March 7, 1944. H. J. McCARTHY 2,343,262

ELECTRIC DISCHARGE LAMP STARTING DEVICE

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Fig. 1

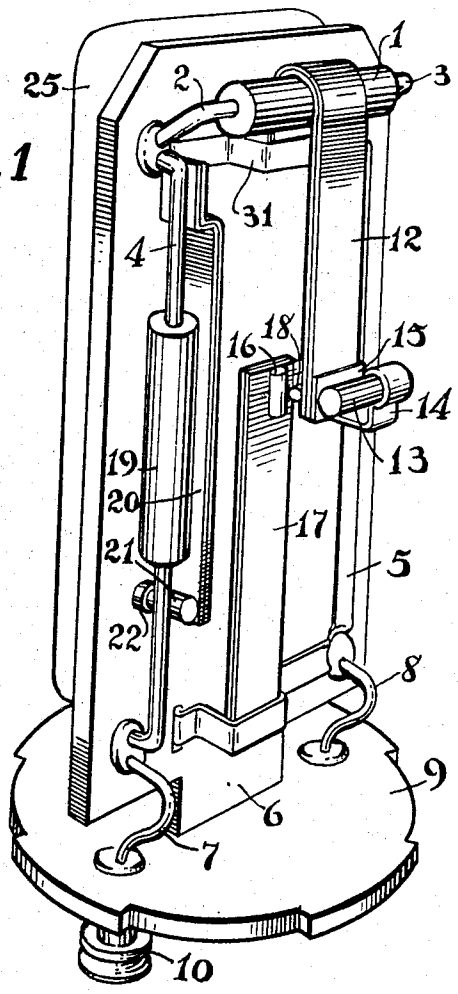

Fig. 4.

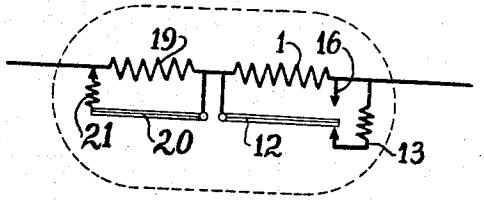

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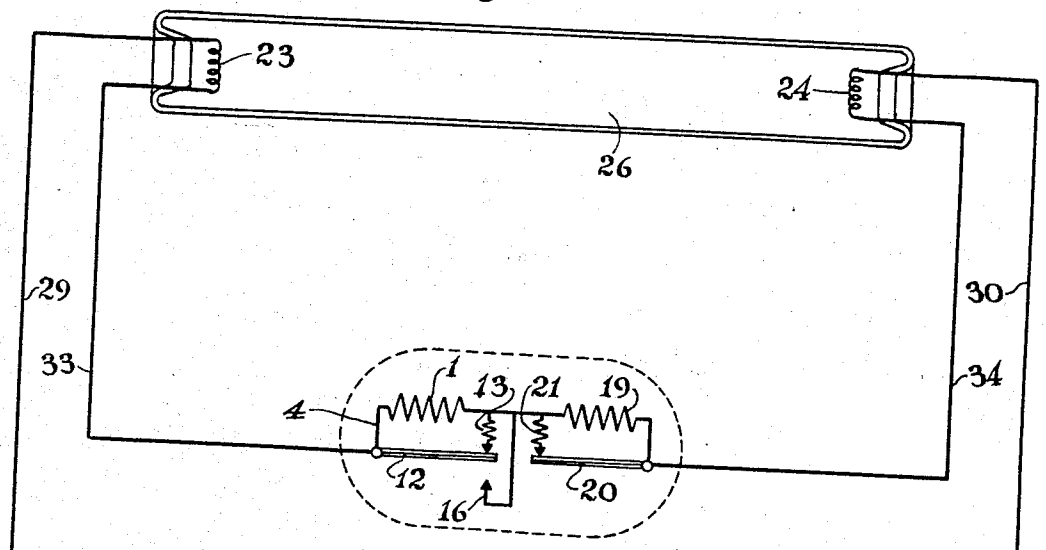
Fig. 2



