

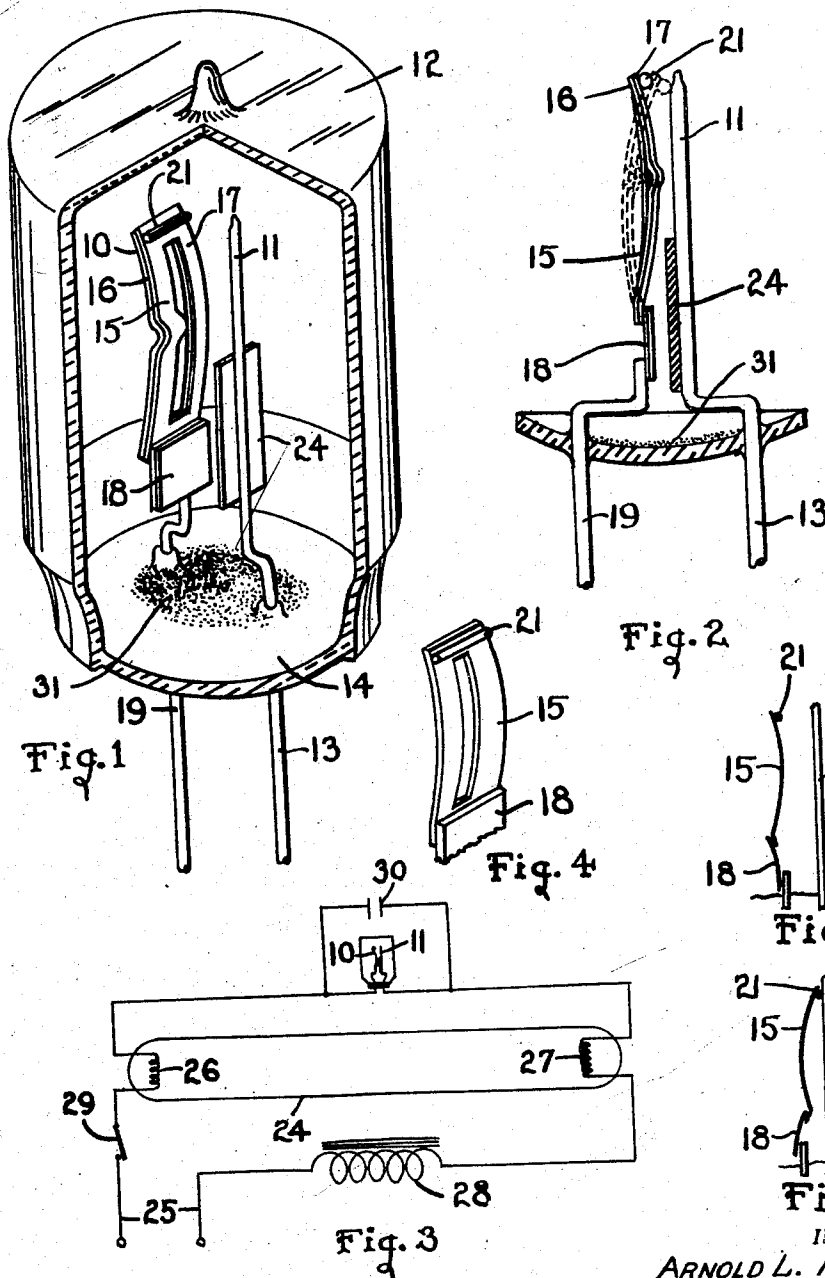
Dec. 9, 1947.

A. L. PEACOCK ET AL

2,432,488

GLOW STARTER FOR ELECTRIC DISCHARGE DEVICES

Filed March 27, 1944



INVENTORS.
ARNOLD L. PEACOCK
CHARLES LESTER SINCLAIR
BY *Louise Burns,*
ATTORNEY

UNITED STATES PATENT OFFICE

2,432,488

GLOW STARTER FOR ELECTRIC
DISCHARGE DEVICES

Arnold L. Peacock and Charles Lester Sinclair,
Danvers, Mass., assignors to Sylvania Electric
Products Inc., Salem, Mass., a corporation of
Massachusetts

Application March 27, 1944, Serial No. 528,306

3 Claims. (Cl. 200—113.5)

1

This invention relates to an automatic time interval switch of the type commonly termed a glow switch and used in connection with the starting equipment for gaseous discharge lamps. It may, however, be used in connection with other devices requiring a measured time interval in their cycle of operation.

