No. 636,875. Patented Nov. 14, 1899.

E. P. WARNER.

ELECTRIC ARC LAMP.

(Application filed Apr. 1, 1899.)

(No Model.) 4 Sheets—Sheet 1.

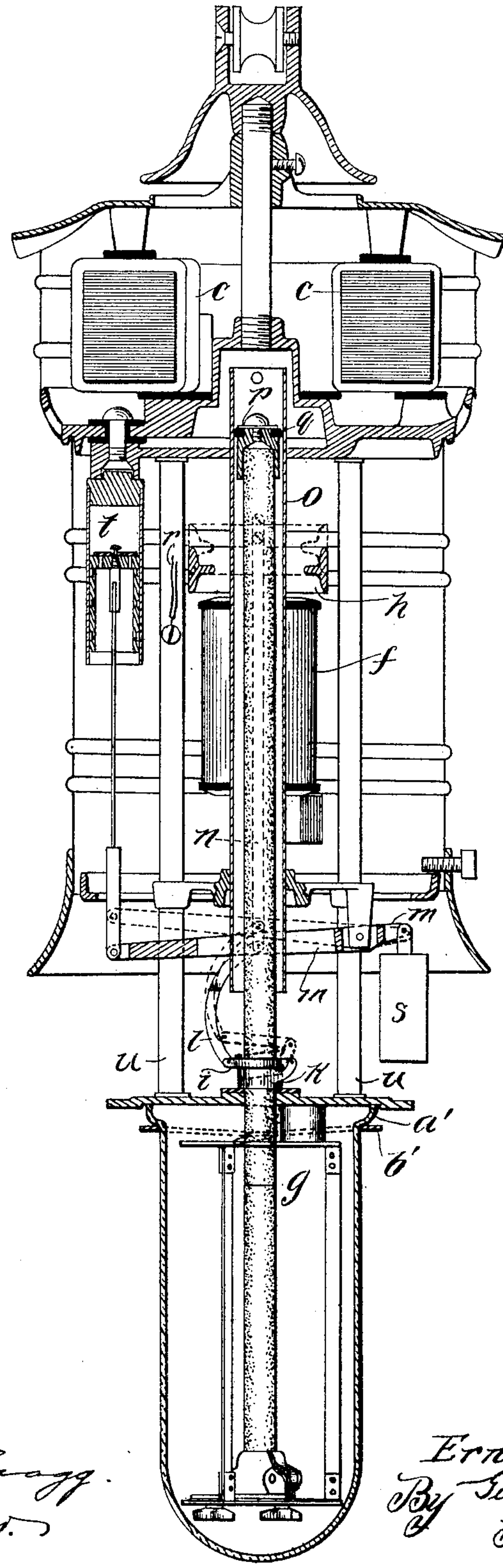

Fig. 1.

Witnesses:
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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4 Sheets—Sheet 2.

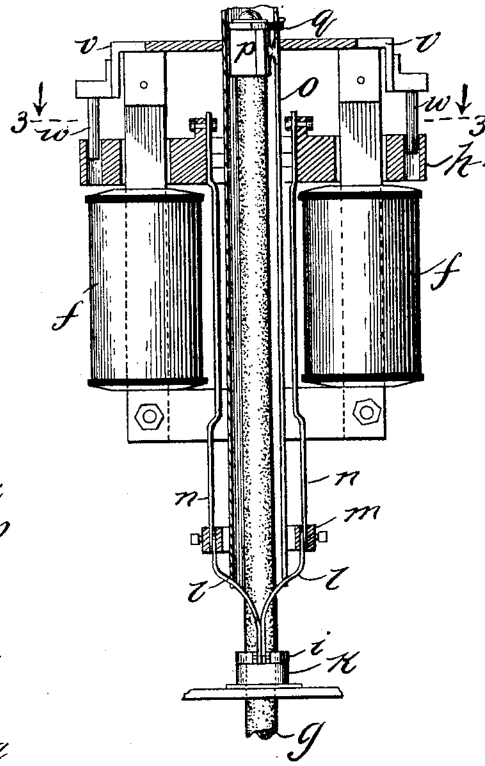


Fig. 2.

