United States Patent

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[54] **BLOWN-FUSE INDICATOR INCLUDING A CIRCUIT-CONTROLLING SWITCHING DEVICE**
7 Claims, 4 Drawing Figs.

[52] U.S. Cl. 337/5, 337/244
[51] Int. Cl. H01h 85/30
[50] Field of Search ..... 337/5, 6, 7, 142, 143, 145, 147, 148, 186, 190, 194, 197, 198, 206, 208, 209, 213, 215, 216, 242, 244; 200/153 T

[56] **References Cited**

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3,450,949	6/1969	Inglis	337/7 X
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ABSTRACT: A unit including an indicating fuse and a switching device under the control of said indicating fuse is designed to be more compact and easier to manufacture than comparable prior art devices. This is achieved by providing a tubular member of insulating material mounted on one of the terminal caps of an indicating fuse, covering but one portion of the particular cap, and exposing another portion thereof, said tubular member of insulating material forming a support for a switching device which includes relatively movable contact means.

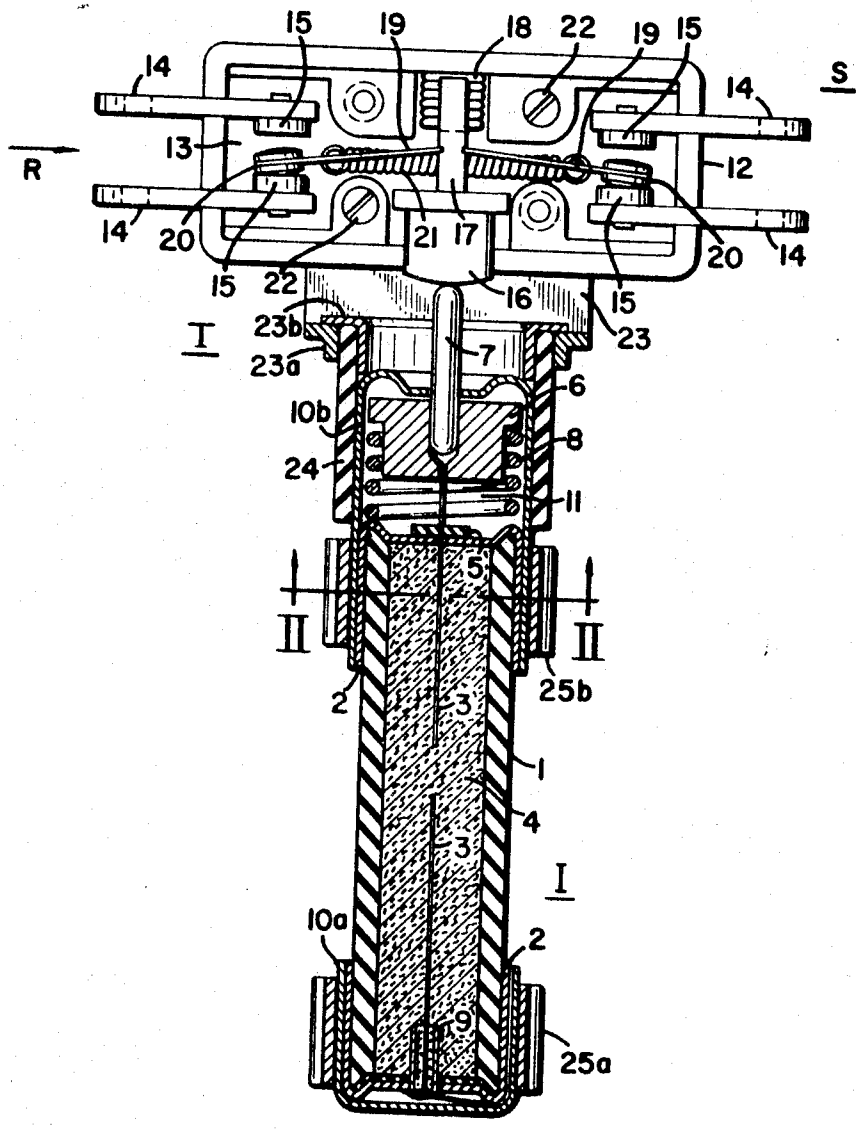

FIG. 1

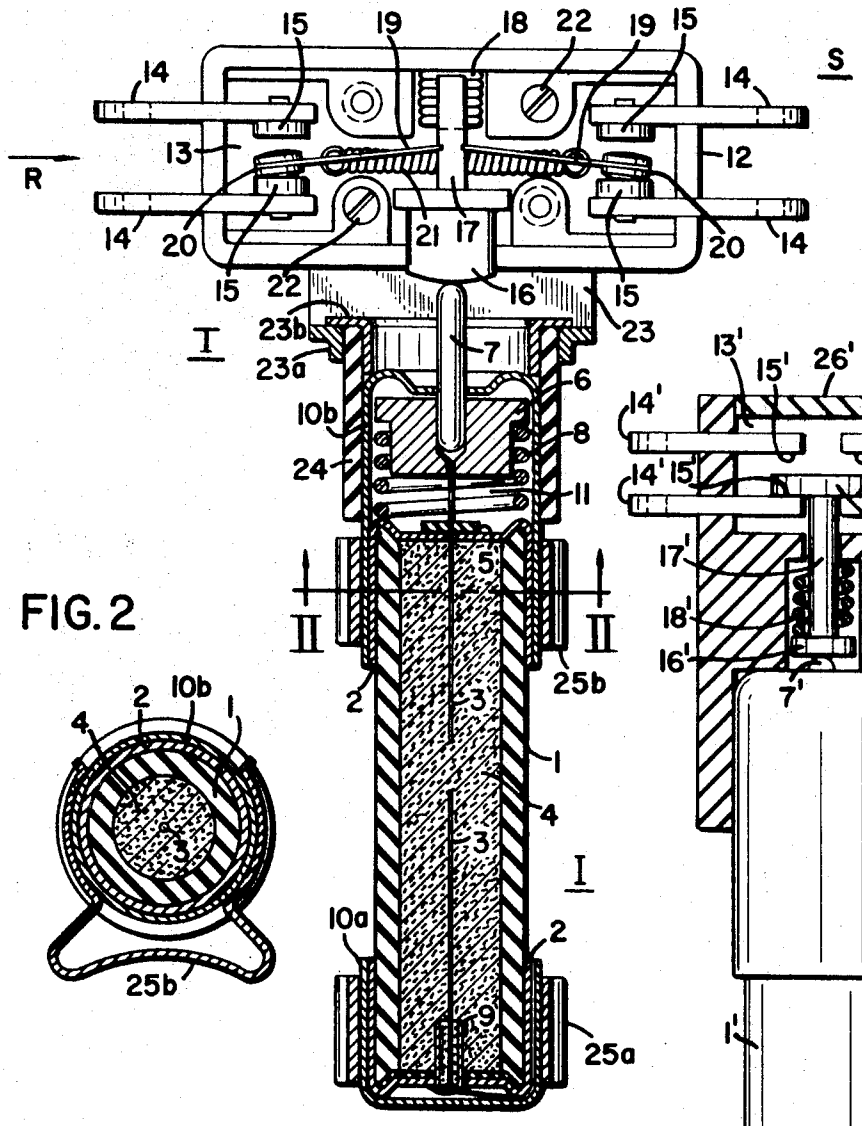

FIG. 2

FIG. 3

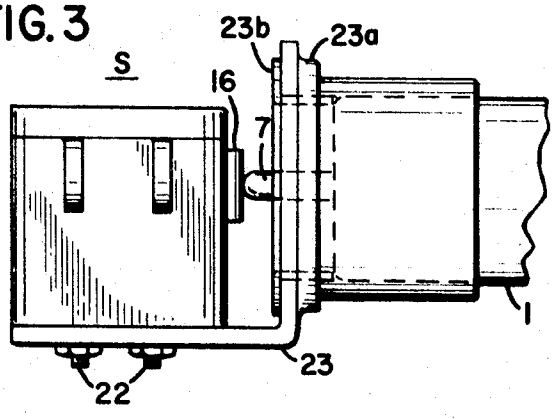

FIG. 4

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BLOWN-FUSE INDICATOR INCLUDING A CIRCUIT-CONTROLLING SWITCHING DEVICE

BACKGROUND OF THE INVENTION

Many power fuses include a blown-fuse indicator to indicate whether or not the power fuse has blown. There are many instances where it is desired to structurally separate the blown-fuse indicating means form the power fuse. In such instances an indicating fuse separate from the power fuse is shunted across the power fuse. The former includes a spring-biased indicator pin, or striker pin, normally maintained against its spring bias in a given position by means of a restraining wire. Upon blowing of the power fuse a voltage appears across the terminals of the indicating fuse and the ensuing current causes fusion of the restraining wire. Hence the indicator pin, or striker pin, is shifted under the action of its spring bias from its initial position to another position, i.e., its indicating or operating position. In many instances it is necessary to translate the aforementioned motion of the indicator pin, or striker pin, into a contact-closing motion, or into a contact-separating motion. This calls for a combination including an indicating fuse and a switching device. Units including an indicating fuse and a switching device must often be used in large numbers at places where there are most stringent space limitations, e.g., in large silicon rectifier systems. This calls for indicator fuse and switching device units of great compactness.

