Jan. 2, 1951 F. G. A. HAEGELE 2,536,280

THERMAL ELECTRIC SWITCH

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FIG. 1.

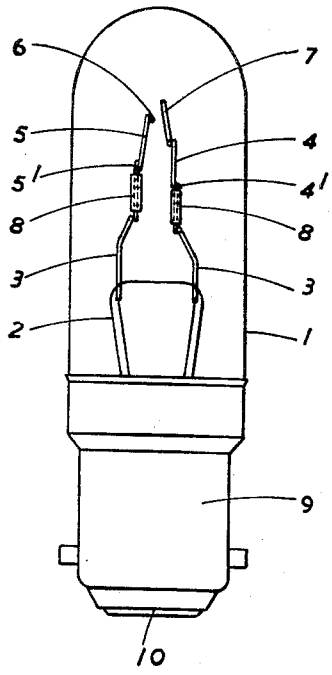

FIG. 2.

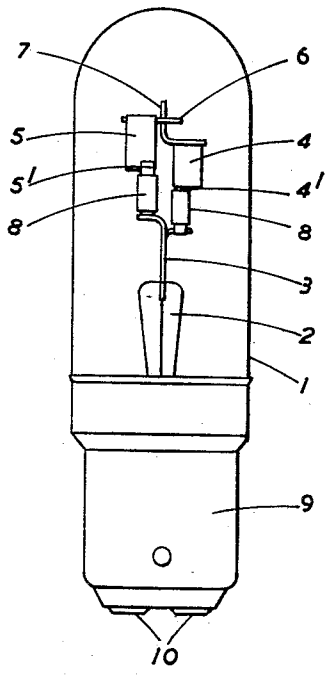

FIG. 3.

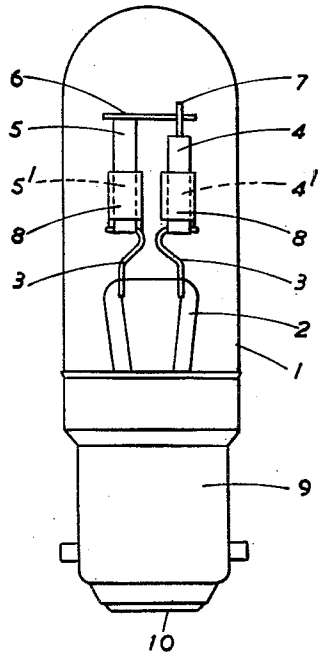

FIG. 4

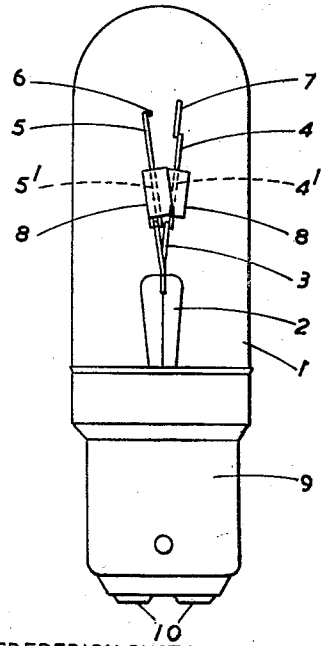

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FIG. 5.

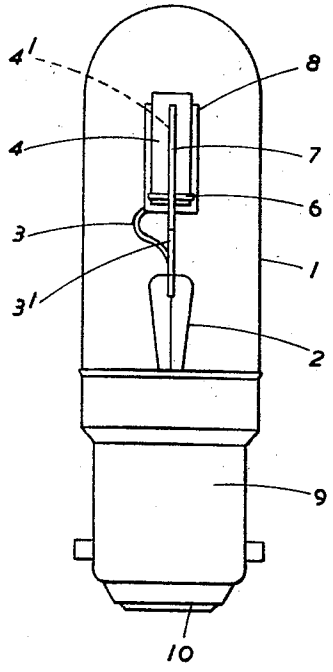
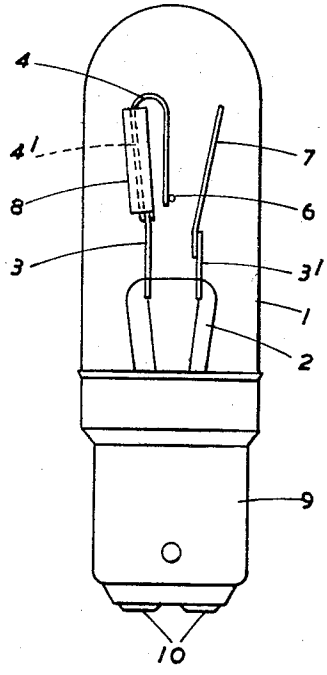


FIG. 6.



