United States Patent [19]

Egurbide

[11] **3,768,056**

[45] **Oct. 23, 1973**

[54] **ELECTRO-THERMIC STARTER FOR IGNITING FLUORESCENT LAMPS**

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[73] Assignee: **"Constructions Electrotechniques du Centre" CETEK,** Blanzat, France

[22] Filed: **Apr. 21, 1972**

[21] Appl. No.: **246,279**

[30] **Foreign Application Priority Data**

June 4, 1971 France 7120358

[52] **U.S. Cl.** **337/23,** 337/27, 337/35, 337/99, 337/378

[51] **Int. Cl.** **H01h 61/00**

[58] **Field of Search** ..... 337/23, 26, 27, 35, 337/85, 96, 99, 100, 101, 109, 273, 362, 337/370, 378; 200/3, 61.58, DIG. 28

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Primary Examiner—Bernard A. Gilheany
Assistant Examiner—A. T. Grimley
Attorney—Richard C. Sughrue et al.

[57] **ABSTRACT**

A starter switch for a fluorescent lamp including a microswitch actuated by an electrically heated bi-metallic expansion element. A second bi-metallic element is provided to compensate for changes in ambient temperature, thus rendering the initial switch adjustments independent of surrounding temperature changes. The elements are selected to provide a desired filament heating delay for the lamp prior to ignition switching, and to recycle after a predetermined time in the event of non-ignition.

