Nov. 4, 1969 O. H. BRAMHALL ETAL 3,477,054

FUSE ACTUATOR SWITCH

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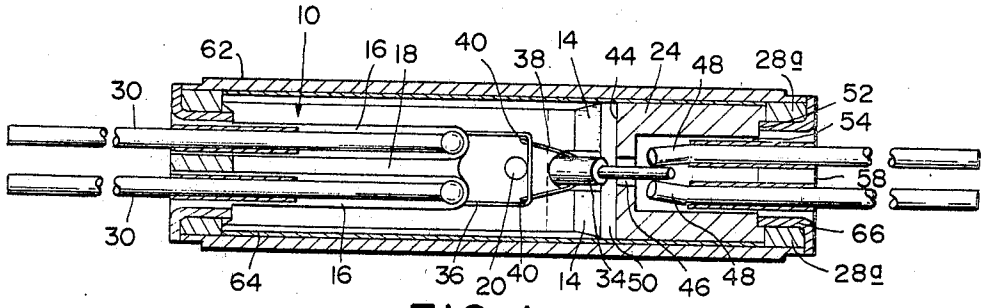


FIG. 1

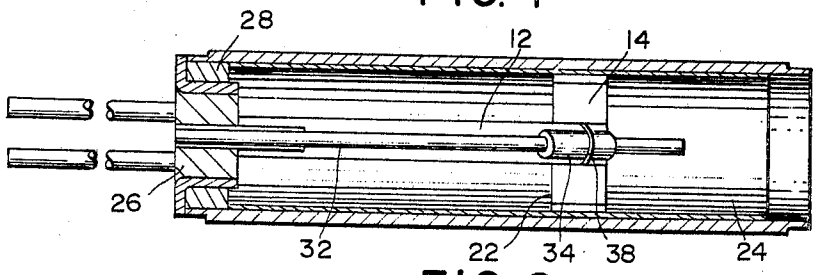


FIG. 2

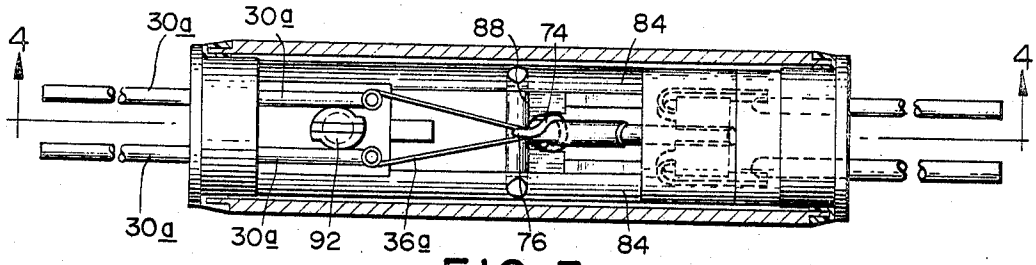


FIG. 3

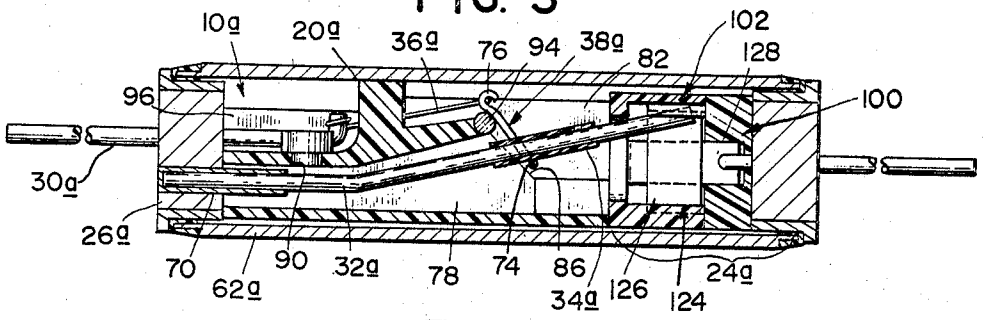


FIG. 4

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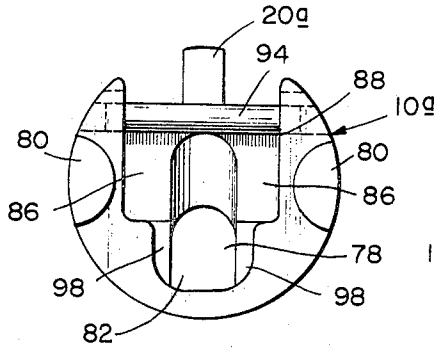


