# United States Patent [19]

**Plasko et al.**

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[45] **May 1, 1973**


[54] **THERMAL LIMITER CONSTRUCTIONS**


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[52] **U.S. Cl.** .....**337/208,** 219/517, 337/201

[51] **Int. Cl.**.....**H01h 85/48**

[58] **Field of Search**.....337/186, 194, 201, 337/202, 208, 216, 225, 349; 219/517; 339/126 R, 217, 219 F, 219 R



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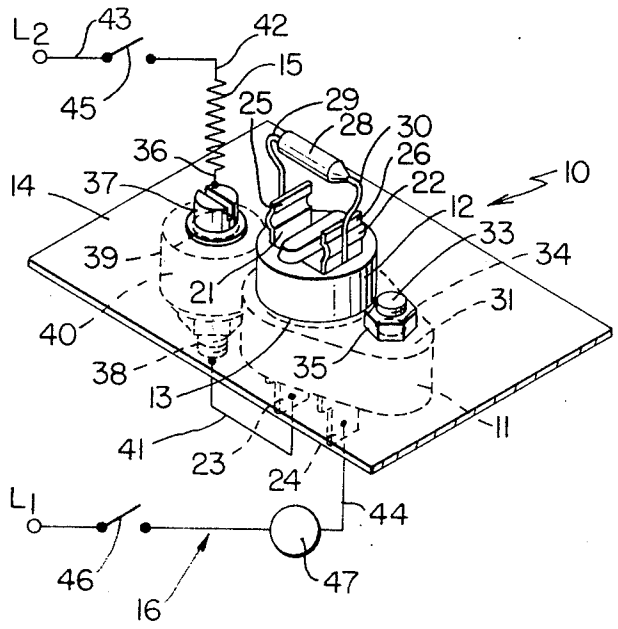
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[57] **ABSTRACT**

A thermal limiter construction for at least one electrical circuit comprising a body member of electrical insulating material having a reduced portion projecting therefrom and adapted for insertion in an opening of a frame while the body member is adapted to abut one side of the frame outboard of the opening. A pair of leads are carried by the body member and project from the body member remote from the projecting portion thereof for lead attachment thereto. A thermally responsive fuse is carried by the reduced projecting portion and is interconnected in series with the leads. Either the body member or one of the leads has a single fastening opening passing therethrough adapted to fasten the body member to the frame solely by a single fastening member passing through the fastening opening when the projecting portion of the body member is inserted in the frame opening.


