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(54) Temperature responsive switch.

(57) A temperature responsive switch has an electrically insulating housing, two unitary contact members which can be slid into the housing in opposite directions along a straight contact path and electrically insulating pins which pass through aligned apertures in the housing and each contact member to prevent withdrawal. One contact member has a movable contact on a resilient arm, the other a fixed contact. A bi-metallic disc and transfer pin serve to displace the arm to make or break electrical continuity at a specified temperature.

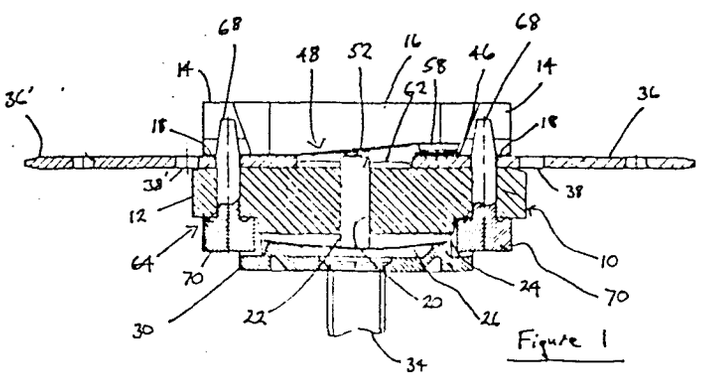

Figure 1

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TEMPERATURE RESPONSIVE SWITCH

This invention relates to temperature responsive switches and particularly to such switches in which a bimetallic disc or other temperature sensitive element displaces a contact arm to make or break electrical continuity.

These switches find wide application in the automobile field and in a variety of domestic appliances. Despite the fact that high accuracy and electrical safety standards are usually demanded of the switches, it is often a commercial necessity that these switches be produced at low cost. Accordingly, it is an object of this invention to produce an improved temperature responsive switch which may be manufactured simply and at low cost.

The present invention consists in a temperature responsive switch comprising an electrically insulating housing formed in one piece and defining a straight contact path; a first unitary contact member having a terminal for external connection and a fixed contact; a second unitary contact member having a terminal for external connection and a contact arm carrying a movable fixed contact; and temperature sensitive means adapted to displace the contact arm at a predetermined temperature thereby to make or break electrical continuity between the said contacts, wherein the housing is provided with integral support formations such that the contact members may on assembly of the switch be slid into the housing in opposite senses along the contact path, engagement between said formations and the contact members preventing any substantial movement of the contact members orthogonally of the contact path, there being provided contact locking means acting after insertion of the contact members to hold the same against movement along the contact path.

Advantageously, the contact locking means comprises for each contact member an electrically insulating pin arranged to pass through aligned apertures in the contact member and housing respectively.

Preferably, the second unitary contact member is formed by welding a sprung contact arm to a rigid terminal.

The invention will now be described by way of example with reference to the accompanying drawings, in which:-

Figure 1 is a longitudinal section through a switch

according to this invention,

Figure 2 is a plan view of the switch shown in Figure 1, and

Figure 3 is an end view of the switch shown in Figures 1 and 2.

The temperature responsive switch shown in the drawings has an electrically insulating housing formed as a single injection moulding. The housing comprises a flat base 12 from which are upstanding four support blocks 14 arranged generally at the corners of the base. On two opposing sides of the base a wall 16 extends between the two corresponding support blocks. In this way, a straight contact path is defined between the support blocks; the contact path being marked XX in Figure 2. Each support block 14 is undercut to form a groove 18, parallel to the contact path.

As seen best in Figure 1, the housing base 12 has a central bore 20 which carries a freely movable transfer pin 22. In the underside , the housing base is formed with a recess 24 to accommodate a bimetallic disc 26. This disc cooperates with the transfer pin in the standard manner to move a contact arm, details of which will be given below. At the sides parallel to the contact path, the housing base 12 carries lateral flanges 28. An aluminium cap 30 is secured to the housing, trapping the bimetallic disc, by means of ears 32 which are crimped over these lateral flanges. The cap shown in the drawings includes a mounting stud 34 but it will be appreciated that the cap can if necessary be provided with apertures or indeed any other suitable mounting elements.

