Nov. 6, 1956 H. J. MACEMON ET AL 2,769,876

ELECTRIC SWITCHING DEVICE

Filed Sept. 6, 1951

Fig. 1.

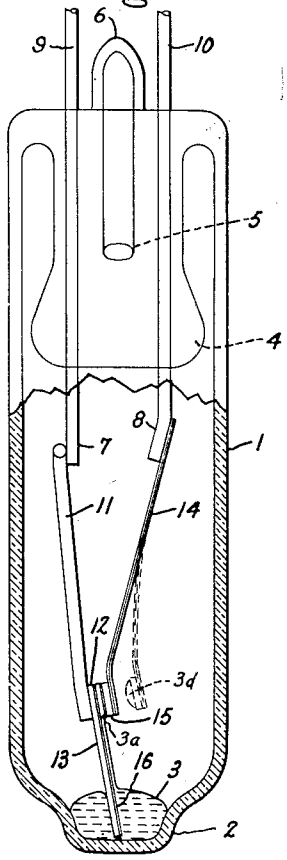


Fig. 3.

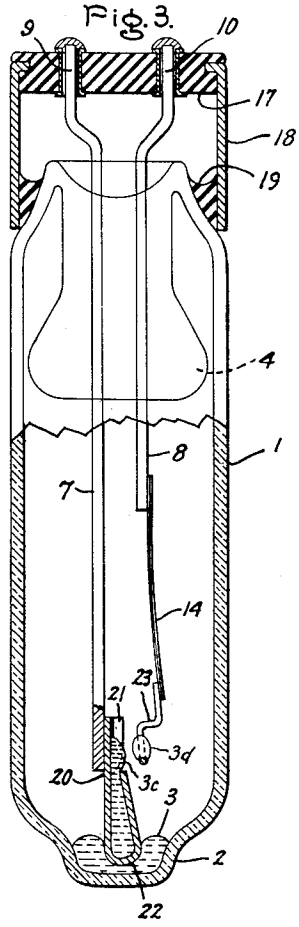


Fig. 2.

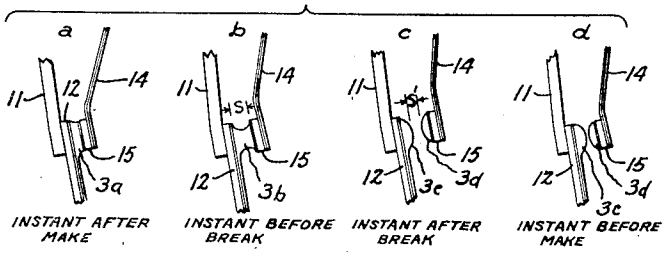
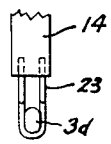


Fig. 4.



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ELECTRIC SWITCHING DEVICE

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12 Claims. (Cl. 200—113)

Our invention relates to electrical switching devices and more particularly to switching devices of the type which automatically make and break the electric circuit of which they are a part.

While not limited thereto, our invention finds a particular application in circuits to be automatically cyclically made and broken, the closed and open circuit periods being relatively long and equal or unequal in duration. Specific applications of the automatically making and breaking switching device are found, for example, in the circuits of flashing lamps for automotive vehicle directional signals, aircraft running signals, flashing beacons, and the like. Such circuit applications in general require that the electric switch or contact making device therein cyclically close the circuit for a period in the order of 0.3 second and open the circuit for a period in the order of 0.15 second. These requirements are more difficult to meet than would appear to one unfamiliar with the attendant problems, especially in an electric switching device which is characterized by simplicity and economy of construction. An ordinary vibrating magnetic switch of the "bell ringing" type, for example, operates at a cyclic frequency far in excess of the required frequency and, furthermore, tends to have equal opened and closed circuit periods. The structure of the vibrating type magnetic switch not only requires a set of making and breaking contacts but also requires a magnetic circuit and an electrical winding to energize the magnetic circuit. An ordinary thermostatic type switching device, in which thermal deformation of an expansible element by heat generated in a separate circuit component or in the element itself as current flows therethrough opens and closes a pair of contacts by alternate heating and cooling of the expansible element, ordinarily operates at a frequency too high for the requirements cited. Such a thermostatic switching device may be slowed somewhat by proper design but, in that event, the slow speed with which the contacts are made and broken results in contact arcing which may, in turn, seriously burn and pit the contacting surfaces and unduly shorten the life of the device. Prior art switching devices for meeting operational requirements for the circuit applications described are made structurally complicated and high in cost by the employment of electromagnetic components and thermally expansible elements in combination or by the employment of mechanical snap action mechanisms in combination with thermally expansible elements.

