(No Model.) 2 Sheets—Sheet 1.

M. S. OKUN.

ELECTRIC ARC LAMP.

No. 522,680. Patented July 10, 1894.

Fig. 1.

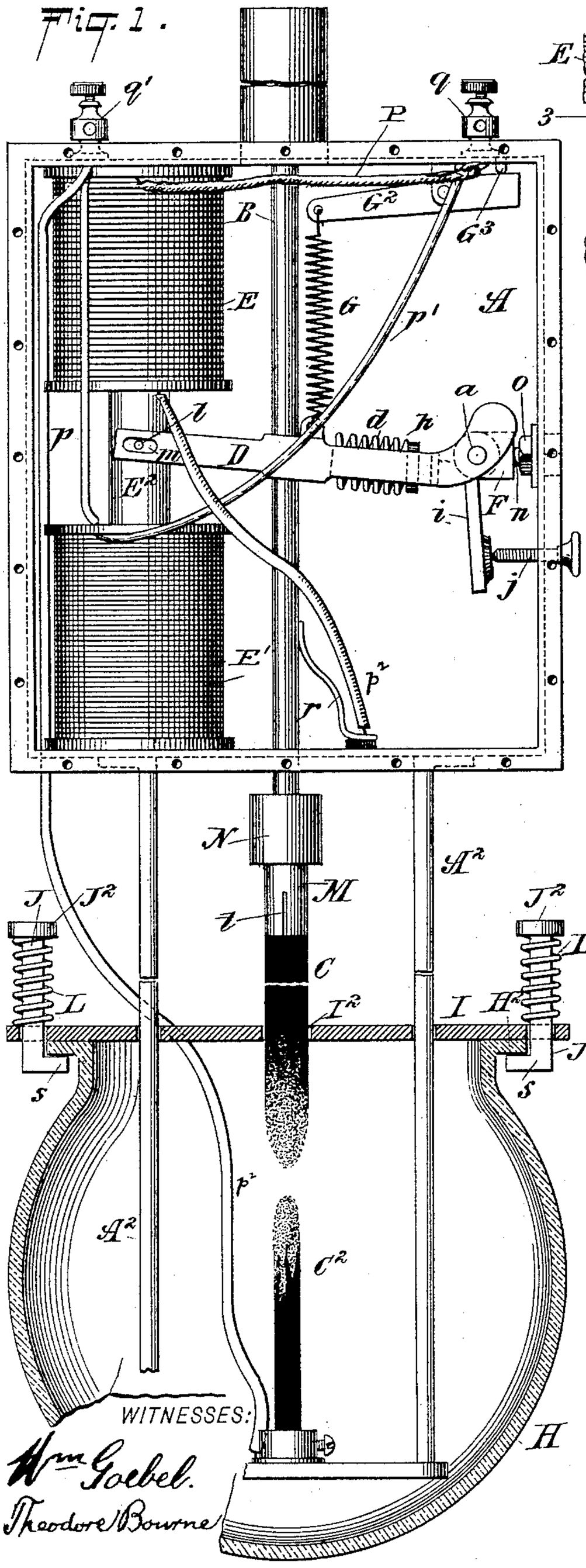


Fig. 2.

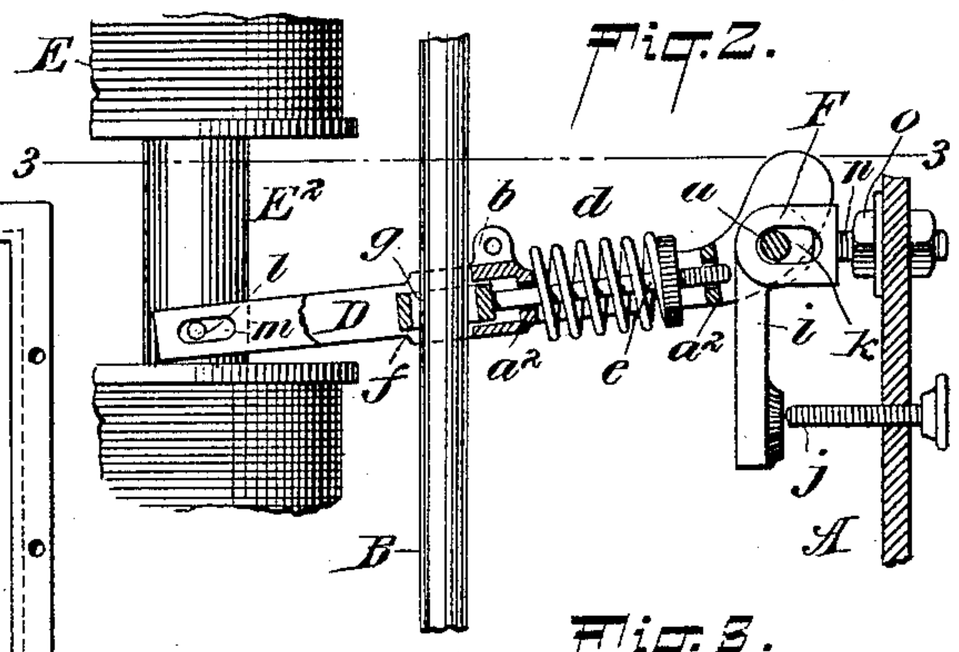


Fig. 3.

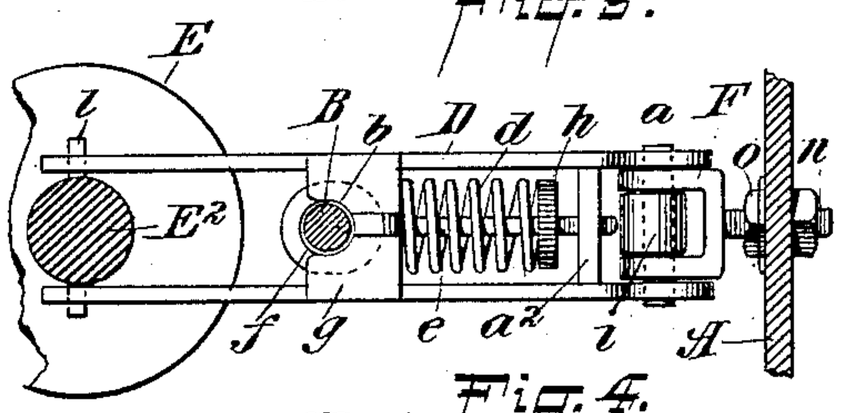


Fig. 4.

