Aug. 26, 1947. R. J. McKENZIE 2,426,463

GLOW STARTER FOR ELECTRIC DISCHARGE DEVICES

Filed March 27, 1944

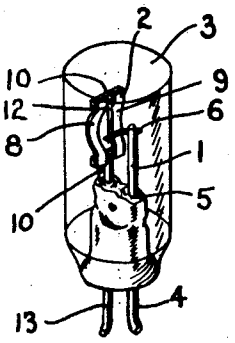


Fig. 1

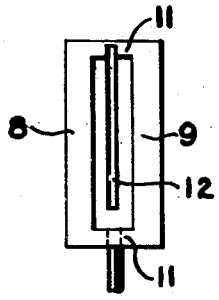


Fig. 3

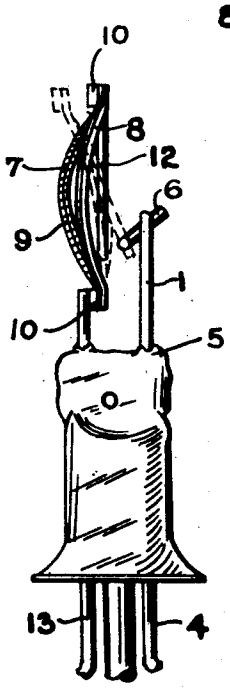


Fig. 2

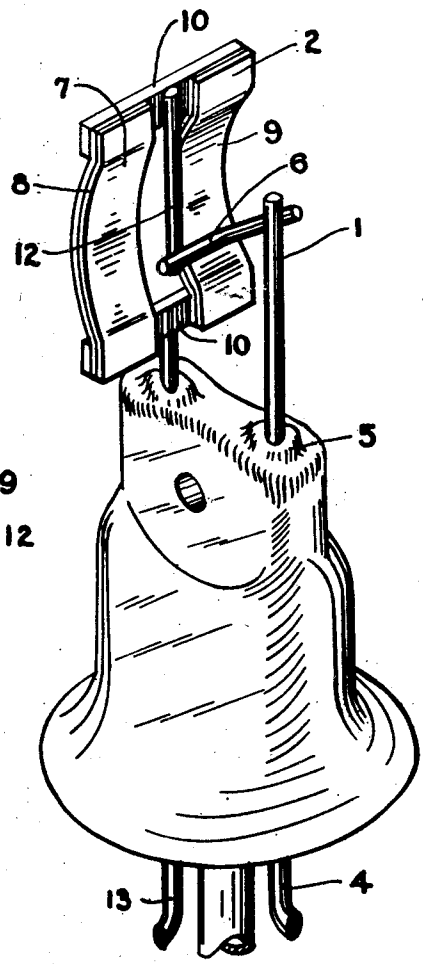


Fig. 4

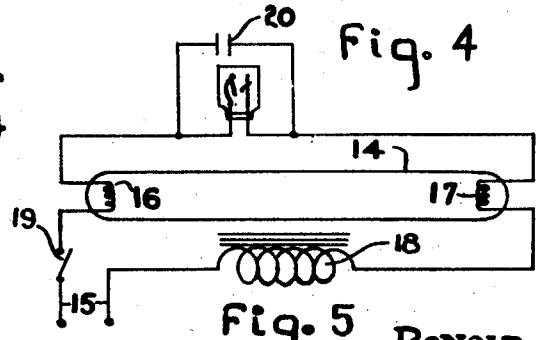


Fig. 5

INVENTOR.
RONALD J. McKENZIE
BY
Lawrence Burns,
ATTORNEY

Patented Aug. 26, 1947 2,426,463

UNITED STATES PATENT OFFICE

2,426,463

GLOW STARTER FOR ELECTRIC DISCHARGE DEVICES

Ronald J. McKenzie, Danvers, Mass., assignor to Sylvania Electric Products Inc., Salem, Mass., a corporation of Massachusetts

Application March 27, 1944, Serial No. 528,305

3 Claims. (Cl. 200—113.5)

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This invention relates to an automatic time interval switch used in connection with starting equipment for gaseous discharge devices or for similar uses.

