(No Model.) 4 Sheets—Sheet 1.

T. E. ADAMS.

ELECTRIC ARC LAMP.

No. 555,891. Patented Mar. 3, 1896.

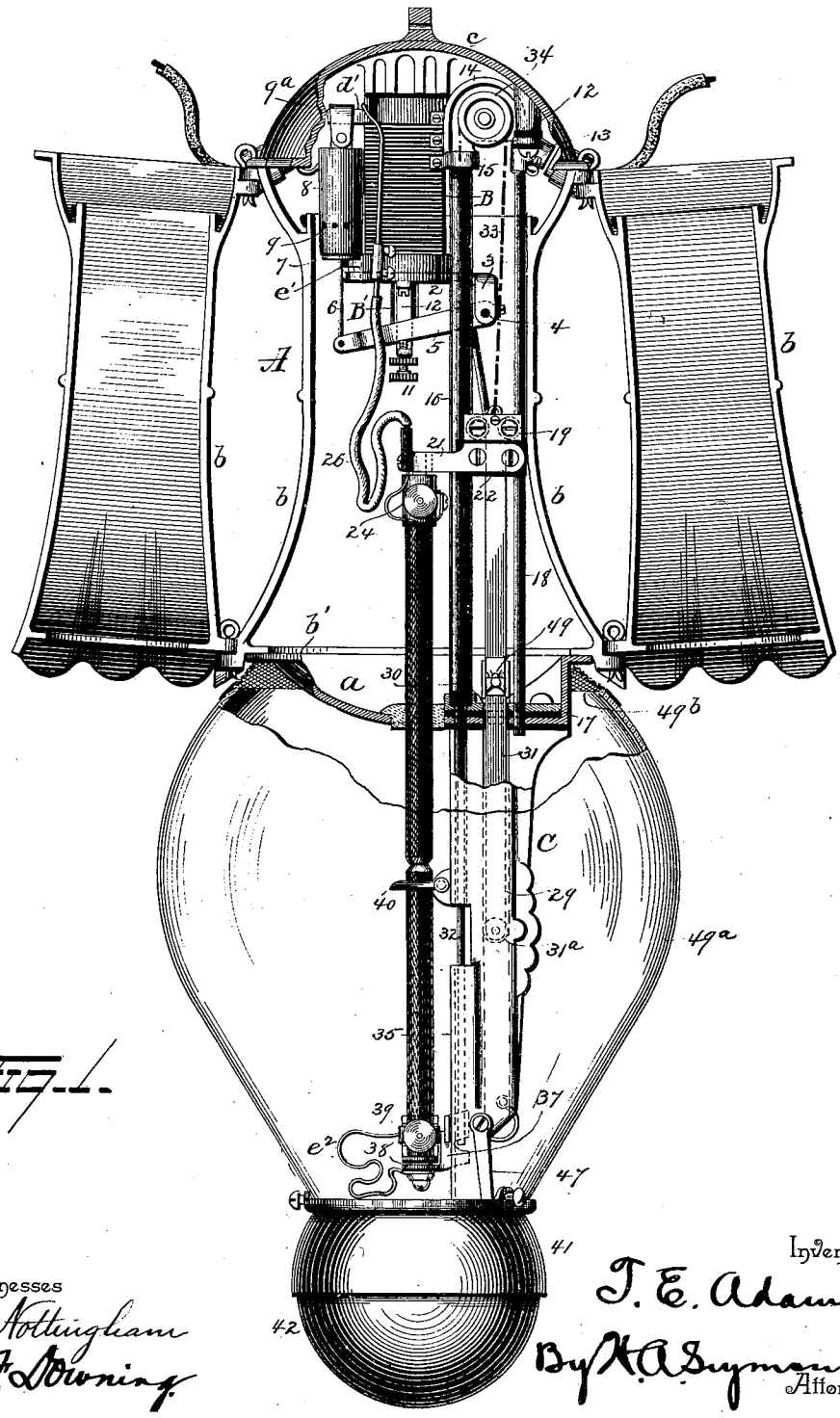

Fig. 1.

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(No Model.) 4 Sheets—Sheet 2.

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FIG. 2.

