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ELECTRIC DISCHARGE LAMP AND STARTING DEVICE THEREFOR

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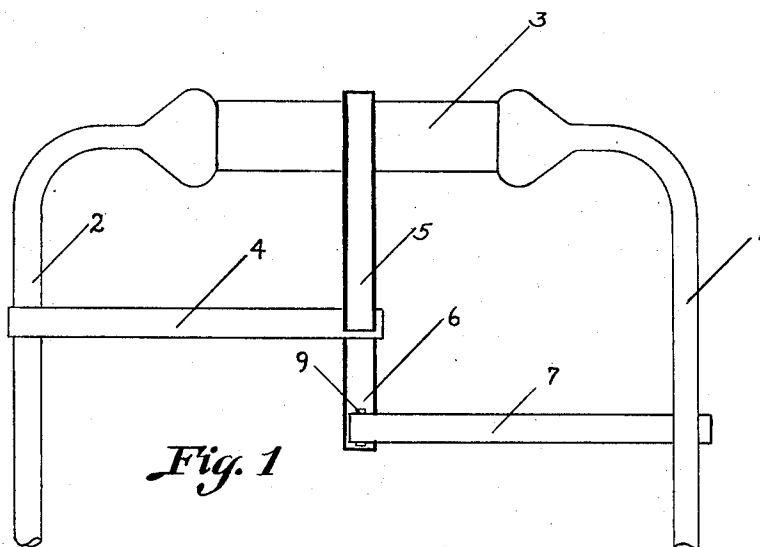


Fig. 1

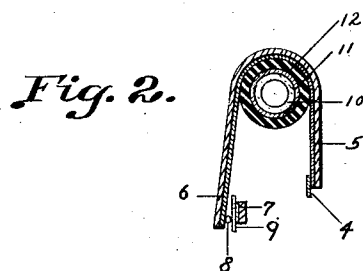


Fig. 2.

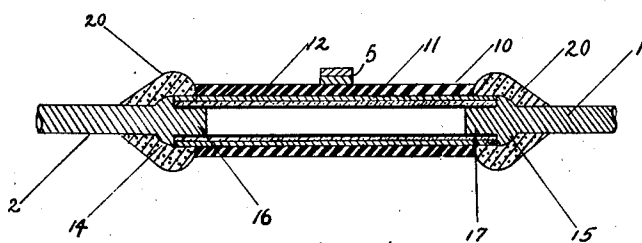


Fig. 3.

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ELECTRIC DISCHARGE LAMP AND
STARTING DEVICE THEREFOR

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6 Claims. (Cl. 200—122)

The present invention relates to electric gaseous discharge lamps, and in particular to apparatus for starting and operating such lamps. It is especially applicable to lamps having thermionic electrodes, but is also applicable in some respects to lamps with other types of electrode.

In my prior and copending application Serial No. 303,397, filed November 8, 1939, Patent #2,195,115, patented March 26, 1940, I have described a circuit for operating a gaseous discharge lamp having filamentary electrodes, and an automatic switch for pre-heating said filamentary electrodes prior to starting the discharge between them. The present application is for an improved automatic switching device which may be used in the same circuit.

Accordingly, an object of the present invention is to provide a thermionic electrode discharge lamp with apparatus for allowing the electrodes to pre-heat for a definite interval before the discharge is started between them. A further object is to provide a switch with the proper time delay to allow pre-heating of the cathode under all possible conditions of starting and restarting, and which will not have a deleterious time lag when put into operation for restarting a lamp. Still another object is to provide a switch which will not cause damage to the fixture or circuit in which it may be used on failure of the lamp which it controls.

A feature of the invention is a switch actuated by a bimetallic strip heated by a resistance rod connected between the electrodes of the lamp to be started. A further feature is a normally open switch which closes when connected to the electromotive force in the lamp circuit, and which then reopens after a period sufficient for the lamp electrodes to become sufficiently heated for starting of the discharge. A further feature is a condenser connected across the switch to reduce radio interference from the lamp.

