

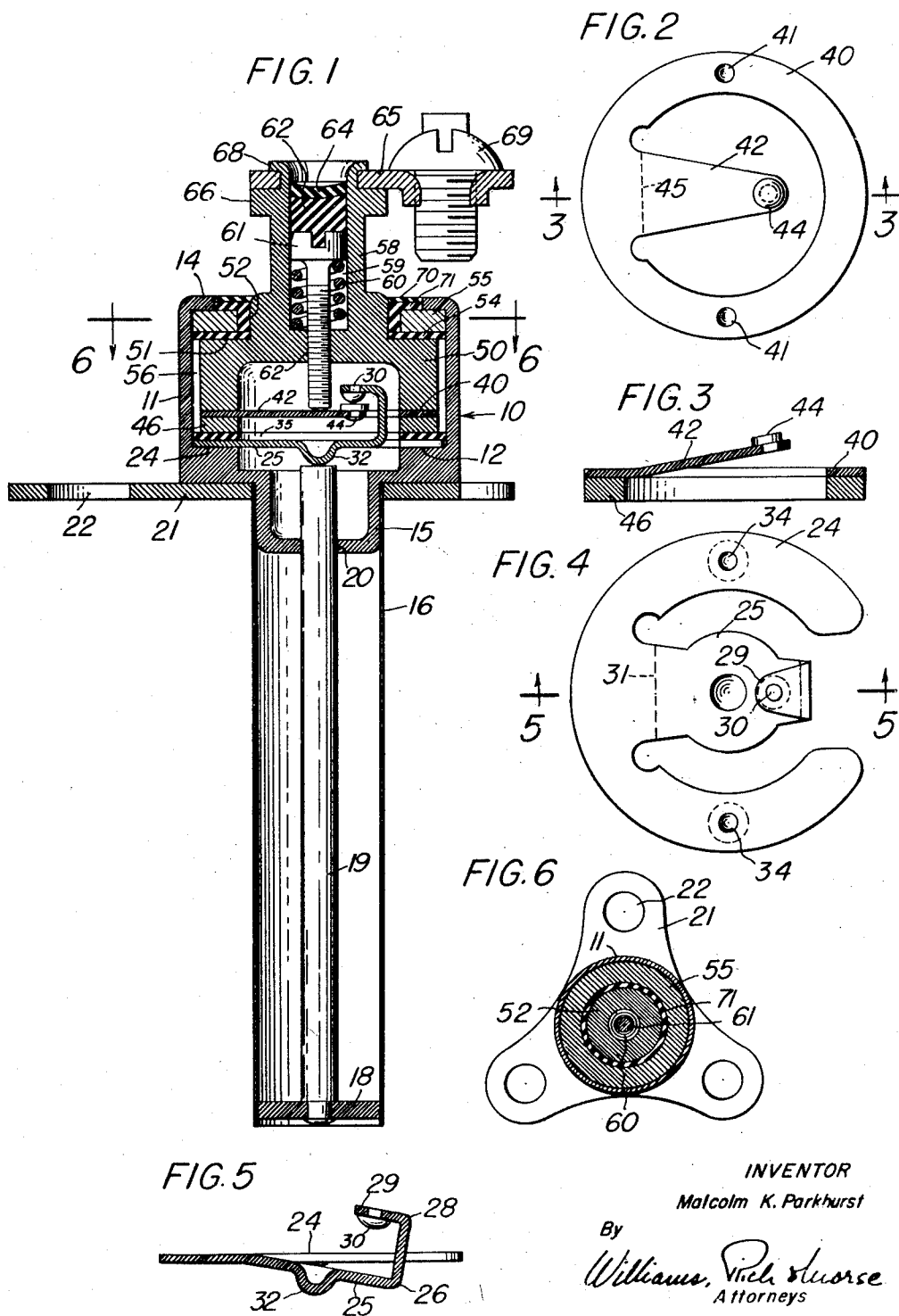
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THERMAL SWITCH

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THERMAL SWITCH

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This invention relates to switching devices for electrical circuits, more particularly to a thermal switch of small dimensions for use in relatively high temperatures.

The principal object of the invention is to provide a small, temperature-responsive switch unit of compact design and rugged construction capable of repeated response when subjected to temperatures such as those encountered by contact with open flame such as accidental fires.

Another object is to provide such a switch which is easily assembled and which can be accurately calibrated.

A further object is to provide a thermal switch which is hermetically sealed so as to remain in perfect working order through long periods of non-use.

A still further object is to provide a switch which will actuate a pair of contacts at a given temperature and thereafter be capable of withstanding a much greater rise in temperature without loss of calibration.