The invention relates particularly to the construction and operation of the contacting elements of the switch. Heretofore, switches of the type and for the purpose indicated have not been sufficiently positive in action and accurate in timing.

It is an important object of the present invention to provide a switch which not only is positive and accurate in operation but which will maintain its efficiency over a long period of use.

A further object of the invention is to provide a switch in which a single unitary element functions to open and close its contacts.

A further object of the invention is to provide a switch capable of producing a closed circuit interval of substantially long and accurately measured duration.

A further advantage of the invention resides in its ability to provide fast and positive action coupled with extreme simplicity of structure.

Still another object of the invention is to provide a switch having resilient rapid action make and break contact elements which function with an efficient wiping action thereby maintaining them in effective working condition.

A further object of the invention is to provide a thermally operated switch in which at least one of its contact members has inherently incorporated therein means operable upon a change in temperature to cause a snap action distortion of its position to establish or interrupt electrical contact between it and its coacting contact member.

Another object of the invention is to provide a thermally activated switch including a snap action contact element having a resilient contact shoe which functions to stabilize the action of the switch and render its operation accurate and reliable.

Other objects and features of the invention will appear more fully in the following specification taken in connection with the accompanying drawings and will be particularly pointed out in the claims.

The switch is enclosed in an evacuated envelope having an ionizable atmosphere. The active elements function both as electrodes and as current carrying contact members. The contact members are provided with lead wires passing through the envelope for connecting the switch in series with the filaments of a hot cathode gaseous discharge lamp which in turn is connected to a supply of electric current.

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An upward extension of one of the lead wires serves as a fixed switch contact member while the other lead wire has secured thereto a bimetallic member divided into at least two longitudinally extending temperature responsive strips connected together at their end portions. Each strip is curved lengthwise the curvature of one differing a calculated amount from that of the other. The variance in the curvature in the strips results in accurately controlled fast acting snap over movement of the contact element into closed or open circuit position when its temperature passes through certain critical temperature ranges.

To present a better understanding of the invention particular embodiments thereof will be described in connection with the accompanying drawings in which:

Figure 1 is a general view in perspective of a preferred embodiment of the invention;

Figure 2 is a side elevation of the contacting elements of the switch showing their open circuit position in full lines and their closed circuit position in dotted lines;

Figure 3 is a detail view of a modified but desirable structure for the bimetallic active switch member;

Figure 4 is an enlarged perspective view of the switch elements and their supporting stem.

Figure 5 is a diagrammatic illustration of an example of the manner in which the switch is used.

The principles of the invention are shown as applied to that type of switch wherein the actuating source of heat is derived from a glow discharge between the switch elements.

The contact elements 1 and 2 are enclosed in an evacuated envelope 3 containing an ionizable atmosphere. The contact member 1 may desirably be rigidly connected to or integral with its lead wire 4 which projects through and is sealed in the envelope 3 at the press 5 thereof. The contact 1 is made of a rod or wire of any suitable electrically conductive material and may be provided with a laterally offset portion 6 integral with or secured thereto.

The other contacting member 2 is composed of a bimetallic element 7 which is divided into at least two relatively narrow temperature responsive strips 8 and 9 which are rigidly connected together at top and bottom by joining portions 10. The element 7 may be stamped out of a sheet of bimetal to form a unitary member

as shown in Figure 3 or it may be fabricated from separately formed members which are welded or otherwise assembled for example as shown in Figures 1, 2 and 4. In the former construction connecting strips 11 of the bimetal serve to connect the ends of the two temperature responsive strips together while in the other construction two separate strips are welded or otherwise secured at their top and bottom portions to the joining portions 10.

A contact shoe 12 is welded or otherwise secured at its upper end to the upper joining portion of the member 7. Desirably the shoe 12 extends downwardly between the strips 8 and 9 which are laterally spaced a substantial distance. The shoe 12 may be of any suitable length but desirably may be only slightly shorter than the strips 8 and 9. The portion 6 of the contact 1 is so situated that the lower end of the shoe 12 will engage it upon actuation of the member 7, as shown in dotted lines in Figure 2. The bottom portion of the member 7 is rigidly secured to a support and lead wire 13 which is anchored in the press 5 of the envelope and extends to the external circuit.

