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THERMAL RESPONSIVE ELECTRIC SWITCH

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Fig. 1.

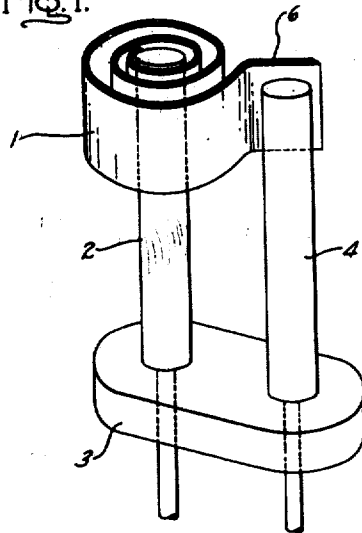


Fig. 2.

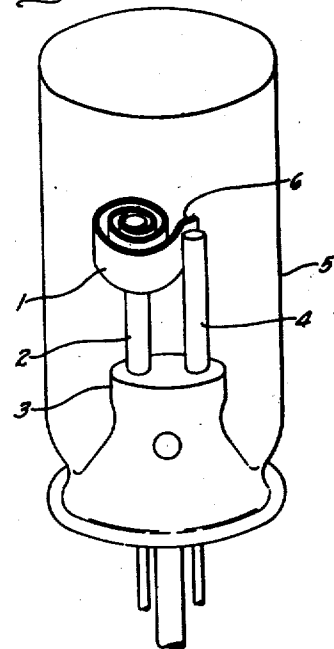
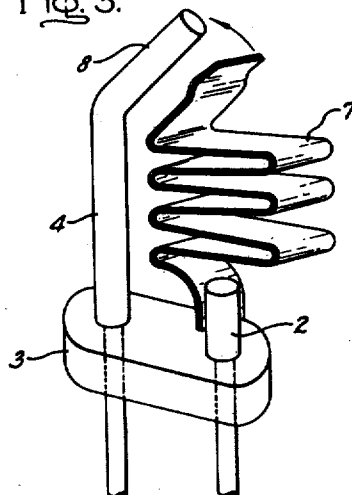


Fig. 3.



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THERMAL RESPONSIVE ELECTRIC SWITCH
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1

This invention relates to glow discharge switches of the type employing a thermal responsive element to make and break the switch contacts wherein the heat for actuating the thermal element is generated by a glow discharge in an ionizable gaseous medium.

When the glow discharge takes place in a device of this nature heat is generated around the contact-carrying members, at least one of which is in the form of a bi-metallic element. The bi-metallic element is caused to distort, thus bringing the contacts into engagement with each other. The glow thereupon ceases and the bi-metallic contact-carrying element cools and separates the contacts. Glow discharge switches of this type are frequently used for controlling the operation of electric arc discharge lamps, particularly those of the low pressure fluorescent type. For this purpose, the contacts of the glow discharge switch are connected to one terminal of each of the electrodes of the lamp requiring preheating prior to the initiation of an arc discharge therebetween. The operating voltage is connected across the remaining terminals of the lamp electrodes, and thus, when the supply voltage is established, it appears across the contact-carrying members of the glow discharge switch establishing a glow discharge therein and causing the bi-metallic element to distort. After a predetermined interval of time the contacts of the glow discharge switch close and heating current flows through the lamp electrodes, causing them to heat to an operating temperature, and thus, when the switch contacts open, operating voltage appears between the lamp electrodes, initiating an arc discharge therein.

A disadvantage in this type of switch, as heretofore manufactured, resides in the fact that the period during which the contacts remain closed is short and erratic depending partly on partial welding of the contacts to delay their opening. Consequently, full starting voltage may be applied to the lamp before the electrodes have reached their optimum operating temperature, or before a conditioning discharge appears across the ends of the cathode. In addition, to shortening the life of the lamps by attempting to create a discharge between the electrodes before they have reached their proper emission temperature, one or more operations of the switch may be necessary to start the lamp so that the life of the switch is also shortened.

An object of my invention is to provide a new and improved switch for starting and operating electrical discharge devices.

2

Another object of my invention is to provide a glow switch wherein the bi-metallic electrode is sufficiently heated to provide a definite time delay action during which engagement of the electrodes occurs for a period of time sufficient to enable a load to receive a required amount of energy.

Further features and advantages of my invention will appear from the following description of species thereof.

For a better understanding of my invention, reference may be had to the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims. Fig. 1 illustrates an electrode structure of a glow discharge switch employing the principles of my invention; Fig. 2 illustrates in more detail a glow discharge device incorporating the switch arrangement illustrated in Fig. 1; Fig. 3 illustrates a modification of the switch illustrated in Fig. 1.

According to my invention, the bi-metallic element of a glow discharge switch is so constructed that the glow discharge is mainly confined to a part or parts only of the element which, on being heated by the discharge, initially deflects in a contact-closing direction and effects closure of the contacts, further contact closure being maintained by a delayed heating of, or delayed heat conduction through the remainder of the element resulting from redistribution of heat between the parts of the element. I provide constructions of a bi-metallic element in strip form having substantial opposed surfaces which serve to retard the rate of heat dissipation from that portion of the bi-metallic element which is removed from the contact area, or which is in the vicinity of the supporting means for the bi-metallic member. In addition, I provide a stationary contact having a relatively large projected area upon a flat bi-metallic element part of which serves as a movable contact. In this manner, when a glow discharge occurs between these contact areas, the glow is mainly restricted to the flat portion of the bi-metallic element serving as the contact, thus creating a large area on one portion of the bi-metallic element hotter than its remaining area. Thus, a flow of heat occurs in the bi-metallic element from the heated areas to the cooler portions thereof, causing distortion of the bi-metallic element to an extent sufficient to maintain the contacts closed during a predetermined time interval, established by the temperature of the part of the bi-metallic element remote from the contact area.