It is an object of our invention to provide a new, improved, simplified, and low cost electric switching device of the type which automatically makes and breaks the circuit of which it is a part.

It is a further object of our invention to provide such an electric switching device which operates with relatively long duration and respectively unequal or equal periods of open and closed circuit positions.

It is a further object of our invention to provide such an electric switching device which is not limited by arcing damage to the contacting surfaces.

It is a further object of our invention to provide such an electric switching device which is relatively insensitive to mechanical vibrations during operation.

And it is a still further object of our invention to provide such an electric switching device which is suitable for application in flashing lamp circuits of automobile turn signal systems and the like.

In the fulfillment of the aforestated objectives, our invention eliminates the necessity of electromagnetic circuit components and mechanical snap action mechanisms by employing a bimetallic thermally expansible element to make and break a pair of contacts in response to atmospheric temperatures or heat generated within the bimetallic element by current flowing therethrough during the times that the contacts are made. In conjunction with this structure, we provide means for wetting the two contacts with mercury from an abundant supply of mercury carried in a reservoir, so that the contacts are coated at all times with a replenishable layer of liquid mercury. In one form, when the contacts are closed and electric current flows through them and the bimetallic element, heat generated within the bimetallic element causes it to deform and move the contact attached to it away from the other, stationary contact. As this occurs, however, the mercury between the contacts maintains the electrical connection, by the action of surface tension which causes the mercury to neck down and bridge the contact gap, for a considerable portion of the breaking travel. Once the mercury neck is broken, with no arcing damage to the contacts since they are covered with a replenishable layer of liquid mercury, and the mercury contracts back into puddles on the contacts, the bimetallic element begins to cool and move the contact attached to it back toward the stationary contact. Such cooling movement, however, must cause the bimetallic contact to travel over the rather great length of the mercury neck before electrical connection is re-established, whereupon the cycle begins to repeat itself. The periods during which electrical connection is complete between the contacts are relatively long in duration since the bimetallic element must heat and deform a considerable amount before the circuit is broken. And because the mercury neck collapses upon being ruptured, the bimetallic element upon cooling must return the movable contact over a considerably longer path than would otherwise be possible before electrical connection between the contacts is re-established, so that the open circuit period is relatively long. The combination of a bimetallic element with mercury wetted contacts provides an electric switching device which is simple and economical, yet, fully satisfactory for the aforestated applications. The mercury wetted contacts which maintain a mercury coat by adhesive forces are insensitive to jars and vibrations which might disturb a mercury pool used as a part of the contacting structure.

The features of our invention which we believe to be novel are pointed out with particularity in the appended claims. However, for a better understanding of the invention, together with further objects and advantages thereof, reference should be had to the following description taken in conjunction with the accompanying drawing, in which Fig. 1 is an elevational view, partially in section, of an electric switching device embodying our invention; Fig. 2 is a series of illustrations of the sequential operation of the mercury wetted contacts employed in switching devices embodying our invention; Fig. 3 is an elevational view, in section, of a modification of the device of Fig. 1 embodying our invention; and Fig. 4 is a side elevation of the movable contact shown in Fig. 3.

