United States Patent [19]

Gressenich et al.

[11] **3,713,067**

[45] **Jan. 23, 1973**

[54] TEMPERATURE-RESPONSIVE SWITCH

[75] Inventors: **Klaus Gressenich, Hans Oppl,** both of Ansbach; **Berthold Walter,** Unterasbach; **Hans Weismann,** Stuttgart; **Hartmut Zobl,** Furth, all of Germany

[73] Assignee: **Robert Bosch GmbH,** Stuttgart, Germany

[22] Filed: **April 7, 1972**

[21] Appl. No.: **242,161**

[30] **Foreign Application Priority Data**

April 8, 1971 Germany.....P 21 17 323.9

[52] **U.S. Cl.** **337/360,** 337/94, 337/112, 337/380

[51] **Int. Cl.**.....**H01h 37/12**

[58] **Field of Search**.....337/94, 360, 85, 112, 333, 337/334, 372, 380, 392, 417

[56] **References Cited**

UNITED STATES PATENTS

2,140,147	12/1938	Vroom	337/360 X
2,405,767	8/1946	Sprague	337/380 X
2,568,323	9/1951	Dales	337/112 X
2,906,840	9/1959	Ulanet	337/360
3,064,102	11/1962	Cassidy	337/112 X
3,171,933	3/1965	Webb et al.	337/380 X
3,206,584	9/1965	Hobson, Jr.	337/94 X

Primary Examiner—Harold Broome
Assistant Examiner—A. T. Grimley
Attorney—Michael S. Striker

[57] **ABSTRACT**

A tubular housing is provided in one of its open ends with an electrically conductive carrier, a circular projection of which extends towards the other end of the housing. At the other end there is located a socket member of electrically insulating material, having one or more exterior terminals and a carrier portion located in the interior and exposed at the other open end of the housing. The carrier portion carries an adjusting screw which can be threadedly moved transversely of the elongation of the housing and carries at its free end a contact, and a second contact is carried at the free end of an elongated bimetallic strip which extends longitudinally within the housing and is mounted with one end on the projection of the carrier by being welded thereto. A U-shaped spring of spring wire is also mounted on the contact carrier and has portions engaging in the screwthreads of the adjusting screw so that the same is frictionally prevented from unintentional turning.