13 Claims, 13 Drawing Figures

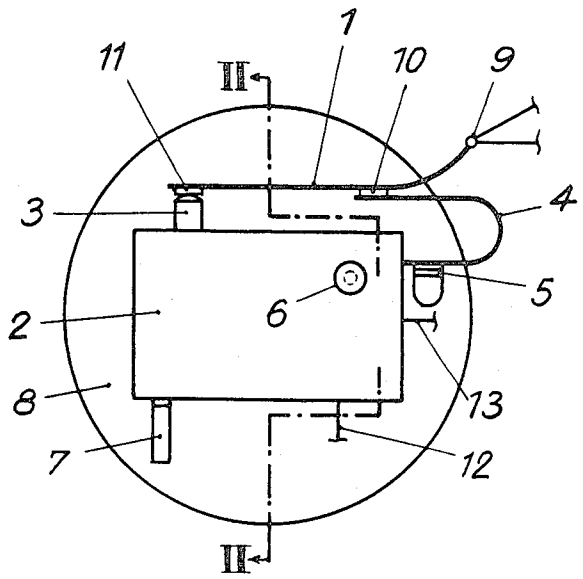


FIG. 1

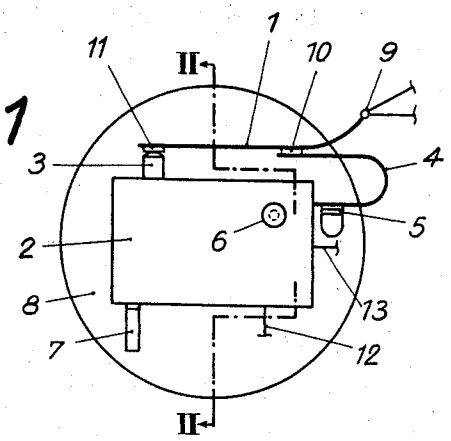


FIG. 2

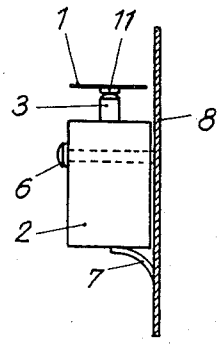


FIG. 3

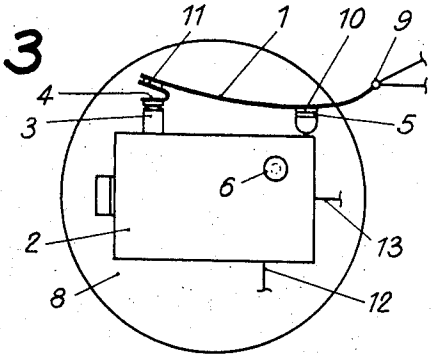


FIG. 1a

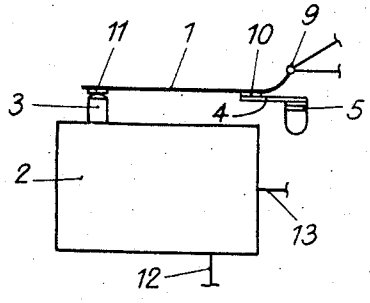


FIG. 3a

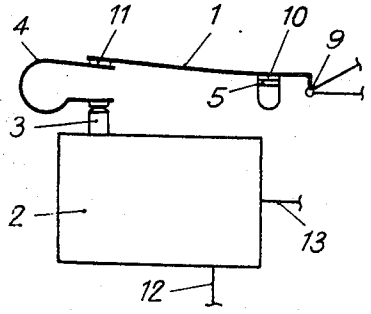


FIG. 4b

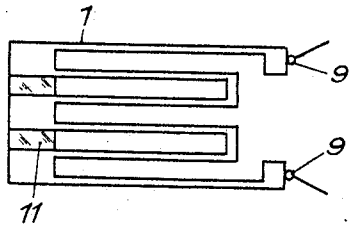


FIG. 4a

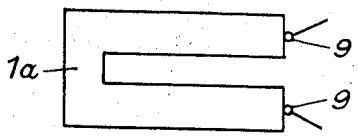


FIG. 5

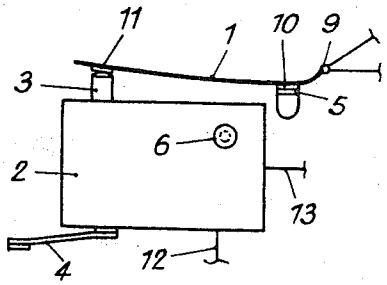


FIG. 4c

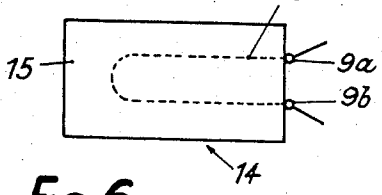


FIG. 6

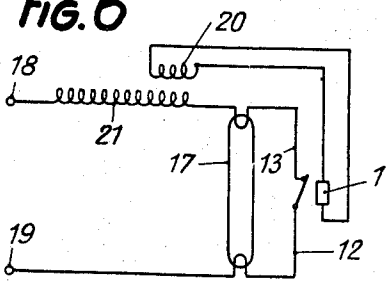


FIG. 7

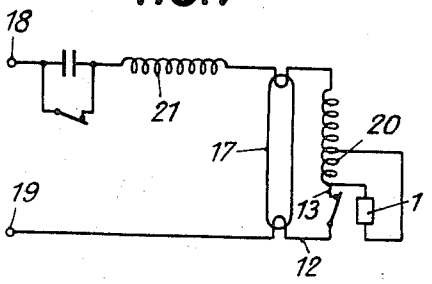


FIG. 8

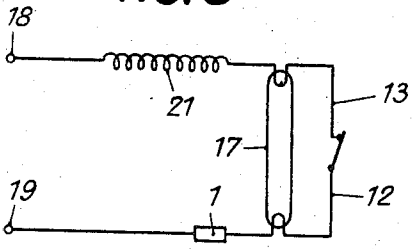
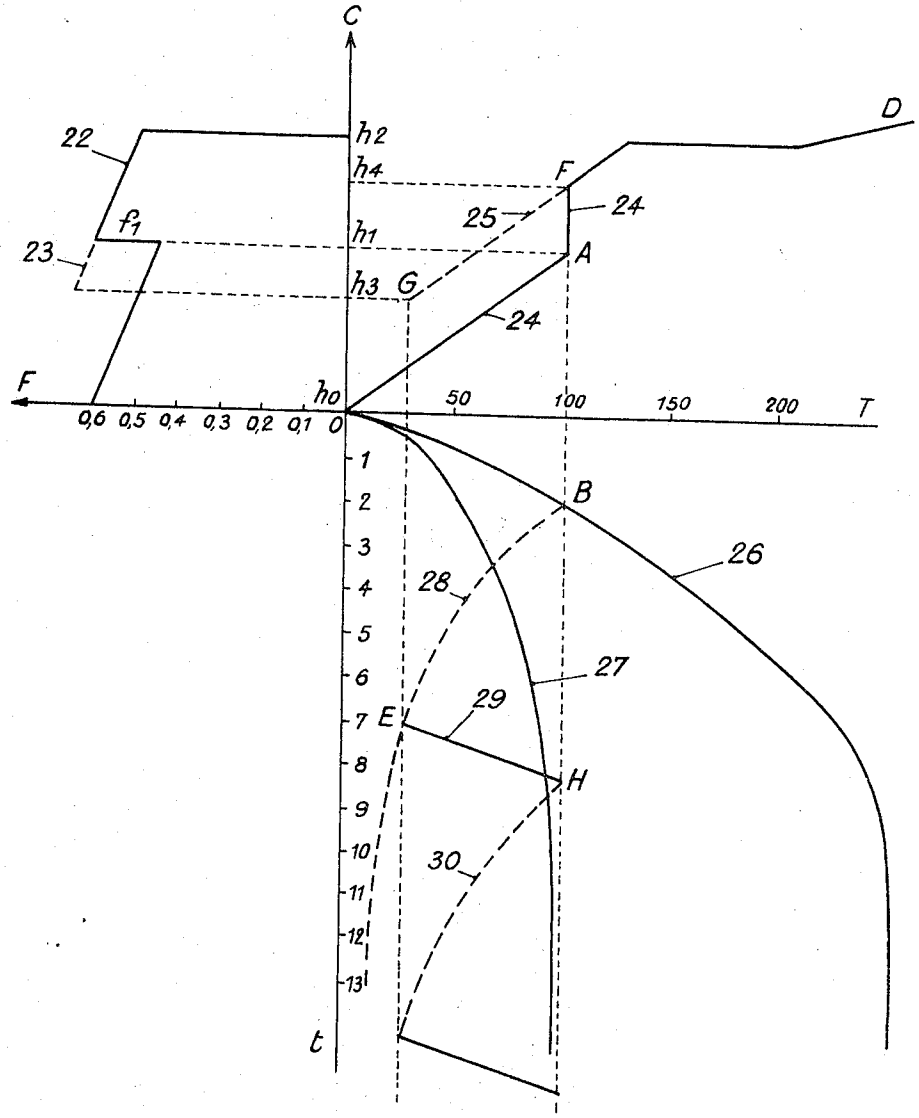


FIG. 9


C
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ELECTRO-THERMIC STARTER FOR IGNITING FLUORESCENT LAMPS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention concerns an electro-thermic starter for igniting fluorescent lamps and has the advantage of excellent reliability and long life while being inexpensive and extremely compact.

2. Description of the Prior Art

Many starters are already available, both electric discharge and electro-thermic starters, but none of them simultaneously has these combined features. Further, the fact that they do not retain their optimum capacity of adjustment involves a gradual reduction in their reliability and a decline in their length of life.

Electric discharge starters, for example, have a relatively low cost, but their life is very short. Furthermore, they are liable to variations in operation, depending on the surrounding temperature and their very low cut-out capacity, and the rapidity with which the opening and closing cycles of the contacts they control are repeated involves a reduction in the length of their own life and the life of the controlled lamps.

Electro-thermic starters have an improved cut-out capacity and a longer life. However, although their use involves an increase in the life of the controlled lamp which is at least twice the life of lamps controlled by electric discharge cycles, all known electro-thermic starters progressively deteriorate in the course of the repetition of the closing and opening cycles of their control contacts. Moreover, their adjustments depend on the surrounding temperature and their cost prices are too high for the performances obtained.

SUMMARY OF THE INVENTION

The principal object of the present invention is to provide a starter for igniting fluorescent lamps comprising at least one feed circuit for the lamp and one pre-heating circuit for the cathodes, at least one heat expansion element inserted in a circuit depending on the aforementioned circuits and having a precise expansion and contraction cycle under the influence of the variations of temperature produced by the said circuits, a trigger contact having a closed position and an open position inserted in the pre-heating circuit of the lamp, and a control member connecting the contact to the said expansion element, characterized in that an adjustment member operated by the said expansion element involves the sudden transfer of the contact from one position to the other after a given interval, whatever the open or closed position may be in which the contact is disposed, the heat expansion element being selected to develop a force enabling it to effect such a movement during a temperature variation between one-fourth and two-fifths of the temperature which the element would assume if the pre-heating circuit operated permanently.