**20 Claims, 9 Drawing Figures**



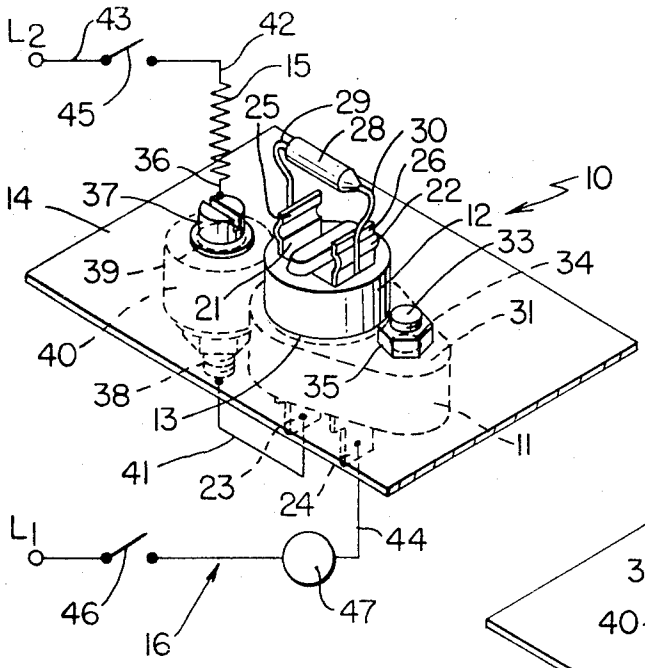



FIG. 1

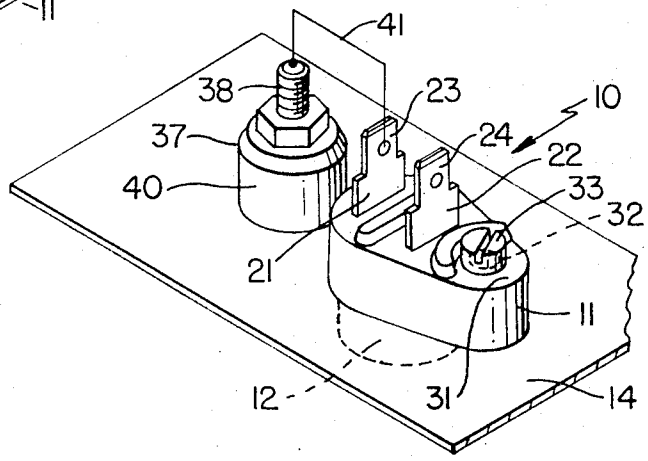



FIG. 2

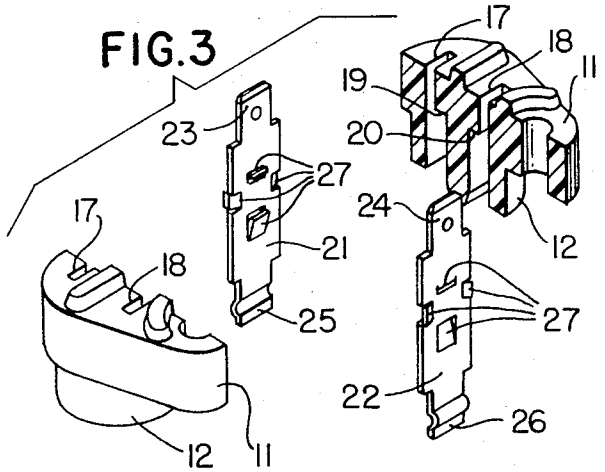



FIG. 3

FIG. 4

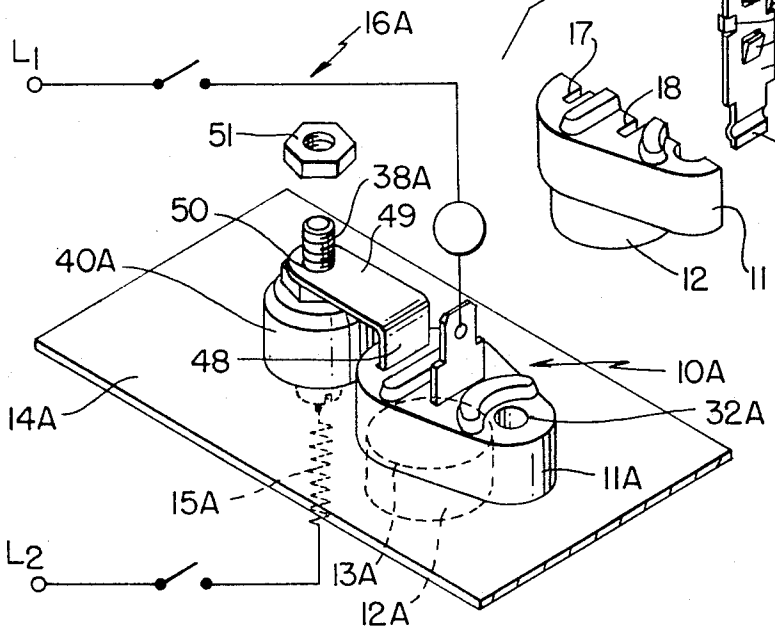


FIG. 5

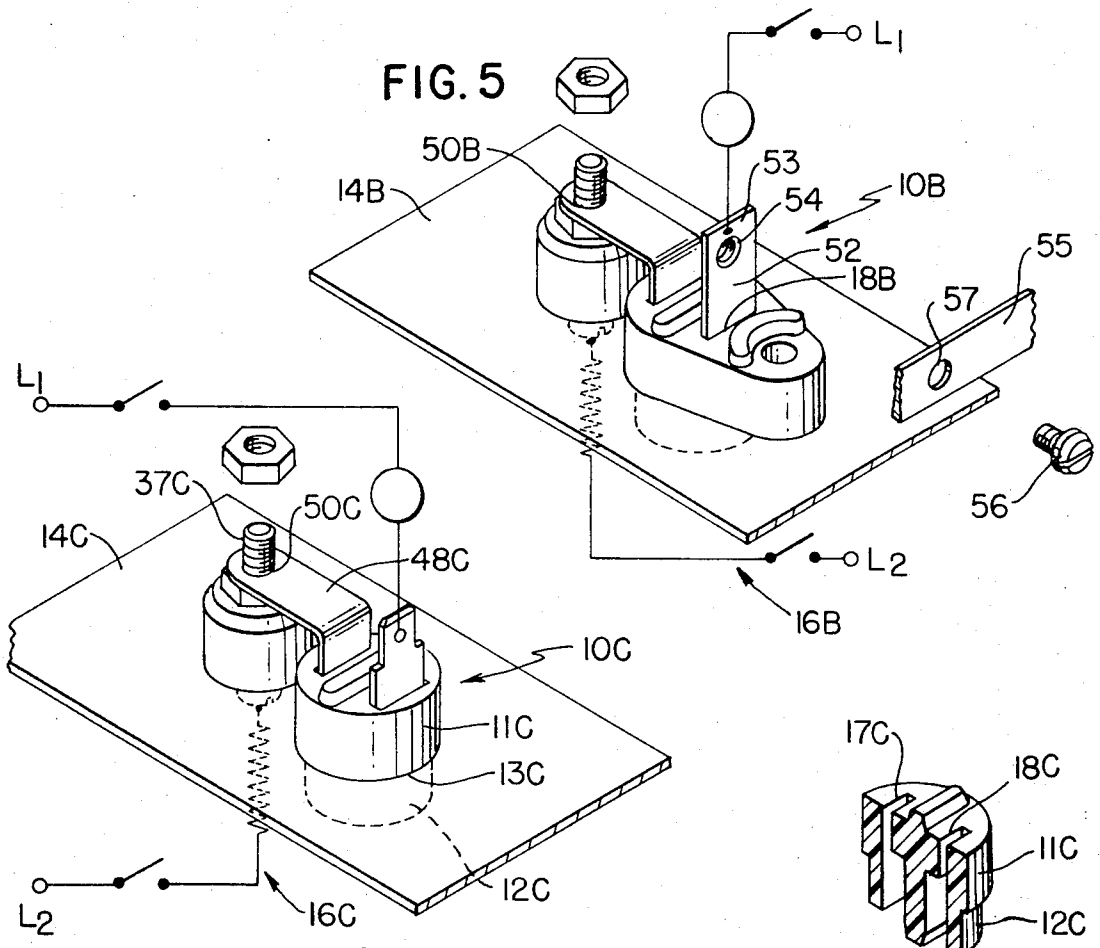






FIG. 6




FIG. 8

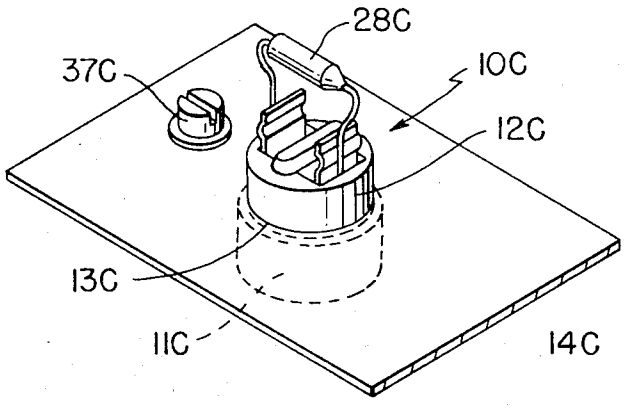



FIG. 7

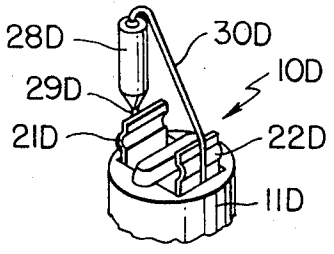



FIG. 9

# THERMAL LIMITER CONSTRUCTIONS

## BACKGROUND OF THE INVENTION

Thermal limiters for controlling the operation of electrical heater means have been provided wherein a thermally responsive fuse is exposed to the output effect of the electrical heater and is electrically interconnected in series therewith so that when the thermally responsive fuse detects a temperature exceeding a safe limit, such fuse blows to effectively disconnect the electrical heater from an electrical power source.

Such thermally response fuse has been carried by a body member of an electrically insulating material that is fastened to a supporting frame by a plurality of fastening means in order to maintain the thermally responsive fuse in a proper position and to withstand shocks and vibrations.

It has been found according to the teachings of this invention that it would be desirable to provide a more simplified mounting arrangement for such a thermal limiter construction while still maintaining the desired feature of having the mounting means for the thermal limiter construction substantially safe from adverse shocks and vibrations.

## SUMMARY

This invention provides an improved thermal limiter construction as well as an improved mounting arrangement therewith.

In particular, one embodiment of the thermal limiter construction of this invention for at least one electrical circuit comprises a body member of electrical insulating material having a relatively long reduced portion projecting therefrom and adapted for insertion in an opening of a frame while the body member is adapted to abut one side of the frame outboard of the opening. A pair of leads are carried by the body member and project from the body member remote from the projecting portion thereof for lead attachment thereto. A thermally responsive fuse is carried by the reduced projecting portion and is interconnected in series with the leads. Either the body member or one of the leads has a single fastening opening passing therethrough and adapted to fasten the body member to the frame solely by a single fastening member passing through the opening when the projecting portion of the body member is inserted in the frame opening whereby the thermally responsive fuse can be exposed to the output temperature effect of a heating means and the leads of the body member can be interconnected in series with an electrical power source and the electrical heater so that should the fuse blow, such thermal limiter construction will effectively disconnect the heating element from the electrical power source.

