Oct. 19, 1943. I. B. BENSIN 2,332,492

STARTING SWITCH

Filed Dec. 30, 1941

Fig. 1.

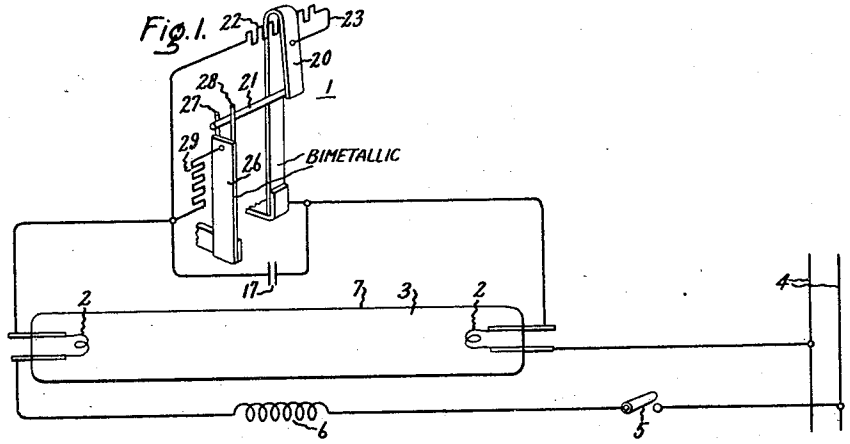


Fig. 2.

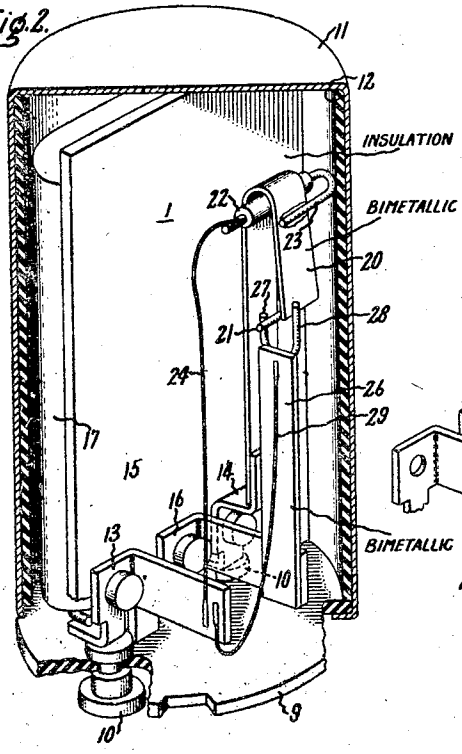


Fig. 3.

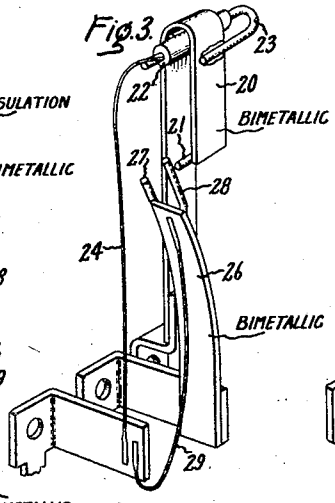


Fig. 4.

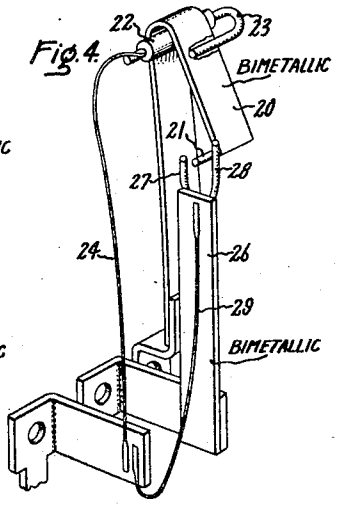


Fig. 5.

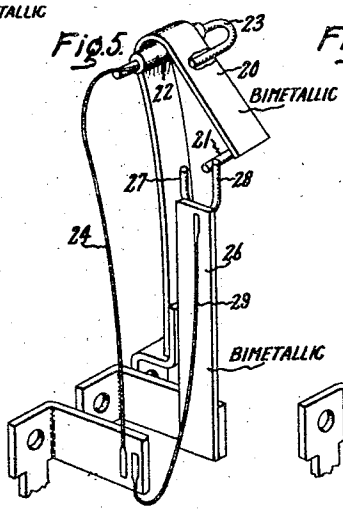


Fig. 6.