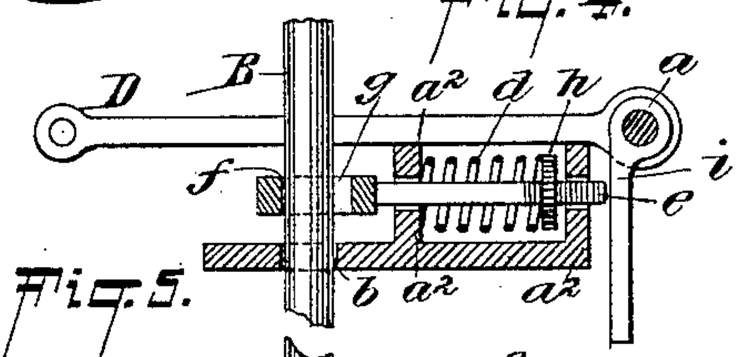


Fig. 5.

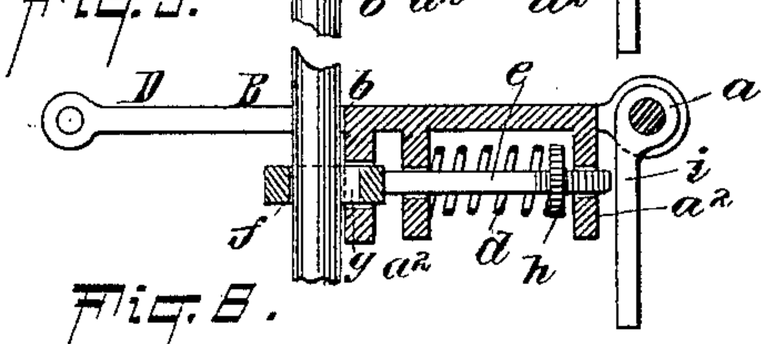


Fig. 6.

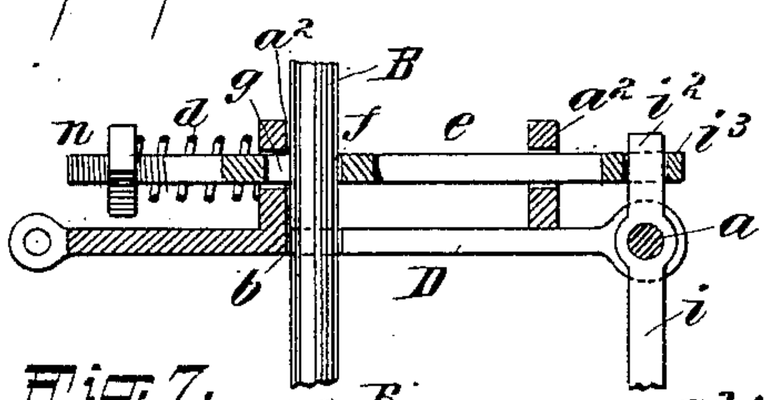
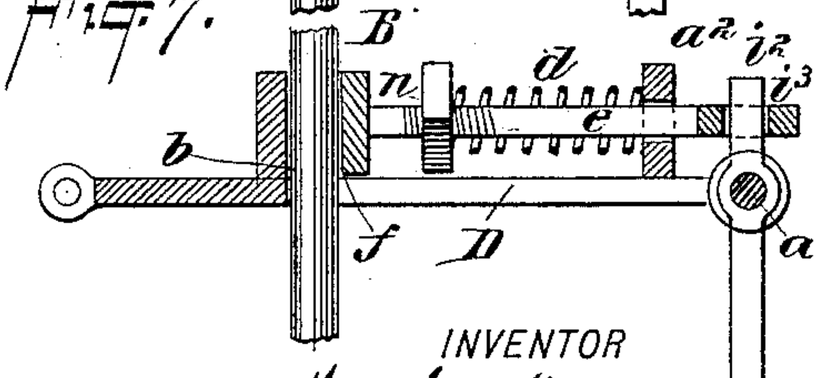


Fig. 7.



WITNESSES:

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(No Model.) 2 Sheets—Sheet 2.

M. S. OKUN.

ELECTRIC ARC LAMP.

No. 522,680. Patented July 10, 1894.

Fig. 8.