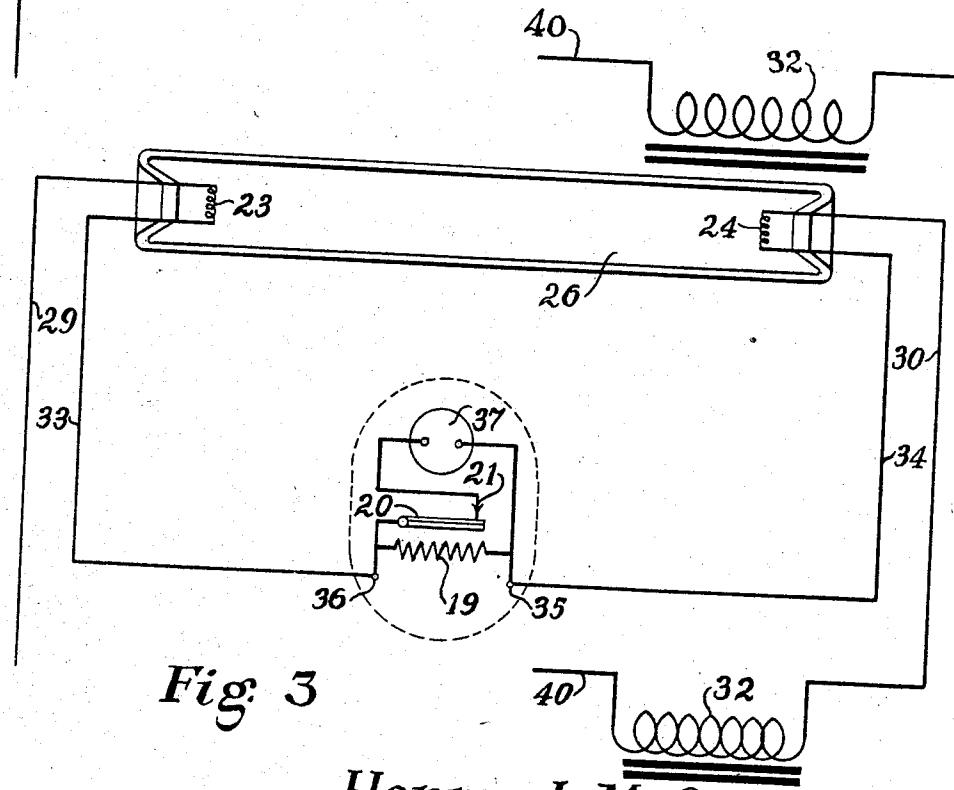


Fig. 3

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ELECTRIC DISCHARGE LAMP STARTING DEVICE

Henry J. McCarthy, Danvers, Mass., assignor to Sylvania Electric Products Inc., a corporation of Massachusetts

Application November 1, 1941, Serial No. 417,544

3 Claims. (Cl. 315—100)

This invention relates to electrical circuit relays and more particularly to relays for regulating the electrode pre-heating period of electric gaseous discharge lamps.

An object of this invention is to provide a fluorescent lamp starter switch which will not only operate to provide a pre-determined heating period for the filamentary electrodes but will also automatically arrest its operation in this respect when for any reason the lamp fails to light.

Another object is to provide a starter switch which will accomplish this arresting operation without putting a strain on the several elements which go to make up the switch or the auxiliary starting apparatus employed in conjunction therewith.

Further objects, advantages and features will be apparent from the following specification taken in conjunction with the accompanying drawings in which:

Figure 1 is a projection of the relay of my invention;

Figure 2 is a schematic diagram of the circuit of the relay of Figure 1.

Figure 3 is a schematic diagram like Figure 2 of another type of circuit to which the features of my invention may be readily adapted without departing from the spirit of the invention.

Figure 4 is a schematic diagram of still another alternate circuit.

In the operation of electric gaseous discharge tubes and more particularly in the operation of fluorescent lamps, a relay is generally employed to permit the pre-heating of the filamentary electrodes sufficient to bring about the striking of the lamp arc. If the lamp arc fails to strike or maintain, the relay operates to provide a second electrode pre-heating period. In this regard, I have found the thermal relay shown in my co-pending application Serial Number 335,968, filed May 18, 1940, and now U. S. Patent No. 2,285,450, granted June 9, 1942, to be of distinct advantage for it provides an auxiliary starting means which operates when the lamp arc fails to strike or maintain in the first instance.

My present invention consists of a thermal relay of the general type shown in the co-pending application with a cut-out embodied therein to arrest the operation of the relay elements if the lamp is faulty. This is a highly desirable feature for it not only eliminates the unsightly appearance which a defective lamp presents when the arc fails to strike despite the successive cycles of electrode pre-heating periods but it also prevents any undue strain being placed upon the auxiliary equipment under said conditions.

In Figure 1 the resistance rod 1 is supported between the supporting wires 2 and 3 which are electrically connected to the wires 4 and 5 running down the relay support 6. The other end of these wires 4 and 5 are connected to the lead-in wires 7 and 8 which extend through the base 9 and into the base pins 10. The bimetallic armature 12 is mounted on the supporting arm 31 on the support 6 and is bent around the resistance rod 1. A coating may be applied to the resistance rod such as the coating described in the above-identified application or in the co-pending application, Serial Number 321,946, filed March 2, 1940. I have found an alumina and shellac mixture satisfactory to insulate the resistor 1 from the bimetallic strip 12 and at the same time conduct heat from the resistor to the strip. I have also found that a coating of thermo-setting and thermo-plastic material also serves to accomplish the desired purpose, i. e., the insulation of the resistor from the bimetallic strip while at the same time permitting the conduction of heat from the resistor to the bimetallic strip. I find it more advantageous if a thermo-setting coat is first applied to the resistor, followed by two coats of thermo-plastic and a final coat of thermo-setting material. In some cases, it may be convenient to form a cylinder of insulation and coat the interior of the cylinder with resistance material such as carbon. A condenser 25 may be placed across the resistance 1 to cut down radio interference due to the operation of the switch and lamp. A condenser of .006 microfarad has proven to be advantageous.

