United States Patent

[11] **3,609,620**

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[21] Appl. No. **865,792**
[22] Filed **Oct. 13, 1969**
[45] Patented **Sept. 28, 1971**
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[54] **THERMOSTATIC SWITCH**
7 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **337/102,** 337/112, 337/113
[51] **Int. Cl.** **H01h 61/02**
[50] **Field of Search** 337/102, 112, 113, 77, 89, 111, 104, 105, 366, 368

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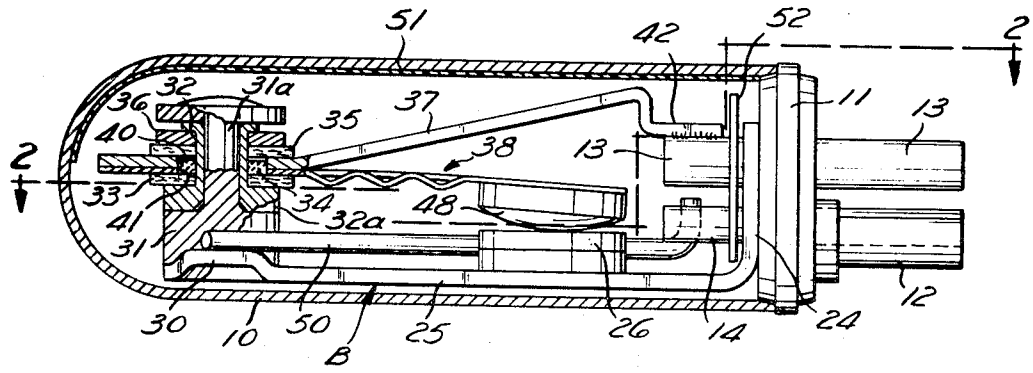
ABSTRACT: A thermostatic switch having an L-shaped metal base attached to a header which closes one end of a metal housing. Supported from the base, and insulated from it, is a cantilever-mounted bimetal switch blade carrying a mobile contact on its free end for engagement with a stationary contact on the base. A main heater extends between a terminal carried by the header and the mounted end of the beimetal switch blade at the latter's low expansion side. An auxiliary heater extends between the base and another terminal carried by the header at the high-expansion side of the switch blade. The foregoing abstract is merely a resume of one general application, is not a complete discussion of all principles of operation or applications, and is not to be construed as a limitation on the scope of the claimed subject matter.