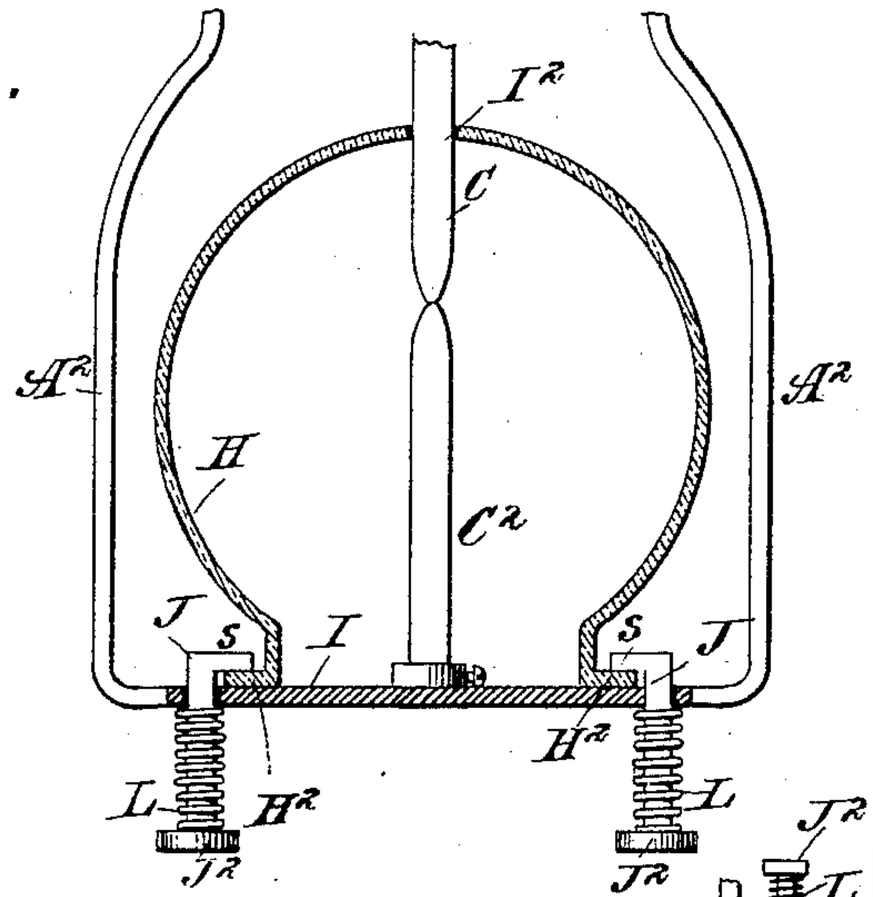


Fig. 9.

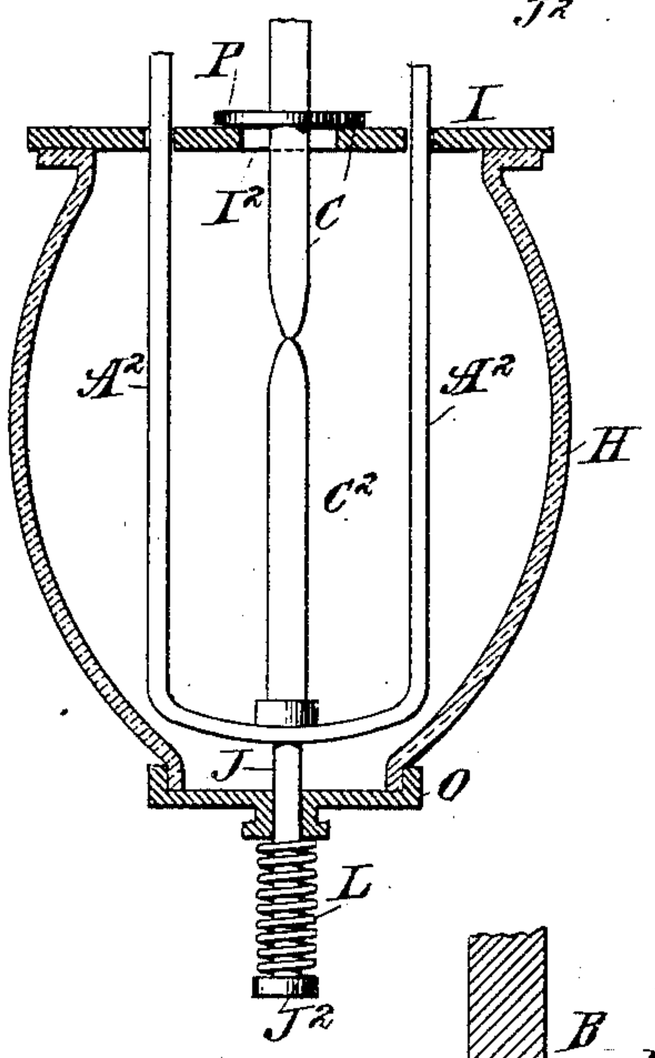


Fig. 10.

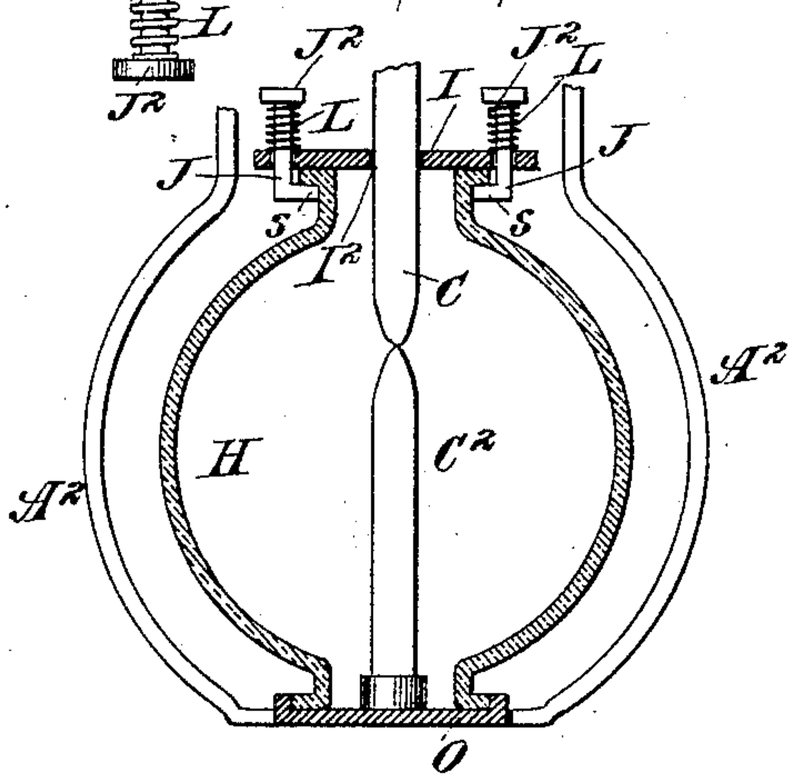


Fig. 12.