The invention relates particularly to the construction and operation of the contacting elements of the switch. Much difficulty has heretofore been experienced in producing a switch of the type suggested which is positive in action and accurate in timing and which will maintain its efficiency for an extended period of time.

It is an important object of the invention to produce a switch of the type indicated which overcomes the above-stated difficulties.

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

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

A further object of the invention is to provide a switch in which a single unitary moving element opens and closes its contacts.

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 at their contact areas thereby maintaining them automatically 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 change or distortion of its position thereby to establish or interrupt electrical contact therebetween.

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

2

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 diagrammatic view illustrating an example of the manner in which the switch is used;

Figure 4 is an illustration of another form of the bimetallic member;

Figures 5 and 6 are diagrammatic illustrations of different phases in the operation of the switch.

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 element 18 is of bimetal material and is so positioned with respect to the element 15 that their distortion upon the application of heat is in opposite directions, the movement of the element 15 is toward the contact 11, while the movement of the member 18 tends to move the element 15 away from the contact 11. One of the functions of the element 18 is to compensate for excessive movement of the member 15 during the process of sealing the stem 14 in its correct position in the envelope 12. At this time a relatively high degree of heat must be applied to effect the seal between the body of the envelope and the stem. In so doing the element 15 is strongly affected and bent an excessive amount in the direction of the contact 11. This excessive movement of the member 15 would tend to bend the member 11 so far from its normal position that it might assume a permanent set out of its proper alignment. However, the element

18 partially neutralizes this excessive movement thereby preventing permanent distortion of the contact 11 or any other associated parts. Another function of the plate 18 will appear hereinafter.

The purpose of the unsymmetrical curvature of strips 16 and 17 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 15 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 15 the strips 16 and 17 enlarge their radius of curvature and approach a flat plane. Since the strip 16 has a longer peripheral length than the strip 17 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 on the member 15 with the contact element 11 thus closing the circuit.

After the heating means is cut off in a manner to be described hereinafter, the element 15 cools, permitting the inherent spring energy therein to cause it to return to its initial contour. As the member 15 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.

When the member 15 is a one piece stamping, the forming of the strips 16 and 17 may be accomplished by stamping a small indentation 22 in one of the strips thereby lengthening its peripheral length the required amount. The variance in curvature between the strips 16 and 17 may also be obtained by a die forming operation without forming the indentation 22. A bimetal element formed in this manner is shown in Figure 4.

It has been determined that when the switch is employed in a circuit containing a capacitive characteristic, as is sometimes the case when it is desired to reduce stroboscopic effects in a two lamp fixture, that there is an excessive delay in opening the circuit after the lamp filaments have reached their proper electron emitting temperature. To overcome this undesirable delay a plate or flag 24 is secured by welding or otherwise to the element 11 at a position opposite to the element 18. This construction provides the required alteration in the circuit characteristics to insure that the cycle of operation of the switch will be equivalent to that of a starting switch connected to the lamp having an inductive circuit.

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 3 of the drawings in which a hot cathode gaseous discharge type lamp 24 is supplied with alternating current

from a supply line 25. The lamp is provided with a pair of electron emitting filaments 26 and 27 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 25 thereto.

The contact elements 10 and 11 are enclosed in an evacuated envelope 12 containing an ionizable atmosphere. The contact member 11 may desirably be rigidly connected to or integral with its lead wire 13 which projects through and is sealed in the envelope 12 at the stem 14 thereof. The contact 11 is made of a rod of any suitable electrically conductive material and is slightly resilient at its upper unsupported end.

The other contacting member 10 is composed chiefly of a bimetallic element 15 which is divided into at least two relatively narrow temperature responsive strips 16 and 17 which are rigidly connected together at top and bottom by joining portions of the element itself.

The bottom margin of the element 15 is welded or otherwise secured to a supporting and compensating element 18 which in turn is rigidly secured to the lead-in and supporting wire 19 extending to the external circuit. The complete contact member 10 is thus rigidly supported at its bottom and free to move at its upper end when a change of temperature occurs in the bimetal.