Such a construction has a number of unexpected advantages. In fact, although the principle parts of the assembly are relatively simple parts which may readily be obtained in the trade or which may be subsequently slightly modified in order to satisfy the stated conditions, so that the selling price of the starter is reduced compared with previous starters, it is possible, by simply adjusting these members relatively to each other and depending on their specific characteristics to obtain a very compact starter, the operation of which is efficient, definite, precise and of long duration, while increasing the life of the controlled lamps.

Another object of the present invention is to provide a starter of such type in which the expansion element maintains the contact in a closed position when the control member is in an initial position $h0$, opens the contact when the control member is in a position $h1$, thus involving the normal ignition of the lamp, and continues its course before being stabilized in a position $h4$. The non-ignition of the lamp causes the cooling of the elements and the return of the control member to a position $h3$ between the position $h0$ and $h1$ in which the contact closes again in order to start a new pre-heating cycle, the position $h4$ being between a position $h2$ and the position $h3$.

Since the position of the expansion element which causes the opening of the trigger contact does not coincide with that which it assumes when it causes the reclosing of the contact, the rapid and interrupted succession of starting and stopping operations of the lamp, which harms the conservation both of the lamp and the starter, are systematically eliminated. Moreover, under the effect of the trigger action produced by the contact when it is opened, a displacement of the expansion element may be observed which contributes to increasing the time taken by this element to pass from the position which it occupies during a faulty start of the lamp to the reclosing position of this contact. The result is that the cycle for repeating the starting of the lamp is longer, without the expansion element being subjected to an excessive loss of heat. Therefore improved operation of the igniting device and a long increase in the life of the contact are obtained.

Another object of the present invention is to provide a starter of this type in which the position of the control member is compensated as a function of the surrounding temperature by means of a second thermic element.

Thus, in contrast to conventional devices, the starters of the present invention may preserve the same adjustment for a very long time, whatever the variations in the surrounding temperature may be, the opening and closing positions of the trigger contact being retained. At least one of the thermic elements of the invention is a bi-metal.

The electric circuit associated with the starter and the fluorescent tube which it controls may then be of a very simple design, since it is only necessary to incorporate a bi-metal formed by a helical member.

Such a system makes it possible to reduce the normal space occupied by a linear bi-metal. Moreover, it is possible to control efficiently the opening of the contact with a relatively low feed current.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be readily carried into practice, embodiments of the present invention will now be described in detail, by way of example, with reference to the accompanying drawings in which:

FIG. 1 is a schematic view of one embodiment of the starter mounted on its support,

FIG. 1*a* is another embodiment of the starter shown in FIG. 1,

FIG. 2 is a partial cross-section through the starter taken on the line II—II shown in FIG. 1,

FIG. 3 is a schematic view showing the construction of another embodiment of the starter shown in FIG. 1,

FIG. 3*a* is a schematic view of a further embodiment of the starter shown in FIG. 3,

FIG. 4*a* shows a construction of a bi-metal,

FIG. 4*b* shows the construction of a bi-metal in the form of a coil,

FIG. 4*c* shows the construction of another bi-metallic element which may be used with the starter,

FIG. 5 is a schematic view of another embodiment of the starter shown in FIG. 1,

FIGS. 6–8 show electric wiring diagrams used for the ignition of the lamp controlled by the starter, and

FIG. 9 shows diagrams of the movement of the push member and variations in the temperature of the bi-metallic member as a function of the surrounding temperature.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the embodiment shown in FIG. 1, the bi-metal member 1 is heated by the electric current fed to the schematically illustrated terminal 9. This bi-metal member is supported by the compensating member 4, to which it is connected by means of the insulating member 10 simultaneously playing the part of an electric and heat insulator. Since materials of this type are known per se, the result is that an insulating fitting may also be used covered with a varnish or a ceramic. The other end of the member 4 is connected to the support 8 by the securing member 5. Due to its mounting, any increase in temperature to which the bi-metal 4 is subjected tends to curve it inwardly more, hence to bring the free end of the bi-metal 1 towards the push member 3 of the mini-switch 2. At the same time, any increase in the temperature of the bi-metal 1 tends to move its free end away from the mini-switch. Thus, bi-metal 4 compensates for ambient temperature changes.