In the form of the invention shown the strips 8 and 9 are curved to present their outer faces convexly away from the contact member 1, one of the strips having a greater radius of curvature than the other or at least having a shorter peripheral length than the other. As shown in the drawings the strip 8 presents a flatter curvature than the strip 9 and is consequently less in peripheral length.

The purpose of the unsymmetrical curvature of strips 8 and 9 is to provide for the rapid closing and opening movement of the switch. By correctly proportioning the strips and forming them to the correct curvature, the element 7 when raised to a predetermined critical temperature is caused to move with a snap action which results in closing the circuit to the lamp filaments.

After a measured interval of time the bimetal cools to a lower critical temperature at which time it snaps back to its initial position.

Upon the application of heat to the member 7, the strips 8 and 9 enlarge their radius of curvature and approach a straight flat plane. Since the strip 9 has a longer peripheral length than the strip 8 it increases in length more rapidly as they both become flatter. Inasmuch as their ends are rigidly tied together a stress accumulates in the bimetal member as its temperature increases and when the critical predetermined temperature is approached the strips start to assume a reverse curve at which time the accumulated stress therein is released and acts rapidly to produce a pronounced reverse curvature in the bimetal which causes the sudden and firm engagement of the contact shoe 12 with the contact element 1 thus closing the circuit.

After the heating means is cut off in a manner to be described hereinafter, the element 7 cools, permitting the inherent spring energy therein to cause it to return to its initial contour. As the member 7 cools and before the contacts open a critical condition is reached wherein a stress is accumulated therein in a manner similar to that which occurs during the closing movement of the member. This stress is suddenly released to cause a rapid snap action separation of the contacts.

It will be noted by reference to Figure 2 of the drawings that when snap over action occurs that the upper portion of the member 7 moves laterally toward and from the member 1 while the shoe 12 is given a rocking movement which causes its free end to engage and disengage the contact member 1.

As herein suggested an important use of the switch described is in the operating circuit of a fluorescent lighting unit. Such a circuit is illustrated diagrammatically in Figure 5 of the drawings in which a hot cathode gaseous discharge type lamp 14 is supplied with alternating current from a supply line 15. The lamp is provided with a pair of electron emitting filaments 16 and 17 at the ends thereof. The glow switch as described is connected in series with the filaments in a manner to control flow of current from the line 15 thereto.

As shown in the drawings one side of the line 15 is connected to one end of the filament 16 while its other end is connected to one terminal of the switch. The other switch terminal is connected to one end of the filament 17 while its other end is connected to one terminal of a ballast unit 18 whose other terminal connects to the remaining side of the line 15. All of the elements of the circuit are thus connected in series across the line 15.

To operate the lamp a line switch 19 is closed which applies line potential between the contacting members 1 and 2 of the glow switch which starts a glow discharge between them. The heat developed by the discharge raises the temperature of the bimetal element until it reaches its critical value at which time it snaps into closed circuit position thereby establishing a metallic circuit through the filaments 16 and 17 and simultaneously extinguishing the glow discharge within the envelope.

The bimetal then starts to cool and after a measured time interval it snaps into open circuit position and finally assumes its initial position. The time interval is adjusted to provide sufficient time to permit the filaments to attain their necessary electron emission temperature.

The opening of the circuit by the glow switch releases potential electrical energy accumulated in the ballast unit 18 which supplies proper electrical conditions to establish a glow discharge in the lamp itself thus producing normal operation thereof. It is desirable to connect a condenser 20 across the switch members 1 and 2 to reduce sparking between them at the instant of making or breaking the circuit. The condenser reduces the tendency to burn the contact areas and also reduces interference in nearby radio receivers.