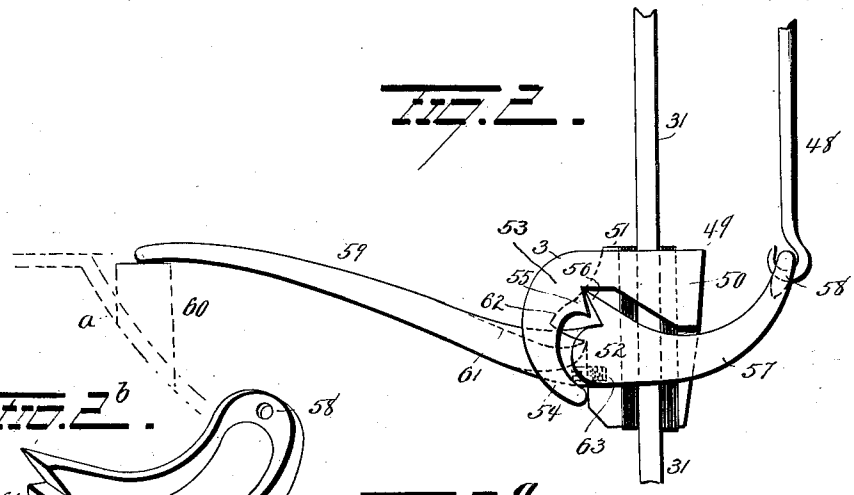


FIG. 2b.

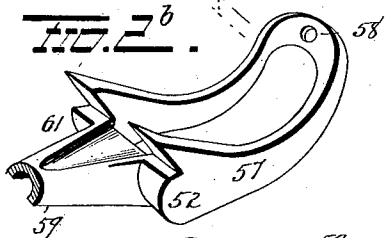


FIG. 2a.

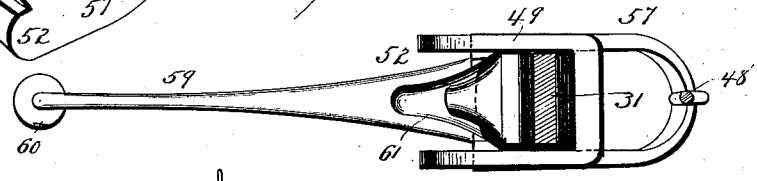


FIG. 3.

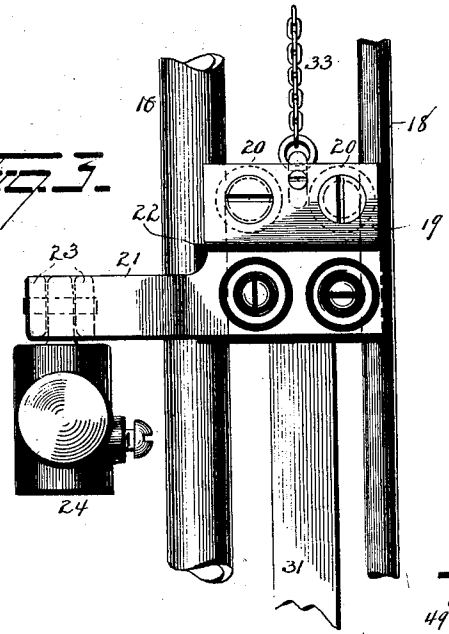


FIG. 3a.

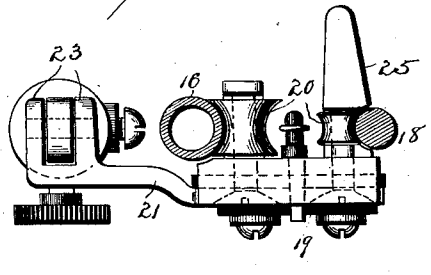
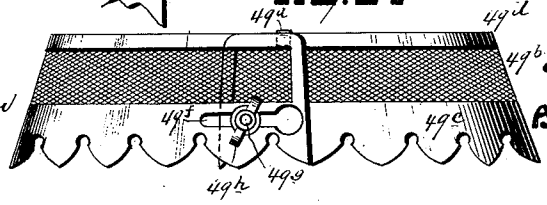


FIG. 5.



Witnesses
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(No Model.) 4 Sheets—Sheet 3.

T. E. ADAMS.

ELECTRIC ARC LAMP.

No. 555,891. Patented Mar. 3, 1896.

Fig. 4.