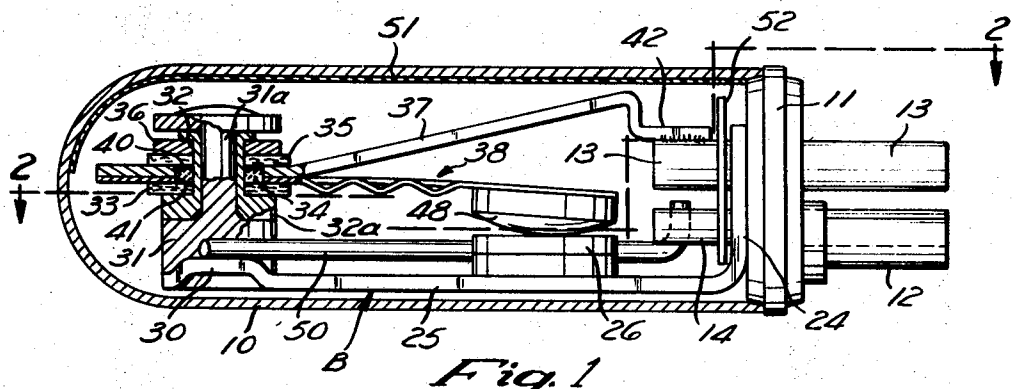


Fig. 1

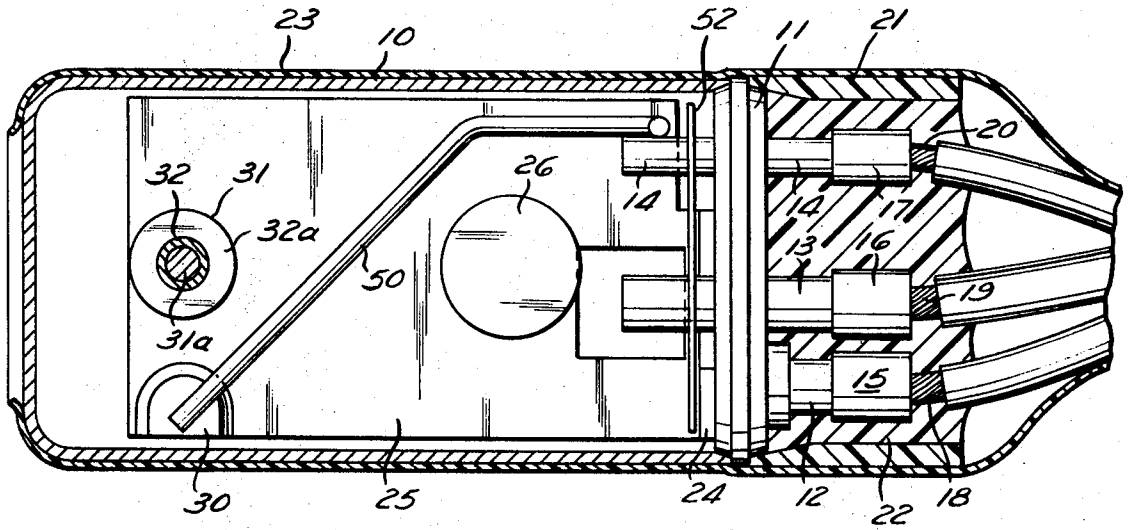


Fig. 2

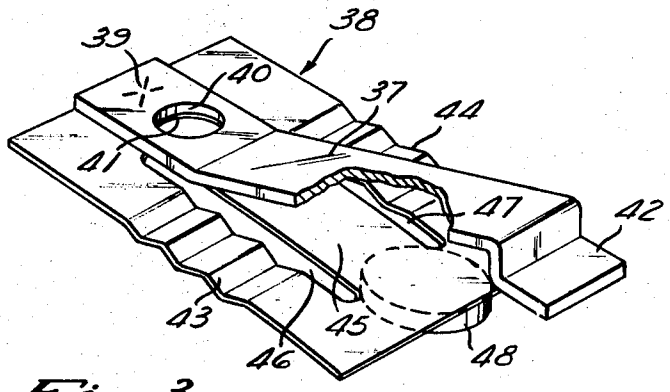


Fig. 3

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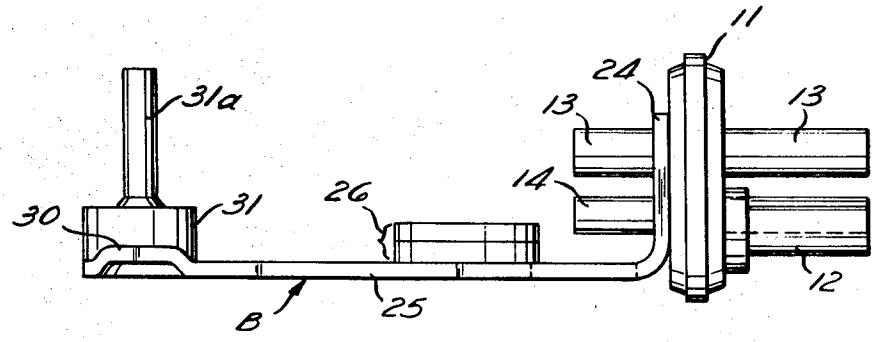
Fig. 4



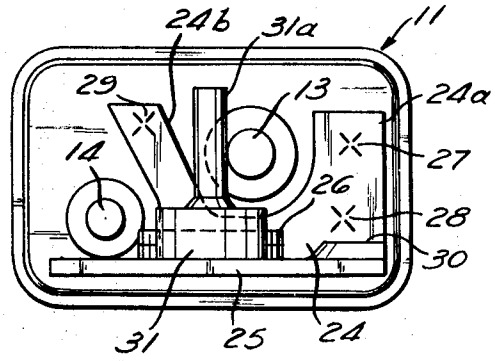


Fig. 5

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THERMOSTATIC SWITCH

This invention relates to a thermostatic switch which is particularly useful in a motor protector circuit, and may be buried in the motor windings to receive heat therefrom.

A principal object of this invention is to provide a novel and improved thermostatic switch of high-current capacity for its physical size.

Another object of this invention is to provide such a switch which may be tested and adjusted for its electrical and temperature-responsive characteristics before being encapsulated in a hermetically sealed enclosure.

Another object of this invention is to provide such a switch which may be assembled in a convenient manner and which is rugged and durable in operation.