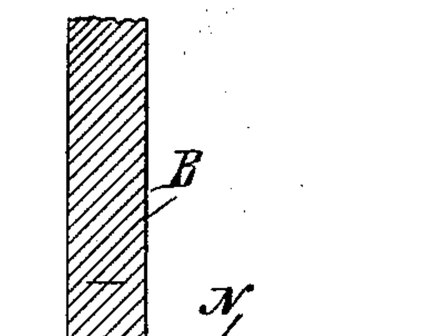
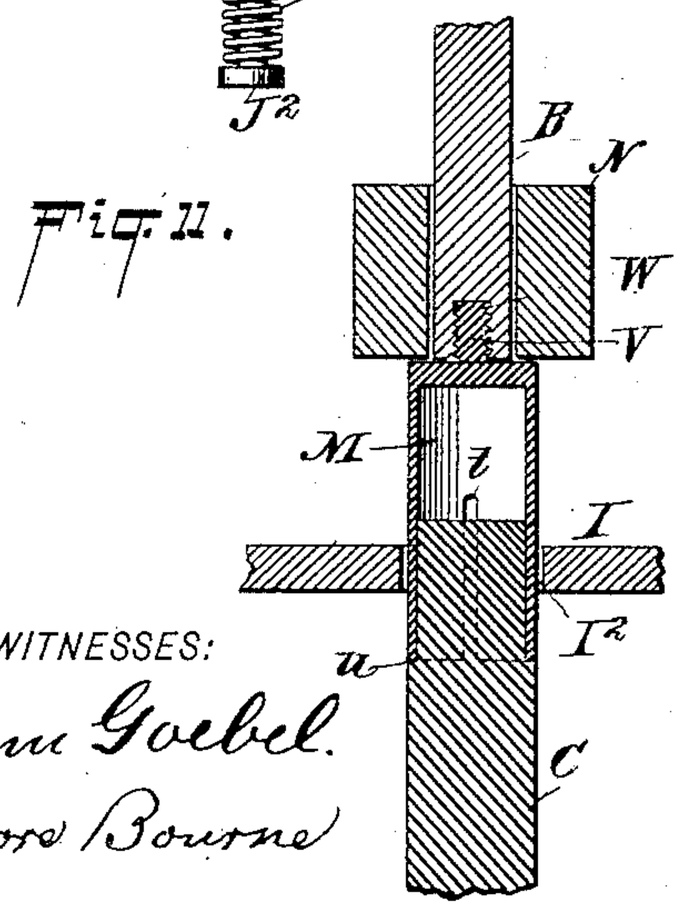


Fig. 11.



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his ATTORNEY.

UNITED STATES PATENT OFFICE.

MOSES SOLOMON OKUN, OF NEW YORK, ASSIGNOR TO THEODORE F. BOURNE, OF CLIFTON, NEW YORK.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 522,680, dated July 10, 1894.

Application filed September 21, 1892. Serial No. 446,375. (No model.)

To all whom it may concern:

Be it known that I, MOSES SOLOMON OKUN, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Electric-Arc Lamps, of which the following is a specification.

My invention relates to electric arc lamps, and consists, in the means employed for actuating the carbons, in means for improving the quality and increasing the steadiness of the light, and in means for reducing the rate of consumption of the carbons.

The objects of my invention are, first, to provide efficient and sensitive mechanism for striking the arc, when the current is turned on to the lamp, and for continually maintaining the carbons at the proper distance apart; second, to provide simple and effective devices for closing, substantially air tight, the globes of electric arc lamps, so that the arc may be formed in a gas, which will retard or prevent the combustion of the carbons; third, to provide for the proper operation and adjustment of the carbons within the globe, while closed; fourth, to provide means whereby the carbons may be permitted to have some lateral motion with relation to the globe, when necessary, without binding or cramping of the carbons, and without danger of admitting air to the globe; fifth, to provide means for permitting the escape of surplus gas when the pressure within the globe becomes too great; sixth, to prevent, as far as possible, the throwing of shadows by the carbons of the lamp; seventh, to provide a carbon holder which may pass freely through an aperture in a disk or cover on the globe, or through the globe, so that as much as possible of the carbon pencil may be utilized, and to so construct this carbon holder that air may not be admitted to the globe when it passes through said aperture. These objects are attained in the arc lamp herein described, and illustrated in the drawings, which accompany and form a part of this application, in which the same reference letters indicate the same or corresponding parts, and in which—

Figure 1 is a side elevation of an arc lamp embodying my invention, the globe and cover thereto being shown in section, and the covering of the box being removed to display the carbon adjusting and actuating mechanism. Fig. 2 is a detail side elevation of the principal portion of the carbon adjusting and actuating mechanism, portions of the mechanism being shown in section. Fig. 3 is a plan view of the mechanism shown in Fig. 2. Figs. 4, 5, 6 and 7 are detail sectional elevations, showing modifications of the carbon adjusting and actuating mechanism. Figs. 8, 9 and 10 are sectional elevations showing methods of closing globes of various forms of lamps, Fig. 8 showing an inverted globe with external supporting frame, Fig. 9 showing an upright globe with internal supporting frame, and Fig. 10 showing an upright globe with external supporting frame. Fig. 9 likewise shows a device employed where it is essential that the movable carbon pencil shall have considerable freedom of motion in all directions. Figs. 11 and 12 are sectional views of a carbon holder adapted to pass through the aperture in the disk or cover through which the carbon passes, and also show a device employed for preventing the admission of air to the globe when the carbon carrying rod is of smaller diameter than the carbon.

In the drawings, A is the box or case inclosing the carbon adjusting and actuating mechanism.

B is the carbon carrying rod, which passes through the casing A, being guided in any suitable manner, and has on its lower end the carbon holder M, within which is the movable carbon C.

A^2 is a frame depending from the box A, which supports the globe H and the lower or fixed carbon C^2.

D is a lever by which the carbon carrying rod B is supported, and which by its movements regulates the position of the upper or movable carbon. The lever D is pivoted to a bracket secured to the casing A by a pivot *a*. At its outer end, the lever D is connected to a plunger or armature E^2 which works within the hollow core of a magnet or solenoid E, the coil of which is connected with the line circuit, so that the strength of the current passing through this coil, and therefore the strength of the attractive force of the so-

lenoid E, varies when the resistance of the arc varies. Variation in the attractive force of the solenoid E causes the plunger E^2 to rise or fall, causing the lever D to vibrate and so to raise or lower the carbon carrying rod B, and so adjusting the length of the arc between the carbons C and C^2.