The illustrated switch has two contact members. The first contact member comprises a terminal 36, of stainless steel or German silver, having at its outer end the shape and dimension of a standard spade terminal. In a position overlying the end of the housing base 12, the terminal is provided with an oval aperture 38 which defines a transverse bending line 40. Inwardly of this oval aperture, the terminal has a circular aperture 42 the purpose of which will be described hereinafter. On either side of the circular aperture 42 the lateral edges of the terminal are thickened to provide mounting shoulders 44. Adjacent the innermost end, the terminal has a welded fixed contact 46 of silver/nickel alloy.

The second contact member comprises a terminal 36' with an oval aperture 38', a circular aperture 42' and mounting shoulders 44' which are substantially identical to those of the first terminal 36. The second contact member differs from the first in that, in place of the fixed contact 46, there is welded a contact arm 48. This contact arm is not formed of the copper beryllium alloy that is customary but is formed of a copper alloy DELCAN S18 which contains substantially no beryllium. The contact arm has a welding portion 50 of reduced width; a central downward projection 52 which engages the transfer pin; longitudinal stiffening ridges 54, one each side of the projection 52 and a contact carrying portion 56 to the underside of which is welded a movable contact 58 of silver/nickel alloy.

Hitherto, it has not proved practical to weld a relatively thin contact arm of copper alloy to a relatively thick terminal of, for example, stainless steel. By selecting the alloy DELCAN S18, the present applicants have been able to produce a unitary contact member by welding the contact arm to a rigid terminal and it is believed that the absence or relatively low level of beryllium in the alloy is an important factor in this success. Similarly it has proved possible to weld the movable contact 58 to the contact arm.

In order to prepare for the weld, the terminal 36' is formed at its inner end with two small ridges 60 running parallel to the contact path and spaced on each side of the centre line. This arrangement is felt to be particularly advantageous in maximising the working life of the switch. After a certain number of flexures of the contact arm, there may be a risk of a slight crack appearing at the weld site. With the present arrangement of two longitudinal welds, a crack appearing at the forward edge of each weld would not seriously affect the current carrying capability of the arm. Moreover, any crack would be expected to follow along the longitudinal edges of each weld so that, until the crack reached the rearward end of the welds, the switch should continue to operate within the defined characteristic. In this way, the working life of the switch, usually measured in numbers of make or break operations, is extended even beyond the point at which some deterioration in the weld might be

expected. Looked at in another way, an externally imposed minimum working life can be met with less substantial components than would otherwise be the case.

The manner in which the two contact members are secured in the housing is substantially identical. The two contact members are pushed into the housing in opposite senses along the contact path XX. Each terminal engages within the grooves 18 formed in the support blocks and, with the contact members in the final position, the shoulders 42 cooperate as a tight fit with these grooves. As seen in Figure 1, the upper face of the housing base 12 is formed with two longitudinally extending abutments 62 which are parallel to the contact path. In the fully inserted position, the innermost end of each terminal engages the ends of these abutments so providing a stop. It will be understood that the engagement of the housing base 12 and support blocks 14 with each contact member serves to prevent substantially any movement of the contact member orthogonally of the contact path. Engagement with the abutments 62 serves to prevent movement along the contact path inwardly of the housing. Movement along the contact path outwardly of the housing is prevented by means of a retaining pin 64 which passes through an aperture 66 in the housing base and through circular aperture 40 in the terminal. Each retaining pin has a tapered free end 68 to facilitate insertion and a cylindrical head 70 which abuts against the lower face of the housing base. In assembly of the described switch, the contact members are slid into position, the retaining pins pushed into the apertures and the cap 30 then secured in position by crimping the ears 32. As seen in Figure 1, the cap partially overlies the heads of the two retaining pins so that the act of securing the cap also secures in position the retaining pins and thereby the contact members.

Once the contact members have been locked in position, they may be bent about the bending line 40 to give the required terminal angle externally of the housing. Since switches are conventionally offered with a range of terminal angles, this feature of bending the terminals after assembly will substantially reduce the inventory that is required to be kept of any one terminal design. In this regard it

will be apparent to the skilled man that the illustrated spade terminal is but one example. The inventory is further reduced by the fact that, until the point at which preparations are made for welding of the fixed contact 46 or contact arm 48, the terminals 36 and 36' are indistinguishable.