Referring now to Fig. 1, we have shown an electrical switching device which includes a hermetically sealed envelope 1 made of glass or any other suitable insulative material and having a reservoir portion 2 containing a

pool of mercury 3. The atmosphere within envelope 1 may be that of a gas inert with respect to mercury, such as hydrogen or argon, at a pressure in the order of 10 to 20 lbs. per sq. in. to reduce mercury vaporization and possible mercury vapor arcing during operation of the device as will be explained hereinafter. Envelope 1 further includes a glass stem press 4 through which a passageway 5 communicates with a final seal-off tubulation 6 and through which are also sealed, in mutually insulated relation, two electrical connectors 7 and 8. Connectors 7 and 8 provide external terminals 9 and 10 for the switching device at the external extremities thereof and provide internal support for cooperating contact areas which, together with connectors 7 and 8, form a stationary contact structure and a movable contact structure. The stationary contact structure comprises connector 7, a conductive member 11 bonded at the inner extremity thereof, and a first or stationary contact 12 bonded at the lower extremity of member 11, although it will be understood that in some instances it may be desirable to provide these as an integral piece. Stationary contact 12 includes means for wetting the contacting surfaces of the device with a layer of liquid mercury, such means comprising an extension 13 of contact 12 which extends as shown to engage mercury pool 3. The movable contact structure includes an elongated temperature responsive bimetallic element or strip 14, mounted at the inner extremity of connector 8, carrying at the lower extremity thereof a movable contact 15. Bimetallic element 14 in this embodiment is positioned so that when it is at the normally encountered ambient temperature, the surface of movable contact 15 is in engagement with the surface of stationary contact 12 through a film of mercury 3*a*. Bimetallic element 14 has that portion thereof possessing the higher coefficient of thermal expansion innermost, or facing member 11, so that as it is heated it assumes a curved shape, as shown by dashed lines, and moves contact 15 away from contact 12. The material, size, and shape of bimetallic element 14 are determined by the desired current rating and frequency of operation of the switching device, as will be apparent to those skilled in the art. The opposing and engaging surfaces of contacts 12 and 15 and the surface of extension 13, which is a continuation of the surface of contact 12, are all wettable by liquid mercury, and may conveniently be made wettable by the plating of a surface layer 16 of certain metals such as platinum, nickel, or copper, which have surface affinity for mercury, thereon. A surface coating of liquid mercury is thus transferred by extension 13 to contact 12 and hence to contact 15 during operation of the device, such a coating being easily and automatically replenished when necessary from pool 3.

During operation, the switching device shown by Fig. 1 may be, for example, connected in series relation with a source of voltage and a lamp to be cyclically flashed. As power is supplied to the circuit and current flows through bimetallic element 14 and the engaged contacts 12 and 15, bimetallic element 14 deforms into a curved configuration shown by the dashed lines of Fig. 1, due to heat generated therein by I^2R energy conversion. Referring to Fig. 2, the first illustration (*a*) shows the switching device contacts in normally closed engagement through the mercury film 3*a* which wets their surfaces, just after the instant of contact make. Then, as the bimetallic element 14 thermally deforms it moves the movable contact away from the stationary contact, but electrical connection therebetween remains established, and the contact travel continues over a relatively great distance, S, due to the stretching of the mercury into a neck 3*b* between the contacts as shown by (*b*) in Fig. 3. Even though the contacts are physically separated on the breaking travel, electrical connection and movable contact displacement continue to the distance, S, so that a period of relatively long duration occurs during which the switching device is in the closed-circuit condition. When the breaking point of the mercury neck is reached, the mercury quickly contracts and redistributes itself in rounded globules 3*c* and 3*d* on the two contacts due to surface tension. The circuit is broken with a snap action and any arcing is received by the mercury puddles 3*c* and 3*d*, which are automatically replenished as stated before from mercury pool 3, so that little damage is done to the contacts themselves and their life is not limited thereby. The purpose of an inert gas under pressure within the envelope is to discourage the vaporization of mercury and the possibility of mercury vapor discharge by ionization which may, at higher voltages, cause the breaking of electrical connection to be slower. This effect is not appreciable at the low voltages usually employed on automotive vehicles, aircraft, and the like.