16 Claims, 4 Drawing Figures

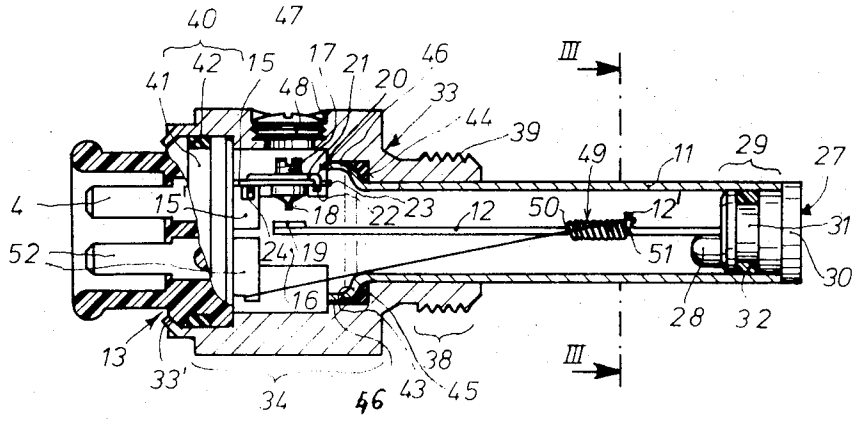


Fig.1

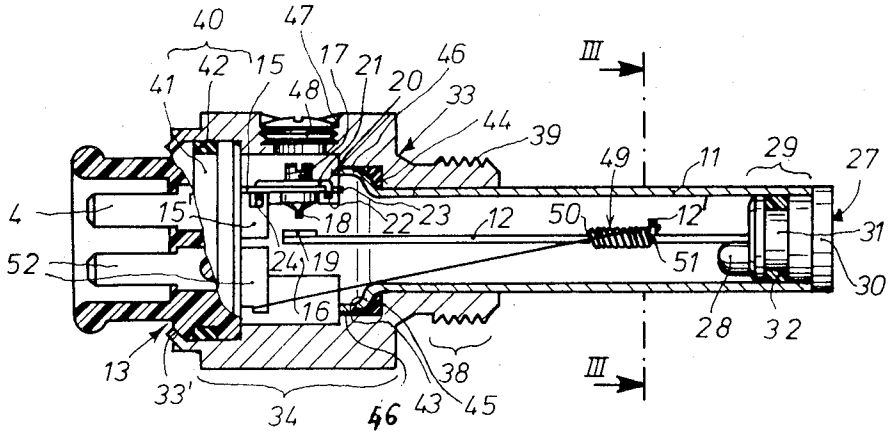


Fig.2

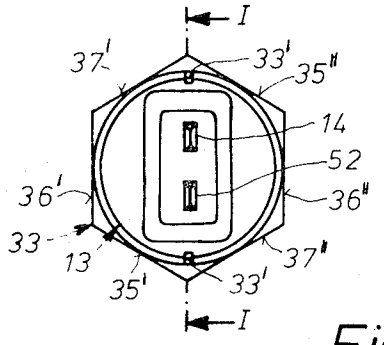


Fig.3

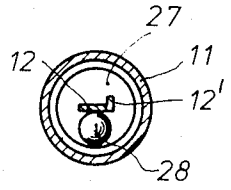
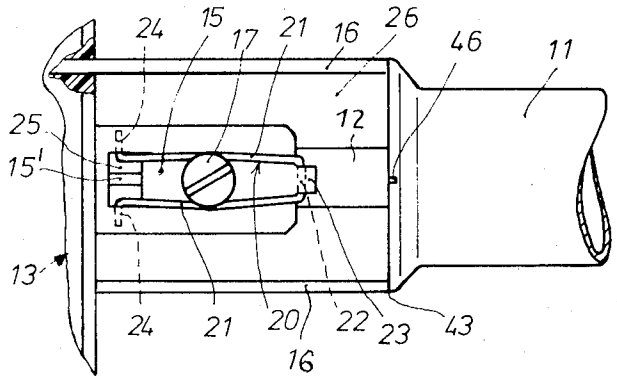


Fig.4



TEMPERATURE-RESPONSIVE SWITCH

BACKGROUND OF THE INVENTION

The present invention relates generally to a temperature-responsive switch, and more particularly to a temperature-responsive switch having a bi-metallic element and means for adjusting the temperature at which the switch operates.

Switches of this type are of course already known, and they are for instance widely used for initiating or terminating electrical signals in dependence upon ambient temperature conditions. One example of use of such switches is their employment in automotive vehicles where they are for instance to initiate or terminate completion of an electric circuit in dependence upon the temperature of a liquid, e.g. the cooling water for the engine or the like.

A temperature switch of this type has been proposed in the prior art in which the bi-metallic element is clamped in place by means of spring elements. Unfortunately, experience has shown that if the temperature switch is subjected over a prolonged period of time to high or very high temperatures, the elasticity of these spring elements tends to decrease and, as a result of this, not only has there been observed a decided danger that the bi-metallic element might come loose, but also a decrease in the effectiveness of transmission of thermal energy between the switch housing and the bi-metallic element has been found as a result of this. Still another disadvantage of this prior-art construction is that when the switch is subjected to constant or very frequent jolting and vibrations, as occurs if the switch is for instance used in an automotive vehicle, the adjusting screw which is used for varying the temperature at which the switch responds, tends to loosen or turn by itself so that the switch no longer reliably responds at the originally pre-selected temperature. Evidently, none of these problems are tolerable because they effect so strongly the proper operation of the switch.

SUMMARY OF THE INVENTION

It is, accordingly, a general object of the present invention to provide an improved temperature-responsive switch which is not possessed of the disadvantages of the prior art.

More particularly it is an object of the invention to provide a temperature-responsive switch in which undesired loosening of the mounting of the bi-metallic element is reliably avoided.

An additional object of the invention is to provide such a temperature-responsive switch in which a change in the efficiency of thermal transmission between the bi-metallic element and the switch housing is made impossible.

A concomitant object of the invention is to provide such a temperature-responsive switch in which the adjusting screw cannot change its position even if the switch is subjected to jolting and vibrations, whereby the possibility that the once-selected operating temperature of the switch might become undesirably changed, is avoided.

Still an additional object of the invention is to provide such an improved temperature-responsive switch which can be produced relatively inexpensively.