The described switch is felt to have considerable advantages over the conventional construction in which rivets are used both to mount the terminals in the housing and to secure the contact arm to the corresponding terminal. There are advantages both in assembly of the switch and in the subsequent operation. Since the two contact members are unitary, there is an overall reduction in components and a simplification in component handling. Assembly is further simplified by the fact that the two contact members may simply be slid into position and are immediately held against any movement orthogonally of the contact path. Preferably, a stop is provided in the housing, as in the described embodiment, so that the contact members are also held in a direction along the contact path, inwardly of the housing. The contact members are now in their final position and the electrical resistance between the terminals may be checked if thought necessary. The retaining pins are inserted together with the transfer pin and bimetallic disc and the assembly is completed once the cap is crimped in position. It will be noted that the cap is the only component which is permanently deformed. Until the cap is added, the components may be disassembled if an inspection or testing operation reveals a flow.

The electrical advantage of the described arrangement is that with the obvious exceptions of external contact to the terminals and the engagement between the switch contacts, all connections within the switch are of a molecular nature. Contact resistancies are therefore minimised and are also constant. They do not for example vary with the force applied to a rivet or the dimension of a housing between the ends of a rivet.

The described method of mounting the contact members is also thought to be the reason why it is practicable to bend terminals after assembly. With a conventional construction of riveted terminals, there would be a risk of the bending force deforming the riveted

connection leading to a possibly significant increase in contact resistance.

It will be understood that the housing may be formed with formations other than the described grooved support blocks for mounting the contact members. All that is required is formations that enable the contact members to be slid into the housing in opposite senses along the contact path and to be held by engagement with the housing against any movement orthogonally of the contact path. Preferably, an abutment or other stop is provided to prevent inward movement of the contact members. The locking means which prevent withdrawal of the contact members along the contact line may take forms other than the described retaining pins. It may be arranged, for example, for the frictional engagement between the contact members and the housing to provide the required resistance to withdrawal of the terminals. The contact members may for example be provided with "saw teeth" on the longitudinal edges. In another alternative, a form of snap action engagement may be provided between the contact member and the housing. Generally, such locking means will offer lower resistance to withdrawal of the terminals than retaining pins or other positive locking means but may nevertheless be sufficient in certain applications.

The advantage of having retaining pins of electrically insulating material is that the pin heads may be left exposed in the completed switch assembly. In other words, the cap need not completely cover the retaining pins and this leads to a further reduction in component costs.

It should be understood that still further modifications may be made to the described switches without departing from the scope of this invention. As a further example, whilst it is thought advantageous to employ a welded contact arm and terminal structure, it will be possible in certain applications to have an integral contact member formed by suitably bending a sheet blank.

CLAIMS

1. A temperature responsive switch comprising an electrically insulating housing formed in one piece and defining a straight contact path; a first contact assembly having a terminal for external connection and a fixed contact; a second contact assembly having a terminal for external connection and a contact arm carrying a movable contact; and temperature sensitive means adapted to displace the contact arm at a predetermined temperature thereby to make or break electrical continuity between the said contacts, characterised in that the first and second contact assemblies comprise respective unitary contact members; in that the housing is provided with integral support formations such that the contact members may on assembly of the switch be slid into the housing in opposite senses along the contact path, engagement between the formations and the contact members preventing any substantial movement of the contact members orthogonally of the contact path; and in that there are provided contact locking means acting after insertion of the contact members to hold the same against movement along the contact path.

2. A switch as claimed in Claim 1, wherein the contact locking means comprises for each contact member a separate locking element arranged to pass through aligned apertures in the contact member and housing respectively.

3. A switch according to Claim 2, wherein the locking element comprises an electrically insulating pin.

4. A switch according to any one of the preceding claims, wherein the second unitary contact member is formed by welding of a resilient contact arm to a rigid terminal.

5. A switch according to any one of the preceding claims, wherein the support formations comprise slots in said housing extending parallel to the contact path.

6. A switch according to Claim 5, wherein said slot is formed for each contact member by opposing grooves lying one to each side of the contact path.

7. A switch according to any one of the preceding claims, wherein an abutment is provided for each contact member to limit, on assembly, inward movement of the contact member along the contact path.