The instant after the circuit is broken, the contacts and the mercury thereon appear as shown at (*c*) in Fig. 3, the puddles 3*c* and 3*d* being widely separated by the distance S'. Since bimetallic element 14 then has no current flowing therethrough, it starts to cool and resume its original shape, at a rate which may be greater or less than the rate of thermal deformation by heating current. The movable contact is therefore carried back toward the stationary contact, and after a period of considerable duration in the open-circuit condition, reaches the position shown at (*d*) in Fig. 3, whereupon the puddles of mercury unite and quickly re-establish electrical connection, the contacts appearing as at (*a*) again, and the cycle described commencing over again.

It is important to notice that the relatively long duration open and closed circuit conditions of the switching device result from contact connection by the mercury neck 3*b* during contact separation travel over the relatively great distance, S, while the contacts are electrically disconnected, due to the collapse of the mercury neck 3*b* upon rupture, over the relatively great contact return distance S'. In the particular device illustrated by Fig. 1, cooling of bimetallic element 14 may take place at a faster rate than heating, so that the open-circuit condition prevails for a shorter duration than the closed-circuit condition during each cycle. However through proper design of the bimetal with respect to the current load, the closed circuit time may be relatively long or short and either greater than, equal to, or less than the open circuit time.

The electrical switching device is further made insensitive to mechanical jars and vibrations and not critically sensitive to the mounting position of the envelope, by virtue of the fact that the mercury which wets the contacts adheres, thereto and is not displaced by such jars and vibrations, as a mercury pool used as a stationary contact may be. The envelope of the device may be displaced considerably from the vertical position shown in the drawings without affecting successful operation, since the mercury pool 3 is cradled in reservoir portion 2, as long as the extension of the stationary contact remains in engagement with the surface of mercury pool 3.

Referring now to Fig. 3, there is shown a modification of the switching device of Fig. 1 which is intended to provide an even more copious supply of liquid mercury to the wetted contacts and to enhance the fulfillment of the aforestated objectives. The device illustrated by Fig. 3 is also intended to illustrate an embodiment of our invention in which the temperature-responsive bimetallic element is actuated by atmospheric temperatures rather than by temperatures produced by heat generated within the bimetallic element due to current flow therethrough and thus which is suitable for use as a thermostatic control for refrigerated or heated enclosures. This modification is similar to the first-described device in that it includes a hermetically sealed envelope 1 having a reservoir portion 2 containing a pool of mercury 3; and further includes two connectors 7 and 8 sealed through a stem press 4 in envelope 1. However, the external terminals 9 and 10 are shown embedded in an insulating material cap 17 for a metallic base 18 which in turn is cemented at 19 to envelope 1. This base arrangement may be employed in co-

operation with a conventional socket for ease in removably mounting and connecting the switching device in an electric circuit.

Attached to connector 7 is a stationary contact 20 which is hollowed by a vertical groove 21 defined therein to effect a capillary action by which mercury is drawn up to the contact surface adjacent groove 21 and facing to the right as shown in the drawing. Means for wetting the contact surfaces of the device with a layer of liquid mercury are embodied in an extension 22 of contact 20, formed in a substantially U-shaped configuration with the lower end or bight thereof engaging mercury pool 3 as shown. The inner surface of U-shaped extension 22 as well as the surface of contact 20 are preferably made wettable with mercury, as by plating with platinum. Thus, the combined action of surface wetting and capillary action transfers an abundant amount of mercury 3c from pool 3 upward through extension 22 and groove 21 to the contacting surfaces of contact 20.

The bimetallic element 14, mounted on connector 8, in this embodiment is made to have a low enough electrical resistance, e. g., made to have a large cross sectional area, so that its temperature is not appreciably affected by the expected current load flowing therethrough when the switching device is in the closed circuit position. A movable contact 23 mounted on the free end of element 14 may be formed from a bight, more clearly seen by reference to Fig. 4, of wire-like metal and the lower portion thereof is made wettable by mercury, as by plating with platinum. The small space between the two sides of this bight enables contact 23 to hold by capillary action a considerable amount 3d of mercury picked up during operation from contact 20; this space is in registry with groove 21 while the two sides of the bight of contact 23 are in registry with the contacting surfaces of contact 20 on each side of groove 21. The very copious supply of mercury on the contacts 20 and 23 affords a greater measure of arc protection for the contacts and successful mercury necking action as described hereinbefore.