Further objects and advantages of this invention will be apparent from the following detailed description of a presently preferred embodiment shown in the accompanying drawings, in which:

FIG. 1 is a longitudinal elevational view, with part broken away for clarity, showing the operating parts of the present switch;

FIG. 2 is a longitudinal section taken along the line 2—2 in FIG. 1 and showing additionally the lead-in wires and parts of the switch enclosure which are omitted in FIG. 1 for clarity;

FIG. 3 is a perspective view, partly broken away for clarity, showing the subassembly of the bimetal switchblade and the main heater in the present switch;

FIG. 4 is a longitudinal elevational view showing the subassembly of the switch base, assembly rivet, stationary contact, header and header terminals in the present switch; and

FIG. 5 is an elevational view of the FIG. 4 subassembly, taken from the left end of FIG. 4.

Referring first to FIG. 1, the present switch preferably is disposed within a housing or body **10** of suitable metal, preferably steel, which is closed at its left end in this figure. The opposite end of the housing **10** is closed and sealed by a metal header **11** which carries terminals for connecting the switch within the housing to lead-in wires. In the particular embodiment illustrated, this header **11** carries three such terminals **12**, **13** and **14**, which are spaced apart laterally, as shown in FIG. 2. Terminal **12** is spot welded to the outer side of the header **11**. Terminals **13** and **14** extend through the header at conventional glass seals (not shown) which electrically insulate them from the header **11**. The outer ends of terminals **12**, **13**, **14**, are connected through conventional wire splices **15**, **16**, **17** (FIG. 2) to individual lead wires **18**, **19** and **20**.

A sleeve **21** of suitable dielectric material extends from the header **11** to the right in FIG. 2, and a suitable potting compound **22**, preferable epoxy resin, fills this sleeve to anchor in place the splices **15**, **16** and **17**. The entire assembly of the housing **10**, header **11** and sleeve **21** is enclosed by a tube **23** (FIG. 2) of heat shrinkable plastic.

Inside the housing **10** the switch assembly includes a generally L-shaped steel base having a short transverse leg **24**, which is spot welded to the inner face of the header **11**, and an elongated leg **25** extending perpendicularly away from the header toward the closed end of the housing **10**. This base **24**, **25** provides a rigid physical support for the movable operating parts of the switch. The header **11** conductively connects the switch base **24**, **25** and the switch housing **10** through terminal **12** to the lead wire **18**, which is grounded. Consequently, both the switch base **24**, **25** and the housing **10** are grounded. The header **11** also supports the switch base **24**, **25** spaced from direct contact with the housing **10**.

A stationary contact **26** is spot welded to the elongated leg **25** of the switch base. To the right of this contact in the drawings the upstanding short leg **24** of the switch base is bifurcated, as best seen in FIG. 5, presenting laterally spaced upstanding segments **24***a* and **24***b* which are spot welded at **27**, **28** and **29** to the inside of the header **11**.

The inner ends of the terminals **13** and **14** support an electrical insulation panel **52** just inward from the upstanding

transverse leg **24** of the switch base which is attached to the header **11**.

At its left end in the FIGS. **1** and **2**, the long leg **25** of the switch base presents an upwardly offset boss **30** at one corner. At a location spaced directly behind this boss in FIGS. **1** and **2**, an assembly rivet **31** is spot welded to the switch base. This rivet has a large cylindrical lower end and a reduced diameter stem **31***a* extending up from the lower end. This stem portion of the rivet snugly receives a steel bushing **32**, which has a transversely-enlarged lower end **32***a* resting directly on top of the lower end of the rivet. Stacked in succession on top of the enlarged lower end **32***a* of bushing **32** and extending around its smaller diameter shank are a mica washer **33**, a porcelain washer **34**, a mica washer **35**, and a steel washer **36**.

A unitary subassembly of a main heater **37** and a snap-acting, bimetallic switchblade or contact carrier **38** (FIG. **3**) is mounted on the rivet, bushing and washer assembly just described. The main heater **37** and the bimetal switchblade **38** are spot welded to each other at a location **39** (FIG. **3**) near their respective left ends in FIGS. **1** and **3**. Just to the right of this location the main heater and the switchblade have respective aligned openings **40** and **41** which snugly the porcelain washer **34**, as shown in FIG. **1**. The attached end of the main heater **37** and the switchblade **38** subassembly is sandwiched between the mica washers **35** and **33**, as shown in FIG. **1**, so as to be electrically insulated from the bushing **32**, the rivet **31** and the switch base **24**, **25**.