Fig. 4.

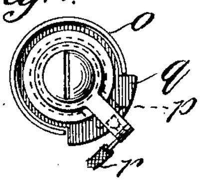


Fig. 5

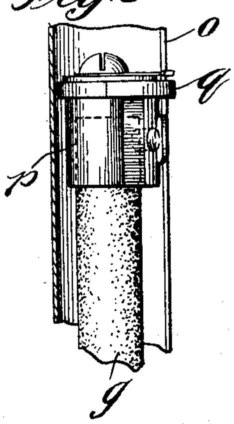


Fig. 6

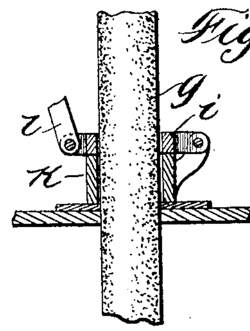


Fig. 3.

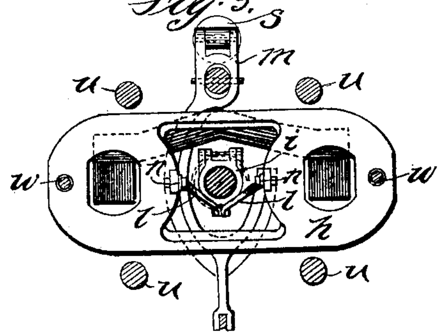


Fig. 7.

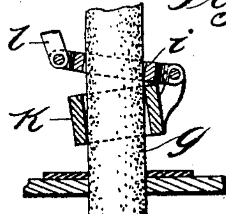
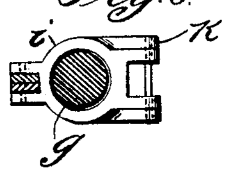


Fig. 8.



Witnesses:

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4 Sheets—Sheet 3.

Fig. 9

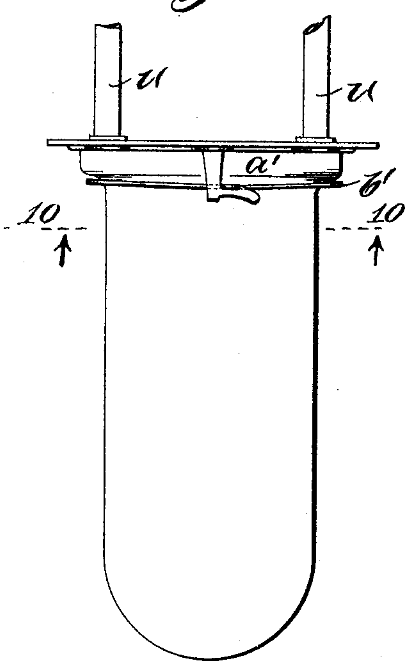

Fig. 10.

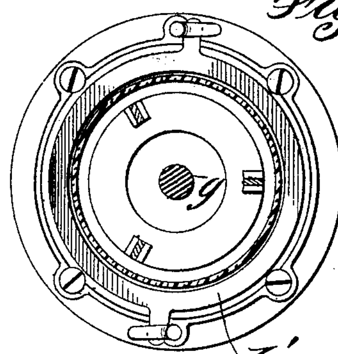

Fig. 11.

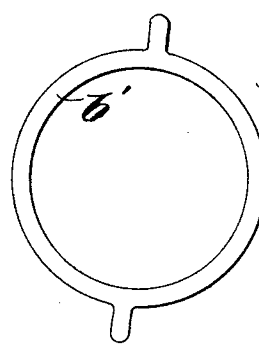

Fig. 12.

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No. 636,875. Patented Nov. 14, 1899.

E. P. WARNER.

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(Application filed Apr. 1, 1899.)

(No Model.) 4 Sheets—Sheet 4.