The temperature-responsive bimetallic element 14 is positioned so that contacts 20 and 23 are in close proximity and electrically connected through unextended mercury puddles 3c and 3d respectively thereon at a predetermined temperature. Depending upon the orientation of bimetallic element 14, the contacts are separated and electrically disconnected at a given temperature deviation above or below the predetermined temperature. For example, if that portion of bimetallic element 14 having the higher coefficient of thermal expansion is outermost, the contacts 20 and 23 will be moved apart at temperature less than the predetermined temperature so that the switching device may be used to thermostatically control the energization of a refrigerator unit motor, for example. Conversely, if that portion having the higher coefficient of thermal expansion is innermost, i. e., facing connector 7, the contacts 20 and 23 will be moved apart at temperatures greater than the predetermined temperature so that the switching device may be used to thermostatically control the energization of an electric heater or the like. In either instance, however, due to the fact that as the contacts 20 and 23 separate, the mercury therebetween necks down and maintains electrical connection over a considerable travel, and that once the mercury neck is broken and contracted back into puddles on the contacts, the contacts must travel a considerable distance before connection is re-established as explained in conjunction with Fig. 2, the open and closed circuit conditions of the switch prevail over a considerable temperature change. This provides a delayed action type of operation and prevents the device from operating at too high a frequency.

While the present invention has been described by reference to particular embodiments thereof, it will be understood by those skilled in the art that modifications may be made without departing from the true spirit and scope of the foregoing disclosure. We, therefore, aim by the appended claims to cover all such equivalents as fall within the purview of the invention.

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

1. In an electric switching device for controlling an electric circuit, a stationary solid contact adapted for being electrically connected to one side of the circuit to be controlled, means mounting said stationary contact, a bimetallic element supported at one end, a movable solid contact mounted on a free portion of said bimetallic element and adapted for being electrically connected to the other side of said circuit, said movable solid contact being positioned to engage said stationary solid contact at a predetermined temperature of said bimetallic element thereby to complete said circuit, a pool of mercury spaced from said contacts, and means for wetting said contacts with mercury from said pool.

2. In an electric switching device for controlling an electric circuit, a satisfactory solid contact adapted for being electrically connected to one side of the circuit to be controlled, means mounting said stationary contact, a bimetallic element supported at one end, a movable solid contact mounted on a free portion of said bimetallic element and adapted for being electrically connected to the other side of said circuit, said movable solid contact being positioned to engage said stationary solid contact when said bimetallic element is at a predetermined temperature for completing said circuit and to be separated from said stationary solid contact by said bimetallic element under a given temperature deviation from said predetermined temperature for opening said circuit, and means including a supply of mercury and a mercury wettable connection between said supply and one of said solid contacts for wetting said solid contacts with a quantity of mercury, whereby said solid contacts are electrically connected during separating movement of said movable solid contact and said circuit is caused to remain closed over a relatively wide temperature range of said bimetallic element and whereby said solid contacts are electrically disconnected during converging movement of said movable solid contact and said circuit is caused to remain open over a relatively wide temperature range.

3. In an electric switching device for controlling an electric circuit, a stationary solid contact adapted for being electrically connected to one side of the circuit to be controlled, means mounting said stationary contact, a bimetallic element supported at one end and adapted for being electrically connected to the other side of said circuit, a movable solid contact mounted on and electrically connected to a free portion of said bimetallic element, said movable solid contact being positioned to engage said stationary contact thereby to complete said circuit through said bimetallic element when said bimetallic element is unheated and to be separated from said stationary solid contact by said bimetallic element for thereby opening said circuit when said bimetallic element is heated to a predetermined degree by electric current flowing therethrough, and means including a supply of mercury and a mercury wettable connection between said supply and one of said solid contacts for wetting said solid contacts with a quantity of mercury whereby said solid contacts are electrically connected and said circuit is caused to remain closed for relatively long duration periods by mercury during the travel of said movable solid contact away from said stationary solid contact and whereby said solid contacts are electrically disconnected and said circuit is caused to remain open for relatively long duration periods during the travel of said movable solid contact toward said stationary contact.

