Sept. 2, 1952 A. GOLDSMITH 2,609,465

AUTOMATIC RESETTING OVERLOAD SWITCH

Filed May 31, 1951 2 SHEETS—SHEET 1

FIG. 1.

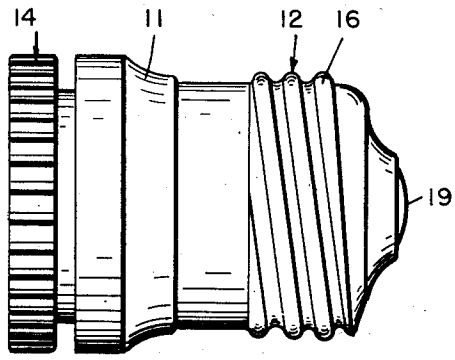


FIG. 3.

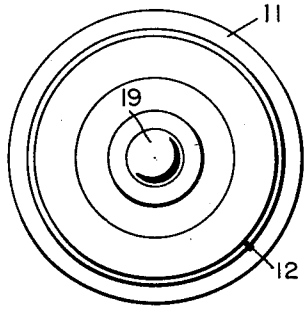
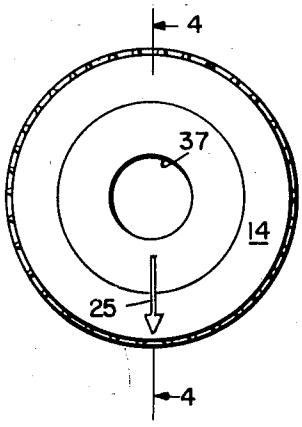


FIG. 4.

FIG. 2.



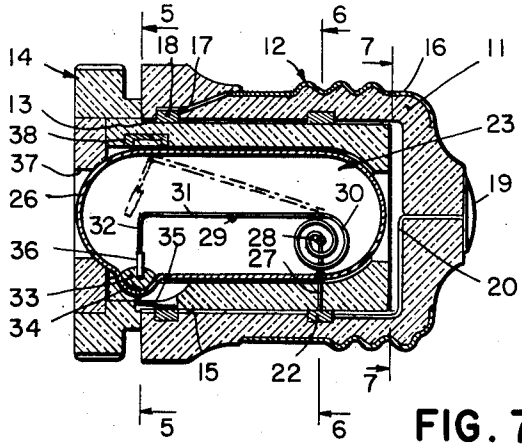


FIG. 7.

FIG. 5.

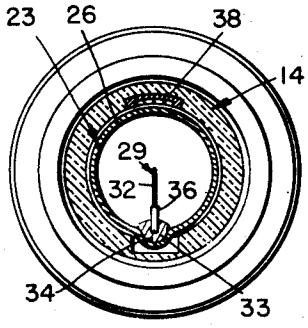
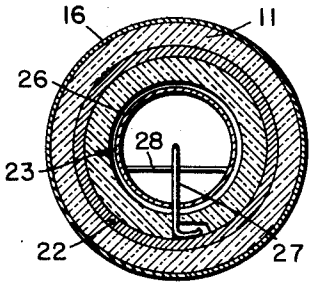
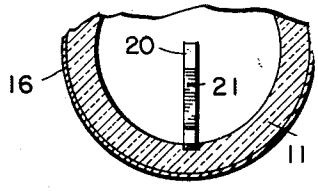


FIG. 6.





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FIG. 8.

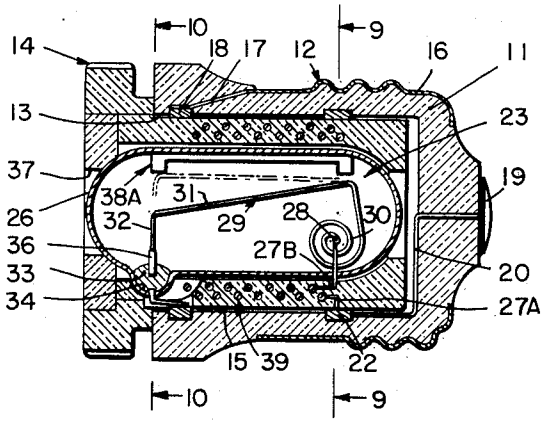


FIG. 10.

