slotted thimble adapted to embrace the carbon, a

split yoke surrounding the thimble, a screw passing from one part of the yoke into the other and adapted to clamp the same about the thimble, a tongue extending upwardly from said yoke, and a depending rod having a recess in its lower end into which recess said tongue is adapted to take, and means for locking said tongue into said rod, substantially as described.

22. In an electric-arc lamp, an inner globe adapted to surround the carbons and from its bottom upward first concave to the carbons and then convex and then cylindrical and having an outwardly-turned flange at its upper end which flange extends laterally farther than any of the portions below it, in combination with a plate having a hole through it of a diameter greater than the external diameter of said cylindrical part and less than the external diameter of said flange, said plate supporting said globe at its upper end and allowing its withdrawal upward from said plate, substantially as described.

23. In an electric-arc lamp, the combination, with suitable carbon-holders adapted to hold a pair of carbons in proper juxtaposition, of an inner globe surrounding the arc produced between the carbons, and an outer globe surrounding the inner globe, said globes being supported only at their upper ends whereby there is no obstruction by their supports to the rays of light emanating from the arc, there being rods operating to support both of said globes and slidable through a portion of the lamp connected to the frame, and means for latching or releasing said rods whereby said two globes may be simultaneously raised or lowered, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

FRANK W. STEINACKER.
EDWIN F. COWLEY.

Witnesses:
E. L. THURSTON,
ALBERT H. BATES.