FIG. 5

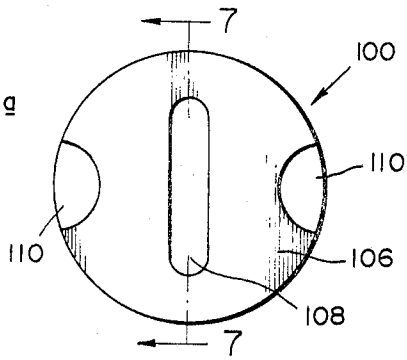


FIG. 6

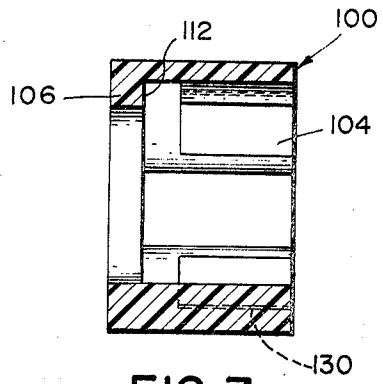


FIG. 7

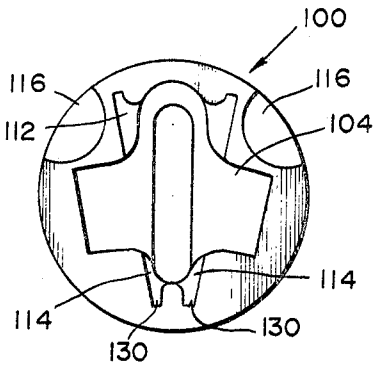


FIG. 8

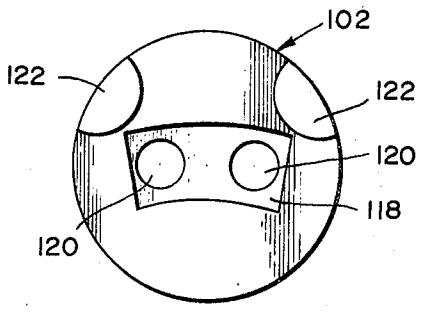


FIG. 9

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FUSE ACTUATOR SWITCH

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Int. Cl. H01h 85/02
U.S. Cl. 337—202 5 Claims

ABSTRACT OF THE DISCLOSURE

A thermally actuated switch having both a fixed contact and a movable contact, the movable contact being held under tension by a fusible means. The fusible means separate at a predetermined current level releasing the movable contact relative to the fixed contact to either make or break a circuit.

BACKGROUND OF THE INVENTION

Early thermal responsive relays utilized mercury as an actuating medium.

In cases where a blown fuse indicator was needed, a fuse element was attached to a spring loaded element whereby breaking of the fuse element released the spring loaded element which, in turn, actuated a switch to turn on a light or other warning device.

There are presently available on the market, current sensitive relays which include a spring loaded plunger contact held in that condition by a fuse wire. The fuse wire is set to melt at a specific amperage releasing the plunger contact to engage a pair of terminals or to disengage from a pair of terminals either opening or closing a circuit.

SUMMARY OF THE INVENTION

This invention is directed at a fuse actuated switch provided with a fixed contact and a movable contact, the latter being held from, or with, the former under spring tension by a fuse wire. In operation, the fuse wire at a predetermined amperage will release the movable contact and thereby either make or break a circuit.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of a fuse actuated switch with the cover removed and partly in section.

FIG. 2 is a bottom plan view of the switch shown in FIGURE 1 with the cover removed and partly in section.

FIG. 3 is a top plan view of a variation of the switch shown in FIGURE 1 with the cover removed and partly in section.

FIG. 4 is a section taken on line 4—4 of FIGURE 3.

FIG. 5 is an end elevation of the fuse insulator of the switch shown in FIGURE 3.

FIG. 6 is an end elevation of the contact engagement portion of the switch shown in FIGURE 3.

FIG. 7 is a section taken on line 7—7 of FIGURE 6.

FIG. 8 is an end elevation taken from the opposite end of the contact engagement portion shown in FIGURE 7, and

FIG. 9 is a top plan view of the terminal portion of the switch shown in FIGURE 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawing, there is shown a fuse insulator **10** generally cylindrical in construction, having a spring retainer groove **12** formed from end to end thereof and having a terminal end **14** chamfered in the direction away from the direction toward which the groove **12** opens. On the

opposite side of the fuse insulator **10** from the groove **12** a lead slot **16** is formed opening at the terminal end opposite to the end **14** and having a rib **18** extending along its mid-line providing two shallow compartments. A protuberance **20** extends from the fuse insulator **10** between the terminal ends **14** and the lead slot **16**. A step **22** is formed in close proximity to the end **14** and transverse the spring retainer groove **12** to provide a space for the yoke **38** and spring contact **32** and also to help in aligning the switch insulator **24** which will be more fully described hereinafter.

