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ENCLOSED ARC STARTING DEVICE

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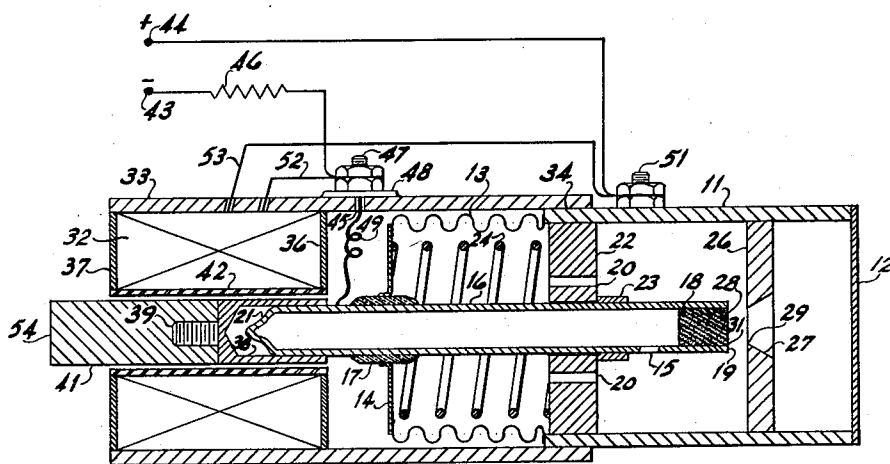


Fig. 1

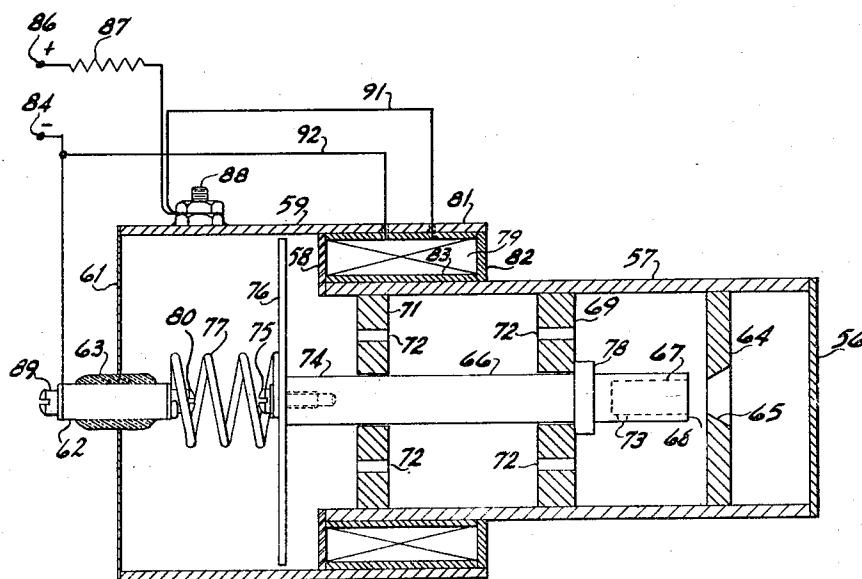


Fig. 2

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ENCLOSED ARC STARTING DEVICE

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11 Claims. (Cl. 313-152)

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This invention pertains to enclosed arc-lighting devices and more particularly to means for starting the arc-discharge in such devices.

This invention is applicable to any type of enclosed arc but it is especially useful when applied to that type of enclosed arc lamp for producing visible light in which light is produced principally at the surface of the cathode electrode. Such an enclosed arc is described in the copending patent application Serial No. 83,129 of Hubert B. Deri, filed March 24, 1949.

Enclosed arcs are ordinarily started by the application of an elevated voltage superimposed upon the arc supply circuit so as to be effective across the arc electrodes. This elevated voltage may be either alternating at low or high frequencies, rectified or pulsed direct voltage, or a momentary inductive surge caused by breaking the current through an inductor. In each of these methods of starting, equipment is required which is bulky and expensive, so that a need has long existed for a better and cheaper method of starting the arc discharge.

The instant invention provides means for moving one of the electrodes within the arc enclosure and without breaking the hermetic seal thereof, to touch the electrodes together momentarily to start the current flow. Then when the electrodes are separated the arc is drawn between them. Means are also provided for automatically starting the arc, if for any reason the arc should be extinguished.