SUMMARY OF INVENTION

Units embodying this invention include an indicating fuse and a circuit-controlling switching device. The indicating fuse has a pair of terminal caps. A tubular member of insulating material is frictionally mounted on one of said pair of terminal caps. Said member of insulating material covers one portion of the lateral surface of said one of said pair of terminal caps and exposes another portion of the lateral surface of said one of said pair of terminal caps. The aforementioned member of insulating material supports the aforementioned circuit-controlling switching device and the contact means thereof.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is substantially a vertical section of a unit embodying this invention including an indicating fuse and a switching device operatively related to the latter, some of the parts of the unit being shown in elevation rather than in section;

FIG. 2 is a section along II—II of FIG. 1;

FIG. 3 is a side elevation of a portion of the structure of FIG. 1 seen in the direction of the arrow R of FIG. 1; and

FIG. 4 shows a modification of the structure of FIG. 1, partly in vertical section and partly in side elevation.

DESCRIPTION OF PREFERRED EMBODIMENTS

In FIGS. 1–3 reference character I has been applied to generally designate an indicating fuse. The particular indicating fuse shown in FIG. 1 is of the type disclosed and claimed in U.S. Pat. No. 3,179,774 to Kenneth W. Swain, Apr. 20, 1965 for INDICATING AND ACTUATING FUSES. Another type of indicating and actuating fuses may be substituted for the fuse I of FIGS. 1–3. In FIGS. 1 and 3 reference character S has been applied to generally designate a switching device operatively related to fuse I, and reference character T has been applied to generally indicate tie means integrating parts I and S to form a self-sustained structural unit. The indicating fuse I of FIG. 1 includes a casing 1 of insulating material closed both ends by ferrules or terminal caps 2. Restraining wire 3 is arranged inside of casing 1 and extends along the axis thereof. The inside of casing 1 is filled with a pulverulent arcquenching filler 4 surrounding restraining wire 3. Each ferrule or terminal cap 2 has a perforation in the center thereof and restraining wire 3 is threaded through the perforations in parts 2. The upper end of restraining wire 3 is threaded through a rubber seal 5 and through the lower opening provided in a pin support 6 and wedged between pin support 6 and the operating pin 7. Pin support 6 has an upper opening receiving operating pin 7, and the latter is press fitted into that opening. Thus the upper end of restraining wire 3 is firmly attached to unit 6,7. The latter is biased in upward direction by helical compression spring 8. The lower end of spring 8 rests against the upper ferrule or terminal cap 2. An eyelet 9 inserted into the center perforation of lower ferrule or terminal cap 2 forms a bushing for the passage of restraining wire 3 from the inside of casing 1 to the outside thereof. Eyelet 9 and the convex end surface of lower ferrule or terminal cap 2 are filled with soft solder, thus affixing the lower end of wire 3 to the lower ferrule or terminal cap 2. An outer terminal cap 10*a* is mounted on the lower ferrule or terminal cap 2, and the lower end of wire 3 is clamped between the lateral surfaces of the first-mentioned and the last-mentioned terminal cap. An outer terminal cap 10*b* is mounted on the upper ferrule or terminal cap 2 and defines a chamber 11 housing seal 5, pin support 6 and helical pin-biasing spring 8. Terminal cap 10*b* has a central aperture for the passage of operating pin 7. The switching device S includes a housing 12 of insulating material which is preferably formed by a molded piece of a synthetic resin defining a switching chamber 13. Four terminal lugs 14 project from the outside of housing 12 through the sidewalls of the latter into switching chamber 13. The ends of terminal lugs 14 inside of switching chamber 13 support fixed contacts 15. Operating member 16 of electric insulating material is arranged above, and in coaxial relation to, operating pin 7 and slidably guided in a conforming aperture formed in the lower wall of switch housing 12. The movable contact support 17 integral with operating member 16 is arranged above the latter and acted upon by helical compression spring 18. Compression spring 18 biases parts 16 and 17 in downward direction. Reference character 19 has been applied to indicate two contact arms whose outer ends support double-faced contact buttons 20 and whose inner ends engage knife bearings formed by contact support 17. Helical spring 21 extends between two points of contact arms 19 relatively remote from contact support 17. Screw studs 22 project through housing 12 and secure an angle member 23 to the former. Angle member 23 includes a horizontal flange defining a pair of coaxial circular sleeves 23*a*,23*b* leaving a toroidal gap therebetween. A tubular member 24 of electric insulating material is press fitted with its upper edge portion into the toroidal gap formed between parts 23*a* and 23*b*, and is thus firmly secured to angle member 23 and consequently also to switch housing 12. Member 24 is frictionally mounted on the upper terminal cap 10*b* of indicating fuse I. Member 24 covers one portion, i.e., the upper portion, of the lateral surface of the upper terminal cap 10*b* and exposes another portion, i.e., the lower portion, of the lateral surface of the upper terminal cap 10*b*. The exposed or lower portion of the lateral surface of upper terminal cap 10*b* is engaged by fuse holder clip 25*b*. The lateral surface of lower terminal cap 10*a* is engaged by fuse holder clip 25*a*. Fuse holder clips 25*a*,25*b* are electrically connected across a power fuse (not shown). As long as the power fuse is intact its fusible means form a low-resistance shunt across fuse holder clips 25*a*,25*b*. Hence no voltage prevails between fuse holder clips 25*a*,25*b*. Upon blowing of the power fuse a voltage appears across fuse holder clips 25*a*,25*b*. Hence a current flows from clip 25*a*, through caps 10*a*, 2, restraining wire 3, pin support 6, spring 8 and caps 2,10*b* to clip 25*b*. This current causes melting of restraining wire 3, thus forming a break between its ends, as shown in FIG. 1. Hence spring 8 tends to propel parts 16 mounted on casing 1′ and 17 in upward direction against the action of relative weak compression spring 18.