The strips 16 and 17 are slightly laterally separated to provide free and independent movement thereof. A contact shoe 21 is secured to the upper portion of the bimetal member 15 in position to engage the contact member 11. The shoe 21 may desirably be made of Nichrome wire welded to the bimetal. It has been found that Nichrome metal functions with a high degree of efficiency since its peculiar property of relatively high electrical resistance reduces the tendency to spark when the switch opens or closes its circuit.

In the form of the invention shown in Figures 1, 2 and 3 the strips 16 and 17 are curved convexly from the contact member 11, 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 16 presents a flatter curvature than the strip 17 and is consequently less in peripheral length.

To operate the lamp a line switch 29 is closed which applies line potential between the contacting members 10 and 11 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 26 and 27 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.

In connection with the operation of the device there are certain vital factors in the construction and operation of the compensator which should receive particular attention. In this connection a further function of the compensator 18 will be set forth as above suggested. In following the opening and closing cycles of the contact members as the bimetal 16 heats up due to the glow discharge its curvature starts to straighten out thus

moving its contact shoe 21 toward the contact member 11 before the critical temperature of approximately 150° C. is reached at which time rapid snap over movement of the shoe 21 occurs. It is during this warming up period that the compensator plate 18 exerts its controlling function. The reactive movement of the element 18 upon a rise in temperature being opposite to that of the member 15 causes the contact shoe 21 to move away from the contact member. The resulting movement of the combined action of the two bimetal elements causes the contact shoe 21 to remain substantially stationary until the snap over movement of the member 15 takes place, at which time the bimetal assumes a reversed curvature. In this manner, excessive movement of the contact element 10 and consequent premature closing of the contacts is prevented. A diagrammatic illustration of the position of the elements at the instant before snap over occurs is shown in Figure 5. In this figure the distortion of the member 18 is shown exaggerated to better illustrate its action. It is apparent that the action described constitutes a highly efficient circuit closing operation because the compensator automatically prevents premature engagement of the contacts. By premature is meant engagement of the contacts due to the slow movement of the upper end of the bimetal 16, occasioned by its rise in temperature and not due to snap action. Such slow motion if and when it results in contact would be a relatively poor contact, since at the instant of engagement the pressure of the contact would be extremely light and probably have a momentary high resistance. These characteristics are undesirable and are overcome by the action of the compensator element which prevents engagement until snap over occurs.

After making contact the glow discharge discontinues and the contact elements start to cool. It is at this time that the contacts must remain closed for a measured period of time during which the filaments heat up to their electron emission temperature. This measured period ends when the bimetal 15 cools to a predetermined temperature at which time it snaps into open circuit position. During this preliminary cooling off period the compensator functions to provide maximum efficiency in maintaining consistently accurate timing of the internal and rapid and positive opening of the circuit. As soon as the bimetal 15 starts to cool, its reversed curvature begins to straighten out, thus tending to move away from the fixed contact 11 and prematurely open the circuit. However, the compensator also starts to cool and in so doing tends to move the contacts into firmer engagement thus overcoming their tendency to separate as shown diagrammatically in Figure 6. The compensating action of the member 18 is aided by reason of the fact that it tends to cool faster than the element 15 not only because it is of smaller area but because it is secured to the supporting lead wire 19 which carries away the heat by direct conduction. This Figure 6 illustrates in a somewhat exaggerated manner the position of the elements just prior to the instant when the bimetal 15 snaps into open circuit position. The compensating bimetal 18 has assumed a curvature toward the contact 11 thus holding the contact shoe 21 firmly in closed circuit position until snap over occurs.

The compensator thus controls the action of the switch rendering its function accurate and reliable over a long period of time. The snap

over action providing fast and positive make and break operation of the switch and moreover such snap action causes the contact areas to engage with substantial pressure at the instant of contact and right up to the instant of separation. Such firm contact also causes a slight degree of wiping action between the contacting areas on the two contact members 10 and 11. This wiping action arises from the fact that not only is the member 15 inherently resilient but the contact member 11 is also resilient. When snap over occurs, therefore, the contacts have a slight relative movement which acts to keep the engaging areas clean, thereby maintaining a desirable low resistance between the switch contacts.

