

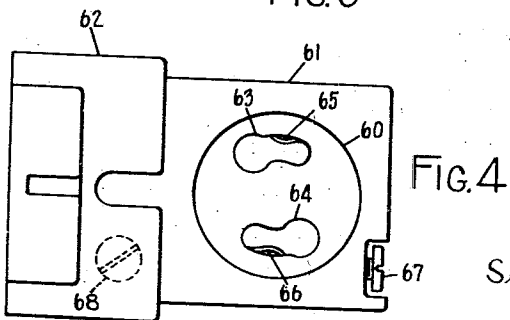
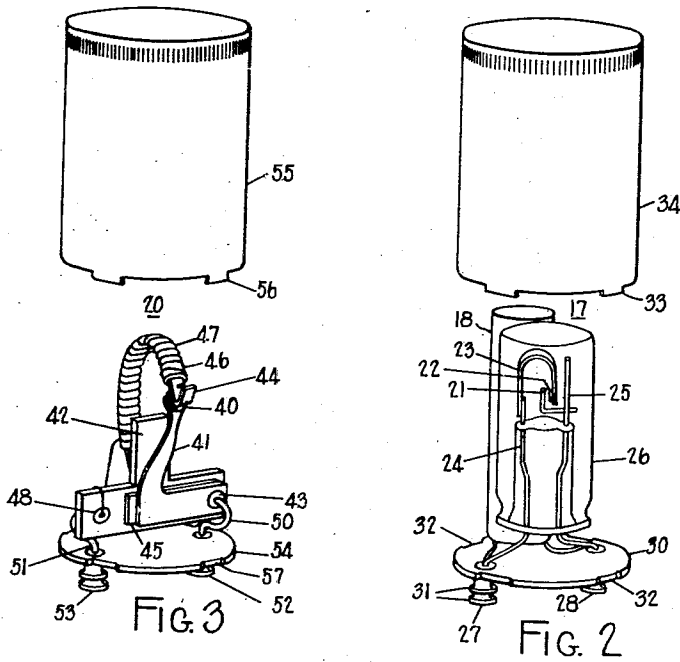
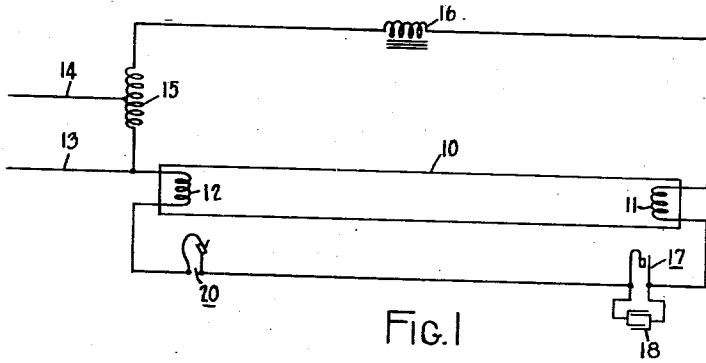
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PROTECTIVE DEVICE FOR FLUORESCENT LAMP CIRCUITS

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PROTECTIVE DEVICE FOR FLUORESCENT
LAMP CIRCUITSSelden Bradley Sanford, Yonkers, N. Y., assignor
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The invention relates to protective devices for auxiliary control equipment for fluorescent lamps, especially the starting switches for such lamps.

In most of the control circuits for fluorescent lamps, each lamp is provided with an automatic starting switch for causing the lighting of the lamp upon the connection of the lamp to its source of current. This switch acts automatically to momentarily close and then open the electrode heating circuit, the inductive kick from the ballast in circuit with the lamp, starting the lamp in operation. In case the lamp does not start, this operation is automatically repeated until it does start. As soon as the lamp starts, the starting switch ceases operation.