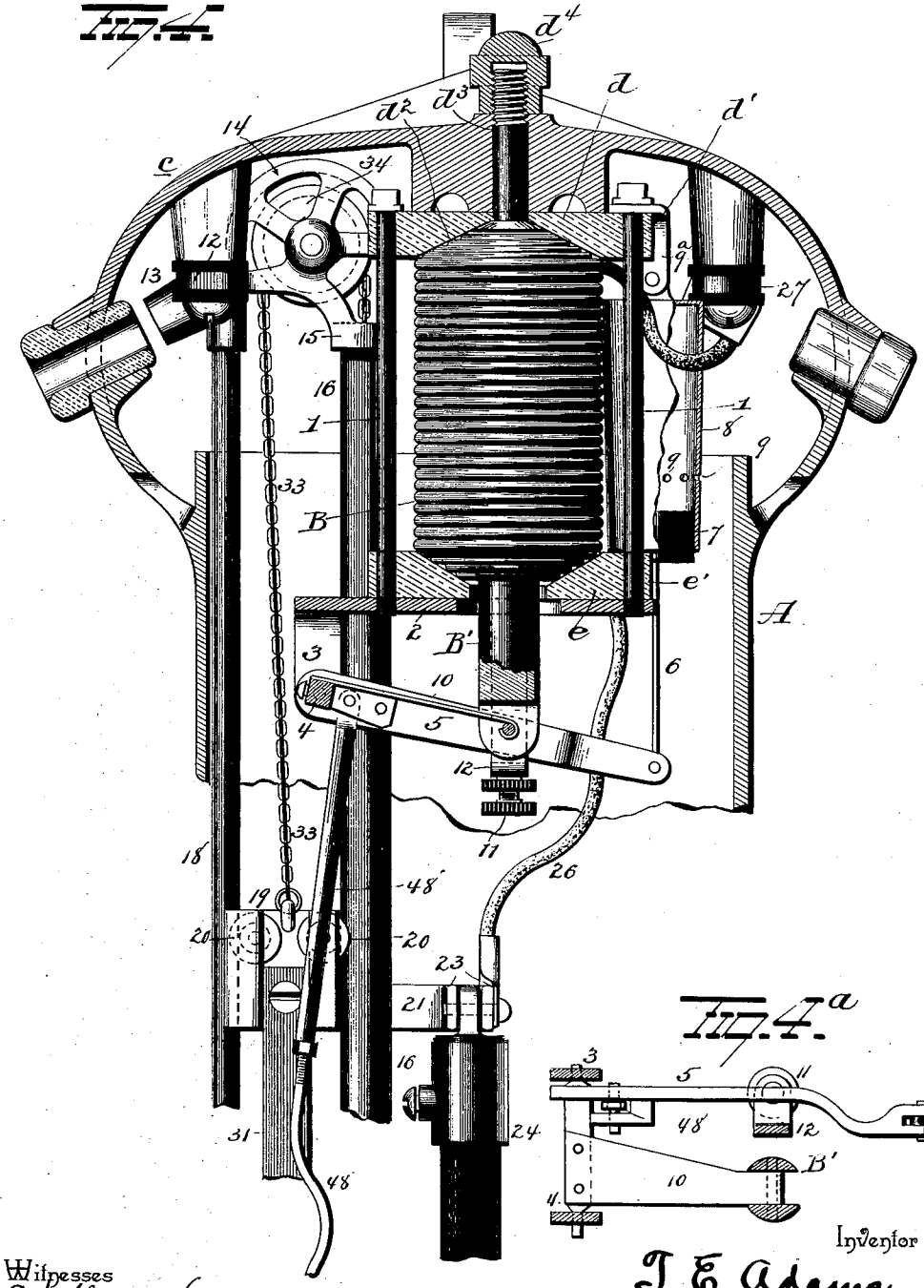

Fig. 4a.

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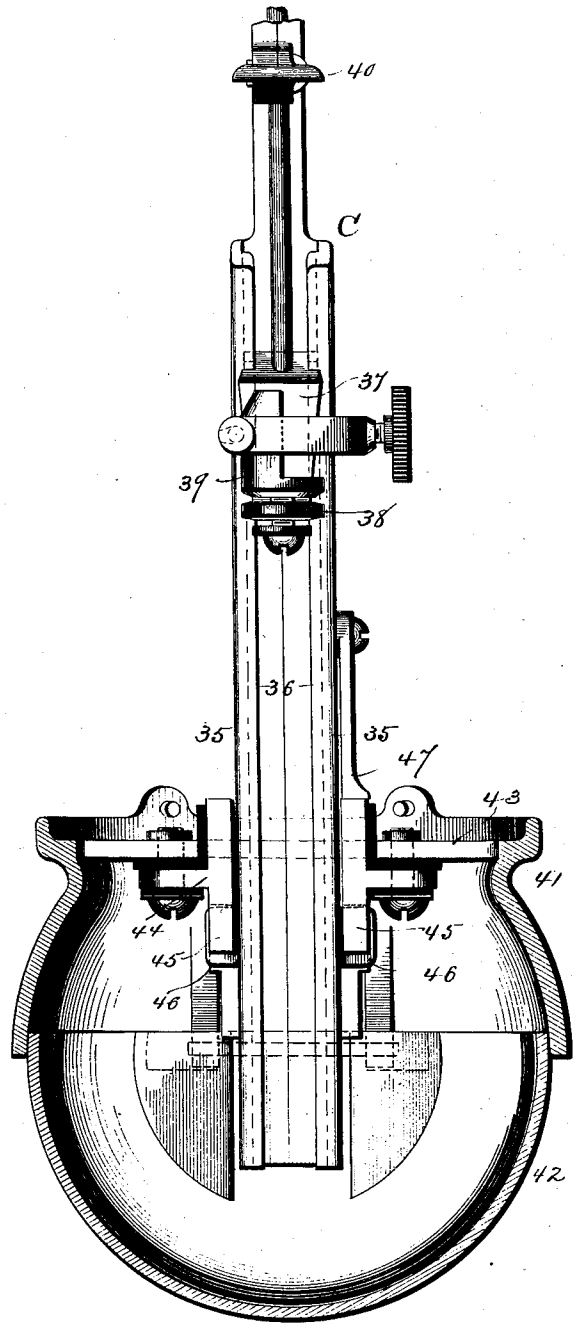

FIG. 5.