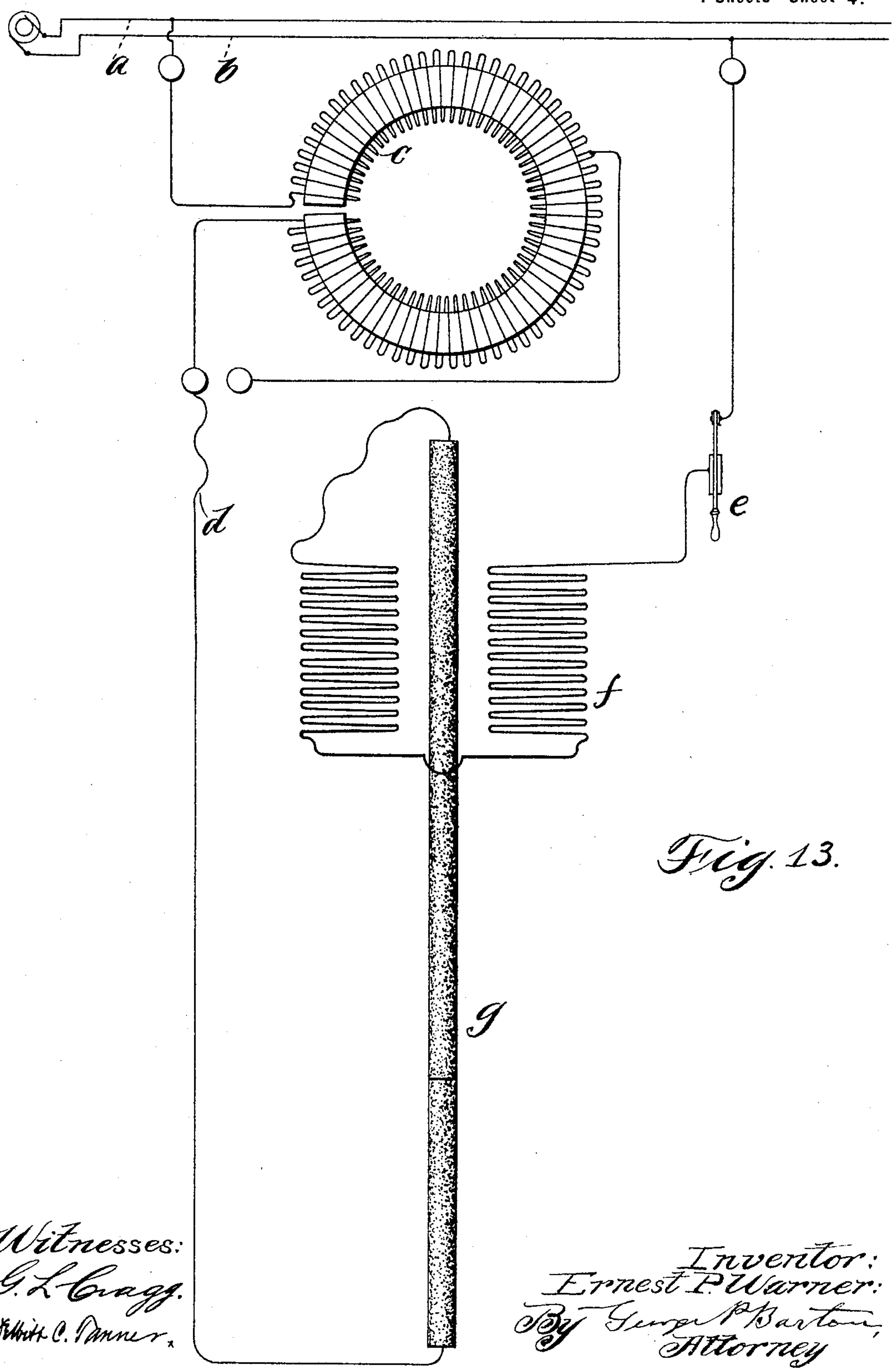

Fig. 13.

Witnesses:
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DeWitt C. Tanner.

Inventor:
Ernest P. Warner:
By George P. Barton,
Attorney

UNITED STATES PATENT OFFICE.

ERNEST P. WARNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF SAME PLACE.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 636,875, dated November 14, 1899.

Application filed April 1, 1899. Serial No. 711,370. (No model.)

To all whom it may concern:

Be it known that I, ERNEST P. WARNER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Electric-Arc Lamps, (Case No. 67,) of which the following is a full, clear, concise, and exact description.