Other objects, advantages and features of the invention will be apparent from the following description, taken in connection with the accompanying drawing in which:

Fig. 1 is a side view of a device according to the invention;

Fig. 2 is a transverse cross-section through the middle of the device of Fig. 1; and

Fig. 3 is a longitudinal cross-section through Fig. 1.

In Fig. 1 the lead-in wires 1 and 2, which may be of copper, have the cylindrical resistor 3 connected between them. From one wire 2, a flat nickel strip 4 has the bimetallic strip 5 connected

to it and bent around the middle of the resistor 3. The free end 6 of the bimetallic strips 5 extends downward toward the other nickel strip 7 attached to the other lead-in wire 1. Contact points 8, 9, which may be small pieces of silver wire, are fixed to the free ends of fixed strips 7 and bimetallic strips 5 so that the contacts will line up properly to meet when the bimetallic strip is heated. If the contact points are wires one is preferably fixed at right angles to the other so that they meet at a fixed point when in contact.

In Fig. 2, the resistor 3 is seen to comprise a glass tube 10, having a conducting coating 11 which may be, for example, a silver paint, on its outer surface. A suitable electrically insulating coating 12 of shellac or the like is placed over the outside of the resistor coating, and the bimetallic strip 5 is bent around the resistor in a U-shape, preferably in contact with the shellac 12. The latter should be thick enough to insulate the resistor electrically from the bimetallic strip, yet thin enough to conduct heat from the resistor to the strip. The free side 6 of the bimetallic U-strip 5 is preferably made longer than the fixed side 13. The contact pieces 8, 9, if of silver wire, should preferably be at right angles as shown. The contacts should be normally spaced far enough apart, so that with the operating voltage of the lamp across the resistor 3 the contacts will be slightly but definitely open, but with the line or starting voltage across the resistor, they will close.

In Fig. 3, the construction of the resistor 3 is shown. The lead-in wires 1, 2, have a shoulder 14, 15 a short distance from their shanks 16, 17. The shanks 16, 17 fit into the hollow glass tube 10, with the shoulders 14, 15 acting as stops. The glass tube 10 has a coating 11 of a conducting material, which may be a metal film, a silver paint, or the like, sufficient, in thickness and material to provide the proper resistance. A carbon cement 20 is placed over the conducting coating at its ends, and over the shoulders 14, 15, to bond the lead-in wires conductively and mechanically to the conductive coating's ends. A layer 12 of an electrical insulator such as shellac, which has good heat conductivity, is placed over the conducting layer.

I have mentioned the insulating layer 12 as being a coating of shellac, but it is preferably of a more abrasion-resistant material, to avoid breakdown of its insulating qualities. The insulating layer 12 may accordingly be a layer of shellac-impregnated paper, or of a mixture

of shellac and alumina, but I have found a double-layer, the inside of shellac and the outside of a mixture of shellac and alumina very satisfactory.

In making the shellac-alumina mixture, four pounds of shellac were dissolved in one gallon of 190-proof alcohol, and the resultant mixed with its own weight of finely-divided alumina.

In many cases, it may be desirable to use, as the resistor 3, a carbon rod as shown in my prior copending application Serial No. 303,397, filed November 8, 1939. In that case, however, a layer of shellac, shellac-impregnated paper, or other suitable insulation, is preferably placed around the carbon rod, so that the bimetallic strip can be placed in contact with the covered rod to secure better heat conduction. If imperfectly graphitized resistor rods of the type now on the market are used, they will be found to have unstable resistance characteristics. I have found however that if the resistors are connected through a ballast, such as a 10 watt incandescent lamp, to a 220 volt line, the resistor will heat up and reduce its resistance at first, eventually reaching a red heat, after which its resistance will rise slowly if the voltage is kept on it, and the temperature will decrease. If the resistor is a carbon rod of about $\frac{1}{2}$ inch length and 0.06 inch diameter, and is to be used for operating a 40 watt fluorescent lamp from a 220 volt line, the lamp taking about 0.4 amp. at 120 volts, the current should be kept on the resistor until the voltage across the latter rises to about 180 volts. This will give a resistance value of about 50,000 ohms, which will be stable at the temperatures to which it will be subjected in practice.