The main heater **37** is a relatively thick and wide plate which is inclined upward to the right in FIGS. **1** and **3** and is in heat-transfer relationship to the switchblade **38** throughout the latter's length. At its right end the main heater is downwardly offset to present an end segment **42** which is spot welded to the innner end of lead-in terminal **13** (FIG. **1**).

The bimetal switchblade **38** has a togglelike, overcenter spring characteristic. As best seen in FIG. **3**, it comprises a pair of outer legs **43**, **44** and a center leg **45** which is separated from the outer legs by elongated slits **46** and **47**. The outer legs and the center leg of the switchblade are integrally joined at the outer free end of the blade, as well as at its mounted inner end. A mobile switch contact **48** is attached to the underside of the switchblade at its outer end. In FIGS. **1** and **3**, the top of the bimetal switchblade **38** is the low thermal expansion side, and the bottom is the high thermal-expansion side.

The outer legs **43** and **44** of the switchblade are crimped to put them under tension and to put the center leg **45** under compression. As shown in FIG. **1**, when the bimetal switchblade **38** is at a temperature below a predetermined value, it assumes an overcenter position in which its free end is displaced downward from its mounted end, so that the mobile contact **48** on its free end is held resiliently in engagement with the stationary contact **26**, as shown in FIG. **1**. When heated above this predetermined temperature, the free end of the switchblade moves overcenter with an abrupt snap action to a position in which it holds the mobile contact up away from engagement with the stationary contact. Then, when the temperature drops a substantial amount below the value at which the contacts opened, the bimetal switchblade **38** returns overcenter with a snap action to the FIG. **1** position, reclosing the contacts.

In the particular embodiment illustrated, the switch has an auxiliary or starting heater **50** disposed between the switch base **25** and the bimetal switchblade **38**. This starting heater is a rodlike member which is spot welded at one end to the raised boss **30** on the switch base **25** and is spot welded at its opposite end to the inner end of terminal **14**, as shown in FIGS. **1** and **2**. The auxiliary heater is in heat transfer relationship to the switchblade **38**.

A flexible sheet **51** of mica or other suitable dielectric material extends from the header **11** into the housing **10** overlying the main heater **37** and the switchblade **38** to electrically insulate them from the housing **10**.

In the operation of this switch, the current path through the starting heater **50** is via lead-in cable **20**, terminal **14**, heater

50, switch base 25, 24, header 11, and grounded terminal 12. The current path through the main heater 37 is via lead-in cable 19, terminal 13, the main heater 37, switchblade 38, the normally closed switch contacts 48, 26, switch base 25, 24, header 11 and grounded terminal 12. When the current through the main heater 37 is sufficiently high, its heating effect will cause the bimetal switchblade 38, to move over center with a snap action to separate the switch contacts 48, 26, thereby opening the circuit for the main heater current.

A particular advantage of the present switch resides in the novel and convenient manner in which it may be assembled. The preferred assembly sequence is as follows:

1. The mobile switch contact 48 is spot welded to the bimetal switchblade 38;

2. The assembly rivet 31 is spot welded to the switch base 24, 25 and then this subassembly is nickel plated;

3. The stationary contact 26 is spot welded to the switch base 24, 25.

4. The ground terminal 12 is spot welded to the header 11, which has the terminals 13 and 14 held in place by glass seals;

5. The short upstanding legs 24*a* and 24*b* of the switch base are spot welded to the inside face of the header 11 at 27, 28 and 29, as shown in FIG. 5, to complete the subassembly shown in FIG. 4;

6. After the dielectric panel 52 is inserted over the inner ends of terminals 13 and 14, the auxiliary heater 50 is spot welded to the terminal 14 and to the raised boss 30 on the switch base;

7. The main heater 37 is spot welded at 39 to the bimetal switchblade 38 to provide the subassembly shown in FIG. 3;

8. The mica washer 33, 35, porcelain washer 34, steel washer 36 and steel bushing 32 are stacked and riveted to the FIG. 3 subassembly;

9. The outer legs 43, 44 of the bimetal switchblade 38 are crimped, and then the switchblade is aged at an elevated temperature;

10. The main heater and switchblade subassembly resulting from step (9) is riveted to the subassembly of the switch base, auxiliary heater, assembly rivet, bushing, washers and header which resulted from step (8);

11. The switch is temperature calibrated by bending the switch base at approximately the location B in FIGS. 1 and 4, so that the switch contacts 48, 26 will open at a predetermined temperature, e.g. about 240° F.;