Accordingly, it is an object of this invention to provide an improved thermal limiter construction having one or more of the novel features set forth above or hereinafter shown or described.

Another object of this invention is to provide an improved arrangement utilizing such a thermal limiter construction or the like.

Other objects, uses and advantages of this invention are apparent from a reading of this description, which proceeds with reference to the accompanying drawings wherein:



## DESCRIPTION OF THE DRAWINGS

The accompanying drawings illustrate the various embodiments of this invention, in which:

FIG. 1 is a fragmentary, perspective view illustrating one thermal limiter construction of this invention for controlling an electrical circuit illustrated schematically therein.

FIG. 2 is an upside down perspective view of the construction illustrated in FIG. 1.

FIG. 3 is an exploded, perspective view of the various parts of the thermal limiter construction of FIGS. 1 and 2.

FIG. 4 is a view similar to FIG. 1 and illustrates another embodiment of the thermal limiter construction of this invention for controlling an electrical circuit schematically illustrated therein.

FIG. 5 is a view similar to FIG. 4 and illustrates another embodiment of this invention.

FIG. 6 is a view similar to FIG. 4 and illustrates another embodiment of this invention.

FIG. 7 is an upside down perspective view of the structure illustrated in FIG. 6.

FIG. 8 is a perspective, broken away view of the body member of the thermal limiter construction of FIGS. 6 and 7.

FIG. 9 is a fragmentary, perspective view of any one of the thermal limiter constructions of this invention having the thermally responsive fuse thereof mounted in a different position thereon.

## DESCRIPTION OF ILLUSTRATED EMBODIMENTS

While the thermal limiter constructions of this invention are each illustrated as controlling an electrical heater system, it is to be understood that the various features of this invention can be utilized singly or in any combination thereof to provide thermal limiter constructions for controlling other systems as desired.

Therefore, this invention is not to be limited to only the embodiments illustrated in the drawings, because the drawings are merely utilized to illustrate some of the wide variety of uses of this invention.

Referring now to FIGS. 1, 2 and 3, a thermal limiter construction of this invention is generally indicated by the reference numeral 10 and comprises a one-piece body member 11 formed of electrical insulating material, such as ceramic material, and formed in the unique configuration illustrated wherein a relatively long cylindrical reduced projecting portion 12 extends from the generally triangularly shaped body member 11 so as to be adapted to pass somewhat snuggly through a circular opening 13 formed in a metallic frame member 14 that forms a support for an electrical heater 15 forming part of an electrical circuit of this invention that is generally indicated by the reference numeral 16 in FIG. 1.

The body member 11 of the thermal limiter construction 10 has a pair of stepped slots 17 and 18 formed in a like manner and passing in parallel relation through the body member 11 and the projecting portion 12 thereof while defining respectively a pair of shoulders 18 and 20 therein. Two like metallic relatively rigid leads 21 and 22 are press-fitted through the slots 17 and 18 of the body member 11 so that one set

of ends 23 and 24 thereof project from the body member 11 remote from the cylindrical projection 12 for lead attachment purposes while the opposite ends 25 and 26 project outwardly as illustrated from the cylindrical projection 12. The metallic and conductive leads 21 and 22 respectively have conventional tangs 27 formed thereon for securing the same within the respective slots 17 and 18 of the body member 11 without auxillary fastening means.

A thermally responsive fuse 28 or other thermally responsive device is carried by the projecting portion 12 of the body member 11 and has opposed electrical leads 29 and 30 respectively electrically interconnected to the ends 25 and 26 of the rigid leads 21 and 22 in any suitable manner, such as by soldering or the like whereby the thermally responsive fuse 28 is disposed in series with the rigid leads 21 and 22. The leads 29 and 30 of the fuse 28 are flexible, but rigid enough to hold the fuse 28 in its spaced relation from the body member 11 as illustrated. The thermally responsive fuse 28 can be of the thermally collapsible pellet type as disclosed in the P. E. Merrill U.S. Pat. No. 3,180,958 issued in April, 1965, with the result being that should the thermally responsive fuse 28 sense a temperature above a certain temperature, the pellet therein will collapse and cause electrical disconnection between the leads 29 and 30 thereof and, thus, a disconnection between the leads 25 and 26 of the thermal limiter construction.