3

With reference to Fig. 1, I provide a bi-metallic element in the form of a relatively close spiral providing a long circuitous path which is supported at its inner end upon a lead-in conductor, the outer end of the spiral serving to carry, or constituting, a contact which cooperates with a contact member supported by a second lead-in conductor. The outer turns of the spiral shield, to some extent, the inner turns of the spiral bi-metallic element from the heating effect of the glow discharge which takes place when a predetermined voltage is applied between the two lead-in conductors. The heating of the outer turns of the spiral causes a deflection of the outer end of the spiral in a direction to effect contact closure. When the contacts close, the glow discharge ceases and the outer turns of the spiral start to cool tending to open the contacts. Opening, however, is delayed by further expansion of the inner turns of the spiral caused by heat conducted toward the inner turns until the spiral as a whole ultimately contracts and results in the opening of the contacts. The inner turns of the spiral, however, serve to retain the heat conducted to it by means of reflection and thus, for a predetermined interval of time, delay the opening of the contacts. In the arrangement shown in Fig. 1 the bi-metallic element 1 is mounted on a lead-in conductor 2 sealed to a glass bead 3 to which is also sealed a lead-in conductor 4 constituting a stationary contact at its upper end. The bead may form part of the usual stem by which the lead-in conductors 2 and 4 are sealed into an envelope 5 as shown in Fig. 2. The envelope is filled with a gas or a mixture of gases at a pressure such that, on applying a suitable voltage between the lead-in conductor 2 and the stationary contact, a glow discharge takes place between element 1 and the stationary contact. Upon application of a suitable voltage a glow discharge takes place between element 1 and the stationary contact and around the outer portion of the spiral, but, owing to the construction of the element this glow is mainly restricted to the flat portion of the element and edge of the spiral, thus causing the element to distort in the contact-making direction. The contacts then close and the glow discharge ceases. The inner convolution of the spiral, however, now continues to heat as a result of a local flow of heat from an outer end 6 of the spiral by conduction and as the result of convection currents in the gas filling involved, with the result that the spiral tends to expand in a direction maintaining contact closure or the spiral tends to remain in the deformed position and thus prevents the immediate reopening of the contacts. Ultimately, the inner portions cool and the contacts reopen, but only after the required delay in contact opening has been obtained.

With reference to Fig. 3 the bi-metallic element 7 is arranged in the form of a zigzag or folded strip providing a long circuitous path secured and supported at one end to the lead-in conductor 2 and having its remote end in co-operating relation with the stationary contact. The glow discharge is largely confined to the outer parts of the bi-metallic strip 7. Upon the application of a suitable voltage to the conductors 2 and 4, a glow discharge takes place between the element 7 and the stationary contact, and as a result of the more rapid heating of the bends in the bi-metallic strip 7, the strip both expands longitudinally and curves toward the left causing the upper end of the strip to engage

4

the stationary contact whereby the glow discharge ceases. Localized flow of heat then occurs from the bends of the bi-metallic strip 7 toward the center of the strip. The turns of the folded strip, in addition, reflect the heat waves radiating therefrom and conserve the heat in the center and end of the folded bi-metallic strip remote from the movable contact. By this means delayed opening of the contacts is effected for a predetermined interval of time. The longitudinal expansion, thus maintained temporarily by the curve of the bi-metallic strip toward the left, and contact reopening, is thus delayed for a predetermined period of time until the strip as a whole cools sufficiently to effect contact opening. The kink 8 in the upper end of lead-in conductor 4 is shaped to conform to the above-described path of movement of the upper end of bi-metallic element 7 and to utilize the particular distortion of the element to obtain the necessary delay in the reopening of the contacts.

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

1. A glow discharge switch for a starting circuit of an electric discharge device comprising an envelope containing an ionizable medium and a pair of spaced electrodes including a bi-metallic electrode fixedly mounted at one end, said bimetallic electrode being formed for substantially its entire length to a compact convoluted configuration having at least several convolutions and so disposed relative to the other electrode as to confine the glow discharge to a portion only of the bimetallic electrode including its free end and to leave certain of said convolutions unheated by said glow discharge, said bimetallic electrode being arranged to deflect into engagement with said other electrode and to maintain said engagement by a delayed heating of the said certain of said convolutions resulting from redistribution of heat between the parts of said bimetallic electrode.

2. A glow discharge switch comprising an envelope containing an ionizable medium, a pair of lead-in conductors extending into said envelope, one of said conductors extending beyond the other to constitute a stationary electrode, and a deformable bimetallic strip electrode folded back upon itself at least several times in the form of a zig-zag supported at one end on said other conductor and extending generally parallel to said stationary electrode with the bands at one side of the zig-zag facing said stationary electrode so as to be heated to a greater extent by the glow discharge, the end of said stationary electrode being bent to lie in the path of movement of the unsupported end of the bimetallic electrode.

3. A glow discharge switch for a starting circuit of an electric discharge device comprising an envelope containing an ionizable medium, a pair of lead-in conductors extending into said envelope and one of which constitutes a stationary electrode, the other electrode being a bi-metallic strip coiled for substantially its entire length in the form of a compact spiral which is supported at its inner end upon the other lead-in conductor, the said spiral strip being so disposed relative to the stationary electrode that the outer end only of the spiral is adjacent said stationary electrode and the glow discharge is confined to the outer end of the spiral to leave the inner convolutions thereof unheated by the glow discharge, said spiral strip being also arranged to deflect into engagement with said sta-

tionary electrode and to maintain said engagement by a delayed heating of the inner convolutions resulting from the redistribution of heat between the parts of said spiral strip.

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10

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