In pursuance of these objects, and of others which will become apparent hereafter, one feature of the invention resides in a temperature-responsive switch which, briefly stated, comprises a tubular housing having opposite ends, with an electrically conductive carrier being mounted on the housing in one of the ends. A bi-metallic strip extends longitudinally in the housing and has one end portion welded to the carrier, and an other end portion adjacent the other end and provided with a first contact. A socket member of electrically insulating material is mounted at the other end and has at least one exterior terminal, and a contact carrier which is conductively connected with this terminal and exposed at the other end. An adjusting screw is carried by the contact carrier and has external screwthreads and a free end provided with a second contact movable toward and away from the first contact in response to requisite turning of the adjusting screw, with spring means being provided on the contact carrier in engagement with the external screws of the adjusting screw to thereby frictionally retain the latter against undesired turning.

This construction, as will already be understood, avoids the disadvantages of the prior art.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a longitudinal section through a switch according to the present invention, taken on line I—I of FIG. 2;

FIG. 2 is an end view of the switch in FIG. 1, looking towards the right;

FIG. 3 is a section taken on line III—III of FIG. 1; and

FIG. 4 is a top-plan view showing a detail of FIG. 1, partially in section, on an enlarged scale.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A single exemplary embodiment has been illustrated in FIGS. 1–4 from which it will be seen that in this embodiment the temperature-responsive switch according to the present invention has a sleeve-shaped or tubular housing 11 of electrically and thermally conductive material, for instance a suitable metal. The opposite ends of the housing 11 are open and a bi-metallic strip 12 extends in the housing longitudinally thereof. At one end of the housing 11, the left-hand end in FIG. 1, there is provided a socket member 13 of electrically insulating material, for instance a synthetic plastic, such as a hardenable synthetic resin material.

As FIG. 1 shows particularly clearly, the socket member 13 is provided with a terminal 14 which here is configurated as a flat strip-shaped element (compare also FIG. 2) which extends in outward direction for connection with an exterior component which forms no part of the invention. Located interiorly and electrically conductively connected with the terminal 14, is a contact carrier 15 which may be molded into the material of the socket member 13. The latter is retained and mounted with respect to the housing 11 by

a pair of arms **16** which extend longitudinally of the housing **11** and are suitably engaged with the socket member **13**, in the illustrated embodiment by being embedded in the material thereof.

As adjusting screw **17** is threaded into a suitable opening provided in the contact carrier **15**, being so located that it can be advanced and retracted at least substantially normal to the general plane of the bi-metallic strip **12**. The free end of the screw **17**, that is the tip thereof, is provided with a contact **18** which is juxtaposed with a cooperating contact **19** provided on a free end of the bi-metallic strip **12**. In conventional manner the contacts **18** and **19** will engage one another when the bi-metallic strip **12** has cooled to a certain temperature which can be predetermined by appropriately spacing the contact **18** from the contact **19** by turning the screw **17**. When the bi-metallic strip **12** is heated beyond this temperature, its deflection will maintain the contacts out of engagement. The drawing (see FIG. 1) shows a supporting web **15'** which further supports the contact carrier **15**, being provided on the socket member **13** for the purpose of supporting the contact carrier **15** in the direction of threading of the screw **17**. However, this web **15'** can be omitted if the additional support is not necessary.

As pointed out earlier, one of the difficulties in the prior-art constructions of temperature-responsive switches is the undesired turning of the respective adjusting screw, resulting in undesired changes in the temperature at which the contacts **18** and **19** will engage or disengage. To avoid this in the switch according to the present invention, that is to prevent the screw **17** from turning when the switch is subjected to vibrations or similar movements, there is provided a spring element **20** which in the illustrated embodiment is of spring wire and of substantially U-shaped configuration. It has a bight or transverse portion **22** which is in engagement with a lug or tongue **23** provided on the contact **15**, as well as having two arm portions **21** which extend along at opposite sides of the screw **17** and whose free end portions **24** extend through an opening **25** provided in the contact carrier **15**. The arrangement is such, as clearly evident from FIG. **4**, that the arm portions **21** are slightly bowed, thus frictionally extending into the screwthreads of the screw **17** and engaging the latter with sufficient force to prevent it from turning when the switch is subjected to vibrations or similar movements. Thus, the screw **17** can still be turned under exertion of requisite force, but only if this force is exerted intentionally, because vibrations and similar motions are no longer sufficient to cause the screw **17** to turn by itself. A free space **26** exists between the arms **16** which mount the socket member **13** to the housing **11**, and through this free space access can be had to the screw **17** with a suitable tool, such as a screw-driver, to turn the screw **17** and afford any adjustments which may be desired. Such adjustments can be carried out without having to remove the spring element **20**, and thus without having to undertake an additional operating step or risking the possibility that the element **20** might become lost when disconnected.