Witnesses
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UNITED STATES PATENT OFFICE.

THOMAS EDGAR ADAMS, OF CLEVELAND, OHIO, ASSIGNOR TO THE ADAMS-BAGNALL ELECTRIC COMPANY, OF SAME PLACE.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 555,891, dated March 3, 1896.

Application filed October 10, 1895. Serial No. 565,252. (No model.)

To all whom it may concern:

Be it known that I, THOMAS EDGAR ADAMS, of Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Electric-Arc Lamps; and I 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.

My invention relates to an improvement in arc lamps, and more particularly to such as are adapted to operate with an alternating current.

In the operation of alternating-current arc lamps as heretofore constructed there has been an annoying chattering when the lamps were started, due to the sudden and repeated making and breaking of the circuit during the period necessary for the carbon points to become sufficiently heated to maintain the normal arc.

It is the object of my invention to provide an alternating-current arc lamp with means whereby to prevent the chattering incident to the starting of such lamps as they have heretofore been constructed.

A further object is to provide simple and efficient means whereby to cause the carbon points to be sufficiently heated to maintain a normal arc before such arc shall have been formed.

A further object is to so construct an alternating-current arc lamp that when current enters the lamp a small arc will be first formed between the carbon points and the separation of the carbons retarded sufficiently to cause their points to be properly heated to maintain the subsequently-formed normal arc.

A further object is to so construct an arc lamp as to prevent an abnormal rise of current.

A further object is to produce an arc lamp which shall be simple in construction and effectual in all respects in the performance of its functions.

With these objects in view the invention consists in the combination, with a magnet and the carbons, of a pivoted lever connected with the armature of said magnet and with the carbons and a dash-pot connected with said lever, said dash-pot being so constructed as to first permit a free movement of the lever, then retard the movement of the lever, and then permit its free movement whereby to retard the separation of the carbons and then permit them to separate sufficiently to form a normal arc.

The invention also consists in the combination, with the separating-magnet and the carbons of an arc lamp, of a pivoted lever, a spring connection between said lever and the armature of the magnet, a connection between the lever and the carbons, and a dash-pot connected with said lever.

The invention also consists in the combination, with a separating-magnet and the carbons of an arc lamp, of a pivoted lever connected with the carbons, and a spring-lever secured to the pivoted end of the pivoted lever and connected with the armature of the magnet; and the invention also consists in certain novel features of construction and combinations and arrangements of parts, as hereinafter set forth and pointed out in the claims.

In the accompanying drawings, Figure 1 is an elevation of my improved lamp with the casing open and the cap of the casing partly broken away. Figs. 2, 2^a and 2^b are views of the clutch. Figs. 3 and 3^a are detail views of the cross-head and parts attached thereto. Fig. 4 is an enlarged sectional view of the lamp. Fig. 4^a is a view of the spring 10. Fig. 5 is a view showing the lower portion of the lamp. Fig. 6 is a detail view of the spark-arrester.

A represents the lamp-casing, made preferably of cast metal, and comprises a base or floor *a*, sides *b*, made in sections hinged together and having flanges *b'* secured to the base or floor, and a cap *c* secured to the upper ends of the side sections *b*.

A magnet or solenoid B is disposed within the casing and depends from the cap *c*, to which it is secured, said cap having a seat against which the upper head of the spool rests.

The heads of the magnet spool or frame are constructed preferably of wood or similar material which is not liable to become unduly heated. The upper head, *d*, of the spool is made with a central conical hole d^2, the smaller

end of which is coincident with the upper face of said head *d*. A screw d^3 is passed through the hole d^2 (from inside the coil) so that its head will rest in the said conical hole and its body project beyond the head *d* of the spool. The screw d^3 is passed through a hole in the cap of the lamp and provided on its free end with a suitable nut d^4. The heads *d e* of the spool are made with perforated ears *d' e'* for the accommodation of bolts 1 1, which serve to secure a plate 2 to the under face of the lower head, *e*, of the spool. One end of the plate 2 is enlarged and made to form an inverted-U-shaped yoke between the depending arms 3, of which a short shaft 4 is pivotally mounted. A lever 5 is secured to the short shaft 4 and projects horizontally therefrom, said lever terminating at a point near the opposite wall of the casing, where it is pivotally connected with the rod 6 of a piston 7. The piston 7 enters a dash-pot 8 and the latter is pivotally connected with an arm 9^a secured to the upper head of the magnet-spool. The upper portion of the dash-pot is made slightly larger than the lower end, and at a point somewhat above said lower end a series of small holes 9 is made in the wall of the dash-pot. Thus when the piston moves upwardly within the dash-pot it will at first meet with little, if any, resistance, owing to the escape of air through the holes; but when the piston reaches and passes these holes, which are in the smaller portion of the dash-pot, considerable resistance will be offered to the movement of the piston. When, however, the piston reaches the enlarged upper portion of the dash-pot, no further resistance will be offered to its progress and it will quickly complete its upward movement. These mechanical operations are of great importance in the electrical operation of the lamp, especially when starting, as will be hereinafter fully explained.