A high resistance contact 13 such as carbon is supported on the outer end of the supporting arm 14, and is normally closed with the bimetallic strip 12 at a point adjacent the free end thereof when the circuit therethrough is dead. A contact 15, such as nickel, may be located on the bimetallic strip 12 so that the closing of the high resistance contact 13 with the bimetal 12 may be through the contact 15, thereby preventing excessive wear on the bimetal. A similar contact 16 may be located on the free end of the compensator 17 for the same reason, in as much as the low resistance contact 18 on the bimetallic strip 12 will come in contact therewith when the auxiliary starting feature of the relay operates.

The cut-out feature of my invention which enables the arresting of the operation of the switch as a means of regulating one or a series of heating periods provided for the filamentary electrodes

of an electric discharge device is accomplished by connecting a resistance rod, a contact of high contact resistance, and a bimetallic strip with the relay as above-described. The wire 4 which connects the wire 2 which supports the resistance rod 1 with the lead-in wire 7 coming up from the base pin 10 has the resistance rod 19 mounted thereon. The bimetallic strip 20 is fixed at one end on the wire 4 and runs along the longitudinal axis of the resistance rod 19 and adjacent thereto to a point beyond an end of said rod. The contact of high contact resistance, such as carbon, 21 is attached to this free end of the bimetal 20 by the supporting clip 22 and when the circuit through the relay is unenergized this contact 21 is closed with the wire 4.

In Figure 2, the lead-in wire 29 from one end of the electrode 23 is connected to one end of the power line from which the apparatus is operated. An end of the other filament 24 is connected through a suitable ballast impedance, such as an inductance coil 32 to the other end of the power line by the lead-in wire 30. The other ends of the electrodes 23 and 24 are connected together by the lines 33 and 34 respectively through the relay.

When the line voltage is placed across the circuit terminals 29 and 40, the electrodes 23 and 24 of the lamp 26 will immediately start to heat. The heat conducted to the bimetallic strip 12 from the contact 13 of high contact resistance will heat it sufficiently to cause the bimetallic strip to break away from the contact. A separate resistance and a low resistance contact may well be used instead of carbon or other high resistance contact, for in either case, heat will be generated to actuate the armature 20. This breaking away is so timed that it will normally take place at about the same moment that the electrodes have been sufficiently heated to support the discharge across the lamp. Since there is about one-half line voltage across the resistance rod during the operation of the lamp, the heat, conducted to the bimetallic strip by the rod will cause the strip to take a position, during the actual operation of the lamp, at a point about half way between its normally closed position with the high resistance contact 13 and the low resistance contact 16. Thus there is no danger of the strip 12 cooling to a temperature where it would re-establish its contact with the high resistance contact and thus renew the starting operation.

If the current should be thrown off, and immediately thrown on again without sufficient time elapsing to allow the strip 12 to cool, or if, for any reason, the arc failed to strike when the strip 12 broke away from the high resistance contact 13, the full line voltage would be across the resistance 1 and the strip 12 would be heated and continue to be deflected further away from the high resistance contact 13 until it struck the low resistance contact 16, thus short-circuiting the resistance rod 1 and starting the pre-heating of the lamp electrodes. If the lamp arc fails to strike when the bimetallic strip 12, now cooling, breaks away from the low resistance contact 16, the full line voltage will again be across the resistor rod 1 and the bimetal will deflect towards the low resistance contact 16 again.

It thus may be readily understood that this repeated cycle of operation is not only unnecessary if the lamp is defective but it also causes excessive wear on the relay parts and causes the lamp to present a very unsightly appearance, namely, intermittent glowing at the electrodes. To overcome this I have arranged the elements as shown in Figure 1 so that after the relay has completed several cycles of operation in attempting to start the lamp, the relay will be cut out from the lamp and will no longer try to start it.

Under ordinary starting conditions, when the lamp starts after the first or second electrode pre-heating interval, the resistance rod 19 will not pass much current, it being shorted out and the current passing through the high resistance contact 21 and the bimetal 20. However, when the lamp arc fails to strike after several pre-heating intervals for the electrodes thereof have been provided therefor by the bimetal 12 and its associated high resistance and low resistance contacts, the high resistance contact 21 and the bimetal 20 will have passed current long enough to cause the bimetal 20 to become distorted sufficiently to cause the contact 21 attached at the free end thereof to break from its normally closed association with the wire 4. When this takes place, the current through the resistance rod 19 will be enough to keep the bimetal 20 sufficiently distorted to keep the high resistance contact 21 on the free end thereof open with respect to the wire 4.