4. An electric switching device for controlling an electric circuit comprising an envelope, a reservoir portion in said envelope, a pool of mercury in said reservoir portion, a stationary contact structure mounted within

and extending through said envelope, said stationary contact structure being adapted for being electrically connected to one side of the circuit to be controlled, said stationary contact structure including a first solid contact disposed in spaced relation to said pool and an extension from said first contact and said extension having a mercury wettable surface whereby mercury is transferred from said pool to said first solid contact, a movable solid contact structure mounted within and extending through said envelope in insulated relation to said stationary contact structure, said movable solid contact structure being adapted for being electrically connected to the other side of said circuit to be controlled, said movable solid contact structure including a bimetallic element secured at one end and movable at the other end thereof and a second solid contact disposed in spaced relation to said pool and having a mercury wettable surface on said movable end of said bimetallic element, said bimetallic element being positioned to cause engagement of said first and second solid contacts for completing said circuit when said bimetallic element is unheated and to cause disengagement of said first and second solid contacts for opening said circuit when said bimetallic element is heated to a predetermined degree by electric current flowing therethrough.

5. An electric switching device for use in electric circuits to be cyclically closed and opened for relatively long duration periods, said switching device comprising a hermetically sealed envelope, a reservoir portion in said envelope, a pool of mercury in said reservoir portion, two electrical connectors extending in insulated relation through said envelope and providing external electrical terminals each adapted for being electrically connected to one side of the circuit to be controlled, a stationary solid contact mounted on one of said connectors within said envelope and in spaced relation to said pool, an extension of said stationary contact engaging said mercury pool, a thermally deformable bimetallic strip mounted at one end thereof on the other of said connectors within said envelope, a movable solid contact mounted on the other end of said bimetallic strip and in spaced relation to said pool, said bimetallic strip being positioned when unheated to cause engagement of said stationary and movable solid contacts for completing said circuit through said bimetallic strip, said bimetallic strip being positioned when heated to a predetermined degree by electric current passing therethrough for opening said circuit, said stationary and movable solid contacts and said extension having mercury wettable surfaces whereby mercury is transferred from said pool to the engaging surfaces of said solid contacts and whereby electrical connection is maintained between said solid contacts for causing said circuit to remain closed during the movement of said movable solid contact away from said stationary solid contact and said electrical connection is broken for causing said circuit to remain open during the movement of said movable solid contact toward said stationary solid contact.

6. An electric switching device for controlling an electric circuit comprising an envelope, a reservoir portion in said envelope, a pool of mercury in said reservoir portion, a stationary contact structure mounted within and extending through said envelope, said stationary contact structure being adapted for being electrically connected to one side of the circuit to be controlled, said stationary contact structure including a first solid contact spaced from said pool of mercury and an extension from said solid contact engaging said pool of mercury both having a mercury wettable surface whereby mercury is transferred from said pool to said first contact, a movable contact structure mounted within and extending through said envelope with insulated relation to said stationary contact structure, said movable contact structure being adapted for being electrically connected to the other side of said circuit, said movable contact structure including a bimetallic element secured at one end and movable at the other end thereof and a second solid contact spaced from said pool of mercury and having a mercury wettable surface on said movable end of said bimetallic element, said bimetallic element being positioned to cause engagement of said first and second solid contacts for completing said circuit through said bimetallic element when said bimetallic element is at a predetermined temperature, said bimetallic element being substantially unaffected in temperature by less than a predetermined amount of electric current flowing therethrough and expansively responsive to the temperature of the atmosphere therearound for opening said circuit at a predetermined temperature.

7. In an electric switching device for controlling an electric circuit, a stationary solid contact adapted for being electrically connected to one side of the circuit to be controlled, a bimetallic element supported at one end, a movable solid contact mounted on a free portion of said bimetallic element and adapted for being electrically connected to the other side of said circuit, said movable solid contact being positioned to engage said stationary solid contact at a predetermined temperature of said bimetallic element thereby to complete said circuit, a pool of mercury, an extension of said stationary solid contact engaging said mercury pool, and mercury wettable surfaces on said extension and said stationary and movable solid contacts whereby said contacts are wetted with mercury from said pool.