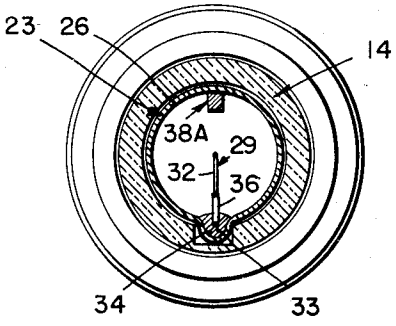
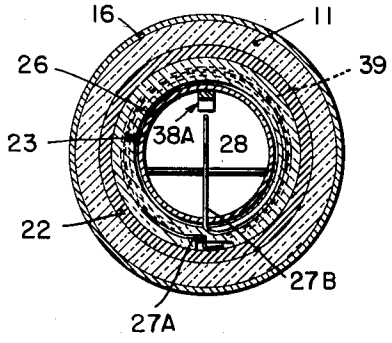


FIG. 9.



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AUTOMATIC RESETTING OVERLOAD SWITCH

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Application May 31, 1951, Serial No. 229,120

12 Claims. (Cl. 200—113)

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This invention relates to an automatic resetting overload safety switch.

My invention relates particularly to overload safety switches of the type having a circuit breaking element capable of being used for many times and designed to replace the ordinary screw plug fuse in which the breaking of the circuit is effected by the melting of a fusible material.

The principal object of the invention is to provide an overload safety switch of simple and inexpensive construction which will break an electrical circuit at a pre-determined overload current. Another object is to provide an overload safety switch which may be constructed of small enough dimensions to be contained in a screw plug type housing, and adapted for use in the same kind of screw plug base. Another object of the invention is to provide an overload safety switch which automatically resets the circuit after the cause of the overload has been removed. Another object is to provide an overload safety switch which will automatically reset itself when the entire load is disconnected from the circuit. A further object is to provide an overload safety switch completely enclosed in a sealed gas filled bulb and which is free from external sparking. A still further object is to provide an overload safety switch which visually indicates whether or not the circuit is overloaded and open, or closed and not in overloaded condition. These and other objects are attained by my invention which will be understood from the following description, reference being made to the accompanying drawings in which:

Figure 1 is a side elevational view of my invention in the form of a conventional screw base plug;

Figure 2 is a front end view of the same;

Figure 3 is a rear end view of the same;

Figure 4 is a longitudinal sectional view taken on the line 4—4 of Figure 2;

Figure 5 is a sectional view taken on the line 5—5 of Figure 4;

Figure 6 is a sectional view taken on the line 6—6 of Figure 4;

Figure 7 is a sectional view taken on the line 7—7 of Figure 4 showing an alternative arrangement of the electrical connection between the plug end terminal and the switch;

Figure 8 is a longitudinal section showing another alternative form of my invention;

Figure 9 is a cross-sectional view taken on the line 9—9 of Figure 8; and

Figure 10 is a cross-sectional view taken on the line 10—10 of Figure 8.

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Referring to the drawings which show a preferred form of my invention, my resetting overload switch consists of a housing 11 which is generally cylindrical in shape and made of insulating material such as porcelain, being provided with a screw threaded portion 12, and having a front opening 13 leading to a cylindrical cavity 15, which is adapted to receive a rotatable switch mounting member 14. The screw threaded portion 12 of the housing 11 is covered with a copper or brass contacting sheath 16 which is adapted to make electrical contact with a screw threaded socket in which the housing 11 is adapted to be inserted. The sheath 16 is electrically connected by the wire 17 to a metallic band 18 on the inside of the cylindrical cavity 15 adjacent the front opening 13. An end contact terminal 19 is provided on the closed end of the housing 11, electrically insulated from the sheath 16, the end terminal being electrically connected by the wire 20 to a contacting band 22, which is disposed in the cylindrical wall of the cavity 15 adjacent the inside end of said cavity.

As shown in Figure 7, a fusible link 21 may alternatively be provided between the wire 20 and the band 22 as a safety device to protect the circuit in the event that the switch parts fail to operate, or become fixed and provide continuous flow of current and continuous overload conditions.