Eventually a condition obtains in which the lamp reaches the end of its life. If the lamp is in operation at the time, the starting switch tries to reestablish operation. If the lamp is out of operation, upon the closing of the circuit to light the lamp, the starting switch tries to start the lamp in operation. In each case, the starting switch is placed in a condition of continuous operation of repeated closing and opening of the starting circuit. Usually under these conditions the lamp circuit is left on, especially where the lamp is arranged in a fixture along with one or more other lamps or where arranged with others in a large group under unit control as in industrial buildings. As a result of this continuous operation, the starting switch wears out and must be replaced along with the lamp. Also this condition may be injurious to other auxiliary control equipment for the lamp.

The object of the invention is automatically to discontinue operation of the starting switch for a fluorescent lamp in the event the lamp fails to light.

In carrying out the invention according to the arrangement which will be described, a protective switch of the latching type is utilized in which the latch is released under the influence of sustained heat. This switch is connected in series with the starting switch to be heated by the current flow in the starting circuit. In case the lamp fails to light immediately upon connection to its source of current, the heating effect due to the continued operation of the starting switch is cumulative so that if the lamp does not light within a certain interval of time, the latch is released, breaking the starting circuit and thus preventing further operation of the starting switch. The protective switch is

manually reset so that the starting circuit remains open until the lamp circuit is serviced.

A general idea of the invention, the mode of carrying it out which is at present preferred, and various features and advantages thereof will be gained from the above statements. Other features and advantages of the invention will be apparent from the following description and appended claims.

10 In the drawing:

Figure 1 is a simplified wiring diagram of the circuits of a fluorescent lamp embodying the invention;

Figure 2 is a perspective view of the starting switch of the circuits of Figure 1 along with the cover therefor;

Figure 3 is a perspective view of the protective switch of the circuits of Figure 1 along with the cover therefor; and,

Figure 4 is a plan view of a bracket having a receptacle for holding the lamp and a socket for receiving either the starting switch or the protective switch.

Referring first to Figure 1, the fluorescent lamp is diagrammatically indicated and is designated generally by the numeral 10. 11 and 12 are the electrode heater elements in the ends of the lamp. 13 and 14 are alternating current feed wires to the lamp circuit, these being connected through an auto-transformer 15 to provide the desired voltage. 16 is a ballast in the form of a choke coil. The starting switch is designated 17, a condenser 18 being connected across the terminals of the switch to minimize interference with radios. The protective switch for the starting switch is designated 20.

Referring now to Figure 2, the starting switch there illustrated is one which is widely used. This switch is of the thermal glow type and comprises a stationary contact 21 and movable contact 22. The movable contact is carried on the end of a U-shaped bimetallic strip 23 soldered to the terminal wire 24. The stationary contact is L-shaped and is soldered to the other terminal wire 25. These contacts are in a gas filled sealed glass container 26, the stationary contact and bimetallic strip forming electrodes to provide a glow discharge upon the application of voltage of a certain value thereto. The condenser 18 is connected to the terminal wires 24 and 25 and these wires are connected to terminals 27 and 28 secured to and extending downwardly from the base 30 of insulating material. Each terminal is formed with spaced annular rings 31 for purposes of mounting the

switch in a socket. The base is formed with notches 32 to receive the prongs 33 on the metallic cover 34 for the switch, said cover being lined with insulating material.

The protective switch 28 illustrated in Figure 3 comprises a contact 40 carried on the end of a contact spring 41. This spring is secured to a mounting plate 42 of insulating material as by a rivet 43. The contact 40 is engaged by the end of a hook shaped bimetallic strip 44 also secured to plate 42 by a rivet not shown, a strip of insulating material 45 being arranged between the lower end of the contact spring and the mounting rivet for the bimetallic strip to insulate these elements from each other. The contacting end of the bimetallic strip hooks over the contact 40 to latch the contact spring 41 in a state of tension. The bimetallic strip is covered with asbestos 46 around which is wound some resistance wire 47 to serve as a heater. This wire is connected at one end to the latching end of the bimetallic strip and at the other end to a rivet 48 secured to the mounting plate 42. The rivets 43 and 48 are connected by wires 50 and 51 respectively to terminals 52 and 53 secured to the base 54 of insulating material. The base 54 and terminals 52 and 53 are the same as base 30 and terminals 27 and 28 of Figure 2. A metallic cover 55 is provided for the protective switch, this cover being formed with prongs 56 to fit into notches 57 in the base 54.