In the form of apparatus shown in Figs. 2 and 3, the lever D is bifurcated, the rod B passing between the two branches. Across the top of the lever D is a bridge or abutment *b*, having a recess in which the rod B fits. This abutment *b* forms one of two jaws by which the rod B is grasped. Mounted in suitable bearings in lever D, and movable longitudinally therein, is a rod *e*, having an aperture *g*, through which passes the rod B. The outer wall *f* of this aperture forms the other jaw or abutment by which the rod B is grasped. A spring *d* bears against the abutment *b*, and against a nut *h* on the rod *e*, which is adjustable in position, so that the pressure exerted by this spring *d* may be adjusted. The spring *d*, by pressing against the abutment *b* and nut *h*, causes the jaw *f* to press against the rod B and to press said rod against the jaw of the abutment *b*, so that the rod is normally held as in a vise by these jaws *b* and *f*.

The coil of the solenoid E is usually connected in series with the arc, and the strength of its attractive force varies inversely with the resistance, that is, with the length of the arc formed between the carbons. As the arc lengthens, owing to the gradual disintegration of the points of the carbons, as C and C^2, since the resistance of the arc is thereby increased, the current flowing through the lamp decreases in strength somewhat, the attractive force of the solenoid E becomes slightly weaker, and the plunger E^2 descends, thus restoring the arc to its original length. But when the lever D has descended to nearly the limit of its travel, it becomes necessary to have the rod B released, so that it may be grasped higher up.

In order to release the rod B it is necessary to decrease the pressure exerted by the jaw *f* against the rod B. To this end, therefore, I provide an abutment *i*, hanging from the pivot *a*, and adjustable in position by means of the set screw *j*. When the lever D has descended to nearly the limit of its travel the end of the rod *e* comes in contact with the abutment *i*, and further movement downward of the lever D causes the rod *e* to be pressed outward somewhat, so that the pressure exerted by the jaw *f* against the rod B is released slightly, and the weight of this rod causes it to slip downward a short distance. This downward movement of the rod B shortens the arc and decreases its resistance, thus increasing the attractive force of the solenoid E, thereby raising the plunger E^2 and lever D, freeing the rod *e* from the abutment *i*, and thus causing the rod B to be grasped again; and this action takes place so quickly that before the rod B can have slipped downward far enough to unduly shorten the arc, the rod B has been grasped again by the lever D, and thus is prevented from falling farther.

Before current is turned on to the lamp, the carbons are in contact, and in order to produce the arc, when the current is turned on, it is necessary to separate the carbons slightly, an operation which is termed "striking" the arc. This is done by the action of the solenoid E; for, since when the carbons are in contact the resistance offered is small, the attractive force of the solenoid is very great, and the plunger E^2 is raised, thus separating the carbons, that is, "striking" the arc.

It is necessary that the rod B should move up and down in a perfectly straight line, so that it follows of necessity that the pivot of the lever D cannot be rigid, but must be capable of some side movement. To this end, I cause the pivot *a* to work in a slot *k*, which may be in either the lever D or in the bracket F, carried by the casing A, by which bracket the lever D is directly supported. The pin *m*, which connects the lever D with the plunger E^2, likewise works in a slot, to permit a similar freedom of movement.

In order that the jaws *b* and *f* may be brought into the proper position relative to the rod B, I make the lever D longitudinally adjustable. To this end, the bracket F is provided with a screw *n*, which screws into the casing A, and this screw may be clamped in any desired position by lock nuts.

To balance the weight of the lever D, I use a spring G, one end of which is attached to lever D, and the other end to a support G^2, secured to the casing A. This support G^2 should, preferably, be adjustable, and may consist of a lever pivoted to the casing, and adjustable in position by means of a screw G^3.

With circuits of high potential it will usually be necessary to use two solenoids, E, the one previously mentioned, and another, E′, below E, and of higher resistance. The coil of solenoid E′ should be connected in a shunt circuit, so that an increase in the resistance of the arc causes an increased amount of current to flow through its coils, so that the plunger E^2 will be drawn downward. This is the ordinary and customary arrangement of differential solenoids.

The magnets or solenoids E and E′ may be connected with the line wires in any convenient manner. In the drawings, the connections are as follows: The line wires are connected to the binding posts *q* and *q′*. A wire *p* connects binding post *q* with one terminal of the magnet or solenoid E; the other terminal of the solenoid E is connected by a wire p^2 with the contact spring *r*, carbon carrying rod B, carbons C and C^2, and so with the binding post *q′*. The magnet or solenoid E′ is connected with the binding posts *q* and *q′* by wire *p′* forming a shunt circuit.

Figs. 4, 5, 6 and 7 exhibit modifications in the forms and arrangement of the parts shown in Figs. 2 and 3. In Fig. 4 the bearings of

the rod *e* depend from the lever D and the abutment or jaw *b* is below the rod *e*. In Fig. 5 the rod *e* likewise depends from the lever D, but the abutment *b* has a broad face, extending longitudinally of the rod B, and the rod *e* works in an aperture in this face. In Fig. 6 the abutment *b* is on the outer end of the lever D and extends upward, forming one of the bearings of the rod *e*, and the spring *d* is on the outer end of the rod *e*. The abutment *i* has an upward projection i^2 that fits within an aperture i^3 in the rod *e*. The apparatus shown in Fig. 7 is similar to that of Fig. 6, except that the spring *d* is on the inner end of the rod *e*, and the abutment *f* has a broad face. The operation of all of these various modified forms of apparatus is substantially the same as that of the apparatus shown in Figs. 2 and 3.

For the purpose of retarding and decreasing the consumption of the carbons C and C^2, and also for the purpose of increasing the steadiness and otherwise improving the quality of the light, I have provided means for closing the globes of arc lamps, so that the carbons may be surrounded by a gas which will not support the combustion of the carbons, like atmospheric air. Such gas is formed within the closed globe, when the lamp is first started, by the combustion of a small portion of the carbons. Carbonic acid gas or carbon dioxide is first formed, by combination of the carbon with the oxygen of the air within the globe; but as the uncombined oxygen in the globe becomes less, carbon monoxide is formed, until all the oxygen in the globe has combined with the carbon, so that the arc is produced in an atmosphere composed of nitrogen, carbon dioxide, and carbon monoxide. None of these gases support combustion of carbon, so that the combustion of the carbons, which is the most serious cause of the wasting away of the carbons of ordinary arc lamps, is prevented, except for such combustion as may result from the very slight leakage of air that may possibly take place from time to time, owing to the difficulty of making perfectly air-tight joints.