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THERMAL ELECTRIC SWITCH

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11 Claims. (Cl. 200—113.5)

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This invention relates to thermal electric switches of the type in which a glow discharge in a gas-filled envelope between two electrodes, of which at least one is constituted by or comprises a bi-metallic strip anchored at one end, causes heating of the bi-metal with consequent deflection of the free end of the strip which deflection is utilised to open or close a circuit. Such glow discharge switches are used as starter switches for electric discharge lamps, in which case the opening of the switch on the cooling of the bi-metal after the cessation of the glow discharge when the contacts close, is utilised in conjunction with a series inductance to produce the starting impulse required for initiating the discharge through the lamp. In the case of hot-cathode discharge lamps, the tendency for the switch to open immediately after it has closed is a disadvantage because it is desired that the switch should remain closed for a length of time sufficient to enable the cathodes to heat to the emissive temperature before the switch opens and produces the high voltage starting surge. In the absence of sufficient closure time, the starting pulse is applied while the cathodes are relatively cold and, apart from difficulty in starting the lamp, this leads to shortening of its life and premature end-blackening. The present invention is concerned with the provision of appropriate delay whilst retaining the relatively simple construction typical of the thermal electric switch as hitherto constructed.

According to the present invention a thermal electric switch of the type set forth comprises means for causing the glow discharge to take place between a relatively insensitive part of a bimetallic electrode and the other electrode whereby the said part of the bimetallic electrode is heated and caused to contact the said other electrode whereupon the gas discharge ceases but due to the conduction of heat along the bi-metallic electrode from the said heated part to a relatively more sensitive part of the said electrode the electrodes remain in contact with one another until the temperature falls sufficiently to allow the said contact to be broken.

More specifically, according to the present invention a thermal electric switch adapted when operated to remain in the operated condition for a determined time interval comprises a gas-filled envelope and two electrodes of which at least one is constituted by or comprises a bi-metallic strip anchored at one end, part of the surface of at least one bimetallic strip adjacent its support being shielded such that the shielded surface is not

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heated directly by the glow discharge produced when a suitable potential is applied across the electrodes.

The invention will now be described more fully with reference to the accompanying drawings, in which:

Figures 1 and 2, 3 and 4, and 5 and 6 taken in pairs are side views at right-angles to one another of three embodiments of the thermal electric switch according thereto.

Referring now to Figures 1 and 2, a glass envelope 1 filled with gas in the usual manner comprises a pinch 2 in which are sealed conductors 3 adapted to support and provide current supply to the thermal switch means. A bi-metallic strip 4, 5 is rigidly secured to the upper part of each of the conductors 3, for example by welding, and each strip 4, 5 is provided with a switch contact member 6, 7 adapted to make contact with one another in the operative position of the switch. The parts 4' and 5' of the bi-metallic strips 4 and 5 are each provided with a mica shielding means 8. The thermal electric switch is mounted on a bayonet type metal base 9 and is provided with current supply contacts 10.

When a suitable voltage is applied across the current supply contacts 10, a glow discharge appears on the upper, unshielded parts of the bi-metallic strips 4 and 5, on the contact members 6 and 7 and on the conductors 3 and these parts become heated by the glow discharge. When a sufficient time has elapsed, the bi-metallic strips are heated sufficiently to deflect inwards to an extent such that the switch contact members 6 and 7 make contact with one another. The time after which contact takes place is less than that for the temperature to equalise itself over the whole length of each strip 4, 5 i. e. the deflection to close the contacts is due substantially to the heating of the unshielded parts thereof. As soon as the contacts are closed, the glow discharge ceases and the heated parts of the switch lose heat by radiation, convection and conduction. Some of this heat goes to heat the hitherto substantially unheated parts 4' and 5'. Initially the effect of the heat being distributed more evenly over the entire lengths of the strips 4 and 5 more than compensates for the cooling of the directly heated parts of the bi-metallic strips and the switch contact members 6 and 7 remain in contact with one another. This is so despite the reduction in the overall temperature of the bi-metallic strips since the deflection of such a strip is proportional to the square of the heated length. After a delay the duration of which is dependent among other