Prior to fusion of restraining wire 3 parts 16,17 are in their lower limit position, spring 18 is expanded and movable contacts 20 engage the upper fixed contacts 15. When parts 7,16,17 are moved in upward direction under the bias of helical spring 8 and the knife bearings of contact arms 19 are moved beyond the dead center position relative to spring 21, the double-face contact buttons 20 snap out of engagement with the upper fixed contact 15 and into engagement with the lower fixed contacts 15.

Fuse I is a device that must be replaced following each blowing, but switch S is a device capable of performing a very large number of switching operations and calls hardly for any replacement. Upon blowing of fuse I it is simply pulled out of tubular insulating member **24** and replaced by a like fuse which is intact.

The switch S shown is a SPDT switch of the type called two-circuit switch. It is designed to normally maintain one circuit closed and another circuit open. Upon blowing of fuse I the normally closed circuit is opened, and the normally open circuit is closed. This is a requirement which often occurs in supervisory systems for electric fuses. The switch S is a snap-action-type device capable of performing a very large number of switching operations under relatively onerous conditions. There are, however, many supervisory systems for electric fuses requiring a relatively small number of switching operations under conditions which are not onerous. In such instances the greatly simplified structure of FIG. **4** may be preferable over that of FIGS. **1–3**.

In FIG. **4** the same reference characters as in FIGS. **1–3** with a prime added have been applied to designate like parts. Thus I′ is an indicating fuse identical to that shown in FIG. **1** and described in connection with FIG. **1**. This fuse includes an upper terminal cap **10***b*′ and an operating pin **7**′. The tubular member **24**′ of insulating material is frictionally mounted on terminal cap **10***b*′. Tubular member **24**′ covers the upper portion of terminal cap **10***b*′ and exposes the lower portion of cap **10***b*′ in order to make it possible to place fuse I′ in a pair of fuse holder clips (not shown) as explained above in connection with FIG. **1**. The operating member **16**′ of insulating material is arranged inside tubular member **24**′ in coaxial relation to member **24**′ and operating pin **7**′. Helical compression spring **18**′ rests with one end thereof against a shoulder formed by tubular member **24**′ and with the other end thereof against operating member **16**′. The upper portion of tubular member **24**′ defines a switching chamber **13**′ and lugs **14**′ project transversely through member **24**′ into switching chamber **13**′. Tubular member **24**′ is closed on the upper end thereof by a cover **26**′. The inner ends of lugs **14**′ form contact surfaces **15**′. The operating member **16**′ of insulating material supports the movable contact support **17**′ which, in turn, supports the contact bridge **19**′. Contact bridge **19**′ is adapted to conductively interconnect selectively either the upper lugs **14**′ or the lower lugs **14**′.