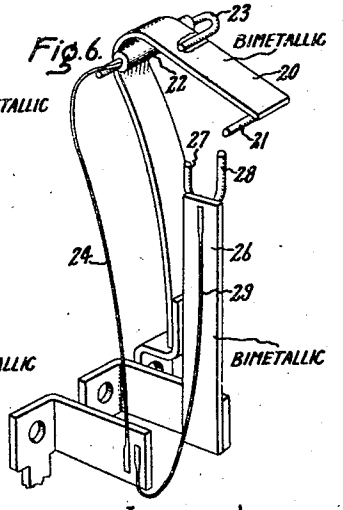
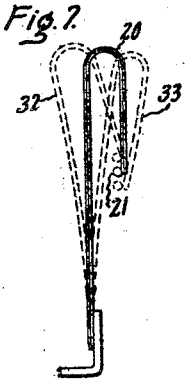


Fig. 7.



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UNITED STATES PATENT OFFICE

2,332,492

STARTING SWITCH

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Application December 30, 1941, Serial No. 424,912

8 Claims. (Cl. 200—122)

My invention relates to switches for starting electric discharge devices.

A common form of electric discharge device, such as a fluorescent lamp, is provided at opposite ends with thermionic electrodes of filamentary form which after the lamp has been connected with the source of current supply and prior to the starting of the discharge in the lamp have their temperature raised to the point of electron emission by current passed through them in series. When the temperature of the electrodes has reached that point the circuit is interrupted between them automatically by a switch whereby a surge of sufficient voltage is produced across the lamp to start the discharge therein.

A common form of starting switch employed in such apparatus is a thermal switch. A well known disadvantage of that type of switch as usually employed to start the discharge is that because of the slow separation of the contacts it does not produce the desired sudden interruption of the circuit which it controls in order to be most effective for starting the discharge.

One object of my invention is the provision of an improved switch which will produce a sudden interruption of the circuit controlled by it notwithstanding the fact that its contacts may, in response to an increase in heat, have a slow relative movement.

Another object of my invention is the provision of a starting switch for the purpose described which initially provides a low resistance path for the electrode heating current and which is constructed to open that path in substantially the same time as that required for the electrodes to become heated to the desired temperature regardless of the temperature of the ambient.

A further object of my invention is the provision of a starting switch which, if the device is not started at the first attempt will make successive further attempts to start it and in the event that the device cannot be started after a reasonable number of attempts have been made will cease making further attempts.

A still further object is the provision of a starting switch which, if the device to be started will not start after making a reasonable number of attempts and the switch then ceases making any further attempts to start it, will thereafter maintain the circuit controlled by the switch in open circuit position.

An additional object of my invention is the provision of an improved thermal switch which compensates for variations in the ambient temperature.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1 is a circuit diagram of an embodiment of my invention; Fig. 2 is a perspective view of the complete switch involving my invention in its normal unenergized position; Figs. 3, 4, 5 and 6 are similar views limited to the essential parts of the switch showing them in their various different positions; and Fig. 7 is a detail view of one thermal member of the switch.

As represented by Fig. 1, the switch 1 comprising my invention is arranged to be connected between the electrodes 2 of the discharge device 3 which may be a fluorescent lamp so that before it starts the discharge in the device it controls the heating of the electrodes in a well known manner. The device is shown connected with a source of supply 4 of alternating current which, for example, may be a 60 cycle, 115 volt lighting circuit, the connections including the control switch 5 and the ballast reactor 6. The device may be of the usual tubular form of fluorescent lamps comprising the glass envelope 7 containing mercury vapor at a low pressure and having the inner surface of its side walls coated with a suitable phosphor which under the influence of an electric discharge through the mercury vapor produces fluorescence. The electrodes 2 are shown of filamentary form and may comprise a suitable refractory metal such as tungsten wire wound in a helix and coated with a suitable electron emitting material such as barium oxide or stronium oxide.

As shown in Fig. 2, the complete switch 1 has the base 9 of insulating material through which extend the two switch-securing terminals 10. Secured to the base is the cup-like casing 11 which is shown having an insulation lining 12. Secured to the terminals 10 are the angles 13 and 14 to which are attached the plate 15 of insulating material which snugly fits within the casing 11. Secured to the front face of the plate 15 is the third angle 16 and to the rear face thereof is the capacitor 17.

The switch which I have devised employs two thermal members each of which may be a bimetallic member which moves cooperating contacts in directions at right angles to each other. The one thermal member 20 has overlapping portions which in configuration somewhat resemble

an inverted J, the lower end of the long arm being rigidly secured to the angle 14, the lower end of the short arm being provided with the laterally extending contact 21 and the loop between the two arms receiving the high resistance heater 22. This thermal member I term the "controlling thermal member." The heater 22 is supported by the conductor 23 forming a part of the circuit thereof which is suitably secured as by soldering or welding to the short arm of the thermal member. The other connection to the heater is the conductor 24 which is fastened to the angle 13. The other thermal member shown at 26 which I term the "timing thermal member" is more sensitive than the thermal member 20. At its lower end it is fixed to the angle 16 and at its upper end has projecting therefrom the two spaced contacts 27 and 28. Thermal member 26 is heated by the low resistance heater 29 which is shown secured at one end to the upper end of the member and connects at its lower end with the angle 13. In the normal unenergized positions of the two thermal members as shown by Fig. 2, a low resistance electrode heating circuit is completed through the heater 29, thermal member 26, contacts 27 and 21, and thermal member 20, it being understood that the contacts 27 and 21 engage each other at that time with light pressure.