Under these conditions, about half the line voltage will be across the resistance rod 19, and the other half across the resistance rod 1. Since, under normal lamp operating conditions, the lamp voltage is about one half the line voltage, the voltage across the resistance rod 1, after the cut-out has come into operation, will be about the same as lamp voltage, thus causing the free end of the bimetallic strip 12 to assume a position about half way between the high resistance contact 13 and the low resistance contact 16. Thus, not only will the operation of the relay in providing a succession of filament preheating intervals for the lamp be arrested, but, what is also of great importance, the several elements of the relay will not be subjected to excessive voltages due to the abnormal condition of a failed lamp. In this way, the life of the relay is prolonged considerably. The several delicately adjusted parts are not called upon to withstand an overload even under failed lamp conditions.

Although I have shown a specific embodiment of my invention in Figure 1, it must be understood, however, that some of the elements contained therein may be changed in certain respects without departing from the spirit of the invention. For example, the high resistance contact 21 may be fixed to the wire 4 instead of to the free end of bimetal 20 and the same result will be obtained for in either case, the bimetal will become distorted sufficiently under abnormal lamp conditions to cause it to break the circuit therethrough and allow the current to flow through the resistance rod 19. In either case, however, it should be made certain that the tension with which the bimetal 19 is closed to the carbon contact 21 or the tension with which the carbon contact 1 is closed with the wire 4 is greater than the tension with which the carbon contact 13 is closed with the armature 12. This is necessary to insure the prevention of the cutout from operating under normal lamp and relay operating conditions. Another embodiment of this cut-out without departing from the spirit of the invention would be the location of the contact of high contact resistance 21 above the resistance rod 19 instead of below it as shown in Figure 1. In this case the tension between

the contact and the wire 4 should be lessened to insure relatively quick operation of the cut-out under failed lamp conditions for when the contact is located in this position it doesn't become heated as quickly as in the position illustrated in Figure 1.

Figure 3 shows another embodiment of my invention different from Figure 2 only in the dotted-line-enclosed cut-out unit. This cut-out can be utilized with various forms of starting relays whether they be thermal or glow. A glow relay, for example, is shown in my United States Patent 2,277,708, issued March 31, 1942, on an application filed March 18, 1940. In this figure, the resistance 19 is connected in parallel with the input terminals 35 and 36 of the relay 37, and the contact 21 in this case need not necessarily be of high resistance.

The cut-out assembly may be mounted on the wire 4 or on the corresponding wire 5 or the other side of the relay without departing from the spirit of the invention. The schematic diagram of the relay as shown in Figure 2 illustrates this construction, while the construction of Figure 1 is schematically illustrated in Figure 4.

What I claim is:

1. In combination with an electric discharge lamp and operating circuit therefor, a starting unit including: a switch, for relatively fast repetitive operation in a series of attempts to start said lamp, comprising heating means and a thermally responsive switch member in such arrangement that repetitive full energizations of said heating means consistently and continually cause said switch member to close said switch in like repetition; and a second switch, separate, distinct, and spaced from said repetitive switch, for relatively slow operation to automatically terminate said repetitive operation of said repetitive switch and thereafter, upon deenergization of said circuit, to automatically reset itself to again permit said repetitive starting attempts; said second switch including a contact and a thermally responsive switching arm arranged to remain in closed relation with each other with the switching arm unmoved during a plurality of said repetitive starting attempts, and to thereafter separate to break a lead to said repetitive switch and terminate the operation thereof, and a heating element, in operative relation with said switching arm to automatically cause said separation, and in shunt with a series arrangement comprising said thermal arm, said contact, and said repetitive switch.

2. A starting unit for an electric gaseous discharge device, said unit comprising: a plate-like base of insulating material; a panel-like upright of insulating material mounted on said base; a pair of contact pins extending from one side of said base; a pair of lead-in wires, each connected to one of said contact pins and extending from the other side of said base; a switch assembly mounted on said upright in connection with said lead-in wires and including a heater element, a thermally responsive member mounted in heat-receiving relationship with said heating element, and a contact assembly including a supporting arm and a contact member, with said thermal member in normally closed relation with said contact member; and a second switch assembly connected with said first named switch assembly and one of said lead-in wires and including heating means and a hook-like thermally responsive member arranged to short circuit said last named heating means when sufficiently heated thereby.

3. The combination of claim 1, and resistance means in series with, and in proximity to, the thermally responsive switching arm to heat the same on passage of current therethrough.

HENRY J. McCARTHY.