8. A switch according to any one of the preceding claims, wherein the housing is provided remote from the support formations with a recess for receiving the temperature sensitive means, the switch further comprising a cap engageable with the housing so as substantially to close said recess.

9. A switch according to Claim 8, wherein the contact locking means comprises for each contact member an electrically insulating pin having a head and passing through an aperture in the housing and an aligned aperture in the respective contact member, said cap engaging the head of the pin to prevent removal of the pin.

10. A switch according to any one of the preceding claims, wherein at least one contact member has a weakened bending line enabling bending of the terminal with respect to the contact after insertion of the contact member in the housing.

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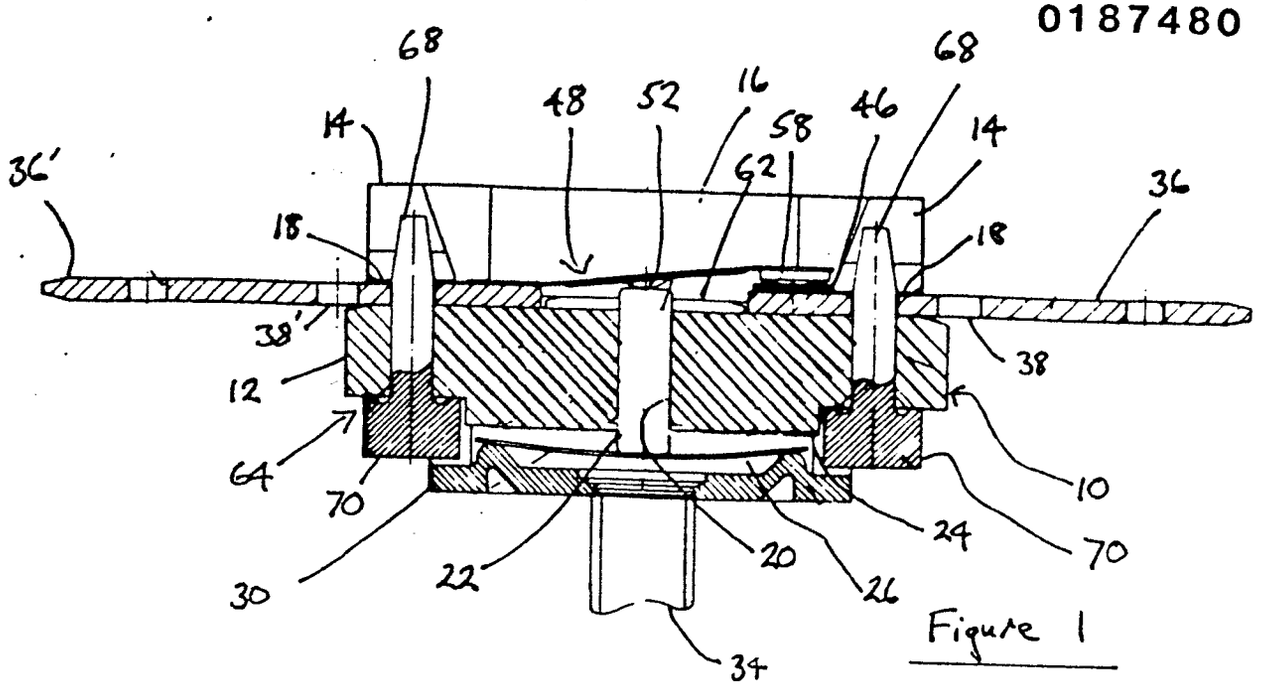