When the control switch 5 is closed a relatively heavy current flows through the ballast 6, the electrodes 2, and the switch by way of the path just mentioned above to produce a rapid heating of the electrodes. By the time they have reached an electron emitting temperature or soon thereafter the thermal member 26 will have been bent as a result of heat received from its heater 29 to such an extent that the contact 27 will have slid along the contact 21 until it will have passed the end thereof at which time the contacts quickly separate to produce a sudden interruption of the circuit controlled thereby. This quick separation of the contacts is due to the resilience of either one or both of the thermal members carrying the contacts for it will be seen that as soon as the member 20 is released it springs from the position shown in Fig. 2 to a position such as that shown by Fig. 3. Likewise when the member 26 is released from the restraint of the friction between the contacts 21 and 27 it springs forward to a position such as shown by Fig. 3. Because of heat inertia, the movement of the member 26 will continue somewhat after the contacts have separated. Thus the circuit of the electrodes is quickly interrupted in spite of the fact that the movement of the contact 27 along the contact 21 was relatively slow. This interruption of the electrode heating circuit occurring between the electrodes presumably starts the discharge in the device. Assuming that it does start, the thermal member 26 and its heater 29 soon cool down so that the member will tend to return toward its original position. The thermal member 20, however, immediately begins to receive heat from its heater 22 since the breaking of the circuit between contacts 27 and 21 removes the low resistance path which formerly existed around the heater 22. The voltage now applied to the heater 22 is the arc drop voltage across the device 3 and the resulting heat supplied to the thermal member 20 is sufficient to move the contact 21 thereof to a position between the contacts 27 and 28 before the thermal member 26 has returned to a position near its normal or starting position. This heating of the thermal member 20 prevents interference of the contacts carried by the two thermal members after the device is started, the relative positions of the switch parts during the normal operation of the device being as represented by Fig. 4.

In the event that the device fails to start at the first attempt, as above described, the voltage applied to the heater 22 will be considerably greater than it would have been had the lamp started, since then it is approximately double the arc drop voltage of the device. As a result thereof the greater heat applied to the thermal member 20 will continue to move the contact 21 after the thermal member 26 has approximately reached its original position so that the contact 21 will engage the contact 28, as illustrated by Fig. 5. These contacts thereby reestablish the low resistance electrode heating current path through the heater 29 to again raise the temperature of the electrodes to the point of electron emission. The thermal member 26 accordingly is again bent whereby the contact 28 thereon slides along the contact 21 until it slips off the end thereof causing a second quick interruption of the electrode heating circuit in a second attempt to start the device. If it starts, the voltage applied to the heater 22 immediately reduces to the arc drop voltage of the lamp whereby the thermal member 20 cools somewhat to bring its contact 21 into a position between the contacts 27 and 28 before they return, upon cooling, to their original position. The switch parts will then again assume approximately the position shown by Fig. 4.

Should the device fail a second time to start, the thermal member 20 would not return its contact 21 between contacts 27 and 28, but rather will tend to move it farther outward. As the member 26 cools off, its contact 28 will again engage the contact 21 but this time on the end thereof whereupon the heater 29 will again become energized and cause the contacts to interrupt the electrode heating circuit in a third attempt to start the device. If this attempt is not successful the apparatus may make several more attempts, each time the contact 28 engaging the end of the contact 21. However, the thermal member 20 gradually accumulates heat partly from its heater 22 and partly from the heater 29 as a result of the series of unsuccessful starting attempts so that the contact 21 finally reaches a position as shown by Fig. 6 in which it is out of the path of movement of the contact 28 and as a result thereof the switch will make no further attempts to start the device. In this position of the thermal member 20 the switch is locked in an open circuit position it being maintained by heat constantly supplied by the heater 22.

If the failure of the device to start is due to a defect in the device and it is replaced by a device in good condition or if the controlling switch 5 should be moved to open position and after the switch parts have had an opportunity to cool down is reclosed, then the thermal member 20 in cooling would move its contact 21 into engagement with the outer or opposite side of the contact 28 from that normally engaged. Although the contact 21 now is in engagement with the contact 28 at its outer side, the switch nevertheless will function in a manner similar to the first starting attempt already described above.