I have found that my switch operates well in air at the usual atmospheric pressure, say about 760 mm. It gives a sharper break in air at such pressures than it gives at a reduced pressure of inert gas; the sharper break giving, of course, a higher peak voltage for starting. To prevent radio interference from the lamp, a condenser of about 0.006 mfd. may be connected across the switch. The whole unit, including the condenser may be enclosed in a metal container, if desired, with two insulated prongs passing through the container and connected to the lead-in wires 1 and 2 of the switch. The condenser plus the switch may, if desired, be placed inside a small metal container with two insulated lead-in wires or contacts extending out of it.

For use with a 40 watt fluorescent lamp, operating at about 120 volts and 0.40 ampere from a 220 volt line I have used a resistor of about 50,000 ohm resistance. The resistor, if of the metallized open type shown in Figures 2 and 3 may be about one-quarter inch between shoulders, and about one sixty-fourth inch in diameter at its middle. The lead-in wires were about one sixty-fourth inch in diameter, while the nickel strips were about one-sixteenth inch wide and 0.010 inch thick. The bimetallic strip was about one-sixteenth inch wide and 0.008 inch thick. The contact pieces were of .03 inch diameter silver wire, about one sixteenth inch long. The lead-in wires 1, 2 may be of tinned copper and should be stiff enough to provide a rigid backbone for the assembly.

To compensate for the effect of ambient tem-

peratures on the normal gap between contacts 8 and 9, the piece 7 may be itself a bimetallic strip of a length and positioning such that the contacts 8 and 9 move equally and in the same direction with changes in ambient temperature. In that case piece 7 may have to be placed further down on lead-in wire 1 and extended upward toward piece 9 at an angle.

What I claim is:

1. A thermally operated switch comprising: a high-resistance rod; a bimetallic strip electrically connected to one end of said rod and bent around the middle only of said rod, with a free end extending away from said rod and bearing an electrical contact point; an electrically insulating and heat-conducting solid coating over the surface of said rod and between said surface and the entire bent portion of the bimetallic strip; and another electrical contact, the latter being electrically connected to the other end of the resistance rod and in position to meet the contact on the bimetallic strip when the latter is distorted by heating.

2. The switch of claim 1, in which the bimetallic strip is bent around the rod coating in the form of a U, with the plane of the U perpendicular to the plane of the rod, and in which the free end of the U is longer than the fixed end.

3. A thermally operated electric switch comprising: a rod of high resistance; a bimetallic strip electrically connected to one end of said rod and bent around the middle of said rod, with a free end extending away from said rod and bearing an electrical contact point; an electrically insulating and heat-conducting solid coating over the surface of said rod and between said surface and the entire bent portion of the bimetallic strip; and a second bimetallic strip, said strip being placed away from the resistance rod, one end of said strip being electrically connected to the other end of said resistance rod and the other end of said strip bearing a contact in position to meet the contact on the first bimetallic strip when the latter is distorted by heating.

4. A thermally operated switch comprising: a high resistance rod; a bimetallic strip electrically connected to one end of said rod and bent around the middle only of said rod, with a free end extending away from said rod and bearing an electrical contact point; an electrically insulating and heat-conducting solid coating of shellac over the surface of said rod and between said surface and the entire bent portion of the bimetallic strip; and another electrical contact, the latter being electrically connected to the other end of the resistance rod and in position to meet the contact of the bimetallic strip when the latter is distorted by heating.

5. The combination of claim 1 in which that portion of the bimetallic strip which is bent around the middle of the rod is in contact with the coating over the surface of said rod.

6. The combination of claim 4 in which that portion of the bimetallic strip which is bent around the middle of the rod is in contact with the coating over the surface of said rod.

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