Figure 1

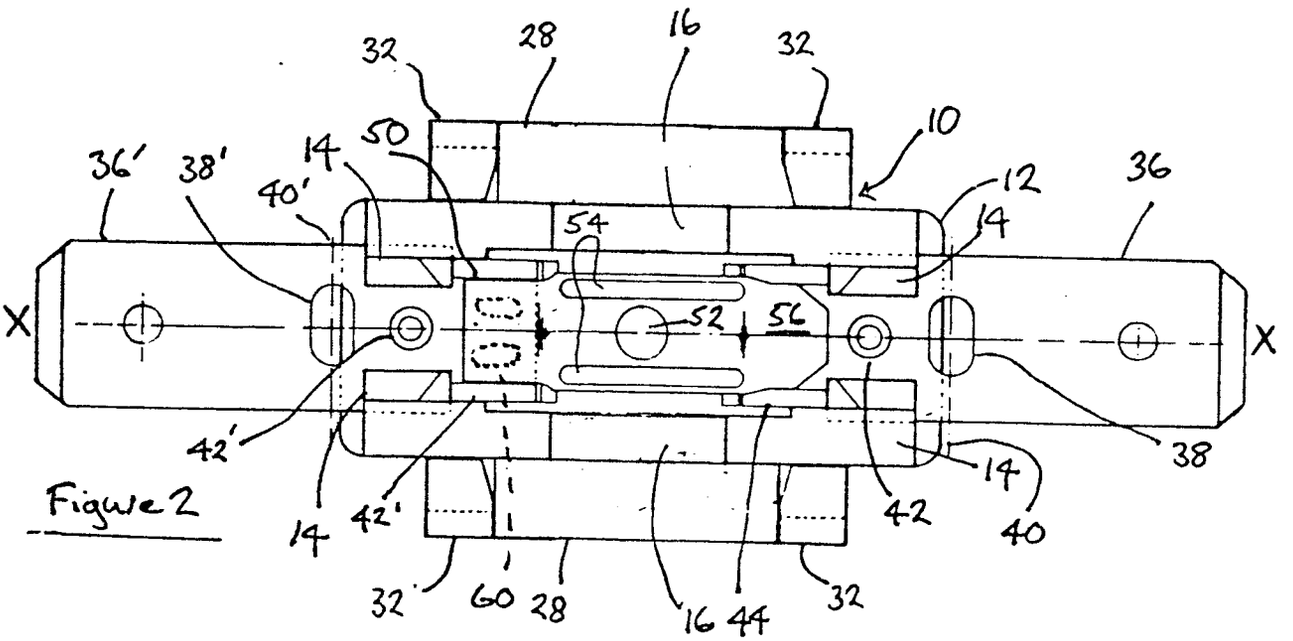

Figure 2

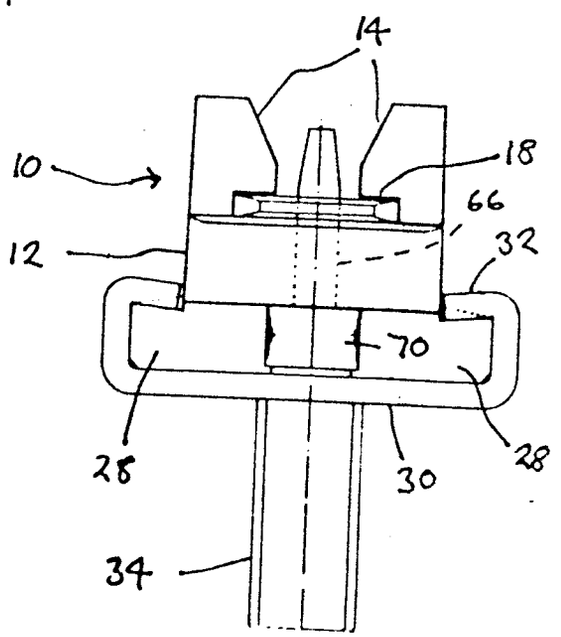

Figure 3

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EUROPEAN SEARCH REPORT

0187460
Application number

EP 85 30 8883

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl 4)
X	DE-A-2 905 149 (MICROTHERM) * Page 7, paragraph 3 - page 9, paragraph 4 *	1,5-8	H 01 H 37/04
A	EP-A-0 103 792 (P. HOFSASS) * Page 8, line 15 - page 9, line 15 *	1,4-7	
A	US-A-4 504 814 (U.S. PHILIPS) * Column 2, lines 7-31; figure 2 *	1-4,8, 9	
A	US-A-4 368 451 (H.C. BUCHEISTER) * Column 3, lines 9-41 *	1,4-8	TECHNICAL FIELDS SEARCHED (Int Cl 4)
A	FR-A-2 437 055 (TEXAS ITALIA) * Page 3, lines 18-31 *	1,4,5, 7,8	H 01 H 37/00
A	US-A-3 537 052 (THERM-O-DISC) * Column 2, line 62 - column 3, line 60 *	1,8,9	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	01-04-1986	LIBBERECHT L.A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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