A long-range spring-arm 10, preferably larger at one end than at the other, is secured at its larger end to the shaft 4 of lever 5 and at its smaller end to the core B' of the solenoid, the movements of the core B' being thus transmitted to the lever through the medium of the said long-range spring arm or lever 10. The upward movement of the lever 5 will be limited by the core B' and the dash-pot, and the downward movement of said lever will be limited by a screw 11 at the lower end of an arm 12, the latter being supported from the plate 2.

A bracket 12 is secured to the cap *c* at one side thereof and made with a binding-post 13 for the reception of one of the leading-in wires of the lamp. A hood or frame 14 is made integral with the bracket 12, and at one end has a perforated enlargement 15 for the reception of the upper end of a guide-tube 16, the lower end of said guide-tube being fastened to a plate 17, secured to but insulated from the lamp-floor. A guide-rod 18 is secured at its upper end to the bracket 12, passes through the plate 17, and at its lower end is electrically connected with the lamp-arm C. Between said guide tube and rod a cross-head 19 is disposed, said cross-head having rollers 20 mounted thereon to run on said guide tube and rod.

An arm 21 is secured to the cross-head and is effectually insulated therefrom, preferably by means of non-combustible material 22, such as mica. The arm 21 projects laterally from the cross-head and is provided at its free end with ears 23, between which the upper-carbon holder 24 is pivotally connected. In order to permit the cross-head 19 to move freely between its guides without binding, said cross-head is provided with a weight 25 at the opposite side thereof from the arm 22, adapted to counterbalance said arm and parts carried thereby.

The upper-carbon holder is connected, by means of a flexible cable 26, with one end of the coil of the solenoid, and the other end of said coil is connected with a binder 27, which latter is also adapted for the reception of the plus leading-in wire.

The arm C of the lamp is secured to and insulated from the base of the lamp-frame and is made throughout the major portion of its length in the form of a flat hollow shield 29, which communicates at its upper end with an elongated slot 30 in the plate 17. Through this slot and into the hollow shield a clutch-blade 31 projects, the upper end of said clutch-blade being secured to the cross-head. The lower end of the clutch-blade is provided with a roller 31^a, adapted to roll within the shield 29.

A rod 32 is located in the guide-tube 16 and projects downwardly through a portion of the lamp-arm. To the upper end of this rod a chain 33 or other flexible device is connected and passes up over a pulley 34, mounted in the hood 14. From the pulley 34 the chain is extended downwardly and connected to the cross-head 19.

The lamp-arm C is made with parallel flanges 35, having inwardly-projecting guide-ribs 36, which enter grooves made in the opposite faces of a sliding bracket 37, the latter being secured to the lower end of the rod 32. The bracket 37 is made with an outwardly-projecting flattened arm 38, to which the lower-carbon holder 39 is connected. Above the lower-carbon holder a carbon-guide 40 is secured to the arm of the lamp, or, more strictly speaking, to a lug projecting from the shield 29.

The globe-holder 41, with attached ash-receiver 42, is removably connected with the lower end of the lamp-arm. For this purpose the globe-holder is made with inwardly-projecting ears 43, to which a socket-piece 44 is secured and adapted to receive the lower end of the lamp-arm and lie flat against the rear face thereof. The socket-piece or casting 44 is made with hooks 45 adapted to engage lugs 46 on the lamp-arm, and thus sup-

port the globe-holder on said arm. The socket-piece 44 is preferably insulated from the globe-holder, and the latter is prevented from accidental displacement from the lugs 46 by means of a bar 47, which is connected to the lamp-arm at one end and at the other end bears on the socket-piece 44. A globe 49^a is supported in the globe-holder, and the space between the top of the globe and the bottom of the lamp-casing is closed by wire netting, which serves as a spark-arrester 49^b. The frame of the spark-arrester is composed of two sheet-metal strips 49^c 49^d, secured to the edges of the wire-netting, the strip 49^c being made wider than the strip 49^d and adapted to rest on the globe, said strip 49^c having a scalloped or otherwise decorated lower edge which gives a finish to the top of the globe. One end of the spark-arrester is made with a lip 49^e to overlap the other end. The strip 49^c is made at one end with an elongated slot 49^f, through which a screw 49^g on the other end of said strip passes. A thumb-nut 49^h is placed on the end of this screw and made to bear on the end of the strip 49^c. Thus the spark-arrester can be readily adjusted to properly fit the globe, and can be secured at any desired adjustment.