things upon the dimensions of the bi-metallic strips and the relative dimensions of the shielded and unshielded parts of the strips, the temperature of the strips drops sufficiently for the contacts to open in the usual manner. In this construction as is shown clearly in Figure 2, the shielded parts 4' and 5' of the bi-metallic strips 4 and 5 are narrower in breadth than the unshielded parts so that a small quantity of heat supplied to the unshielded parts produces a substantial deflection and the unshielded parts are adapted to provide a comparatively considerable quantity of heat without that the dimensions of the strips are so great that the heating period necessary before the switch contact members 6 and 7 are initially made becomes excessive. The conditions of gas pressure within the envelope 1 are also chosen to be such that fast heating of the exposed bi-metal takes place.

The thermal electric switch shown in Figures 3 and 4 operates in a similar manner as that described with reference to, and similar components are indicated by the same reference numerals as in Figures 1 and 2. In this case, however, the shielding means 8 are constituted by four-sided, metal boxes. Each box is welded to one of the conductors 3 to each of which is also secured one of the bi-metallic strips 4 and 5. The bores 8 have no other points of contact with the bi-metallic strips. In this case, as may be seen clearly from Figure 3, the individual strips are of equal breadth along the shielded and unshielded parts.

The switch illustrated in Figures 5 and 6 comprises one bi-metallic strip 4 only and two switch contact members 6 and 7, the latter of which is fixed in position and secured to the conductor 3'. The part 4' of the bi-metallic strip 4 is shielded by a three-sided or trough-shaped shielding means 8 which is welded to the conductor 3 but has no other point of contact with the strip 4. The operation is similar to that of the embodiment described with reference to, and similar components are indicated by the same reference numerals as in, Figures 1 and 2. The delay action arises due to heat flowing from unshielded parts of the switch means and the conductor 3 to the shielded part 4' after the switch contact members 6 and 7 have closed.

The shielding means may consist of a material of high work function relative to the material of the bi-metal in order that the glow discharge may light preferentially on the unshielded surfaces of the bi-metal and so provide rapid heating of the bi-metal and initial operation of the switch. The material of high work function may alternatively be in the form of a coating on the surface of a metallic base or be applied directly to the bi-metal surface, for example by spraying.

The shielding means may of course exhibit any convenient shape and the dimensions and shapes of the component parts of the switch according to the invention may be chosen to provide any reasonable delay period.

Throughout this specification reference is made to bi-metallic strips. Such a strip may be provided from one plate or made up, for example for convenience of manufacture where different parts of a strip are narrower and/or thinner than other parts of the same strip, from a plurality of strip parts.

I claim:

1. A thermal electric switch comprising an envelope having a gaseous medium and first and second electrode members between which electrode members a glow discharge takes place, said first electrode member comprising a bimetallic strip having an upper end portion which under the influence of heat occasioned by said glow discharge deflects to contact the second electrode member and a lower end portion fixedly positioned at one extremity thereof, and shielding means surrounding said lower end portion and protecting said portion from the said glow discharge, and said lower member portion being heated substantially solely by heat transmitted thereto by said upper portion.

2. A thermal electric switch comprising an envelope having a gaseous medium and first and second electrode members between which electrode members a glow discharge takes place, said first electrode member comprising a bimetallic strip having an upper end portion which under the influence of heat occasioned by said glow discharge deflects to contact the second electrode member and a lower end portion fixedly positioned at one extremity thereof, the said lower end portion being more responsive to heat than said upper portion and being heated substantially solely by heat transmitted thereto by said upper portion and insulating shielding means surrounding said lower end portion and protecting said portion from the said glow discharge.

3. A thermal electric switch comprising an envelope having a gaseous medium and first and second electrode members between which electrode members a glow discharge takes place, said first electrode comprising a bimetallic strip having an upper end portion, which under the influence of heat occasioned by said glow discharge deflects to contact the second electrode member and a lower end portion fixedly positioned at one extremity thereof, the said lower end portion being more responsive to heat than said upper portion and being heated substantially solely by heat transmitted thereto by said upper portion, and a mica member surrounding said lower end portion and protecting said portion from the said glow discharge.

4. A thermal electric switch comprising an envelope having a gaseous medium and first and second electrode members between which electrode members a glow discharge takes place, said first electrode comprising a bimetallic strip having an upper end portion of relatively substantial mass which under the influence of the heat occasioned by the said glow discharge deflects to contact the said second electrode member, and a lower end portion fixedly positioned at one extremity thereof, said lower end portion having less mass than said upper end portion and being more responsive to heat than said upper end portion and being heated substantially solely by heat transmitted thereto by said upper portion, and shielding means surrounding said lower end portion and protecting said portion from the said glow discharge.