The switch mounting member 14 consists of a cylindrical insulating body having a cavity in which the switch member 23 is mounted, the mounting member 14 being also provided with a knurled ring on the forward end by which the switch member may be rotated, and an indexing mark 25 showing the axial position of the member.

The switch itself consists of a bulb 26 preferably made of glass or transparent plastic, which is generally cylindrical in shape, both ends being closed, and having a spring bar or wire slide contact member 27 sealed into the side wall of the bulb at a position which allows the exterior end of said spring contact member 27 to make sliding contact with the band 22 in the inside wall of the cavity 15 of the housing. The spring wire member 27 at its end inside the bulb 26 is connected to the cross pin 28 which is embedded in the opposite walls of the bulb 26. A bi-metallic bar 29 composed of superimposed strips of metal having different coefficients of expansion, and formed into a spiral coil 30 at one end is attached to the cross pin 28, the arm portion 31 extending forwardly within the bulb 26, and having

a downwardly bent contacting arm 32 at its end opposite said spring coil. The bi-metallic element is so arranged that when the circuit is operating normally without overload, the contacting arm 32 dips into a pool of mercury 33 formed in a depression 34 in the bulb 26 near the forward end of said bulb. The pool of mercury 33 is connected through the shell of the bulb 26 by a second spring bar or wire member 35, which is adapted to make contact with the connecting band 18 disposed in the cylindrical cavity 15 of the housing adjacent the front opening 13. When current passing through the bi-metallic bar 29 is great enough to cause heating of the bi-metallic bar 29, the contacting arm 32 of said bar rises out of the pool of mercury 33 and takes the position shown in broken lines in Figure 4. When the current flowing through the metallic bar 29 exceeds the pre-determined safe amount, then the bi-metallic element expands so as to cause the contacting arm 32 to rise out of the mercury 33 and break the contact. The end of the contacting arm 32 is provided with a high resistance contact point 36 and as it goes out of the mercury, it becomes hot enough to vaporize the mercury and to cause the mercury vapor and filler gas to ionize and glow, under which condition the gas content of the bulb 26 will carry enough current to heat the inside of the bulb and cause the bi-metallic bar 29 to remain in position out of the mercury until all the load is removed from the circuit. When the load is removed from the circuit flowing through the device, the temperature inside the bulb will drop and this in turn will cause the bi-metallic bar 29 to drop back into the mercury 33 and the circuit will be again closed.

The bulb 26 may be filled with various gases such as nitrogen, neon, helium, etc., or mixtures of gases at various pressures, to give different colors during the glowing period and these differences in color may be used as a visual indicator of the current carrying capacity of the switch. The bi-metallic element 29 may be made of suitable cross-sectional area so that it will operate at selected current capacities.

The switch mounting member 14 is arranged to be rotated in the cylindrical cavity 15 so that the pool of mercury 33 may be positioned for operation at the lowest point in the bulb 26, and the circuit may be manually disconnected merely by rotating the switch member mounting 14 so that the mercury is not in the depression 34. It if is desired to reset the switch without disconnecting all of the current load, then the switch mounting member may be momentarily removed from the cavity and again replaced in the usual manner.

A permanent magnet 38 may alternatively be imbedded in the wall of the switch mounting member 14 to hold the bi-metallic bar 29 in the disconnected position, and under certain operating conditions prevent oscillation of this arm. The presence of the magnet prevents the arm from dropping back into the mercury until the temperature has either decreased to the point where the energy of the spring coil 30 breaks the magnetic holding force and positively forces the contacting arm 32 into the pool, or under some conditions until light tapping of the outside of the device breaks the magnetic hold after the temperature has decreased. If the bi-metallic member is not attracted by a magnet, a small iron armature may be suitably attached to the arm 31.