From the construction and arrangement of parts above described it will be seen that the upper-carbon holder is electrically connected with the coil of the solenoid, which latter is connected with the plus leading-in wire, and that the lower-carbon holder is electrically connected with the minus terminal of the lamp through the lower-carbon holder, rod 32, chain 33 to hood 14, also through lamp-arm, guide rod and tube, plate 17, cross-head, flexible mechanical connection between cross-head and rod 32. The lower-carbon holder is connected with the lamp-arm by means of a flexible conductor e^2.

An adjustable rod 48 is connected at one end to the lever 5 at a point in proximity to its fulcrum, and at the lower end said rod is connected with a clutch 49 adapted to grasp the clutch-blade 31, so that when the lever 5 is raised the clutch-blade will also be raised, resulting in the separation of the carbons, the upper carbon moving upwardly and the lower carbon moving downwardly.

The clutch 49 comprises two jaws 50 51, having flat faces adapted to engage the respective faces of the clutch-blade and an operating-lever 52. The jaw 50 is made with parallel arms 53, between which the jaw 51 is disposed, and these arms terminate in curved downward extensions 54. Each arm 53 is made with a downwardly-projecting tooth 55 which are engaged by similar teeth 56 on the lever 52, whereby to form a fulcrum for said lever. The lever 52 is made with a yoke 57 which projects forwardly and loosely embraces the jaws 50 51, the free end of said yoke being curved upwardly and made with a hole 58 for the attachment of the rod 48. The curved extensions 54 of the jaw embrace the rear end of the yoke and prevent the displacement of the lever 52. The lever 52 is made with a long arm 59 adapted to engage an insulated stop 60 on the lamp floor or base, and at the inner end of this arm a recess 61 is made in the upper face thereof for the accommodation of a lug 62 projecting from the back of the jaw 51. A screw 63 is inserted in the rear face of the jaw 51, and so as to be disposed under the inner end of the arm 59, said lug and screw serving to prevent vertical displacement of said jaw 51.

The extreme inner end of the arm 59 of the lever 52 bears against the rear face of the jaw 51 between the lug 62 and screw 63 and below the fulcrum of said lever on the arms 53 of jaw 50. From this construction and arrangement of parts it will be seen that when the lever 5 moves up the rod 48 will pull on the yoke end of lever 52 and cause the latter to turn on its fulcrum and force the jaws tightly against the blade 31, so as to clutch the same, a continued upwardly movement of said lever 5 causing the clutch-blade to be raised and the carbons separated in an obvious manner. When the lever 5 moves downwardly the clutch-blade and clutch will move downwardly also, and when they have moved downwardly sufficiently to permit the arm 59 of lever 52 to engage the stop 60 on the lamp-floor the arm 59 of lever 52 will be raised and the clutch-blade released from the clutch to permit the carbons to feed.

As above stated, the most objectionable feature in the operation of an arc lamp with an alternating current is the annoying chattering caused when the lamp is started, and this chattering is due to the repeated breaking and making of the circuit between the carbons during the time the points of the carbons are becoming sufficiently heated to insure the maintenance of the normal arc. It is known that before the normal arc can be maintained, when an alternating current is employed, the carbon points must be sufficiently heated to throw a certain amount of volatilized carbon. In alternating-current arc lamps the separating solenoid or magnet is included in series in a normally-closed circuit with the carbons, so that when the current first enters the lamp the resistance is so low that a heavy current passes through the solenoid or magnet and causes it to become so strong as to violently separate the carbons to the full extent for a normal arc and before the points of the carbons can have possibly become sufficiently heated to insure the maintenance of the normal arc. The arc is therefore ruptured and the circuit instantly broken, thus depriving the solenoid of its energy and permitting the carbons to again come together and close the circuit through the solenoid, the result of which is to again violently separate the carbons. These operations, with the accompanying chatter, will continue until the temperature of the points of the carbons shall have reached such a degree as will cause them

to throw off sufficient volatilized carbon to insure the maintenance of the normal arc. By my improvements I avoid these continuous violent separations of the consequent breaking of the circuit with accompanying chatter, and this result I accomplish by causing a small preliminary arc to be formed and maintained for a sufficient length of time to properly heat the carbon points to insure the maintenance of the subsequently-formed normal arc. The action of the parts in the performance of these functions is as follows:

When no current is passing through the lamp the parts assume the positions shown in Fig. 1, with the carbons in contact with each other. When the current enters the lamp, the solenoid will be energized to raise its core, which movement of the core will be transmitted to the lever 5 through the medium of the long-range spring 10. The free upward movement of the lever 5 will be permitted until the piston of the dash-pot reaches the perforations in the latter, during which movement of said lever the carbons will be slightly separated, so as to form a small preliminary arc between them. As soon as the piston 7 reaches the perforations in the dash-pot, the upward movement of the lever 5 and the separation of the carbons will be retarded, and this retarded movement of the lever and carbons will continue until the piston 7 passes above the smaller portion of the dash-pot 8, during which time the preliminary arc is being maintained and the carbon points heating to a sufficient degree to maintain a normal arc. As soon as the piston 7 reaches the enlarged upper end of the dash-pot 8, the resistance against its further upward movement will be removed and it will move freely upwardly, permitting the lever 5 to be freely raised by the action of the solenoid, acting through the long-range spring 10, and the carbons to be separated sufficiently to form a normal arc which will be maintained. The enlarged portion of the dash-pot is of sufficient extent to permit a free movement of the piston up and down to allow the proper movements of the lever 5 for feeding the carbons.

An advantage gained by having the core or armature attached to the mechanism through a proper range-spring of proper strength is the prevention of an abnormal rise of current, as the core having drawn up into the spool forms an effectual choking-coil and the current cannot rise much above normal. The action continues while the arc is slowly forming its proper resistance.

By a proper proportioning of the strength and range of the lever-spring 10 in connection with the dash-pot that will first allow a short free movement of the carbons, then retard their movement for a short period and again permit perfect freedom, a complete and perfect starting of an alternating lamp without the usual chattering is secured.

My improvements are comparatively simple in construction and effectual in all respects in the performance of their functions.

Various slight changes might be made in the details of construction of my invention without departing from the spirit thereof or limiting its scope, and hence I do not wish to limit myself to the precise details of construction herein set forth; but,

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

1. In an arc lamp, the combination with a separating-magnet and the carbons, of a pivoted lever connected with the carbons and with the armature of the magnet, and a dash-pot, the piston of which is connected with the armature of said lever said dash-pot being so constructed and arranged as to first permit a free movement of the lever to cause the formation of a small arc between the carbons; then retard the movement of the lever whereby to maintain said small arc for a short period, and then permit the free movement of the lever whereby to allow the carbons to be separated sufficiently to form a normal arc, substantially as set forth.

2. In an arc lamp, the combination with a separating-magnet and the carbons, of a pivoted lever connected with the armature of the magnet and with the carbons and a dash-pot having its piston connected with the lever, the bore of said dash-pot being larger at one end than at the other, substantially as and for the purpose set forth.

3. In an arc lamp, the combination with the separating-magnet and the carbons, of a pivoted lever connected with the armature of the magnet and with the carbons, and a dash-pot having its piston connected with said lever, said dash-pot having a bore larger at one end than at the other and having perforations in its smaller part, substantially as and for the purpose set forth.

4. In an arc lamp, the combination with a separating-magnet and the carbons, of a lever pivoted at one end and connected with the carbons, and a long-range spring secured at one end to the pivoted end of the lever and connected at the other end to the armature of the magnet, substantially as set forth.

5. In an arc lamp, the combination with a separating-magnet and the carbons, of a pivoted lever connected with the carbons, and a flat spring secured at one end to the pivoted end of the lever and connected at the other end to the armature of the magnet, substantially as set forth.

6. In an arc lamp, the combination with the separating-magnet and the carbons, of a plate secured to the spool of the magnet and having arms, a shaft mounted between said arms, a lever secured to said shaft and connected with the carbons, and a spring also secured to said shaft and connected with the armature of the magnet, substantially as set forth.

7. In an arc lamp, the combination with a

separating-magnet and the carbons, of an oscillatory shaft, a lever secured to said shaft, a dash-pot having its piston connected with the free end of said lever, and a spring secured at one end to said shaft and connected at its other end with the armature of the magnet, substantially as set forth.

8. In an arc lamp, the combination with a casing, of a magnet having a wooden headed spool secured to said casing, a plate secured to said wooden spool, a lever pivotally supported by said plate, having a yielding connection between the pivoted end of said lever and the armature of the magnet, and a connection between said lever and the carbons of the lamp, substantially as set forth.

9. In an arc lamp, the combination with a frame or casing having a hole in its top, of a separating-magnet, the upper head of the spool of said magnet having a conical hole, and a screw having its head disposed in said conical hole and its body portion projecting through said hole in the top of the casing, and a nut on said screw, substantially as set forth.

10. In an arc lamp, the combination with a guide-tube and a guide-rod, connected at one end with the negative terminal of the lamp and a plate connected with their other ends, of a sliding cross-head disposed between said tube and rod, an arm secured to and insulated from the cross-head, an upper-carbon holder connected to said arm and with the positive terminal of the lamp and a lower-carbon holder connected with the cross-head, substantially as set forth.