5. A thermal electric switch comprising an envelope having a gaseous medium and first and second electrode members between which electrode members a glow discharge takes place, said first electrode comprising a bimetallic strip having an upper end portion which under the influence of heat occasioned by said glow discharge deflects to contact the second electrode member and a lower end portion fixedly positioned at one extremity thereof, the said lower end portion being more responsive to heat than said upper portion and being heated substantially solely by heat transmitted thereto by said upper portion,

said second electrode member also comprising a bimetallic strip having an upper end portion exposed to the said glow discharge and a lower end portion fixedly positioned at one extremity thereof, the said lower end portion being more responsive to heat than said upper end portion and being heated substantially solely by heat transmitted thereto by said upper portion, a first mica member surrounding said lower end portion of said first electrode and protecting said portion from the said glow discharge, and a second mica member surrounding said lower end portion of said second electrode and protecting said portion from the said glow discharge.

6. A thermal electric switch comprising an envelope having a gaseous medium and first and second electrode members between which electrode members a glow discharge takes place, said first electrode member comprising a bimetallic strip having an upper end portion which under the influence of heat occasioned by said glow discharge deflects to contact the second electrode member and lower end portion fixedly positioned at one extremity thereof, and a metallic shield surrounding said lower end portion and protecting said portion from the glow discharge, and said lower member portion being heated substantially solely by heat transmitted thereto by said upper portion.

7. A thermal electric switch comprising an envelope having a gaseous medium and first and second electrode members between which electrode members a glow discharge takes place, said first electrode member comprising a bimetallic strip having an upper end portion which under the influence of heat occasioned by said glow discharge deflects to contact the second electrode member and a lower end portion fixedly positioned at one extremity thereof, and a shielding member of high work function surrounding said lower end portion and protecting said portion from the glow discharge, and said lower member being heated substantially solely by heat transmitted thereto by said upper portion.

8. A thermal electric switch comprising an envelope having a gaseous medium and first and second electrode members between which electrode members a glow discharge takes place, said first electrode member comprising a bimetallic strip having an upper end portion which under the influence of heat occasioned by said glow discharge deflects to contact the second electrode member and a lower end portion fixedly positioned at one extremity thereof, said second electrode member also comprising a bimetallic strip having an upper end portion exposed to the said glow discharge and a lower end portion fixedly positioned at one extremity thereof, a metallic shield surrounding said lower end portion of said first electrode and protecting said portion from the said glow discharge, and a second metallic shield surrounding said lower end portion of said second electrode and protecting said portion from the said glow discharge, and each of the lower end portions of the respective bimetallic strips being heated substantially solely by heat from the upper portion of the respective strips.

9. A thermal electric switch comprising an envelope having a gaseous medium and first and second electrode members between which electrode members a glow discharge takes place, said first electrode member comprising a U-shaped bimetallic strip having a first side thereof exposed to the said glow discharge which under the influence of heat occasioned by the said glow discharge deflects to contact the second electrode member and a second side fixedly positioned at one extremity thereof, and a shield of high work function surrounding said second side of said U-shaped member and protecting said side from the glow discharge, and said second side being heated substantially solely by heat transmitted thereto by said first side of the said bimetallic strip.

10. A thermal electric switch comprising an envelope having a gaseous medium and first and second electrode members between which members a glow discharge takes place, said first electrode member comprising a bimetallic strip having an upper portion which under the influence of heat occasioned by the said glow discharge deflects to contact the second electrode member and a lower end portion fixedly positioned at one extremity thereof, the said lower end portion being more responsive to heat than said upper end portion and being heated substantially solely by heat transmitted thereto by said upper portion, and an insulating coating surrounding said lower end portion and protecting said portion from said glow discharge.

11. A thermal electric switch comprising an envelope having a gaseous medium and first and second electrode members between which electrode members a glow discharge takes place, said first electrode member comprising a bimetallic strip having a first portion which under the influence of heat occasioned by said discharge deflects to bring about contact between said electrode members and a second portion secured to said first portion, and shielding means surrounding said second portion and protecting said portion from the said glow discharge, said second portion being heated substantially solely by heat transmitted thereto by said first portion.

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