The second alternative structure shown in Figures 8 and 9 provides means for immediate disconnection of the circuit in the event that a sudden heavy current flows through the device, as in the event of a short circuit. An electromagnet is provided which attracts the arm 31, and causes it to rise quickly to break the circuit. The iron strip 38A is placed in position adjacent the arm 31, preferably inside the bulb 26, and the copper coil 39 is embedded in the switch mounting member 14, being electrically connected in series between spring contact member 27A and the connecting bar 27B to the bi-metallic bar 29 through the coiled spring portion 30. The magnetic flux produced by a heavy current will cause the arm 31 to rise and break the circuit, and will drop back again to re-connect the circuit when the normal load on the circuit is re-established. This device avoids the use of the fusible link 21, and the renewing thereof, since this circuit breaker is fully automatic.

The advantages of my automatic resetting overload switch will be apparent. The device does not require any manual resetting if the current load is removed from the circuit in which case the circuit is again closed when the gas in the bulb ceases to conduct current and cools off. The condition of the contacting arm 32 may be observed through the window 37 in the knurled ring 24 and also the glowing of the gas in the pool may be observed through this window when the switch is out of contact. In the second alternative form, the device is fully automatic in re-establishing connection in the circuit after any magnitude of overload current.

I claim:

1. An automatic resetting overload switch comprising a housing having two external terminals adapted to make electrical connection in an electric power circuit, said housing having an axial cylindrical cavity; a bulb mounting member arranged in said cavity and adapted to be turned axially therein; a gas-filled breaker switch bulb mounted in said mounting member, said bulb having a mercury well adjacent the front end thereof, and having a sealed-in contact wire in the bottom of said mercury well, and also having a lead-in wire adjacent the rear end of said bulb; a globule of mercury in said well; means to connect said sealed-in contact wire with one of said external contact members; means to connect said lead-in wire to the other of said external contact members; and a bi-metallic bar mounted within said bulb and arranged for lever movement at one end, said bar having a dipping point at the lower end arranged to make contact with the mercury in said well, said dipping point being arranged to break contact with said mercury in said well when said bar is over-heated by the passage of an overload current through said switch bulb.

2. A screw plug type housing having an externally threaded contacting surface and an external central end contact button adapted to make electrical connection in an electric power circuit, said housing having an axial cylindrical cavity; a bulb mounting member mounted in and adapted to be turned axially in said cavity; a gas-filled breaker switch bulb mounted in said mounting member, said bulb having a mercury well adjacent the front end thereof, and having a sealed-in contact wire in the bottom of said mercury well, and having a lead-in wire adjacent the rear end of said bulb; a globule of mercury in said well; means to connect said

sealed-in contact wire with one of said external contact members; means to connect said lead-in wire to the other of said external contact members; and a bi-metallic bar mounted within said bulb and arranged for lever movement at one end, said bar having a dipping point at the lever end arranged to make contact with the mercury in said well, said dipping point being arranged to break contact with said mercury in said well when said bar is over-heated by the passage of an overload current through said switch bulb.

3. A screw plug type housing having an externally threaded contacting surface and an external central end contact button adapted to make series electrical connection in an electric power circuit, said housing having an axial cylindrical cavity; a bulb mounting member mounted in and adapted to be turned axially in said cavity; a gas-filled breaker switch bulb mounted in said mounting member, said bulb having a mercury well adjacent the front end thereof, and having a sealed-in contact wire in the bottom of said mercury well, and also having a lead-in wire adjacent the rear end of said bulb; a globule of mercury in said well; means to connect said sealed-in contact wire with one of said external contact members; means to connect said lead-in wire to the other of said external contact members; and a bi-metallic bar shaped as a spiral spring coil at one end and bent down to a dipping point at the other, said bar being mounted within said bulb for lever movement on said spring coil, said dipping point being arranged to break contact with said mercury in said well when said bar is over-heated by the passage of an overload current through said switch bulb.

4. A screw plug type housing having an externally threaded contacting surface and an external central end contact button adapted to make series electrical connection in an electric power circuit, said housing having an axial cylindrical cavity; a bulb mounting member mounted in and adapted to be turned axially in said cavity; a gas-filled breaker switch bulb mounted in said mounting member, said bulb having a mercury well adjacent the front end thereof, and having a sealed-in contact wire in the bottom of said mercury well, and also having a lead-in wire adjacent the rear end of said bulb; a globule of mercury in said well; means to connect said sealed-in contact wire with one of said external contact members; means to connect said lead-in wire to the other of said external contact members; and a bi-metallic bar shaped as a spiral spring coil at one end and bent down to a dipping point at the other, said bar being mounted within said bulb for lever movement on said spring coil, said dipping point being arranged to break contact with said mercury in said well when said bar is over-heated by the passage of an overload current through said switch bulb.