Therefore, one purpose of this invention is to provide a simple and inexpensive means for starting an enclosed arc.

Another purpose is to provide an improved enclosed arc lamp structure in which the two electrodes are readily movable relative to each other without affecting the hermetic seal.

A further purpose is to provide improved electrically operated mechanical starting means for an enclosed arc.

A still further purpose is to provide an improved electrical starting means for an enclosed arc lamp that automatically restarts the lamp if it becomes extinguished while power remains connected.

A better understanding of the invention can be secured from the detailed description together with the drawings, in which:

Figure 1 is a cross-sectional elevation of an embodiment of the invention.

Figure 2 is a cross section of a modified form of the invention having all moving parts within a sealed enclosure.

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Referring now to Fig. 1, an embodiment of the invention chosen for purposes of illustrating the invention comprises a gas-tight envelope having a metal cylinder 11 closed and sealed at one end by a transparent glass disc 12. To the other end of the metal cylinder 11 is sealed one end of a flexible metallic bellows 13, the other end of the bellows being sealed to a metal disc 14. A metal tube 16, drawn to an enlarged scale for clarity, extends through a central hole in the disc 14; the disc 14 and tube 16 being sealed together mechanically and electrically insulated each from the other, by the interposition of a metal-to-glass seal, indicated at 17.

The metal tube 16 constitutes part of the arc cathode structure. The cathode 18, per se, comprises a plug of metallic oxides serving as a light emitter. The exposed end 28 of this plug is flush with the end 19 of the tube 16. A hole 15 in the tube 16 insures equalization of gas pressure on both ends of the plug 18. The other end 21 of the tube 16, opposite to the cathode end, is utilized as the tubulation for exhausting the envelope and filling it with an inert gas, after which it is pinched off and sealed. A ceramic disc 22 is fixed in the cylinder 11 to serve as a guide for the tube 16, fixing it against transverse movement while permitting axial movement. Holes 20 in the disc 22 insure equalization of gas pressure on the two sides of the disc. A stop ring 23 is fixed to the tube 16, and a compression spring 24 is provided inside the bellows 13, with the respective ends of the spring 24 engaging the disc 14 and the ceramic disc 22. The preloading of the spring 24 is such that normally the cathode tube 16 is forced to the left until the stop ring 23 abuts the ceramic disc guide 22.

The gas with which the envelope is filled may be of any desired inert kind, for example argon or helium, and at any desired pressure which will maintain an arc discharge without appreciably combining with the electrode materials during operation of the arc. In this embodiment the pressure is approximately one atmosphere.

A metallic disc 26 is fixed in the cylinder 11 to serve as the anode. The disc anode 26 is preferably made of tungsten or molybdenum. It has an aperture 27 preferably of conical shape, so that light emitted by the emitting surface 28 of the emitter plug 18 can radiate out of the arc lamp through the transparent disc window 12. The inner edge 29 of the aperture 27 is in line with the inner edge 31 of the tube 16, so that

upon movement of the tube 16 to make contact with the anode 26 in the operation of starting, to be described later, the metal of the tube 16 rather than the emitter plug 18 makes contact with the metal of the anode 26.

A starting solenoid 32 is mounted on a cylindrical frame member 33 that is telescoped over the cylinder 11, forming a rigid and fixed lap joint 34. To enhance the operation of the solenoid 32, the frame member 33 is preferably made of magnetically permeable material, or at least so much of member 33 as encloses the solenoid 32. The remainder of member 33 may be made of insulating material, if desired. The ends 36 and 37 also are permeable for the same reason. A brass member 38 is press-fitted over the tube 16 and is provided with a screw-threaded stud 39 which engages a threaded bore in a magnetically permeable extension 41 that constitutes an armature for the solenoid 32. The solenoid is mounted on a nonpermeable cylinder 42 to allow the magnetic effect of the solenoid to be exerted upon the armature 41. The material of the lining 42 is chosen to be electrically nonconductive to obviate the possibility of short-circuiting the electrodes during any side motion of the armature 41.

A direct current supply of electrical power is applied at terminals 43 and 44, a stabilizing impedance being interposed in series with either one of the supply terminals as indicated by the resistor 46 connected to the negative terminal 43. From the other end of the resistor 46 connection is made to a terminal 47 on the frame 33 of the arc-light device, the terminal 47 being insulated from the casing 33 by a pad of insulating material 48. This terminal 47 is electrically connected by a conductor 49 extending through the opening 45 to the cathode tube 16. The positive supply terminal 44 is connected to a terminal 51 electrically connected to the metallic envelope 11 of the enclosed arc, which is in thermal and electrical contact with the anode disc 26. The two terminal conductors 52 and 53 of the solenoid 32 are connected, respectively, to the two terminals 47 and 51, putting the solenoid in shunt with the electrodes 18 and 26.