The adapter terminal assembly comprises a glass seal **26** generally circular in configuration circumscribed by an eyelet with a flange extending therefrom and three tubes extending axially therethrough. The eyelet of the glass seal **26** is circumscribed in abutting relationship by an adaptor sleeve **28** made of a conductive material such as brass.

The leads **30** extend through two of the tubes of the glass seal **26** and each of them lies within a compartment of the lead slot **16**. Each of the leads **30** are soldered into their respective tubes. The flexible wire spring contact **32** is soldered to the third tube of the glass seal **26** and extends along and beyond the spring retainer groove **12**.

An insulator sleeve **34** is slipped around the contact **32**.

A wire fuse element **36** formed of an electrically conducting material which will melt at a predetermined temperature or at a predetermined electrical current level, is soldered to the terminal ends of the leads **30** and lies within the lead slot **16**, providing a loop which extends beyond the protuberance **20**. The wire fuse element is placed under a fixed amount of tensile force to be more fully described hereinafter.

The yoke **38** comprising a loop of flexible wire having each of its free ends bent to provide arcuate engagement portions **40** is engaged to the fuse assembly placing the bight of the yoke **38** against the insulating sleeve **34** which surrounds the spring contact **32** flexing the spring contact **32** against the bottom of the spring retainer groove **12**. While the spring contact **32** is in this fixed and tensioned position the loop of the wire fuse element **36** is engaged with the arcuate engagement portions **40** completing the assembly.

The relationship of the wire diameter of the yoke **38** and the wire fuse element **36** is important. The yoke **38** material diameter should be larger than the diameter of the wire fuse element **36** material. If it is too small when the fuse wire breaks, the remaining portion of the fuse wire would be unable to slip freely around the yoke thereby causing the yoke **38** and spring contact **32** to hang up and not operate properly.

The switch portion of the electrical assembly comprises the switch insulator **24** which is tubular in outer configuration and has a front face **44** provided with a longitudinal slot **46** which acts as a guide for the spring contact **32** and also lines up the free terminal end of the spring arm with contact lead wires **48**. The dimensions of the slot **46** are such as to prevent excessive lateral movement of the spring arm under shock or vibration. A tongue **50** extends from the bottom of the front face **44** and has the form of a section of a cylinder. The rear face **52** of the switch insulator **24** is provided with a keyed aperture **54** which will accept the lead wires **48** in two different positions, as will be more fully explained hereinafter. The switch contact subassembly includes a flanged grommet **66** having an electrically insulating seal **58** which has tubes formed therein through which the lead wires **48** are bent at an angle to engage the end of the spring contact **32** in a closed circuit position or the switch contact subassembly may be turned 180° so that the lead contacts **48** are bent away from the contact spring **32** in an open circuit position.

To engage the switch portion with the fuse or actuator portion of the assembly, an outer tubular housing element **62** formed of metal is slipped over the fuse assembly, with an insulating sleeve portion **64** lining the interior of the tubular housing element, and is then soldered in place as shown in FIGURE 1, to make a hermetic seal. The switch assembly is then slid within the housing element **62** with the tongue **40** engaging the step **22** of the fuse insulator **10**. The contact lead wires **48** will either be engaged with the wire spring contact **32** if a normally closed switch is desired or will be turned 180° to provide a normally open switch. The housing element **62** is now soldered to the flange of the grommet **66** to complete the total hermetic construction. It is somethings necessary that a spacer **28***a* similar to the adapter sleeve **28** be used between the housing element **62** and the grommet **66**.

When a current flows through one of the leads **30**, its path would be through the wire fuse element **36** and out the other lead **30** for whatever purpose is desired such as a tie-in with a sensitive instrument, or to provide a trigger for an electrical circuit at a predetermined current. The inventors use an 80% nickel, 20% chrome wire of .005" diameter which will melt or separate at 1½ amps of current in one second and is rated to carry ½ amp of current continuously without actuating the switch circuit within required design parameters.