The opposite end of the housing **11** is closed by an essentially plug-shaped carrier **27** of electrically and thermally conductive material, such as metal. This carrier **27** extends into the open end of the housing **11** as shown and is provided with an axially extending projection **28** which is here of circular cross-section and has a rounded free end. The bi-metallic strip **12** overlies the projection **28** in line contact therewith, being welded to the projection **28** either along the entire line of contact or intermittently, as by spot welding. Such an arrangement permits proper spot welding in particular, and the rounding of the free end of the projection **28** prevents a sharp edge of the projection **28** from possibly doing damage to the material of the bi-metallic strip **12**. The projection **28** may be arranged centrically or eccentrically with reference to the longitudinal axis of the carrier **27**, as desired.

Obviously, the carrier **27** need not be configurated as a plug as shown in the illustrated embodiment, but such a construction is advantageous. If this is desired, then the carrier **27** will have a portion **29** as shown, which is accommodated in the open end of the housing **11**, as well as a portion **30** which is a flange and abuts the axial end face of the housing **11** to determine the extent to which the carrier **27** can be inserted into the latter. The reliable retention and a sealing effect of the carrier **27** are obtained by providing the circumferential surface of the portion **29** with a circumferentially extending groove **31** in which a sealing ring **32** is accommodated which sealingly engages the inner circumferential surface of the housing **11**.

At the opposite end portion of the housing **11** there is provided a sleeve-shaped or nut-like mounting element **33** of electrically conductive material, such as metal, which overlies the opening **26** and tightly surrounds and engages a portion of the housing **11** as well as of the socket member **13**. The bi-metallic strip **12** is an electrically conductive contact with he element **33** via the carrier **27** and the housing **11**.

The outer circumferential surface of the mounting element **33** is provided on one longitudinal portion **34** thereof with at least one pair of diametrally opposite parallel flat facets; in the illustrated embodiment there are three such pairs provided, with the diametrally opposite facets being identified with reference numerals **35'**, **35''**, **36'**, **36''** and **37'**, **37''**. A further longitudinal portion **38** of the outer circumferential surface of the element **33** is provided with screwthreads **39** to permit the switch to be threadedly connected into a housing or other element which may for instance contain a liquid whose temperature is to be supervised by the switch.

It will be appreciated that the switch can be incorporated in a non-illustrated signal current circuit which includes the element **33**, the housing **11**, the carrier **27**, the bi-metallic strip **17**, the contacts **18** and **19**, the adjusting screw **17**, the contact carrier **15** and the terminal **14**.

The purpose of providing the facets **35'–37''** is to facilitate engagement of the switch with the aid of a tool, for instance a wrench or the like, to permit the switch to be tightly mounted and also to permit it to be released if and when necessary.

The switch according to the present invention cannot only be constructed simply and inexpensively, but can similarly be readily assembled. This in facilitated by the fact that the socket member **13** is accommodated in a portion **40** of enlarged diameter of the passage in the element **33**, and is provided with a circumferentially extending groove **41** in which a sealing ring **42** is

located which sealingly engages the element **33**. If it is considered necessary or advisable, then the edge at the open end of the member **33** may be bent inwardly, either around the entire circumference or at selected locations, as indicated at **33'** in FIG. **1**, in order to provide locking tongues to still more reliably assure the retention of the socket member **13** in the element **33**.

It is also advantageous, but not absolutely necessary, if the inner passage of the element **33** is provided with a constriction **44**, with the housing **11** having a bead or expansion **43** which is located inwardly of the constriction **44** and tends to abut against the same, with a sealing element **45** being located between and in sealing engagement with both of them. This prevents an extraction of the housing **11** from the element **33**, that is it prevents a disconnection of them. To assure despite such a provision a reliable electrical contact between the components **11** and **33**, the bead **43** may be provided with small noses or projections **46** which are in conductive contact with the inner wall bounding the passage in the element **33**.

It is of course desirable that access to the adjusting screw **17** be readily available, even with the switch installed in a place of use. To assure this the element **33** is provided with an aperture **47** which affords access to the head of the screw **17** and which can be closed by a simple plate or, as in the illustrated embodiment, by an additional screw **48** which removably closes it.