Before the enclosed arc is put into operation the relative positions of the anode 26 and cathode 18 are as shown in Fig. 1, with the cathode stop 23 pressed against the ceramic guide 22 by the spring 24, and with the cathode and anode separated. The cathode and anode are therefore insulated from direct contact with each other but as they are shunted by the solenoid 32 a current path exists from the positive terminal 44 to terminal 51, through conductor 53 through the solenoid 32 and conductor 52 to terminal 47, and thence through resistor 46 to the negative supply terminal 43. When, therefore, a suitable potential is applied to the terminals 43 and 44 the solenoid 32 is energized and moves the plunger 41 to the right to a position nearer the center of the solenoid. Movement of the plunger 41 moves the tube 16 against the force of the spring 24 and toward the anode 26, so that the end 19 of the tube 16 is pressed against the metal anode 26 and makes electrical contact therewith. With electrodes in contact the solenoid 32 is short-circuited and thereby de-energized, permitting the spring 24 to restore the cathode 16 to its former position with its stop 23 pressed against the guide 22. During this action, as the cathode tube end 19 leaves the anode lip 29, an arc is drawn between these two parts. Experience shows that

the cathodic termination of the arc, that is, the point on the cathode at which the arc terminates, quickly migrates to the center of the emitter plug 18 of the cathode. It will readily occur to those skilled in the art that instead of the shunt solenoid, a properly designed series solenoid could be substituted. In the latter event, it would be necessary to arrange the spring so that the cathode 18 is normally urged toward the anode when no current is flowing. Then when current was flowing the solenoid would retract the cathode to start the arc.

After the arc starts, its impedance being substantially less than that of the solenoid 32, the short-circuit of the solenoid is effectively continued, so that the solenoid 32 remains de-energized as long as the arc is maintained. If, however, the arc should be extinguished in any manner, while the electrical power supply remains connected to the device, as for instance by a transient pulse of opposing polarity superimposed upon the supply power, the solenoid 32 is then immediately reenergized and the above described starting action automatically takes place again, restarting the arc.

It is obvious that the arc can be started manually by pressing the projecting end 54 of the armature of plunger 41 until the anode 26 and cathode 18 make contact with each other, then releasing the armature, which is returned to its normal operating position by the spring 24, drawing and starting the arc as before described. In such manual operation the solenoid 32 is not necessary and may be omitted from the device, and the automatic restarting will of course not occur. Such manual operation can of course be effected not only by pressing with the hand against the plunger 41 but as well by moving the tube 16 by any other means such as by mechanical or hydraulic devices.

In Fig. 2 the arc is enclosed in a sealed envelope comprising a transparent glass disc 56, a metal cylinder 57, an insulating sealing ring 58, a second metal cylinder 59, an end disc 61, and a cylindrical electrical terminal 62 sealed to the end disc 61 by a glass seal 63. This envelope is provided at any convenient point with a tubulation, not shown, in accordance with conventional practice for evacuating and filling the gas envelope to approximately atmospheric pressure. The metal cylinder 57 contains a metallic anode disc 64 in good electrical and thermal contact therewith. The anode disc is provided with a conical aperture 65. Behind this aperture is the cathode structure consisting of a cylindrical bar 66 having a recess 67 in the forward end filled with a plug of emitting material the outer end of which is flush with the plane of the end 68. This end is so positioned that upon movement of the cathode to the anode the metal rim of the end 68 makes metallic contact with the metal anode disc 64. The bar 66 is guided by two guide discs 69 and 71, made of insulating material, preferably, ceramic material. Both discs have perforations 72 to equalize the gas pressure on the opposite sides of the discs. A magnetically permeable armature disc 76 is fixed to the end 74 of the bar 66 by means of a suitable screw 75 which also secures one end of a tension spring 77 to the bar 66. The other end of the spring 77 is secured by means of a screw 80 to the electrical terminal 62. The spring 77 is preferably made of a material having good electrical conducting properties, such as Phosphor bronze, because it must carry the current through the arc. The bar 66 has a stop-

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collar 78 which normally is pressed against the guide disc 69 by the tension of the spring 77, holding the anode and cathode apart at a specific distance.