12. The offset end 42 of the main heater 37 is spot welded to the header terminal 13;

13. The flexible dielectric sheet 51 is positioned overlying the operating parts of the switch and abutting at its right end against the header, and then the housing 10 is slid over the switch assembly until it engages the header 11, to which it is then welded to provide a hermetic seal;

14. A predetermined current is applied to terminals 13 and 14 to test the contact opening action of the switch.

15. The lead wires 18–20 are attached to the header terminals 12–14;

16. The header sleeve 21 is positioned against the outer side of the header, as shown in FIG. 2, and then it is filled with the epoxy resin 22;

17. The heat shrinkable tube 23 is applied over the outside of the assembly and then it is heated to shrink in place.

From the foregoing, it will be apparent that the present switch may be calibrated (by bending the switch base 24, 25) before it is enclosed and sealed. No manufacturing operations need be performed on the bimetal switchblade 38 after it has been heat treated, thereby avoiding any possibility of shifting its temperature response. The mobile contact 48 is located on the switchblade 38 beyond the region of its togglelike, overcenter snap action, so that no undesirable stresses are introduced by spot welding this contact to the switchblade Because the mounted end of the bimetal switchblade 38 is electrically insulated from the switch base 24, 25 (by washers 33, 34 and 35), the main heater 37 may be spot welded directly to this end of the switchblade without introducing undesirable stresses.

The provision of the starting or auxiliary heater 50 at the high-expansion side of the bimetal switchblade 38 and the main heater 37 at the low expansion side minimizes any "creep" action of the bimetal. For certain applications, however, where a slower contact-opening action of the switch is permissible, the starting heater 50 and its header terminal 14 and lead-in wire 20 may be omitted.

The present switch is extremely compact in size for its current capacity, as well as being relatively simple to assemble, as described. This physical compactness of the switch is due in part to the novel manner in which the main heater 37 and the bimetal switchblade 38 are mounted so as to be electrically insulated from the switch base, with the current flow between these elements and the switch base taking place only through the switch contacts.

The present disclosure includes that contained in the appended claims, as well as that of the foregoing description. Although this invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of the circuit and the combination and arrangement of circuit elements may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. A thermostatic switch comprising a rigid metal base,
a stationary contact supported by and conductively connected to said base,
an electrically conductive cantilever-mounted mobile contact carrier carrying a mobile contact on its free end in confronting relationship to said stationary contact,
an electrically conductive heater engaging the mounted end of the mobile contact carrier,
support means attaching the mounted end of the mobile contact carrier to the base and electrically insulating the mobile contact carrier from the base,
a pair of terminals connected respectively to the base and to the heater remote from the latter's engagement with the mounted end of the mobile contact carrier,
a metal housing receiving said base, contacts, contact carrier, heater and support,
an electrically conductive header closing one end of said housing and hermetically sealed thereto and supporting said terminals,
said base at one end thereof having a transverse leg attached to said header, and
said header supports said base spaced from said housing.

2. A switch according to claim 1, wherein said support for the mobile contact carrier is at the opposite end of the base from said transverse leg.

3. A switch according to claim 2, wherein said stationary contact is located along the base between said support for the mobile contact carrier and said transverse leg of the base.

4. A thermostatic switch comprising a metal housing closed at one end,
a rigid metal header closing the opposite end of said housing and hermetically sealed thereto,
a rigid metal base attached to said header and extending transversely therefrom lengthwise into said housing in spaced relationship to the housing,
a cantilever-mounted movable contact carrier extending generally lengthwise of the housing and having a free end,
a support assembly attached to the base and providing a cantilever support for the opposite end of the contact carrier,
said support assembly electrically insulating the mounted end of the contact carrier from the base,
a stationary contact mounted on the base adjacent the free end of the contact carrier and connected conductively to the base,
a mobile contact on the free end of the contact carrier for engagement with the stationary contact,
a terminal projecting through the header into the interior of the housing, and

a heater connected at one end to said terminal and at its opposite end to the cantilever-mounted end of the contact carrier.

5. A thermostatic switch according to claim 4, wherein said contact carrier is a snap-acting bimetal switchblade having a high expansion side facing toward the base and a low expansion side facing away from the base, and

said heater is disposed at the low expansion side of the switchblade.

6. A thermostatic switch according to claim 5, and further

comprising an additional terminal extending through the header, and an auxiliary heater connected at one end to the inner end of said additional terminal and at its opposite end to the base,

said auxiliary heater being disposed between the switchblade and the base.

7. A thermostatic switch according to claim 4, wherein said metal base may be bent transversely to its lengthwise dimension to calibrate the temperature of actuation of said contacts.