The switch 2 is mounted on the support 8 by means of the rivet 6 and a spacer 7, making it possible to adjust the clearance between the end of the control member of the mini-switch 2, that is to say, of the push member 3, and the free end of the bi-metal member 1. The end of the bi-metal is insulated from the push member 3 by an insulating plate 11 which may, for example, be of the same material as the plate 10.

FIG. 2 shows the spacer 7 for adjusting the gap between the bi-metal 1 and the end of the push member 3. The spacer may, for example, be formed by a simple bent strip of the support 8.

In the embodiment shown in FIG. 1*a*, the compensating member 4 is mounted so that, when the surrounding temperature is average, the bi-metal remains in alignment both with the push member 3 and the bi-metal 4. An insulating plate 10 may be mounted either on the member 1 or 4, these members having no rigid connection between them. A second insulating plate 11 insulates the push member from the bi-metal member 1.

The embodiment of the starter shown in FIG. 3 differs from the one which has just been described in that the compensating member 4 is the member whose free end controls the member 3, while the bi-metal element 1 itself acts as a support. The element 1 is secured to the support 5 by means of the insulating plate 10. The connection between the members 1 and 4 is obtained by the insulating support 11 which may also be cemented between these members or kept in position by means of rivets, any other desired method of attachment also being possible.

FIG. 4*c* shows the particular construction of a bi-metal capable of being used as the element 1. This construction, indicated as a whole by 14, is formed by two superimposed bi-metals 15 insulated by two sheets of mica between which is disposed a heating element 16 welded at its ends 9*a* and 9*b*, these welds being effected on the edges of the upper bi-metal 15 and the lower bi-metal respectively.

The heat resistor 16 is selected so that, by reason of the available heating power, it is minimum for the maximum deflection required by the bi-metal for controlling the trigger contact incorporated in the mini-switch 2 in the preferred embodiment of the invention.

It is obvious that the invention is not limited to the use of single bi-metals as those shown by 1 and 4 in FIGS. 1, 1*a*, 3 or 3*a*, or of bi-metals of the type shown in FIG. 4*c*.

Hence, the bi-metal 1 may have the shape indicated in FIG. 4*a*, the part 1*a* acting on the push member 3, or again have a helical form, as indicated in FIG. 4*b*, from which it is apparent that the insulating plate 11 is intended to come into contact with the push member.

The trigger contact symbolized by the connecting wires 12 and 13 may also be controlled by means of a wire extending from the control member of the contact, that is to say, in this embodiment, from the push member 3.

The second embodiment shown in FIG. 5 differs from the foregoing in that the compensating member 4 is separated from the member 1 and directly actuates the trigger contact assembly, the only modification of which is that it is mounted to swing about a fixed axis. In the embodiment selected by way of example, the member 4 actuates the casing of the mini-switch 2 which swings freely about the axis 6, while the member 1 urges the push member 3 inwardly each time it cools down. While the mini-switch is mounted and fixed to the support 8 by means of strips such as 7 shown in FIG. 2, in the previous embodiments, the casing 2 shown in FIG. 5 has no obstacle to its free displacement under the actions of the bi-metals 1 and 4.

FIGS. 6–8 show by way of example three methods of mounting the starter in the circuits serving for the ignition of the lamps 17. Reference to any of these Figures and to FIG. 9 giving diagrams of the movement of the tip of the bi-metal normally in contact with the push member 3 as a function of the force exerted by the bi-metal, the temperature and the variation in the temperature according to the weather, will enable the description of the operation of the starter according to the invention to the understood.