My invention may be stated generally as comprising the following features: The armature is made of aluminium and consists of two rings connected by bars in such a manner as to leave an opening midway between the rings, which opening accommodates the guide for the upper carbon. The clutch I form of two rings differing in weight, which are pivotally attached to each other at one side of the carbon, so that each of the rings can take an independent grip upon the carbon. In order to make the amount of energy sufficient to secure an efficient and positive regulation of the lamp, I connect the aluminium armature with the clutch-lever, so that a portion of the weight of the moving parts—that is, of the armature and its load—may be counterbalanced by means of a weight. The upper-carbon clamp, which is attached to the upper end of the upper carbon, moves in a tubular guide and at its upper portion is provided with a washer of non-metallic material for the purpose of reducing the vibration and noise that might otherwise result. This washer I have made of mica, also of certain compositions of rubber, so as to prevent metallic contact between the clamp and the guide through which it travels, the washer being slightly smaller than the bore of the tube, so that the carbon may not be impeded by the guide. The rim of the inclosing globe is enlarged and conforms to the annular seat provided upon the under side of the feeding-floor of the lamp and is held in place by an annular spring-clamp, the clamp being provided with projecting arms, which are forced under catches attached to and extending from the feeding-floor.

In the accompanying drawings, Figure 1 is a front elevation of a lamp, partly in section, embodying my invention. Fig. 2 is a side elevation of the feeding and clutch mechanism, certain parts beings hown in section. Fig. 3 is a plan view on line 3 3 of Fig. 2. Fig. 4 is a plan view of the tubular guide with the upper-carbon clamp in place therein. Fig. 5 is a side elevation thereof, the tube being shown in section. Fig. 6 is a sectional view of the clutch resting upon the feeding-floor. Fig. 7 shows the same in position after the carbon has been lifted. Fig. 8 is a plan view of the clutch. Fig. 9 shows the globe in position. Fig. 10 is a sectional view on line 10 10 of Fig. 9. Figs. 11 and 12 are plan and edge views, respectively, of the annular ring-clamp. Fig. 13 is a diagram illustrative of the circuits.

Like parts are indicated by similar letters of reference throughout the different figures.

The general operation of the lamp will be most clearly understood by reference to Fig. 13, in which I have shown the mains or supply-circuits *a b*, between which the lamp is connected. The choke-coil *c* may be of usual construction and is provided with connections at different portions of the coils, so that the impedance thereof may be adapted to different frequencies of alternations. As indicated on the drawings, the wire *d* from the lower carbon is connected to include the entire winding of the coil, as is required when the periods are of low frequency—as, for example, forty or sixty cycles per second. I have indicated diagrammatically the cut-out switch *e*, the regulating-magnet *f*, and the pair of carbons *g*, included in proper relations in the circuit.

The armature *h* I make preferably of aluminium, since aluminium has sufficient conductivity and least weight. This armature is so formed as to make a complete metallic circuit surrounding each of the cores, as shown particularly in Fig. 3. This armature comprises two complete electric circuits, a different circuit surrounding each of the cores of the electromagnet *f*, these circuits being placed in such inductive relation to the magnet-cores that currents of proper lag will be set up therein to produce the action of repulsion or the tendency to force the armature toward the tips of the cores. This armature I have shown as consisting of a single casting, the two rings or circuits surrounding the different projecting poles of the electromagnet being rigidly joined together—that is, constituting a single casting. The metal of the casting on either side of the central opening of the armature is preferably provided with a rib, making the connecting-bars between the two rings, which is T-shaped in cross-section to give rigidity with a minimum amount of metal in the bars.

The clutch consists of two rings *i* and *k*, one ring being of greater weight than the other and the two being pivoted together, so as to permit each ring to engage the carbon to an extent independently of the other. As one of the rings—in this instance *k*—is heavier than the other ring *i*, any vibrations communicated to the rings will affect them differently owing to their difference in fundamental. The consequence is that the two rings are not liable to be disengaged or relaxed at the same time on account of vibrations. I thus avoid the well-known trouble which is experienced so frequently when a single clutch-ring is employed.