While FIG. **1** shows the fuse I following blowing thereof, FIG. **3** shows fuse I′ prior to blowing thereof. Upon blowing of fuse I′ its pin **7**′ is propelled upwardly under the action of its pin-biasing spring overcoming the bias of compression spring **18**′. Consequently contact bridge **19**′ is moved out of engagement with lower lugs **14**′ and into engagement with upper lugs **14**′.

It will be apparent that in the switch structure of FIG. **4** the current path between the upper lugs **14**′ is normally open and the current path between the lower lugs **14**′ closed, while in the structure of FIG. **1** the current path between upper lugs **14** is normally closed and the current path between lower lugs **14** normally open. Normally means in this context prior to energizing and blowing of the fuse by which the respective switching device is controlled.

The tubular member **24** of FIGS. **1–3** and the tubular member **24**′ of FIG. **4** are preferably made of nylon. They may also be made of an elastomer. In the latter instance the inner diameter of members **24** and **24**′, respectively, ought to be smaller than the outer diameter of upper terminal caps **10***b* and **10***b*′, respectively. Members **24,24**′ expand when mounted on caps **10***b*,**10***b*′.

I claim as my invention:

1. A blown-fuse indicator and electric switch unit including

a. a tubular casing of insulating material, a fusible restraining wire housed in said casing, a spring-biased indicator pin arranged adjacent one of the ends of said casing and normally restrained by said restraining wire, and a pair of terminal caps mounted on the axially outer ends of said casing and normally conductively interconnected by said restraining wire;

b. a circuit-controlling switching device arranged adjacent said one of the ends of said casing and adjacent said indicator pin and operable by said indicator pin, said switching device including a pair of contacts for closing and opening an electric circuit; and

c. a tubular member of insulating material frictionally mounted on one of said pair of terminal caps, said member of insulating material covering one portion of the lateral surface of one of said pair of terminal caps and exposing another portion of the lateral surface of said one of said pair of terminal caps, and said member of insulating material supporting said switching device and said pair of contacts thereof.

2. A blown-fuse indicator as specified in claim **1** wherein the lateral surface of said member of insulating material is shorter than said lateral surface of said one of said pair of terminal caps and exposes the axially inner end of said lateral surface of said one of said pair of terminal caps.

3. A blown-fuse indicator as specified in claim **2** wherein said member of insulating material consists of an elastomer.

4. A blown-fuse indicator as specified in claim **1** wherein said member of insulating material is in the form of an additional cap and wherein said pair of contacts is arranged inside said additional cap and wherein terminal means for said pair of contacts are arranged on the lateral surface of said additional cap.

5. A blown-fuse indicator as specified in claim **1** wherein said tubular member of insulating material consists of nylon.

6. A blown-fuse indicator as specified in claim **3** wherein said tubular member of insulating material has a smaller inner diameter than the outer diameter of said one of said pair of terminal caps.

7. A blown fuse indicator and electric switch unit including

a. a tubular casing of insulating material, a fusible restraining wire housed in said casing, a spring-biased indicator pin arranged adjacent one of the ends of said casing and normally restrained by said restraining wire, and a pair of terminal caps mounted on the axially outer ends of said casing and normally conductively interconnected by said restraining wire;

b. a circuit-controlling switching device arranged adjacent said indicator pin and adjacent one of said pair of terminal caps and operable by said indicator pin, said switching device including fixed contacts and movable contacts;

c. a tubular member of insulating material frictionally mounted on said one of said pair of terminal caps, said member of insulating material covering one portion of the lateral surface of said one of said pair of terminal caps and exposing another portion of the lateral surface of said one of said pair of terminal caps, and said member of insulating material supporting parts of said switching device including the fixed contacts thereof; and

d. a pair of contact clips, one of said pair of contact clips engaging the portion of the lateral surface of said one of said pair of terminal caps exposed by said tubular member, and the other of said pair of contact clips engaging the other of said pair of terminal caps.

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