11. In an arc lamp, the combination with a hood connected with the negative terminal of the lamp, of a guide-tube and a guide-rod secured to said hood, a sliding cross-head between said tube and rod, an upper-carbon holder carried by but insulated from the cross-head, a rod in the tube, a lower-carbon holder attached to said rod, a pulley mounted in said hood and a chain connected to the rod in the guide-tube and to the cross-head and passing over said pulley, substantially as set forth.

12. In an arc lamp, the combination with a casing and vertical guides therein, of a sliding cross-head between said guides, a laterally-projecting arm secured to but insulated therefrom, a lower-carbon holder, a flexible connection between the lower-carbon holder and the cross-head, and a weight on said cross-head adapted to counterbalance said laterally-projecting arm and parts carried thereby, substantially as set forth.

13. In an arc lamp, the combination with the upper-carbon holder, of guides, a lamp-arm, lower-carbon holder, and a cross-head between said guides all connected with the negative terminal of the lamp, a flexible mechanical connection between the cross-head and lower-carbon holder, and an arm secured to but insulated from the cross-head for carrying the upper-carbon holder, substantially as set forth.

14. In an arc lamp the combination with a casing and a lamp-arm secured thereto and having lugs near its lower end, of a globe-holder having inwardly-projecting ears, a socket or casting secured to and insulated from said ears and adapted to receive the lamp-arm, and hooks on said socket or casting adapted to engage the lugs on the lamp-arm, substantially as set forth.

15. In an arc lamp the combination with a casing and a lamp-arm secured thereto, and having lugs near its lower end, of a globe-holder having inwardly-projecting ears, a socket or casting secured to and insulated from said ears and adapted to receive the lamp-arm, hooks on said socket or casting adapted to engage the lugs on the lamp-arm and a bar attached to the lamp-arm and adapted to prevent accidental displacement of the globe-holder, substantially as set forth.

16. In an arc lamp, the combination with a casing, and guides therein, a sliding cross-head between said guides, and an upper and a lower carbon holder connected with said cross-head, of a hollow, flat lamp-arm, a clutch-blade secured to the cross-head and entering said arm, a roller mounted in the end of said clutch-blade, and a clutch, substantially as set forth.

17. In a clutch, the combination with the jaws, of arms projecting from one jaw, and a lever having its fulcrum on said arms and having bearing below its fulcrum against the other jaw, substantially as set forth.

18. In a clutch, the combination with two jaws, of arms on one of said jaws adapted to receive the other jaw between them, a lever adapted to bear against the last-mentioned jaw, said lever having a yoke to embrace both of said jaws and having its fulcrum on said arms above the bearing of said lever against the jaw, substantially as set forth.

19. In a clutch the combination with two jaws, of arms projecting from one jaw and adapted to receive the other jaw between them, teeth projecting from said arms, a lever adapted to embrace said jaws and bear against one of them, and teeth or projections on the lever adapted to bear against the teeth on said arms, substantially as set forth.

20. In a clutch the combination with two jaws, of arms projecting from one of said jaws and embracing the other jaw, said arms having curved extensions and a lever adapted to embrace both of said jaws and bear against one of them, said lever having its fulcrum on said arms and said curved extensions serving to prevent displacement of said lever, substantially as set forth.

21. In a clutch the combination with two jaws, of arms projecting from one of said jaws and embracing the other, said arms having curved extensions, and a lever having one end made to form a yoke to embrace said jaws

and bear against one of them, said curved extensions being disposed behind said yoke to prevent the displacement of the lever, substantially as set forth.

22. In a clutch, the combination with two jaws, of arms projecting from one of said jaws, a lever fulcrumed on said arms, one end of said lever being made to form a yoke to embrace the jaws and the other end being made in the form of a long arm, the inner end of which engages one of said jaws, substantially as set forth.

23. In a clutch, the combination with two jaws, one of said jaws having arms, of a lug on the back of the other jaw and a lever fulcrumed on said arms and bearing against said last-mentioned jaw at the base of the lug thereon, substantially as set forth.

24. In a clutch, the combination with two jaws, one having arms, of a lug and a screw on the back of the other jaw, and a lever having a yoke to embrace said jaws and having a fulcrum on said arms, said lever also having a bearing against the last-mentioned jaw between said lug and screw, substantially as set forth.

25. In an arc lamp, the combination with the lamp casing and globe, of a spark-arrester between said casing and globe, the frame of said spark-arrester being slotted, a screw passing through said slot and a thumb-nut on said screw, substantially as set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

THOMAS EDGAR ADAMS.

Witnesses:
CHAS. H. POST,
B. F. WHITMAN.