The trigger contact mounted between the wires 12 and 13 is connected in the pre-heating circuit of the cathodes of the lamp 17 and in parallel with this lamp. The heat expanding member of the expanding wire of the bi-metal, whether compensated or not, is shown at 1. It will therefore be seen that, as soon as an alternating current is applied to the terminals 18 and 19 of the pre-heating circuit of the lamp 17, the member 1 is energized either directly or by means of a secondary winding 20. In the case of FIG. 7, the turns 20 are also coupled to the coil 21. When the trigger contact controlled by the member 1 is opened, the induction coil 21 produces a voltage surge across the electrodes of the lamp 17 normally causing the ignition of the lamp when its electrodes have been suitably heated.

In the diagram shown in FIG. 9, the axes OF, showing the force exerted by the bi-metal and OC showing the movement of the push member, give the corresponding values of these magnitudes for each point of the curves 22 and 23. Similarly, the curves 24 and 25 indicate the displacements of the bi-metal parallel to the axis of the push member 3 as a function of the variations of centigrade temperatures suffered by the axis OT, and the curves 26, 27 shown the variations in the temperature of the bi-metal as a function of the weather. In the example shown, OC is expressed in millimeters, OF in Newtons, OY in centigrade degrees and O*t* in seconds.

Under the initial conditions, that is to say, when the operator applies voltage between the terminals 18 and 19, the force exerted by the bi-metal is maximum, so that the level of penetration of the push member 3, engaged by the bi-metal, is *h*O whose ordinate, on the axis of OC, is selected as the origin. The current directly or indirectly heating the member 1 raises its temperature and involves the linear displacement of its end in contact with the push member 3, as shown by the curve 24 as far as the point A in which the trigger contact of the mini-switch suddenly opens. This opening occurs when the push member is displaced to the level *h*1 and this action is shown on the curve 22 by the horizontal part f1 corresponding to the additional force of the trigger starting the opening movement. The time taken to reach the point A is furnished by the ordinate of the point B on the curve 26 of the same abscissa as the point A, that is to say, approximately 2 seconds. Since the opening of the trigger contact involves the breaking of the pre-heating circuit of the cathodes of the lamp 17, it produces a voltage surge generally sufficient to ignite the lamp. The current fed to the inductance coil 21 is however, sufficient to increase and maintain the temperature of the bi-metal. The end of the bi-metal is displaced to the level F, as shown by the curves 22 and 24.

If for any reason, for example a momentary lowering of voltage, the lamp does not ignite, the bi-metal fails to receive any power and it cools down according to a curve such as 28 to the point E which it reaches in the embodiment shown in a time of 7 seconds. Corresponding to the cooling curve 28 is the contraction curve 25 starting from the point F and descending linearly to the point G at which there occurs the reclosing of the trigger contact. This closure corresponds to the movement 23 of the push member 3, the level of which reaches the value *h*3 for the point G. Since the trigger contact is closed again, a new pre-heating cycle begins and the temperature of the bi-metal rises again, as shown by the curve 29, to the point H in which the contact opens again as already explained. If however, the lamp still does not ignite, a new cycle is repeated after the cooling of the bi-metal, as shown by the curve 30.

From these diagrams, the advantage obtained from selecting, as a function of the push member - applied force diagram, a bi-metal having a characteristic related to the curve 26 is apparent since a characteristic similar to that of the curve 27 would require an excessive pre-heating period, while omitting a trigger contact closing its contact only after a variation of the reverse movement of the push button and of the same order of magnitude as the variation of the movement used to produce the opening thereof. In fact, under these conditions, the time required for producing the reclosing of the contact is sufficient for the bi-metal to cool down partially and permit a pre-heating time sufficient for the reignition of the lamp.

It would also be possible to operate the starter in the reverse direction, opening being always ensured in the course of the heating cycle by means of a mini-switch, the contact of which is closed when inoperative, opening this time being effected by the insertion of the control push member. Mounting is then more delicate, since it is necessary to check at the moment of adjustment that a momentary temperature rise does not produce excessive stressing of the bi-metal. Similarly, the mini-switch could comprise two contacts instead of only one, and the extra contact could be used for the appropriate modification of the characteristics of the control circuits of the lamp. No anti-interference circuits are shown, since these circuits are already known.