If the switch end is normally closed, there will also be a circuit through the contact lead wires **48** and the terminal end of the wire spring contact **32**. When the wire fuse element **36** separates, the wire spring contact **32** will move away from the contact lead wires **48** opening the circuit. This operation will be reversed if the switch end is normally open. Note that once the wire fuse element **36** has blown and the switch is actuated, that the function cannot be reversed.

The variation shown in FIGURES 3 and 4 differs from the original construction in that the leads **30***a* are sealed directly in the glass without the use of tubes. The wire spring contact **32***a* is engaged to the glass seal **26***a* through the use of a blind tube **70** as shown in FIGURE 4. The use of the blind tube **70** assures, since there is no opening to the outside, that the seal is hermetic.

The yoke **38***a* comprises a shank portion having a large hook **74** formed at one end, a smaller hook **76** formed at the other end which lies on a plane normal to the plane of the hook **74**. The bight of the wire fuse element **36***a* is engaged around the small hook **76** while the large hook **74** is engaged around the wire spring contact **32***a*.

The fuse insulator **10***a* is generally tubular in configuration and has a spring retainer tunnel **78** formed through it from end to end along the lower level as shown in FIGURES 4 and 5. The spring retainer tunnel **78** has the general configuration of a truncated ellipse and is completely enclosed on the bottom. A lead cavity **96** is formed for approximately one-third the length of the fuse insulator **10***a*, open at the top, and having an aperture **90** formed on its floor, opening into the spring retainer tunnel **78** as shown in FIGURE 4. The fuse insulator **10***a* has a raised portion which has its upper surface on a plane above that of the floor of the lead cavity **96** and has a rectangular protuberance **20***a*, extending from its midline upwardly away from the spring retainer tunnel **78** to maintain centering of the fuse insulator **10***a*, by having its upper surface butted against the housing element **62***a*, when the switch is assembled. The upper surface of the raised portion is slanted upwardly from the lead cavity **96** and terminates in an inclined forward wall **86** which provides surfaces on which the large hook **74** of the yoke **38***a* rests when the switch is assembled. The spring retainer tunnel **78** divides the forward wall **86** into two surfaces which are continued as shown in FIGURE 5 as two shelves **98** along the side walls of the fuse insulator **10***a*. A pair of spaced semicircular keys **80** extend from the terminal end of the fuse insulator **10***a*, and have an outer surface which conforms to the outer surface of the fuse insulator **10***a*. The shelves **98**

and the bottom of the fuse insulator **10***a*, define a narrow portion of a cavity **82** which occupies the end of the fuse insulator **10***a*, from the forward wall **86**. The spring retainer tunnel **78** opens into the cavity **82** as shown in FIGURES 4 and 6. At the upper portion of the forward wall **86** a transverse bearing pin groove **88** is formed which passes through each side wall of the fuse insulator **10***a*. A cylindrical bearing pin **94**, formed of a tough material, is engaged in the bearing pin groove **88**.

The switch insulator **24***a* comprises a contact engagement portion **100** and a terminal portion **102**. Contact engagement portion **100** is tubular in configuration and has a contact cavity **104** in the general shape of a cross formée which is closed off at one terminal end by a base portion **106**. The base portion **106** has a slot **108** formed through it and a pair of spaced arced slots **110** formed on its edge to accept the keys **80** of the fuse insulator **10***a*. An upper shoulder portion **112** and a pair of spaced lower shoulder portions **114** extend from the base portion **106** as shown in FIGURES 7 and 8, for a purpose to be set forth hereinafter. A pair of spaced arced slots **116** are formed on the edge of the contact engagement portion **100** at its lower portion as shown in FIGURE 8 remote from the base portion **106**.

The terminal portion **102** is generally cylindrical in configuration having a rectangular slot or trough **118** formed centrally in the plane surface. The base of the terminal **102** is pierced by a pair of spaced terminal apertures **120** which open into the rectangular slot **118**. The rectangular slot **118** is arced at its top and bottom wall surfaces and its side walls are angled to define with the top and bottom walls what may be referred to as a truncated triangle. A pair of spaced key portions **122** extend from the edge of the plane surface as shown in FIGURE 10.

The contracts **124**, formed of a conductive material, such as copper comprise a flat contact portion **126** which is slightly bowed and which has a spring leg **128** extending from an edge at a central portion of the contact portion **126**. The spring leg **128** is bent back on itself to provide a major portion spaced from the contact portion **126** and providing a generally T-shaped configuration therewith. The fuse element subassembly comprising the leads **30***a*, the wire spring contact **32***a*, the looped wire fused element **36***a*, which is soldered or otherwise fastened at its terminal ends to the leads **30***a*, as shown in FIGURE 3, the glass seal **26***a* formed inside the flanged eyelet with the parts assembled as set forth hereinbefore.