The links *l l* extend from the upper ring of the clutch to the clutch-lever *m*, the lever being connected to the armature *h* by the arms *n n*. These arms *n n* are preferably rigidly attached to the armature and pivotally connected with the clutch-lever.

The tube *o*, which surrounds the upper carbon and serves as a guide for the upper-carbon clamp *p*, is disposed between the arms *n n*, the clutch-lever *m* being provided with an opening to accommodate the said tube, so that the lever may be unimpeded, while provision is made for suitably connecting the links *l l* and arms *n n* with the said clutch-lever *m*. The tube *o*, as most clearly shown in Fig. 4, is open on one side throughout its length, and through this opening projects a segment of the non-metallic washer *q*. The metallic washer which is secured to the upper end of the carbon-holder *p* is provided with an arm by which connection is made through the medium of the flexible cord *r* from the frame of the lamp, so as to afford a sufficient path for the current.

The weight *s* is attached to the projecting end of the clutch-lever *m* and is made sufficient to counterbalance the greater portion of the armature *h* and its load. The dash-pot *t*, which is connected with the clutch-lever, is provided with a valve in the piston, so that the retardation may be only during the upward movement of the piston. The weight *s* is adjusted so that but little if any more than the weight of the upper carbon is required to be lifted and moved by the regulating-magnet at any time in regulating the lamp.

Four pillars *u* extend upwardly from the feeding-floor of the lamp to form a support for the plate *v*, to which the regulating-magnet is secured. Upon this plate are mounted two downwardly-projecting pins *w w*, which pass freely through corresponding openings provided in the armature *h*, thus preventing any abnormal lateral motion of the armature.

The inclosing globe is enlarged at its opening and for a short distance only from the end thereof, as indicated at *a'*, to provide an upper edge which may be readily ground flat, while at the same time a shoulder is formed, against which the annular spring-clamp *b'* is pressed. The flat surface thus formed fits closely to the surface of the metal plate, against which it is pressed and forms practically an air-tight joint. This construction should not be confounded with one wherein the walls of the globe are thickened to provide an annular shoulder or wherein the edge of the globe at its mouth is turned outwardly to form a flange. With any such construction the work of grinding the walls of the globe at its mouth is made very difficult, because of the great amount of material which must be ground away, and where the wall is thicker in some places than it is in others the glass is very apt to crack when heated. The clamp which I prefer to employ is made of thin resilient material and is adjusted to hold the ground edge of the globe tightly against the under surface of the feeding-floor. If, however, the pressure from the gases within the globe becomes considerable, the resilient clamp will yield, so as to give such vent as may be required. In the drawings, Fig. 1, I have not shown the portion of the casing which surrounds the clutch mechanism and supports the shade.

I will now briefly describe the operation of my lamp. The lamp being connected in circuit, as illustrated in Fig. 13, and the current established, there will be immediately a repulsion of the armature *h*, causing the same to move upward and carry with it the clutch-lever and clutch to approximately the position indicated by dotted lines in Fig. 1, and the arc will be established. The first rush of current will be quite strong; but as the carbons are separated and the resistance at the arc increased the current will be brought to its normal and approximately constant strength. As the arc persists and the carbons are consumed the armature descending gradually maintains the voltage and current practically constant until the clutch comes against a stop or the floor of the lamp, whereupon, the clutch releasing its hold, the upper carbon slips downwardly, thus effecting the feeding. Immediately after the feeding the armature is moved by the repelling action of the magnet *f* to the position required to maintain the arc at the required voltage and current strength. My lamp as thus described is intended for use upon constant-potential circuits of about one hundred and ten volts, the lamps being connected in multiple. When the arc is first established, the armature will be repelled upward along the iron cores in the manner described, and the upper carbon being disengaged by the clutch it will be lifted about three-eighths of an inch from its mate and an arc established as they separate. This arc will be ordinarily of seventy volts with a current of six amperes. After being thus started the carbons will burn away gradually, and as this takes place the armature will be gradually lowered on the cores, there being at the same time a slight diminution in current until the clutch which holds the upper carbon comes against the plate or floor of the lamp, as previously described, whereupon a slight further decrease in current will cause the upper carbon to be fed downward a slight distance. The clutch once more grasps the carbon, and in case the downward movement should have been more than that required to bring the current to the normal the armature will be raised a sufficient distance to reëstablish the voltage and current conditions. The electromagnet-cores are preferably of laminated iron in order to reduce the local currents therein and consequent heating.