Referring to Figure 4, a socket 60 is formed in the base 61 of the lamp holder bracket 62. This socket is provided with elongated apertures 63 and 64 in the bottom thereof. The opposite ends of these apertures are enlarged to receive the terminals of either the starting switch or the protective switch, the remainder of the apertures being of a size to lock the switch in position upon its being inserted into the socket with the terminals in the enlarged ends of the apertures and turned clockwise, thus forming a bayonet lock. Contact springs 65 and 66 are provided beneath and to the side of apertures 63 and 64 respectively to engage the terminals between the annular rings upon their being inserted into the apertures and swung into locked position. 67 and 68 are binding posts for connecting the bracket in the system. With this arrangement the brackets at the ends of the lamp can be of the same construction with the starting switch inserted in the socket at one end of the lamp and protective switch inserted in the socket at the other end. However, the protective switch may be connected in the circuit otherwise if desired, especially where it is desired to adapt it to existing installations without changing the mounting brackets for the lamps.

In operation, upon the application of voltage to the supply lines 13 and 14 a glow discharge takes place between the bimetallic strip 23 of the starting switch and the stationary contact 21. This causes local heating of the bimetallic strip with the result that it is bent in a direction to engage the movable contact 22 with the stationary contact 21, completing the lamp electrode heating circuit. This also short-circuits the glow discharge of the starting switch so that the bimetallic strip cools off and soon disengages the stationary contact. During this period the lamp electrodes are heated to a relatively high temperature. The opening of the starting switch results in an inductive kick from the choke coil 16. The relatively high voltage thus applied to the lamp is sufficient to cause a discharge from one electrode

of the lamp to the other, causing the lamp to light. The lighting of the lamp reduces the voltage across the terminals of the starting switch to a value which is insufficient to cause further operation of the switch. Thus the starting switch consumes no energy during the lamp operation.

In case the lamp does not light upon the initial operation of the starting switch, the operation is repeated until the lamp does light. However, conditions may be such that the lamp has reached the end of its life, in which event the repeated operations of the starting switch are not capable of lighting the lamp. As a result of the continued operation of the starting switch, the heater coil of the protective switch gradually heats the bimetallic strip causing it to be bent upwardly and eventually reach a point where it releases the contact spring. This breaks the starting circuit for the lamp preventing further operation of the starting switch and thereby prolonging its useful life. This also results in preventing undue heating of the other parts of the circuit, for example the choke coil, reduces power consumption and eliminates the disagreeable continued flickering of the lamp which would be the case if the starting switch continued to operate. The bimetallic strip does not reengage the contact spring upon cooling off owing to the fact that the contact spring was latched under tension. Thus the starting circuit is not reestablished. The timing of the protective switch may be adjusted by varying the heater element for the bimetallic strip. It has been noted in actual operation that in some instances the inductive kick from the choke coil obtained upon the opening of the protective switch is high enough to start the lamp in operation where the starting switch has failed.

When a defective lamp is replaced, the protective switch may be reset manually or a preset protective switch may be substituted for the unlatched one and the latter reset under more convenient circumstances. This would be particularly desirable in case the protective switch is arranged within a glass container. While an operation has been described in which the protective device operated because the lamp had reached the end of its life, it is also effective to open the starting circuit in the event the lamp fails to operate for some other reason, and in the event that the control equipment is defective as where the contacts of the starting switch freeze together. Also, the protective device may be applied to the control circuits for manually controlled fluorescent lamps and to the control circuits for other forms of gaseous discharge lamps such as the germicidal lamps.

It is to be understood that the construction of the protective switch is only illustrative and that this switch may be of various forms. When the protective switch is enclosed, provision may be made to reset the switch electromagnetically as by providing an armature on the bimetallic strip to be operated by a magnet manually brought in proximity of the switch. The bimetallic strip may be utilized solely for a latch with the contact made by separate elements and the heating accomplished in other ways. Also other types of protective devices may be employed in which the timing is obtained electrically or mechanically, or the protective device may be arranged to be operated upon a predetermined number of operations of the starting switch.