The invention will best be understood from the following detailed description of the present preferred embodiment thereof taken in conjunction with the drawings in which,

Fig. 1 is a central sectional view through a complete switching unit which has been calibrated and sealed;

Fig. 2 is a plan view of one of the contacts;

Fig. 3 is a sectional elevation taken on the line 3—3 of Fig. 2;

Fig. 4 is a plan view of the other contact sub-assembly;

Fig. 5 is a sectional elevation taken on the line 5—5 of Fig. 4; and

Fig. 6 is a transverse section taken on the line 6—6 of Fig. 1, drawn to a smaller scale.

The switching unit embodies the principles of the well known rod and tube type thermostat in which the actuating elements comprise coaxial members in the form of a rod surrounded by a tube which is connected to the rod at one end, these two elements being made of materials having different thermal coefficients of expansion. The tube is mounted in fixed relation to a switching structure containing a pair of contact members, one of the contacts being arranged to be moved by the rod and the other being stationary. The invention resides in the particular combination and arrangement of elements which will now be described.

Referring to the drawings, the complete switching unit comprises a head 10 made of a suitable machinable metal, such as stainless steel, which

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has an upstanding cylindrical side wall 11 defining a cavity, in the lower portion of which is a shoulder or step 12. Before assembly, the upper edge of the side wall 11, which is shown as flanged over at 14, is straight and in line with the wall 11. The lower part of the head 10 is formed with a cylindrical boss 15 to which is secured, as by welding for example, a metal tube 16. At its lower end the tube is provided with a fixed plug 18 to which is secured the rod 19. The plug is hermetically sealed to the tube and the tube is hermetically sealed to boss 15, by brazing for example. To provide the necessary differential expansion, the tube may be made of an alloy such as "Inconel" and the rod may be made of a different alloy such as 42% nickel steel or "Invar." At its upper end, the rod is supported concentric with tube 16 in an opening 20 in the boss 15 through which it is free to slide. Surrounding the tube 16 and abutting the head 10 the unit may be provided with a suitable mounting flange 21 having bolt holes 22. It will be understood that when the unit is mounted in a location where increases in temperature are to be detected, such for example as the engine compartments of aircraft, the tube 16 will be located in the area where fire may possibly occur. In the event of fire, the tube is subjected to increased temperature which will cause it to expand and become longer. The rod, having a different coefficient of expansion, will produce movement within the cavity in the head 10.

On the step 12 are mounted a stack of elements commencing at the bottom, as seen in Fig. 1, with the lower contact member shown in Figs. 4 and 5. This member may be formed from suitable spring metal and comprises a circular body 24, the diameter of which corresponds to the inside diameter of the cylindrical wall 11. Integral with body 24 is a tongue portion 25, the end of which is twice bent at right angles as shown at 26 and 28 to provide an overhanging support 29 for a contact 30. Before assembly, the tongue 25 is bent with relation to the body 24 along the broken line 31 so as to be biased downwardly as shown in Fig. 5. This lower contact member has a downwardly extending projection 32 adapted to rest upon the top of rod 19 and its body 24 is provided with slight downwardly extending projections 34 by which it can be secured to the face of the step 12 by means of projection welding. After the lower contact has thus been secured within the head 10, an insulating washer of mica or the like 35 is placed over it, this washer also having the same diameter as the contact body 24.

The other contact member is formed as shown in Figs. 2 and 3 and has a circular body 40 with indentations 41 and an integral tongue 42 carrying a contact 44, the tongue 42 being bent along the broken line 45 so as to be biased upwardly as shown in Fig. 3. This upper contact member is preferably fastened concentrically to a metal spacing washer or ring 46 by projection welding and this sub-assembly is placed in the cavity in head 10 with the aid of a centering jig so as to be uniformly spaced from the side wall 11. It is placed in position with the tongue 42 turned so as to pass the overhanging support 29 after which it is rotated to bring the contacts into vertical alignment, as shown in Fig. 1. Washer 46 may be considered as part of the body 40 after it is fastened to it since it serves only as a spacer. The interengagement of contacts 30 and 34 under their respective spring pressures will hold this sub-assembly in position on the insulating washer 35 while the assembly of the remaining elements is completed. A cap 50 which has a flat shoulder 51 surrounding a boss 52 is then placed over the contact body 40 and is centered with respect to the cavity in head 10 by a second annular insulating washer 54 which is of such size as to engage the side wall 11 and the boss 52. This washer is preferably made of mica. A metal washer 55 having the same outside diameter but a smaller inside diameter than the mica washer 54 is then positioned on top of the latter, and the upper edge of the side wall 11 is formed over as shown at 14 under very heavy pressure so as to clamp together all of the elements within the head 10. It will be observed that the cap 50, contact body 40 and the washer 46 are electrically insulated from the head by the insulating washers 35 and 51 and the annular air space 56.