The form of globe shown in Fig. 1 has no opening at the bottom, the supporting frame of the lamp passing within the globe. The top of the globe is provided with a cover or disk I, which is secured to and supported by the supporting frame A^2, and which has in it an aperture I^2 through which passes the upper carbon C. To support the globe H and to hold the mouth of the same firmly against the cover I, as well as to allow of the escape of gas from the globe when the pressure therein becomes too high, because of an explosion or great expansion of the gases therein, or for any other reason, hooked rods J, the ends of which engage with a flange or rim H^2 of the globe, pass through apertures in the cover I, and springs L bear against the cover I and against the nuts J^2 on these rods, thus drawing the globe H firmly up against the cover I. The pressure exerted by these springs insures that the joint between the globe H and cover I shall be practically air and gas tight, and yet provide for the escape of gas from the globe, should the pressure therein become too great, for in this event this pressure will overbalance the tension of the springs L and will separate the globe and cover slightly, thus permitting the surplus gas to escape. The globe will be closed again by the springs L, however, before the pressure in the globe can become so slight as to make it possible for air to enter. To detach the globe from the cover I, the hooked ends *s* of the rods J are moved away from the flange of the globe, which may then be removed. I do not confine myself to this or to any of the methods herein shown for securing the cover and globe together, as it is evident that many other suitable devices may be used for the purpose.

In Fig. 8 there is shown a form of lamp in which there is used an inverted globe, closed at the bottom by a disk I, upon which the globe rests, rods J and springs L holding the globe and disk together. The upper carbon C passes through an aperture I^2 in the top of the globe.

The form of lamp shown in Fig. 9 is, in general, similar to that of Fig. 1, except that the globe as here shown has an opening at the bottom which in practice is tightly closed by a disk O. For simplicity a somewhat different method of securing together the bottom and top disks and the globe H is here shown. The supporting frame A^2 to which the disk I is secured, has a downwardly projecting rod J which passes through a closely fitting aperture in the bottom disk O, and has screwed on its end a head or nut J^2. A spring L, bearing against this head and against the disk O, presses this disk against the globe H, and since the cover or top disk I is secured to the supporting frame A^2, presses the globe against the cover I. In this manner both the top and bottom of the globe are tightly closed. In this Fig. 9 is likewise shown a device, which is applicable alike to the lamps shown in the other figures, whereby the upper carbon may be permitted to pass very freely through the cover I, and may be permitted to have considerable lateral motion with relation to the globe, without friction and binding, and without admitting air to the interior of the globe. Such freedom of motion is always desirable and frequently necessary, because the swinging motion, observed in most lamps, from time to time, causes the carbons to sway from side to side to a greater or less extent, and also because the carbons are not always straight, so that the upper carbon may not be concentric with the aperture I^2 at all times. To this end, the aperture I^2 in the cover I is made somewhat larger than the diameter of the carbon C, so that the carbon may have considerable freedom of movement. Over this aperture I^2 is a second disk P, of greater diameter than the aperture I^2, and having in

it an aperture just large enough to permit of the passage of the carbon C. This second disk P serves two important functions. It acts as a movable cover for the aperture I^2, preventing air from entering therethrough, for when the carbon C moves to one side it carries with it the cover P, which slides upon the top of the disk I, and since this disk has a diameter considerably greater than that of the aperture I^2, this motion of the carbon does not uncover the same. The disk P likewise acts as a puppet relief valve to permit the escape of surplus gas from the globe H, so that the globe H and cover I may be separated only in the event of a very sudden and violent explosion within the globe. But under all ordinary circumstances the disk P forms a sufficient valve; for when the pressure within the globe becomes great enough to lift the disk P, the latter rises, being guided by the carbon C, and permits the escape of the surplus gas, falling again to close the aperture I^2 as soon as the pressure within the globe H has decreased sufficiently. This disk is therefore, in effect, a simple form of the puppet check or relief valve in common use in connection with steam, hydraulic, and pneumatic apparatus, having a somewhat similar form, being guided in a similar manner, and performing the same functions in substantially the same way, as the valve plugs of such valves. The pressure at which the disk P will rise is determined by the weight of the disk, and may be varied as desired. The disk P may be insulated from the cover I.

The lamp shown in Fig. 10 is in general similar to that shown in Figs. 1 and 9, differing therefrom in that the support A^2 is without the globe, which is therefore supported directly from the support A^2, the cover I resting upon the top of the globe and securely fastened thereto by means of the rods J and springs L. The carbon carrying rod B should, preferably, have the same diameter as the carbon itself, so that after the carbon is entirely within the globe H, air may not leak in between the sides of the aperture in the disk P and the rod B. In the lamps now in use, the carbon carrying rod is usually of a diameter considerably less than the diameter of the carbon pencils proper. To prevent leakage of air into the globes of such lamps, I place upon the rod B a second disk N, which fits the rod closely, and normally rests upon the top of the carbon holder M, as shown in Figs. 1 and 11. This disk has a diameter sufficient to entirely close the aperture in the cover I or disk P, through which aperture the carbon passes, and so prevents the leakage of air into the globe after the end of the rod B has entered the globe, as shown in Fig. 12.

The form of carbon holder shown in Figs. 11 and 12 is particularly applicable to my lamp, since it may have substantially the same diameter as the carbon itself, and has no outward projections. It consists of a hollow cylinder M, of thin metal, secured to the rod B, and having longitudinal slits in its sides so that these sides become springs which grasp the carbon and hold it securely. The end of the carbon which enters the holder M should be reduced in diameter somewhat, so that the external diameter of the carbon holder will be no greater than the diameter of the carbon itself. Other suitable carbon holders may be used.