What is claimed is:

1. A starter for igniting a fluorescent lamp comprising: at least one feed circuit for the lamp and one pre-heating circuit for the lamp cathodes, at least one electrically heated expansion element inserted in a circuit supplied by the feed circuit and having a precise expansion and contraction cycle under the influence of the variations of temperature produced by the current flowing through the element, a trigger contact switch having a closed and an open position inserted in the pre-heating circuit of the lamp, and a control member connected to the contact switch and engagable by expansion member, wherein the control member, engaged by the said expansion member, causes the sudden transfer of the said contact switch from one position to the other after a given movement whatever position the contact switch is disposed in, the expansion element being selected to develop a force allowing it to effect such a movement during a variation of temperature between one-fourth and two-fifths of the temperature which the element would assume if the preheating circuit operated permanently.

2. A starter as claimed in claim 1, wherein the expansion element keeps the contact switch in a closed position when the control member is in an initial position *h*0, opens the contact switch when the control member is in a position *h*1, and continues its movement until it reaches a position *h*2 beyond *h*1, the non-ignition of the lamp causing the cooling of the element and the return of the control member to a position *h*3 between the position *h*0 and *h*1 in which the contact switch closes again in order to start a new pre-heating cycle.

3. A starter as claimed in one of claim 1, the expansion element of which is formed of two superimposed bi-metals, separated by sheets of mica between which there is disposed a heat resistor, the ends of which are welded to each of the edges of the bi-metals respectively, and the length of which is selected so that the release of power is just sufficient to obtain the desired movement of the end engaging the control member of the trigger contact switch.

4. A starter as set forth in claim 3 further comprising a compensating expansion element operating only under the effects of the surrounding temperature.

5. A starter as claimed in one of claim 1, also comprising a compensating expansion element operating only under the effects of the surrounding temperature.

6. A starter as claimed in claim 3, wherein the compensating element is mounted at a fixed point, the expansion element being engaged by the compensating

element.

7. A starter as claimed in claim 3, the compensating element of which is secured to one end of the expansion element, the free end of the compensating element engaging the control member of the trigger contact switch.

8. A starter as claimed in claim 3, the compensating element of which is secured to one end of the expansion element, the control member of the trigger contact switch being engaged by the free end of the expansion element.

9. A starter as claimed in claim 3, the trigger contact switch of which is incorporated in a casing of a microswitch, the casing being mounted to turn freely about an axis, one of the ends of the expansion and compensating elements being fixed relative to the axis and the free ends of these elements affecting the control member and a side of the casing opposite to the control member respectively.

10. A starter as claimed in one of claim 3, the parts of the expansion and compensating elements of which co-operate mechanically with each other and other elements by means of thermally and electrically insulating plates.

11. A starter as claimed in one of claim 3, also comprising a support for the attachment of the assembly of the contact switch and its control member and the assembly of the expansion and compensating elements, and also two adjustment means, a first adjustment means adjusting the position of the assembly of the contact switch and its control member relative to the free part of the expansion and compensating elements, the second adjustment means adjusting the position of the fixed part of the assembly relative to the support.

12. A starter as set forth in claim 11 wherein the expansion element is formed of two superimposed bi-metals separated by sheets of mica between which there is disposed a heat resistor, the ends of which are welded to each of the edges of the bi-metals respectively, and the length of which is selected so that the release of power is just sufficient to obtain the desired movement of the end engaging the control member of the trigger contact switch.

13. A starter as claimed in claim 9 wherein the extension member is in the form of a coil.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,768,056 Dated October 23, 1973

Inventor(s) Pierre C. EGURBIDE

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, Line 53, after "vention to", delete "the", and insert --be--.

Column 5, Line 12, delete "OY", and insert --OT--.

Line 17, delete "hO", and insert --h0--.

Column 6, Line 50, after "as claimed in", delete "one of".

Line 63, after "as claimed in", delete "one of".

Line 66, delete "3", and insert --5--.

Column 7, Line 2, delete "3", and insert --5--.

Line 7, delete "3", and insert --5--.

Line 20, after "as claimed in", delete "one of".

Column 8, Line 1, after "as claimed in", delete "one of".

Column 7, lines 12 and 20 and column 8, line 1, "3", each occurrence, should read -- 5 --.

Signed and sealed this 17th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.

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