Furthermore, the protective device may be associated with other types of starting switches.

It is not intended to enumerate all the variations which may be made, as many other than those mentioned may be effected within the scope of the invention so long as the control circuit for the lamp is opened in the event that the lamp fails to light. Therefore, all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A gaseous discharge lamp; a starting circuit for said lamp; starting means for controlling said starting circuit to cause upon application of voltage to said lamp heating of the lamp electrodes and thereafter the application of voltage across the electrodes sufficient to light said lamp; and protective means operable to open said starting circuit in the event the lamp does not light in response to repeated operation of said starting means.
2. A gaseous discharge lamp; a starting circuit for said lamp; starting means for controlling said starting circuit adapted upon the application of voltage to said lamp to cause heating of the lamp electrodes and thereafter the application of voltage across the electrodes sufficient to light the lamp and adapted to repeat such operation until the lamp lights; and protective means operable to discontinue such operation of said starting means in the event the lamp fails to light after repeated operation of said starting means.
3. A gaseous discharge lamp; a starting circuit for said lamp; starting means including contacts for closing and opening said starting circuit and adapted upon the application of voltage to said lamp to cause current flow through the lamp electrodes to effect heating thereof when the contacts are engaged and upon separation of the contacts to cause the application of voltage across the electrodes sufficient to light the lamp; and protective means having contacts in said starting circuit and operable to open said starting circuit in the event the lamp does not light in response to the operation of said starting means.
4. A fluorescent lamp; a starting switch for said lamp adapted upon the application of voltage to the lamp to make repeated operations until the lamp lights; means responsive to operation of said starting switch for lighting the lamp; and protective means operable to effect discontinuance of the operation of said starting switch in the event the lamp does not light within a predetermined time interval after the application of voltage thereto.
5. A fluorescent lamp; a starting switch for said lamp operable when voltage is applied to the lamp to effect repeated opening and closing until the lamp lights; means operable each time said starting switch operates to induce a relatively high voltage across said lamp for lighting the lamp; a circuit for said lamp connected to said starting switch, and protective means operable to effect opening of said circuit connected to said starting switch in the event said lamp fails to light within a predetermined time interval after the application of voltage thereto.
6. A fluorescent lamp; a circuit for said lamp; a starting switch in said circuit operable when voltage is applied to the lamp to effect repeated opening and closing of said starting switch circuit until the lamp lights; means operable each time said starting switch circuit is broken to induce a relatively high voltage across said lamp for lighting the lamp; and protective means operable to effect opening of said starting switch circuit in the event said lamp fails to light within a predetermined time interval after the application of voltage thereto.
7. A fluorescent lamp; a starting circuit for said lamp; a starting switch in said starting circuit operable when the lamp is out and voltage is applied thereto to effect repeated opening and closing of said starting circuit until the lamp lights; a ballast for said lamp operable each time said starting circuit is broken to induce a relatively high voltage across said lamp for lighting the lamp; and protective means operable to effect discontinuance of the operation of said starting switch in the event it fails to start said lamp in operation within a predetermined time interval after the initial operation thereof.
8. A fluorescent lamp; a starting circuit in parallel with said lamp; a starting switch in said starting circuit operable when the lamp is out and voltage is applied thereto to effect repeated opening and closing of said starting circuit until the lamp lights; a ballast in series with said lamp operable each time said starting circuit is broken to induce a relatively high voltage across said lamp for lighting the lamp; and a normally closed protective switch connected in said starting circuit operable to effect the opening of said starting circuit in the event the continued operation of said starting switch fails to start said lamp in operation within a predetermined time interval after the initial operation thereof.
9. A fluorescent lamp; a starting circuit in parallel with said lamp; a starting switch in said starting circuit for starting the lamp in operation, said switch operating when the lamp is out and starting voltage is applied thereto to effect repeated opening and closing of said starting circuit until the lamp lights; a choke coil in series with said lamp operable each time the starting circuit is broken to induce a relatively high voltage across said lamp for lighting the lamp; and a protective switch connected in series with said starting switch in said starting circuit, said protective switch being biased to open position and having means for latching it in closed position and means operable to release said latching means to effect the opening of said protective switch to break said starting circuit in the event the continued operation of said starting switch fails to start said lamp in operation within a predetermined time interval after the initial operation of said starting switch.
10. A fluorescent lamp having heater electrodes in the ends thereof; a choke coil in series with said lamp; a starting circuit in parallel with said lamp; a starting switch having contacts in said starting circuit, and means operable upon the connection of the lamp to its source to cause the engagement of said contacts to complete said starting circuit and thereupon acting to effect the separation of said contacts to break said starting circuit, said choke coil acting upon the breaking of said starting circuit to induce a relatively high voltage across said lamp electrodes to light said lamp, said means causing the repeated engagement and separation of said contacts in the event said lamp fails to light but causing them to remain separated after the lamp lights; and a protective switch connected in series with said starting switch in said starting circuit, said protective switch comprising a pair of contacts, means biasing said protective switch contacts to disengaged condition, a latch for holding said