I find that where carbons of one-half inch or greater diameter are used in an atmosphere such as that of my lamp, blunt points may form on the lower carbon, which may result in the throwing of shadows, both because a portion of the carbon may project beyond the arc, and because the arc may run around or across the carbon. In my lamp, therefore, I may use a lower carbon of smaller diameter than the upper carbon, say from one-eighth to one-quarter inch in diameter, while the upper carbon may be of any desired size. This is clearly shown in Fig. 1. When a small lower carbon is used, the arc is confined to a small space and is prevented to a great extent from running around the carbon, and as no portion of the lower carbon will project beyond the arc it will not interfere with the radiation of light from the arc, and so no shadows will be thrown.

It is evident that the cover or disk I can be held against the globe H by weight instead of by springs, one being the equivalent of the other.

The operation of my lamp is as follows:—Supposing the lamp to be assembled for operation, but with no carbons in the carbon holders, the globe H may be removed or access obtained thereto by moving the rods L out of engagement with the flange of the globe, in the lamps shown in Figs. 1, 8 and 10, thus releasing the globe, or by unscrewing the head of the rod J^2, in the lamp shown in Fig. 9. The carbons may then be placed within the carbon holders, and the weight of the upper carbon will carry it down until its point is in contact with the point of the lower carbon. The globe may then be replaced and secured as before and the lamp is then ready for use. When the current is turned on, as hereinbefore described, the carbons are in contact, the resistance offered to the passage of the current through the carbons is comparatively slight, and for an instant, a considerable current will pass through the coil of the solenoid E, and if the lamp be provided with the shunt solenoid E′, a correspondingly small amount of current will pass through this solenoid. The attractive force of the solenoid E being very great, while the attractive force of the solenoid E′ is very small, the plunger E^2 will be instantly raised, carrying with it the carbon carrying rod B and carbon C, thus "striking" the arc. As the carbons separate, the resistance of the arc increases, the attractive force of the solenoid E becomes weaker and

that of solenoid E′ stronger, and a point of equilibrium is quickly reached at which the length of the arc is constant.

In placing the carbons in the lamp, fresh air is necessarily admitted to the globe H. At first, therefore, the consumption of the carbons is nearly as rapid as in an ordinary lamp. But by this consumption, which is largely the result of combustion, carbon dioxide is formed, by the combination of the carbon so consumed with the oxygen of the air in the globe. As the amount of uncombined oxygen grows less and less, the rate of consumption of the carbon likewise grows less, as in the course of a few minutes all the free oxygen in the globe has combined with the carbon, so that the atmosphere within the globe is a mixture of nitrogen, carbon dioxide, and probably, carbon monoxide. None of these gases will combine further with carbon, so that the combustion of the carbons practically ceases, and whatever consumption or disintegration of the carbons which thereafter ensues is slight and is due to other causes. This consumption of the carbons above described increases the length of the arc and hence its resistance, thus disturbing the equilibrium formerly existing between the attractive forces of the solenoid E and the weight of the moving parts of the mechanism and the attractive force of the solenoid E′, where the latter is used. The plunger E^2 therefore descends slightly, thus restoring the arc to its original length and reestablishing the equilibrium. But as the further consumption of the carbons goes on, the plunger E^2 descends until it nearly reaches the end of its travel, and it becomes necessary to cause the lever D to take a fresh grasp upon the rod B. At this point the rod *e* comes in contact with the abutment *i*, and a slight further downward movement of the plunger E^2 releases the pressure exerted by the abutment *f* against the rod B sufficiently to allow the rod B to slip downward slightly. This downward movement of the carbon decreases the length of the arc and its resistance, the plunger E^2 is raised, and the lever D grasps the rod B again at a point slightly above the point where it grasped it before. In this manner the feeding of the upper carbon goes on by an alternate upward and downward motion of the plunger E^2, until the rod B has descended to the limit of its travel or the current is cut off. In the course of time the carbons will be consumed to such an extent that the carbon holder M and carbon carrying rod B will pass through the aperture I^2 and through the disk P into the interior of the globe. If the carbon carrying rod B is of the same diameter as the carbon C, no leakage of air will follow; but if the rod B be smaller than the carbon, a disk N will be mounted upon said rod, and when the carbon holder has entered the globe, this disk N will rest upon the cover I or disk P, completely closing the aperture through which the carbon is fed and effectually preventing the leakage of air.

If, as is preferable, the globe cover has the enlarged aperture I^2, and movable disk or cover P, shown in Fig. 9, swaying of the lamp or the use of a crooked carbon C will not interfere with the proper operation of the lamp, the cover P moving from side to side to accommodate itself to the position of the carbon while at the same time the aperture I^2 is securely closed, so that no air can enter.

As has been seen, when new carbons are placed in the lamp, some air will inevitably enter the globe H. If there be a considerable proportion of carbon monoxide in the globe, an explosive compound will be formed, and when the lamp is first lighted, a slight explosion will follow. Such an explosion will cause the cover P to rise, sliding upward upon the carbon C as a guide, and so permitting the surplus gas in the globe to escape. If the explosion in the globe be at all violent, the globe H may likewise be separated slightly from the cover I, thus affording an additional outlet for these gases; and in any case, if the lamp is not provided with the movable cover P, the globe H and cover I will separate to permit the escape of the surplus gas.

Having thus completely described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In an arc lamp, the combination, with a carbon carrying rod, of a lever, an abutment thereon adapted to engage with said rod, a sliding rod or bar for pressing said carbon carrying rod against said abutment, thereby grasping the rod, and means for actuating the lever for the purpose of feeding the carbon, substantially as described.

2. In an arc lamp, the combination, with a carbon carrying rod, of a lever, an abutment thereon adapted to engage with said rod, a sliding rod or bar for pressing said carbon carrying rod against said abutment, thereby grasping the rod, and a magnet or solenoid adapted to operate said lever for the purpose of feeding the carbon, substantially as described.

3. In an arc lamp, the combination, with a carbon carrying rod, of a lever, an abutment thereon adapted to engage with said rod, and a sliding rod or bar for pressing said carbon carrying rod against said abutment, thereby forming, with the abutment, a clutch which grasps and holds said carbon carrying rod, and means for actuating said clutch for permitting the carbon to feed, substantially as described.