A coil 79 is positioned upon the cylinder 57 and an annular flat ring 82 of magnetic material cooperates with the permeable cylinders 81 and 83 to provide a magnetic path of increased permeability. The magnetic path is open on the side adjacent the insulating and nonmagnetic ring 58 to increase the magnetic flux through the armature 76.

Electrical power is applied from direct current terminals 84 and 86 through a series stabilizing resistor 87 to an anode terminal 88 and a cathode terminal 89, respectively, so that the power to the arc is supplied from the anode terminal 88 through the annular flat ring 82 and the cylinder 57 to the anode disc 64, and from the cathode terminal 89 through the electrical terminal 62 and spring 77 to the cathode bar 66 and the emitting material in the recess 67. The terminal conductors 91 and 92 are connected to the terminals 88 and 89 so that the coil 79 is in shunt with the arc electrodes.

Upon application of electrical power to the terminals 84 and 86 the coil 79 is energized, attracting the disc armature 76 and forcing the cathode bar 66 into contact with the anode 64 against the tension of spring 77. Upon contact, the coil is deenergized, the spring retracts the cathode bar, and an arc is drawn, the low impedance of the arc in shunt with the coil preventing reactuation thereof as long as the arc is maintained. If the arc should go out while power remains on, the starting action is automatically repeated to restart the arc.

The action of this embodiment is thus similar to that of the embodiment of Fig. 1, a principal difference being that in Fig. 2 the magnetic armature is within the sealed envelope.

It is obvious that numerous other combinations may be made of solenoids of various types with various sealing arrangements that will be equivalents of the described preferred embodiments. As an example, a simple flexible diaphragm may be substituted for the two embodiments shown. Also, it will be readily apparent that either electrode may be movable.

What is claimed is:

1. An enclosed arc lamp comprising, a gastight metallic tubular envelope enclosing an inert gas atmosphere and having a transparent window sealed in one end of said tubular envelope, a cathode assembly insulatingly sealed to the other end of said envelope and comprising a metallic tubular support member having a recess facing said window and having a light emissive material filling at least the outer end of said recess, said elongated support member being supported for longitudinal movement within said envelope, a disc shaped metallic anode positioned between said cathode and said window and having its periphery in intimate electrical engagement with the interior surface of said metallic envelope, said disc shaped anode having an aperture in the center thereof for transmission of light therethrough from said cathode, the size of said aperture being substantially the same as that of said recess in the elongated support member of said cathode assembly, and means for moving said cathode assembly toward said anode for momentary contact to strike an arc between said elongated support member and said anode.

2. An enclosed arc lamp comprising, a gastight

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metallic tubular envelope enclosing an inert gas atmosphere, a disc anode fixed in electrical contact within the surface of said envelope and positioned transversely of the axis of said cylinder, a cathode assembly insulatingly sealed to said envelope and comprising a metallic elongated support member having a recess in the end thereof which is within said envelope, said recess having light emissive material filling at least the outer part of said recess, said elongated support member being mounted for longitudinal movement axially of said envelope, resilient means for normally holding said cathode at a position spaced from said anode, and means for moving said elongated support member of said cathode assembly toward said anode for momentary contact to strike an arc between said elongated support member and said anode.

3. A combination as set forth in claim 2 in combination with means for applying an energizing potential between said cathode and anode and means responsive to energization of said electrodes for moving said elongated support member against said anode for momentary contact to strike an arc.

4. In an enclosed arc lamp, a gastight metallic tubular envelope enclosing an inert gas atmosphere and having a transparent window sealed in one end thereof, a disc anode fixed in electrical contact with said envelope and positioned within said envelope adjacent said window, a cathode assembly insulatingly mounted within said envelope for movement axially of said envelope, said cathode assembly comprising a metallic elongated tubular member having a recess in the end thereof facing said window, said recess having light emissive material filling at least a part of said recess, said anode having a central aperture which is of substantially the same size as the recess in said elongated member, and resilient means for normally holding said cathode structure in a position such that the support member is spaced from said anode, means for applying an energizing potential across said anode and said cathode, and means responsive to the energization of said electrodes for moving said elongated support member toward said anode for a momentary contact to initiate the arc discharge.