5. The device claimed in claim 1, in which a permanent magnet is attached to said switch bulb at a position to attract said bi-metallic bar when said bar is out of contact with said mercury pool, whereby said contact remains broken until a mechanical force overcoming the attractive force of said magnet acts upon said bar to release it from said magnet.

6. The device claimed in claim 1, in which said dipping point has high electrical resistance relative to said bi-metallic bar, whereby heat is generated and mercury vaporized when said point breaks contact with said pool of mercury during overloading of current through said bimetallic bar.

7. A screw plug type housing having an externally threaded contacting surface and an external central end contact button adapted to make series electrical connection in an electric power circuit, said housing having an axial cylindrical cavity; two concentric electrical contact rings embedded in the surface of said cavity, said rings being electrically connected respectively to said external threaded contact surface and to said contact button; a bulb mounting member mounted in and adapted to be turned axially in said cavity; a gas-filled breaker switch bulb mounted in said mounting member, said bulb having a mercury well adjacent the front end thereof and having a sealed-in contact wire in the bottom of said mercury well, and also having a lead-in wire adjacent the rear end of said bulb; a globule of mercury in said well; spring means connecting said sealed-in contact wire with one of said contact rings; spring means connecting said lead-in wire to the other of said contact rings; and a bi-metallic bar shaped as a spiral spring coil at one end and bent down to a dipping point at the other, said bar being mounted within said bulb for lever movement on said spring coil, said dipping point being arranged to break contact with said mercury in said well when said bar is over-heated by the passage of an overload current through said switch bulb.

8. The device claimed in claim 7, in which said dipping point has high electrical resistance relative to said bi-metallic bar, whereby heat is generated and mercury vaporized when said point breaks contact with said pool of mercury during overloading of current through said bi-metallic bar.

9. The device claimed in claim 2, in which a fusible link is disposed in the lead-in wire circuit between said contact button and said bi-metallic bar.

10. The device claimed in claim 1, in which an electromagnet is disposed in said switch in position to attract said bi-metallic bar when said bar is in contact with said mercury pool, the coil of said electromagnet being connected in the circuit of said switch, whereby when a heavy overload current passes through said circuit, said bi-metallic bar breaks contact with said mercury pool irrespective of its bending due to heating.

11. The device claimed in claim 2, in which an electromagnet is disposed in said switch in position to attract said bi-metallic bar when said bar is in contact with said mercury pool, the coil of said electro-magnet being connected in the circuit of said switch, whereby when a heavy overload current passes through said circuit, said bi-metallic bar breaks contact with said mercury pool irrespective of its bending due to heating.

12. A screw plug type housing having an externally threaded contacting surface and an external central end contact button adapted to make electrical connection in an electric power circuit, said housing having an axial cylindrical cavity; a bulb mounting member mounted in and adapted to be turned axially in said cavity, said bulb mounting member having embedded therein a magnetic coil adapted to activate an iron core in a switch bulb; a gas-filled breaker switch bulb mounted in said mounting member, said bulb having a mercury well adjacent the front end thereof and having a sealed-in contact wire in the bottom of said mercury well, and having a

lead-in wire adjacent the rear end of said bulb; a globule of mercury in said well; means to connect said sealed-in contact wire with one of said external contact members; means to connect said lead-in wire to the other of said external contact members; a bi-metallic bar mounted within said bulb and for lever movement at one end, said bar having a dipping point at the lever end arranged to make contact with the mercury in said well, said dipping point being arranged to break contact with said mercury in said well when said bar is over-heated by the passage of an overload current through said switch bulb; and a magnet bar in said bulb adjacent said bi-metallic bar, the magnet coil in said mounting member being electrically connected in the circuit passing through said breaker switch.

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No references cited.