4. In an arc lamp, the combination, with a carbon carrying rod, of a lever, an abutment thereon adapted to engage with said rod, a sliding rod bearing against said carbon carrying rod and so actuated by a spring as to press said carbon carrying rod against said abutment, an abutment for counteracting the pressure of said spring to permit the feeding of the

carbon as said lever moves in a corresponding direction, and means for actuating said lever for the purpose of feeding the carbon, substantially as described.

5. In an arc lamp, the combination, with a carbon carrying rod, of a lever having an abutment adapted to engage with said rod, a sliding rod carried by said lever and likewise having an abutment adapted, in conjunction with the first-named abutment, to grasp said carbon carrying rod, a spring acting on said sliding rod, and an adjustable abutment coacting with said sliding rod to release the carbon carrying rod at a suitable point in the travel of said lever and so to permit feeding of the carbon, and means for actuating said lever for the purpose of feeding the carbon, substantially as described.

6. In an arc lamp, the combination, with a carbon carrying rod B, a lever D extending substantially at right angles thereto, and an abutment *b* on said lever to engage with said rod B, of a sliding rod *e* carried by said lever and likewise having an abutment *f* adapted in conjunction with said abutment *b* to grasp said rod B, an adjustable spring acting on said sliding rod as the lever moves, and means for actuating said lever to permit of feeding of the carbon, substantially as described.

7. In an arc lamp, the combination of a rod B, a longitudinally adjustable lever, a clutch to connect said rod and lever, a laterally adjustable pivotal connection for said lever and means for actuating said lever for the purpose of feeding the carbon, substantially as described.

8. In an arc lamp, the combination of a rod B, a longitudinally adjustable lever having a pivot *a*, a clutch to connect the lever and said rod, a bracket F for said lever, a slot in which said pivot works and means for actuating said lever for the purpose of feeding the carbon, substantially as described.

9. The combination of a carbon carrying rod, a longitudinally adjustable lever, a clutch to support the rod carried by said lever, a bracket or pivotal support for said lever, means for adjusting said bracket or support and means for actuating said lever for the purpose of feeding the carbon, substantially as described.

10. The combination of a rod B, a lever, a clutch carried by said lever, an adjustable abutment *i*, to operate said clutch with a screw or the like *j*, to adjust said abutment, substantially as described.

11. The combination of a carbon carrying rod B, a lever, a sliding rod carried by said lever to support the rod B, and a counterbalance to equalize the weight of said lever, substantially as described.

12. In an arc lamp a globe having a cover or disk movably connected therewith to permit escape of gases and to prevent the admission of air, said cover having an opening for the passage of a carbon, said opening being substantially the same size as the thickness of the carbon so that the carbon will fit snugly in said opening to prevent the escape of gases, substantially as described.

13. In an arc lamp a globe having a cover or disk movably connected therewith, combined with a spring to hold the cover and globe together and permit a separation of said parts to allow escape of gases, substantially as described.

14. In an arc lamp, a globe having a flange at its open end, combined with a cover or disk over said open end, a rod to engage said flange and a spring acting to hold said rod against the flange and the cover on the globe, substantially as described.

15. In an arc lamp, a globe having a flange at its open end combined with a cover or disk over said open end, a rod having a projection to engage said flange and a spring acting on said rod and cover to hold the latter to the globe, substantially as described.

16. In an arc lamp, a globe having a flange at its open end, combined with a cover or disk over said open end, a rod having a projection to engage said flange, and a nut on said rod, and with a spring surrounding said rod and bearing at one end against said cover or disk, and at its other end against the nut on the rod, substantially as described.

17. In an arc lamp, the combination of a casing to contain mechanism, a rod depending therefrom and a cover or disk carried thereby, a globe to rest at its open end against said disk and a spring for holding said globe against said cover or disk, substantially as described.

18. In an arc lamp, the combination, with a globe inclosing the arc and having an opening in its top for the passage of a carbon, and a movable cover or valve mounted upon the carbon, covering said aperture and preventing the passage of air therethrough, and adapted to permit of lateral motion of the carbon, substantially as described.

19. In an arc lamp, the combination with a globe inclosing the carbons, of a cover closing the open end of said globe and having an opening therein of a size sufficient to permit of lateral movement of the carbon, and means mounted upon the cover for permitting lateral movement of the carbon without admitting air to the interior of the globe, substantially as described.

20. In an arc lamp, the combination, with a globe inclosing the carbons, of a cover or disk closing the open end of said globe and having an opening therein, for the passage of a carbon, of a larger size than said carbon, and a movable cover or valve, perforated to permit the passage of the carbon therethrough and fitting closely to the carbon, and adapted to close said opening in the said cover or valve, whereby lateral motion of the carbon is permitted but the admission of air to the interior of the globe is prevented, substantially as described.

21. In an arc lamp, a globe having a cover

and an opening in said cover to permit the entrance of a carbon, combined with a carbon holder to pass through said opening, said holder being approximately of the same external diameter as the carbon, said carbon fitting snugly in said opening, substantially as described.

22. In an arc lamp a globe having a cover or disk to close its open end, said cover having an aperture to permit the passage of a carbon, combined with a disk or the like N to cover said opening, and a carbon carrying rod B carrying said disk, substantially as described.

23. In an arc lamp, a globe and a cover or disk resting against its open end, said cover having an aperture to permit the passage of a carbon, combined with a rod B, a carbon holder carried thereby and of a greater transverse diameter than said rod, and with a disk N carried by said rod and resting upon the carbon holder, and adapted to close the opening in the cover when the carbon holder passes therethrough, substantially as described.

24. In an arc lamp a tightly closed globe having an aperture to permit the entrance of a carbon, combined with a carbon carrying rod, and a disk carried by said rod to cover said opening when the carbon passes within the globe, substantially as described.

Signed at New York, in the county of New York and State of New York, this 17th day of September, A. D. 1892.

MOSES SOLOMON OKUN.

Witnesses:

WM. S. TISDALE,

T. F. BOURNE.