The bi-metallic strip **12** may be provided with a heating coil **49** as shown in FIG. **1**, if and when this should be necessary or desired. If so, one end of the coil **49** is in electrically conductive contact with the bi-metallic strip **12** and the other end **51** is connected with a tongue **12'** formed in the strip **12** and is in electrically conductive engagement with an additional terminal **52** provided for this purpose in the socket member **13**. With such an arrangement a circuit is established via the components **14, 15, 17, 18, 19, 12, 49** and **52**. Current flowing in this circuit is interrupted when it causes so significant a heating of the bi-metallic strip **12** that the latter bends and the contacts **18** and **19** move apart. As pointed out before, however, the winding **49** can be dispensed with if it is not desired or required for a particular purpose.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in a temperature-responsive switch, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

We claim:

1. A temperature-responsive switch, comprising a tubular housing having opposite ends; an electrically conductive carrier mounted on said housing in one of said ends; a bi-metallic strip extending longitudinally in said housing and having one endportion welded to said carrier, and an other endportion adjacent the other of said ends and provided with a first contact; a socket member of electrically insulating material mounted at said other end and having at least one exterior terminal, and a contact carrier conductively connected with said terminal and exposed at said other end; an adjusting screw carried by said contact carrier and having external screwthreads and a free end provided with a second contact movable toward and away from said first contact in response to requisite turning of said adjusting screw; and spring means provided on said contact carrier and engaging said external screwthreads for frictionally retaining said adjusting screw against undesired turning.

2. A switch as defined in claim **1**, said bi-metallic strip having a general plane, and said adjusting screw being elongated in direction transversely to said general plane.

3. A switch as defined in claim **1**, wherein said carrier is dimensioned to close said one end of said housing.

4. A switch as defined in claim **1**, said one end of said housing having an opening, and said carrier being configurated as a plug for closing said opening, said carrier having a first portion received in and closing said opening, a second portion abutting said housing exteriorly of said opening, and a third portion projecting inwardly of said housing from said first portion, said one endportion of said bi-metallic strip being welded to said third portion.

5. A switch as define in claim **1**, said one end of said housing having an opening, and said carrier including an outer portion located exteriorly of said one end, and an inner portion received in said one end, said inner portion having a circumferential outer surface provided with a circumferentially groove; and further comprising an annular sealing element located in said groove and sealing engaging the inner side of said housing.

6. A switch as defined in claim **1**, said spring means being of spring wire.

7. A switch as defined in claim **1**, said spring means comprising a substantially U-shaped element of spring wire having a transverse portion and a pair of arm portions extending from said transverse portion and located at opposite sides of said adjusting screw; said contact carrier having a lug engaging and retaining said transverse portion, and at least one cut-out through which the respective free ends of said arm portions extend and in which they are retained so that said arm portions are bowed about said adjusting screw and each extend into and frictionally engage said screwthreads of said adjusting screw.

8. A switch as defined in claim **1**, said carrier having a projection extending in said housing in direction towards said other end, and said one endportion of said bi-metallic strip being welded to said projection.

9. A switch as defined in claim **8**, said projection being of circular cross-section, and said one endportion engaging said projection in line contact therewith and being at least spot-welded to said projection.

10. A switch as defined in claim 9, said projection having a free end facing towards said other end, and said free end being rounded.

11. A switch as defined in claim 1, said housing being electrically conductive and said socket member having a peripheral wall provided with an opening for access to said screw; and further comprising a mounting element of electrically conductive material tightly surrounding said other end and a portion of said socket member, overlying said opening and being in electrically conductive contact with said housing.

12. A switch as defined in claim 11, said mounting element being annular and having an outer circumferential surface which is provided on one longitudinal portion of said mounting element with exterior screwthreads, and on another longitudinal portion with at least two diametrally opposite exterior flat facets.

13. A switch as defined in claim 11, said mounting element being annular and having an interior passage provided with a smaller-diameter portion accommodating said other end of said housing, and a larger-diameter portion accommodating said socket member in part, said part of said socket member having an exterior circumferential surface provided with a circumferentially extending recess accommodating an annular sealing element in sealing engagement with said mounting element.

14. A switch as defined in claim 11, said mounting element being annular and having an interior passage accommodating said other end of said housing, said passage having a constriction forming a first shoulder and said housing having an external bead forming a second shoulder located axially adjacent said first shoulder; and further comprising a sealing ring between and in sealing engagement with both of said shoulders.

15. A switch as defined in claim 11, said housing being provided in the region of said other end with a plurality of outwardly extending projections which engage an inner surface bounding an interior passage provided in said mounting element and accommodating said other end of said housing.

16. A switch as defined in claim 11, said mounting member having an aperture affording access via said opening to said adjusting screw; and further comprising removable closure means for closing said aperture when access to said adjusting screw is not desired.

* * * * *