protective switch contacts in engagement against the force of said biasing means, and means controlled by the flow of current in said starting circuit for releasing said latch to effect the separation of said protective switch contacts and thus break said starting circuit in the event the continued operation of said starting switch fails to start said lamp in operation within a predetermined time interval after connection of said lamp to said source.

11. A fluorescent lamp having heater electrodes in the ends thereof; a choke coil in series with said lamp; a starting circuit in parallel with said lamp; a starting switch in said starting circuit, said starting switch having a stationary contact and a movable contact, and means operable upon the connection of the lamp to its source to cause the engagement of said contacts to complete the starting circuit connecting said lamp electrodes in series to said source, said means acting to effect the disengagement of said contacts after the completion of the starting circuit to break said circuit, said choke coil acting upon the breaking of said starting circuit to induce a relatively high voltage across said lamp electrodes to light said lamp, such operation being repeated in the event said lamp fails to light until the lamp lights; and a protective switch connected in series with said starting switch in said starting circuit, said protective switch comprising a contact spring, a bimetallic strip having a hooked end for engaging the end of the contact spring to latch it in a state of tension, said ends of said protective switch bimetallic strip and contact spring serving as contacts, and heating means for said protective switch bimetallic strip operable to cause the bending of said protective switch bimetallic strip under the influence of heat to unlatch the contact spring and thus break said starting circuit in the event the continued operation of said starting switch fails to start said lamp in operation within a predetermined time interval after connection of said lamp to said source.

12. A fluorescent lamp having heater electrodes in the ends thereof; a choke coil in series with said lamp; a starting circuit in parallel with said lamp; a starting switch in said starting circuit, said starting switch having a stationary contact and a movable contact carried by a bimetallic strip arranged within a gas filled container, said strip and contacts serving as electrodes upon the connection of the lamp to its source to cause a glow discharge to heat the bimetallic strip, said bimetallic strip bending under the influence of such heat to engage said contacts to complete the starting circuit connecting said lamp electrodes in series to said source, said bimetallic strip cooling to effect the disengagement of said contacts after the completion of the starting circuit to break said circuit, and said choke coil acting upon breaking of said starting circuit to induce a relatively high voltage across said lamp electrodes to light said lamp, such operation being repeated in the event said lamp fails to light until the lamp lights; and a protective switch connected in series with said starting switch in said starting circuit, said protective switch comprising a contact spring, a bimetallic strip having a hooked end for engaging the end of the contact spring to latch it in a state of tension, said ends of said protective switch bimetallic strip and contact spring serving as contacts, an asbestos covering for said protective switch bimetallic strip, and resistance wire wound on said asbestos to serve as a heater, said resistance wire being connected in series with said contacts of the protective switch and acting to cause the bending of said protective switch bimetallic strip under the influence of heat to unlatch the contact spring and thus break said starting circuit in the event the continued operation of said starting switch fails to start said lamp in operation within a predetermined time interval after connection of said lamp to said source.

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