The neck portion 58 of cap 50 is provided with a cavity 59 containing a coil spring 60 through which extends a screw 61, the latter being threaded through cap 50 at 62. Screw 61 engages the tongue 42 of the uppermost contact member and by turning the screw, the position of contact 44 may be adjusted for the purpose of calibrating the device. It is contemplated that this calibration will be permanently made and hence the portion of cavity 59 which is above the head of screw 60 will be filled with a suitable sealing cement which is shown in Fig. 1 as comprising the two layers 62 and 64. Before this cement is applied, however, the upper end of cap 50 is provided with a terminal lug 65 which is clamped against a collar 66 by flaring over the edge 68. Screw 69 is provided for making electrical connection with contact 44 through cap 50. The other connection with contact 30 is made through the supporting bracket 21 and head 10, these two elements preferably being welded together.

Preferably, the space at the upper end of head 10 between boss 52, washers 54 and 55, and the flanged edge 14, is filled with one or more layers of baked dielectric cement as shown at 70 and 71. This hermetically seals the chamber in head 10.

The embodiment described above is shown in the drawings on an enlarged scale to facilitate description. In actual practice, the entire unit is constructed as a very small device approximately $\frac{1}{3}$ the size of Fig. 1 as it appears in the original drawings. Notwithstanding its small size and light weight, the extremely rugged construction provides a thermal switch of great utility and accuracy which is capable of continued use after repeated exposure to tempera-

tures such as are encountered in accidental engine fires and the like. It will be observed that the only moving parts are rigidly supported without the use of any pivotal connections or the like and that the contacts are securely clamped in position so that no shifting or deformation of the parts can occur through vibration or wear.

By means of screw 61, the spacing of the contacts can be adjusted so that the circuit will be closed after any desired rise in temperature, the contacts being normally open. And it will be appreciated that by positioning contact 30 below contact 44 instead of above it, the switch may be arranged so as to be normally closed and adjusted to open upon a given rise in temperature. A principal use of the above described switch is the operation of electrical signaling devices to give warnings when unusual or dangerous temperatures or fires exist in the area surrounding the tube 16.

Another advantage of the construction shown is that it permits of considerable "overshoot" without getting out of calibration. In other words, rod 19 may move a considerable distance beyond what is necessary to move contact 30 against contact 44, without subjecting any of the parts to strain. The continued movement of rod 19 after the contacts have closed merely separates it from the projection 32, with which it is not connected. Thus the switch is unaffected by subjection of the tube to temperatures far above the temperature at which the switching takes place.

It is to be understood that the invention is not limited to the precise details of construction above described for purposes of illustration, but is to be construed broadly within the purview of the claims.

What is claimed is:

1. A thermal switch comprising a head having a chamber defined in part by a cylindrical wall open at one end, said wall terminating at the other end in an annular seat normal to the wall, said chamber containing in stacked relation the following elements arranged in the order named from said seat toward said open end: a first contact having a circular body of the same diameter as said chamber, an insulating washer of like diameter, a second contact having a body of less diameter than said chamber and spaced from said wall, a cap of less diameter than said chamber spaced from said wall and having a boss, an insulating washer extending from the periphery of said boss to said wall, and a metal washer in peripheral contact with said wall and spaced from said cap, the edge of said wall being flanged over upon said last-mentioned washer to compress said stacked elements; and thermal expansion means comprising a tube attached to said head, and a rod carried by the tube and extending into said chamber and adapted to actuate said first contact.

2. A switch according to claim 1 wherein said cap is provided with an adjusting screw bearing against said second contact.

3. A switch according to claim 2 wherein said cap is provided with a bore within which the head of said screw is received, said bore extending beyond said head to provide a space for the reception of sealing material.

4. A switch according to claim 1 wherein the space between the boss of said cap and said flanged over edge and said metal washer is filled with dielectric material.

5. A switch according to claim 2 wherein said

first contact is of spring metal and biased toward said rod and said second contact is of spring metal and biased toward said screw.

6. In a thermal switch, in combination, a tube, a rod secured at its outer end to the outer end of the tube, said tube having a greater thermal coefficient of expansion than said rod, a casing attached to the inner end of said tube, a pair of contacts mounted in said casing, one of said contacts being resiliently mounted for movement into engagement with the other of said contacts, said resiliently mounted contact resting freely upon said rod without attachment thereto and pressing toward the outer end of the rod, said rod upon increase of ambient temperature moving in a direction away from said resiliently

mounted contact to permit closing of the contacts, said rod at normal temperature maintaining said contacts out of engagement with each other.

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