An imporant feature of my invention is that the operation of the switch is independent of

the effect of changes in the temperature of the ambient. By reason of the shape of the thermal member **20** and the proportions of the two arms thereof, the short arm being approximately one-half to one-third the length of the long arm, the contact **21** is moved in a path substantially parallel to the member in response to changes in the ambient temperature. This property of the thermal member is illustrated by Fig. 7 where the thermal member **20** at normal room temperature is shown in full lines. When heated as a result of an increase in the temperature of the ambient it bends throughout its length assuming the shape and position shown by the dotted line **32** and likewise when cooled as a result of a low ambient temperature it may take the position shown by the dotted line **33**. As the thermal member moves from the full line position to either of the dotted line positions, the contact **21** carried thereby moves up or down, as shown by Fig. 7, in substantially a straight line. Since the contacts **27** and **28** which cooperate with the contact **21** stand substantially vertical the effect of changes in the ambient temperature have substantially no effect on the contact pressure and very little effect on the time of interruption of the electrode heating circuit.

I have chosen the particular embodiment described above as illustrative of my invention and it will be apparent that various modifications may be made without departing from the spirit and scope of my invention which modifications I aim to cover by the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A quick opening switch comprising cooperating switch contacts, means for sliding one of said contacts over the other and beyond the end thereof, and means for resiliently pressing said contacts together during the sliding movement thereof and for producing relative movement of the contacts in a direction transversely of said sliding movement after the one contact passes beyond the end of the other.

2. A quick opening thermal switch comprising cooperating switch contacts, means for sliding said contacts over each other to a point at which one passes beyond the end of the other, and means for yieldingly holding said contacts in engagement with each other and for causing them to separate suddenly with a movement transversely of the direction of said sliding.

3. A quick opening switch comprising cooperating current carrying contacts, means for causing said contacts to slide over each other in frictional engagement to a point at which one contact slips off the end of the other, said means including a resilient member arranged to be tensioned by the friction of said engagement.

4. A thermal switch having terminals and having cooperating contacts connected therebetween and normally engaging each other, a thermal member arranged to move one of said contacts out of engagement with the other contact, a heater for said thermal member connected in series with said contacts, a second thermal member arranged to move said other contact out of the path of movement of said one contact when the thermal moving member therefor cools, and a heater for said second thermal member connected between said terminals.

5. A thermal switch having terminals and having cooperating contacts connected therebetween and normally engaging each other, a thermal member arranged to move one of said contacts in a direction to disengage said other contact, a heater for said thermal member connected in series with said contacts, a second thermal member arranged to move said other contact in a direction substantially at right angles to the direction of movement of said one contact to prevent re-engagement of said contacts when the thermal moving member for said one contact cools and a heater for said second thermal member connected between said terminals.

6. In combination, an electric discharge lamp having spaced electrodes adapted to be preheated by current flow therethrough, a ballast for said lamp, means including said ballast for connecting one end of each of said electrodes with a source of current supply and a starting switch for said lamp connected between the other ends of said electrodes, said switch comprising a pair of spaced contacts and a single contact normally engaging one of the contacts of said pair of contacts, means responsive to said current flow for causing said one contact to disengage said single contact thereby making an attempt to start the lamp, means responsive to the resulting voltage between said other ends of the lamp electrodes if the lamp fails to start for causing said single contact to engage the other contact of said pair, said other contact being then operative in response to said current flow to disengage said one contact to make a second attempt to start the lamp.

7. In combination, an electric discharge lamp having spaced electrodes adapted to be preheated by current flow therethrough, a ballast for said lamp, means including said ballast for connecting one end of each of said electrodes with a source of current supply and a starting switch for said lamp connected between the other ends of said electrodes, said switch comprising cooperating contacts, a heat accumulating heater connected between said other ends of the lamp electrodes, means responsive to said heater for causing one of said contacts to engage the other, means responsive to the resulting current flow for causing said other contact to disengage said one contact, said heater being responsive to the heat accumulated therein after a number of unsuccessful attempts to start the lamp for thereafter maintaining said contacts disengaged.

8. A thermal switch comprising a plurality of thermal strips constructed and arranged to warp in directions substantially at right angles to each other when heated, cooperating contact members each carried by one of said strips, one of said contact members sliding over and off the end of the other contact member when the strip which carries said one contact member is heated, the strip which carries the other contact member having two substantially parallel over-lapping arms joined together at corresponding ends, one arm being approximately twice the length of the other, the free end of the longer arm being fixed and said other contact member being secured to the free end of the shorter arm, and means for heating said last mentioned strip to cause said contact members to separate.

IGOR B. BENSIN.