To assemble the switch, the fuse element subassembly with the wire spring contact **32***a*, is connected to the fuse insulator **10***a*, by passing the wire spring contact **32***a*, into the spring retainer tunnel **78** while simultaneously placing the loop of the wire fuse element **36***a* around the protuberance **20***a*, and butting the flanged eyelet against the terminal end of the fuse insulator **10***a* as shown in FIGURES 3 and 4. An insulator sleeve **34***a* is placed around the wire fuse contact **32***a*, either before assembly with the fuse insulator **10***a*, or after such assembly. The yoke **38***a* is engaged to the assembly by looping the smaller hook **76** around the bight of the wire fuse element **36***a* and looping the large hook **74** around the insulator sleeve **34***a* with the large hook **74** abutted against the forward wall **86**. The bearing pin **94** formed of a tough material is now driven into the bearing pin groove **88** after the wire spring contact **32***a* is flexed upwardly, placing it under spring tension. Since the bearing pin **94** presses against the yoke **38***a* the wire spring contact **32***a* will be maintained in a flexed or stressed position and will not become imbedded in the relatively soft plastic forward wall **86**.

The contacts **124** are assembled with the contact engagement portion **100** by dropping their bight portions into the contact cavity **104** with the terminal ends of the contact portion fitted into longitudinal slots **130**

as shown in FIGURE 8. The slots **130** are so arranged that the contact portions **126** of the contacts **124** form angles with the longitudinal midline of the contact engaging portion **100**. The assembled contact portions **126** define an open V construction. The free terminal ends of the spring legs **128** extend beyond the end of the contact portion **126**.

The contact engagement portion **100** with its contacts **124** is assembled with the fuse insulator assembly by passing the end of the wire spring contact **32***a*, through the slot **108** in the base portion **106** to engage the bearing surfaces of the contact portions **126** proximate the apex of the open "V." The keys **80** of the fuse insulator **10***a*, are engaged in their proper arced slots **110** in the contact engagement portion **100** butting the base portion **106** against the terminal end of the fuse insulator **10***a*. If we turn the contact engagement portion **100** around 180° we provide a normally open switch construction rather than the normally closed construction described hereinbefore. Behind the protuberance **20***a* and aperture **90** is formed through the upper wall of the spring retainer tunnel **78**. A double sided cam **92** having a shank portion fitted into the aperture **90** lies between the two leads **30***a*. To increase the amount of tension between the leads **30***a* the yoke **38***a* and the wire fuse element **36***a*, the double sided cam **92** is turned camming the leads **30***a* away from each other and thereby increasing the tension on the wire fuse element **36***a* and the yoke **38***a*. When the tension reaches a satisfactory or sufficient level, the cam **92** is fixed in position using an adhesive or other appropriate means.

The variation operates substantially in the same way as the switch disclosed in FIGURES 1 and 2 as described in column 1 thereof.

With reference to the foregoing description it is to be understood that what has been disclosed herein represents several embodiments of the invention and is to be construed as illustrative rather than restrictive in nature and that the invention is best described by the following claims:

1. A thermal relay comprising a housing, a resilient movable contact mounted within said housing, and at least one fixed contact, the housing having a longitudinal channel within which a portion of the movable contact lies, the movable contact being fixedly held at one end by the housing and having its other end held under flexure by a yoke formed of nonfusible material, said yoke being engaged to a heat fusible material which will fuse when a predetermined electric current is passed therethrough thereby releasing the flexible movable contact which changes its position relative to the fixed contact to either make or break a circuit.

2. A thermal relay as set forth in claim **1** wherein said fusable material is in the form of a looped wire having terminal ends each of which is attached to a lead wire.

3. A thermal relay as set forth in claim **2** wherein said housing includes a switch insulator portion adapted to be turned 180° degrees in relation to the remaining portion of said housing, whereby said relay may be changed from one which is normally opened, to one which is normally closed.

4. A thermal relay as set forth in claim **2** wherein said housing includes a means of flexing said leads away from each other and thereby increasing the tension on said movable contact.

5. A thermal relay as set forth in claim **4** wherein said yoke is looped about said fusable wire and about said movable contact, and abuts a surface within said housing which is in angular relation to the plane of the axis of the housing.

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