8. In an electric switching device for controlling an electric circuit, a stationary solid contact adapted for being electrically connected to one side of the circuit to be controlled, a bimetallic element supported at one end, a movable solid contact mounted on a free portion of said bimetallic element and adapted for being electrically connected to the other side of said circuit, said movable solid contact being positioned to engage said stationary solid contact at a predetermined temperature of said bimetallic element thereby to complete said circuit, a pool of mercury, and a U-extension of said stationary solid contact with the bight thereof engaging said mercury pool, said U-shaped extension transferring mercury from said pool to said stationary solid contact by capillary action.

9. An electric switching device for use in electric circuits to be cyclically closed and opened for relatively long duration periods, said switching device comprising a hermetically sealed envelope of insulative material, a reservoir portion in said envelope, a pool of mercury in said reservoir portion, two electrical connectors extending in insulated relation through said envelope and providing external electric terminals each adapted for being electrically connected to one side of a circuit to be controlled, a stationary solid contact mounted on one of said connectors within said envelope and disposed in spaced relation to said pool, an extension of said stationary contact engaging said mercury pool, a thermally deformable bimetallic strip mounted at one end thereof on the other of said connectors within said envelope, a movable solid contact mounted on the other end of said bimetallic strip and disposed in spaced relation to said pool, said bimetallic strip being positioned when unheated to cause engagement of said stationary and movable solid contacts for completing said circuit through said bimetallic strip, said bimetallic strip being positioned when heated to a predetermined degree by electric current passing therethrough for opening said circuit, said stationary and movable solid contacts and said extension having mercury wettable surfaces whereby mercury is transferred from said pool to the engaging surfaces of said solid contacts and whereby electrical connection is maintained between said solid contacts for causing said circuit to remain closed during the movement of said movable solid contact away from said stationary solid contacts and said electrical connection is broken for causing said circuit to remain open during the movement of

said movable solid contact toward said stationary solid contact.

10. In an electric switching device for controlling an electric circuit, a stationary solid contact adapted for being electrically connected to one side of the circuit to be controlled, means mounting said stationary contact, a bimetallic element heated by current flowing therethrough and electrically connected to the other side of said circuit, a movable solid contact mounted on said bimetallic element, said movable solid contact being positioned to engage said stationary contact, thereby to complete said circuit through said bimetallic element when said element is unheated and to be separated from said stationary solid contact by said element for thereby opening said circuit when said element is heated to a predetermined degree by electric current flowing therethrough, a pool of mercury spaced from said contacts, and means for wetting said contacts with said mercury from said pool.

11. In an electric switching device for controlling an electric circuit, a stationary solid contact adapted for being electrically connected to one side of the circuit to be controlled, a bimetallic element adapted for being heated by current flowing therethrough and electrically connected to the other side of said circuit, a movable solid contact mounted on said bimetallic element, said movable solid contact being positioned to engage said stationary contact thereby to complete said circuit through said bimetallic element when said element is unheated and to be separated from said stationary solid contact by said element for thereby opening said circuit when said element is heated to a predetermined degree by electric current flowing therethrough, a pool of mercury, an extension of said stationary solid contact engaging said mercury pool, and mercury wettable surfaces on said extension and said stationary and movable solid contacts.

12. In an electric switching device for controlling an electric circuit, a stationary solid contact adapted for being electrically connected to one side of the circuit to be controlled, a bimetallic element adapted for being heated by current flowing therethrough and electrically connected to the other side of said circuit, a movable solid contact mounted on said bimetallic element, said movable solid contact being positioned to engage said stationary contact thereby to complete said circuit through said bimetallic element when said element is unheated and to be separated from said stationary solid contact by said element for thereby opening said circuit when said element is heated to a predetermined degree by electric current flowing therethrough, a pool of mercury, and a U-shaped extension of said stationary solid contact with the bight thereof engaging said mercury pool, said U-shaped extension transferring mercury from said pool to said stationary solid contact by capillary action.

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