It is known in the art that the armature of an electromagnet excited by an alternating current may be so constructed and adjusted as to be repelled. I make use of this principle in my lamp in such a way that the feeding movement of the carbons and their regulation is effected directly from the armature. The armature might be made of copper or other good conducting metal; but I have found aluminium best fulfils the conditions, for the reason that it secures a maximum activity with a minimum inertia of the moving parts. The clutch-lever, the dash-pot, the piston, and connections I preferably make of aluminium also, but simply for the purpose of reducing the inertia.

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

1. In an arc-lamp, the regulating-magnet *f* and the aluminium armature thereof adapted to be repelled when alternating currents traverse the magnet, said armature comprising two rings, one for each of the projecting cores of the electromagnet, the rings being connected together by bars formed integral therewith to leave an opening midway between the rings; in combination with a tubular guide for the upper carbon passing through the said opening, and clutch mechanism directly attached to the armature, the weight of the armature and the moving parts carried thereby being counterbalanced, substantially as and for the purpose specified.

2. In an inclosed alternating arc-lamp, the combination with the regulating-magnet thereof, of the armature having different parts thereof surrounding the projecting cores to form circuits of good conductivity about the same, arms *n n* secured to the said armature and pivoted to the clutch mechanism, the carbon and the guide for the same inclosed between the said arms and passing through a central opening in the armature, the upper-carbon clamp *p* and the insulating-washer *q*, substantially as and for the purpose specified.

3. The combination with the tubular guide for the movable carbon, of the carbon-clamp *p* provided with the non-metallic washer *q* adapted to move in the said guide, the guide being provided with a slot through which a portion of the washer *q* projects; the armature *h* having the central opening through which the guide passes, the armature being adapted to be repelled when alternating currents are set up in the coils of the electromagnet thereof, and clutch feeding mechanism attached to the said armature and controlled by the movement thereof, substantially as and for the purpose specified.

4. The combination with the movable carbon of an electric-arc lamp, of the electromagnetic regulating mechanism thereof controlling the clutch, said clutch consisting of two rings pivoted together, one of said rings being of greater weight than the other, as described, whereby, owing to their difference in fundamental, vibrations communicated to the rings will affect them differently, thereby preventing both rings from being disengaged or relaxed at the same time, substantially as described.

5. The double-ring clutch consisting of parts *i* and *k* linked together, the upper ring *i* being of less weight than the lower ring *k*, in combination with the feeding-rod of an arc-lamp, and mechanism for controlling the clutch; whereby, owing to the difference in weight of the two rings, they are not liable to be disengaged or relaxed at the same time on account of vibrations.

6. The globe of an electric-arc lamp enlarged or expanded for a short distance at the opening thereof, the walls of said expanded portion being of substantially the same thickness as the main body of the globe, the upper edge of said expanded portion forming the mouth of the globe being ground to a plane, in combination with a thin annular clamp of resilient material pressed against the annular shoulder provided by the enlargement of the globe, and a plate having an annular plane surface against which the edge or end of the globe is pressed by the spring-clamp to form a practically air-tight joint, said clamp being adapted to yield to vent the globe when there is undue pressure within, substantially as set forth.

7. The globe of an electric-arc lamp having an annular enlargement or expanded portion, the walls of said expanded portion being of substantially the same thickness as the main body of the globe, the upper edge of the globe at the mouth thereof being ground to a plane, in combination with a thin annular clamp of resilient material pressed against the annular shoulder provided by the enlargement of

the globe, and a plate having an annular plane surface against which the ground edge of the mouth of the globe is pressed by the spring-clamp to form a practically air-tight joint, said clamp being adapted to yield to vent the globe when there is undue pressure therein, substantially as set forth.

In witness whereof I hereunto subscribe my name this 30th day of March, A. D. 1899.

ERNEST P. WARNER.

Witnesses:
DE WITT C. TANNER,
WINFIELD W. LEACH.