Among the other important benefits resulting from the manufacture of switches of the type herein presented having the compensator 18 incorporated in their structure, is the fact that switches so made possess consistent and reliable operating characteristics which are not as difficult to maintain when they are manufactured under quantity production methods as are switches not having the compensation.

In the manufacture of switches having the compensator it is important to determine the relative sizes of the bimetal members 15 and 18 to produce a predetermined time interval. Once having determined the proper ratio and maintaining this ratio in their manufacture the completed switches are found to possess practically one hundred per cent consistent operational characteristics. The broad principles of the invention, however, apply equally well to switches with or without the compensator element.

The stem portion 14 of the envelope 12 desirably is of the wafer type and the exhausting operation is performed through an exhaust tube at the top of the envelope. It is also desirable that the stem 14 be dished slightly as shown in Figure 2 with its concave surface facing toward the switch elements. Furthermore, it is desirable that the establishing of the discharge between the elements 10 and 11 be facilitated to insure that the arc discharge will not fail to start even when the exciting voltage is at a minimum. To aid in starting the discharge a layer of an especially prepared material is coated upon the central area of the inner face of the stem. A suitable coating material has been found to have the following ingredients:

Parts by weight	
Aluminum	1
Zinc	1
Magnesium	3/4

These materials if available in commercial powder form should be further reduced in particle size by at least ninety-six hours treatment in alcohol in a ball mill. A suitable vehicle is added to provide the necessary binding for the particles and insure their adherence to the envelope.

What we claim is:

1. An automatic interval timing thermal switch comprising an envelope having an ionizable atmosphere therein, a pair of contacts in said envelope, one of said contact members being an active thermally actuated bimetallic member divided into two sections of unsymmetrical curvature adjusted to cause the member to snap into closed circuit and open circuit positions at predetermined temperatures, a support for said active bimetallic member, a bimetallic compensator element secured at one end to said support and at its opposite end to said bimetallic snap action member, said compensator having a reverse ther-

7

mal reaction acting to prevent premature closing of the contacts before snap over occurs and to maintain firm engagement of the contacts prior to the open circuiting snap over action thereof, and lead wires connecting said contact members to an external circuit.

2. An automatic interval timing switch for starting gaseous discharge lamps comprising an envelope having an ionizable atmosphere therein, a pair of contact members in said envelope one of which is thermally actuated to close the contacts and the other is fixed, lead wires connected to said contact members and extending out of said envelope, said thermally actuated contact member 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 sections rigidly secured together at their ends, said sections being formed in a curve departing from a common plane and presenting different degrees of curvature and having equal chordal lengths whereby when the temperature of said bimetallic member is raised to a predetermined degree its unsupported end will snap into closed circuit position engaging said fixed contact member and an auxiliary compensating bimetal member operably connected to said movable bimetal member and acting to prevent premature engagement and disengagement of the contacts prior to the instant of their snap over action.

3. An automatic interval timing thermal switch comprising an envelope having an ionizable atmosphere therein, a movable and a fixed contact in said envelope each having a lead wire extending out of said envelope, a main bimetal-

8

lic element divided into two temperature responsive strips each strip being curved convexly from a common plane one strip being of shorter peripheral length than the other but of substantially equal chordal length, an auxiliary compensator member of bimetal operatively connected to said main bimetal and having a reverse thermal reaction, said auxiliary bimetal member acting to prevent premature engagement and disengagement of said contacts, and a metallic plate of substantial area secured to said fixed contact member in generally parallel relation to said bimetallic element.

ARNOLD L. PEACOCK.
C. LESTER SINCLAIR.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,181,294	Biggs	Nov. 28, 1939
2,200,443	Dench	May 14, 1940
2,210,701	Bletz	Aug. 6, 1940
2,228,210	Hays	Jan. 7, 1941
2,259,111	Laidig	Oct. 14, 1941
2,267,098	Hays	Dec. 23, 1941
2,299,767	Schmidinger	Oct. 27, 1942
2,329,134	Peters	Sept. 7, 1943
2,343,172	Cook	Feb. 29, 1944

FOREIGN PATENTS

Number	Country	Date
348,686	Great Britain	May 13, 1931
732,488	France	Sept. 21, 1932