5. An enclosed arc lamp as defined in claim 4 in which said means for moving said elongated member toward said anode is responsive to the initiation of the arc to permit said resilient means to thereafter move said elongated support member of said cathode assembly to a position spaced from said anode to maintain the continuation of said arc.

6. In an enclosed arc lamp, a gastight tubular envelope enclosing an inert gas atmosphere and having a transparent window sealed in an end thereof, a cathode assembly insulatingly supported within said envelope and mounted for movement axially of said envelope, said cathode assembly comprising a metallic elongated tubular member having a recess at the end thereof facing said window, said recess having light emissive material therein, a disc shaped metallic anode positioned between the end of said elongated member having said light emissive material and said window, said metallic anode having its periphery in electrical engagement with the interior surface of said metallic envelope and having a central aperture therein for transmission of light therethrough from the light emissive material in said elongated tubular mem-

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ber, a magnetic armature on the other end of said elongated tubular member means magnetically associated with said armature to move said elongated tubular member into engagement with said anode to initiate the arc.

7. In a combination with the enclosed arc lamp defined in claim 6, resilient means for normally holding the recessed end of said tubular member at a position spaced from said anode member, means for applying an energizing potential between said cathode and said anode, and an electromagnet connected in parallel with the electrodes for magnetic association with said armature for moving said elongated member toward said anode for momentary contact with the latter to strike an arc between the electrodes.

8. In an enclosed arc lamp, a gastight metallic tubular envelope enclosing an inert gas atmosphere and having a transparent window sealed in an end thereof, a cathode assembly insulatingly sealed in the other end of said envelope and comprising a metallic elongated support member having a recess at the end facing said window said recess having light emissive material filling at least part of said recess said elongated support member being supported for longitudinal movement within said envelope, a disc-shaped metallic anode positioned between said cathode and said window and having its periphery in intimate electrical engagement with the interior surface of said metallic envelope, an aperture in said anode for transmission of light therethrough from said cathode, an electrical solenoid, an armature operably associated therewith fixed to said elongated support member of said cathode assembly for moving the latter into contact with said anode, and electrical connections connecting said solenoid and said anode and cathode in parallel.

9. In an enclosed arm lamp a gastight metallic tubular envelope enclosing an inert gas atmosphere, said envelope having a transparent window sealed in one end thereof, an expansive metallic bellows sealed to the opposite end of said envelope, a cathode assembly insulatingly sealed to the other end of said metallic bellows, said cathode assembly comprising a metallic elongated tubular member mounted for movement axially of said envelope and having a recess at the end thereof facing said window, said recess having a light emissive material filling at least a portion thereof, a disc shaped metallic anode positioned between the end of said tubular member and said window and adjacent said window, said anode having its periphery in intimate thermal and electrical engagement with the interior surface of said envelope, a central aperture in said anode for transmission of light

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therethrough from said cathode, a metallic armature fixed to the end of said elongated tubular member opposite to the end containing said recess, a solenoid surrounding said armature for coaction therewith and resilient means for normally positioning the recessed end of said tubular member away from said anode and in opposition to the action of said solenoid.

10. In an enclosed lamp, a metallic tubular envelope having a transparent window sealed in one end thereof and a metallic support insulatingly sealed in the other end thereof, a cathode assembly axially supported for limited longitudinal movement within said metallic tubular envelope comprising a metallic elongated support member having a recess at one end thereof and having a light emissive material filling at least part of said recess, a disc-shaped metallic anode positioned between said cathode and said window and having its periphery in intimate thermal and electrical engagement with the interior surface of said metallic envelope, an aperture in said anode for transmission of light from said cathode therethrough, a filling of inert gas in said envelope, a tension spring connecting the end of said metallic elongated support member opposite said recess to said metallic support within said envelope, a magnetically permeable armature affixed to said metallic elongated support member, and a solenoid positioned to coact with said armature to draw said cathode assembly into contact with said anode against the retractile force of said tension spring.

11. An enclosed arm lamp as defined in claim 10 including means for applying an energizing potential across said cathode and anode and means connecting said solenoid in parallel with said electrodes whereby upon initial energization of said solenoid and said electrodes said cathode tubular member will be brought into momentary contact with said anode member to initiate an arc discharge, the contacting of the electrodes and the subsequent arc discharge serving to short circuit said solenoid whereby said spring will move said elongated support member away from said anode to maintain the arc.

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