It is important to note in the operation of the invention that when the bimetal moving contact snaps into open or closed circuit position certain beneficial results follow not heretofore to be found in switches of the same type. Prior to the present invention thermal switches of similar construction not having snap action movement close their contacts with a very slow movement and as a consequence at the instant of contact a very light pressure exists at the area of contact. This light pressure fails to provide satisfactory and positive connection. This indefinite contact may fail to provide adequate current carrying capacity to light the filaments within the required time and moreover this low current capacity tends to cause heating and possible burning of the contacts. The present invention eliminates the above suggested difficulties. When the bimetal member 7 snaps into closed circuit position it engages the contact member 1 with a sudden and firm pressure de-

rived from the snap action of the member. This firm rapid motion produces a substantial wiping action at the contacts thus insuring permanently clean contact areas of substantial extent which contribute to the long life and efficient operation not only of the switch but also of all the electrical elements of the fixture as well.

The contact shoe 12 desirably is so constructed that it is inherently resilient to a predetermined degree. This resilient characteristic of the shoe aids in retaining a firm contact pressure between the switch elements 1 and 2 up to the instant that snap action occurs to open the circuit. When the element 7 snaps into closed circuit position it engages the contact 1 with considerable pressure which flexes the shoe 12 thus building up potential spring energy therein. Immediately after the glow discharge ceases the element 7 starts to cool and has a tendency under certain operating conditions prematurely to open the circuit before snap action occurs. The stored up spring energy in the shoe 12, however, maintains firm engagement of the contacts and counteracts the tendency to prematurely open the circuit until the member 7 reaches it predetermined snap over temperature. By properly proportioning the elements of the member 7 and observing the reaction characteristics of the bimetal sheet material employed, the correct heating period for the filaments 16 and 17 is established.

In the switch described, the travel of the free end of the shoe 12 is relatively great which fact, considered in connection with its rapid opening movement, insures that a positive non-sparking and non-arcing interruption of the circuit takes place particularly when a high voltage supply is used.

Another valuable characteristic which follows from the use of a resilient contact shoe is that due to the wiping action which takes place between the contact elements 1 and 2 at the instant of making and breaking the circuit. The resilient character of the shoe causes a slight relative movement between it and the contact 1 thereby producing and maintaining clean low resistance contact areas.

What I claim is:

1. An automatic interval timing thermal switch comprising an evacuated envelope having an ionizable atmosphere, a pair of contact members therein one of said contact members having a temperature responsive element including a pair of bimetallic strips each presenting predetermined but different degrees of curvature and presenting their convex faces toward a common plane and having equal chordal lengths, means rigidly connecting their ends together, and means for rigidly anchoring one end of said temperature responsive element whereby upon raising its temperature to a predetermined value its free end will be caused to snap into closed circuit position in engagement with the other contact member.

2. An automatic interval timing switch for starting gaseous discharge lamps, comprising an evacuated envelope having an ionizable atmosphere, a pair of contact members one of which is thermally actuated and the other fixed, lead wires connecting with said contact members and leading out of said envelope, said thermally actuated contact having a fixed supporting base portion and a bimetallic moving element fixed at one end to said support, said moving element being divided into two temperature responsive sections rigidly secured together at their opposite ends, said sections being curved convexly toward a common plane a predetermined but different degree and having equal chordal lengths, whereby when the temperature of said bimetallic element is raised to a predetermined value its unsupported end will snap into closed circuit position engaging said fixed contact member.

3. An automatic time interval thermally actuated starting switch for gaseous discharge lamps comprising an envelope having an ionizable atmosphere therein, a movable and a fixed contact member within said envelope, lead wires connecting said contacts to the external circuit, said movable contact having a bimetallic portion rigidly anchored at one end and divided into two relatively movable temperature responsive sections which are curved with their convex faces away from said fixed contact and which have equal chordal lengths and different peripheral lengths means for securing their ends ends against relative movement and a contact shoe secured at one of its ends to the free end of said movable contact member whereby when the said strips are raised to a predetermined temperature by a glow discharge within said envelope the free end of the shoe will be rocked into closed circuit position engaging said fixed contact.

RONALD J. McKENZIE.

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