Since the internal workings and structure of the fuse 28 do not form the features of this invention, further description thereof is unnecessary as reference can be made to the aforementioned U.S. patent for any desired details thereof.

The triangular apex portion 31 of the body member 11 that extends beyond the cylindrical portion 12 in offset relation relative thereto has a single fastening opening 32 passing therethrough and through which a threaded bolt 33 can pass and through an aligned and cooperating opening 34 in the frame 14 to be interconnected thereto by a nut 35 so as to firmly fasten the thermal limiter construction 10 to the frame means 14 by the single fastening member 33 because the same cooperates with the relatively large projecting portion 12 of body member 11 being received in the opening 13 of the frame 14 to withstand vibrations and shocks so that the fuse 28 will remain in its proper location relative to the heater element 15 as illustrated.

Thus, it can be seen that the thermal limiter construction 10 of this invention can be simply and inexpensively fastened to the frame means 14 by a single fastening member to control the electrical circuit 16 in a manner now to be described without requiring the multiple fastening arrangements as utilized in the past.

One end 36 of the electrical heater element 15 is fastened to the frame 14 by a terminal post arrangement 37 that includes a threaded fastening member 38 passing through opening 39 in the frame 14 and being insulated from the frame 14 by an insulating bushing 40 that has part thereof also disposed in the frame opening in a conventional manner. The end 23 of the terminal 21 of the thermal limiter construction 10 of this invention is adapted to be electrically interconnected to the threaded fastening member 38 of the heater 15 by an electrical lead 41, the lead 41 being soldered respectively to the fastening member 38 and lead 21 or fastened thereto in any other desired manner.

The other end 42 of the electrical heater element 15 is adapted to be interconnected to a power source lead $L^2$ in any suitable manner, such as by a lead 43 as illustrated in FIG. 1. Similarly, the end 24 of the lead 22 of the thermal limiter construction 10 of this invention is adapted to be interconnected to the other power source lead $L_1$ in any suitable manner, such as by lead 44 as illustrated in FIG. 1.

Thus, it can be seen that the thermally responsive fuse 28 of the thermal limiter construction 10 is now disposed in series with the electrical heater element 15 across the power source leads $L_1$ and $L_2$ whereby should during the operation of the electrical heater 15, when conventional on-off switch means 45 and 46 in the leads 43 and 44 are disposed in closed positions thereof, the output temperature effect of the element 15 as sensed by the thermally responsive fuse 28 exceed a certain high limit safe value or limit that is usually a value higher than that attempted to be maintained by the usual electrically operated thermostatic control means 47 that controls the circuit means 16, the fuse 28 will blow in the manner set forth in the aforementioned United States patent and thereby terminate the flow of electrical current through the heater element 15 and maintain such circuit open condition until the thermal limiter 10 is replaced.

However, since the thermal limiter construction 10 of this invention is mounted to the frame 14 by only a single fastening member, the replacement of a blown thermal limiter construction 10 of this invention is a relatively simple matter, because once the same is mounted in place by the single fastening member 33, the lead ends 23 and 24 can be respectively coupled into the circuit 16 in the manner previously described by the lead means 41 and 44.

Therefore, it can be seen that the thermal limiter construction 10 of this invention can be firmly mounted in place on the frame means 14 to control the electrical circuit 16 in an effective and efficient manner by merely having a single fastening member 33 utilized for the fastening arrangement because the relatively long projecting portion 12 of the body member 11 will not jar out of its frame opening 13 during adverse vibrations and shocks, imposed against the frame 14 as normally encountered during transportation etc. of the unit 16.

Another thermal limiter construction of this invention is generally indicated by the reference numeral 10A and is utilized in an electrical control system 16A, the parts of the thermal limiter construction 10A and the electrical system 16A that are the same as the thermal limiter construction 10 and circuit 16 of FIGS. 1–3 are indicated by like reference numerals followed by the reference letter "A."

As illustrated in FIG. 4, the thermal limiter construction 10A is substantially identical to the thermal limiter construction 10 previously described except that the rigid lead 21 has been replaced by a rigid lead 48 that is mounted in the body member 11A in the same manner as the lead 22A but has an end 49 bent at right angles relative thereto with the bent part having an opening 50 passing therethrough to receive the threaded fastening member 38A for the heating element 15A when the

projecting portion 12A of the body member 11A is fully received through the opening 13A in the frame 14A as illustrated so as to be secured to the threaded fastening member 38A by another nut 51 sandwiching the free end 49 of the lead 48 between the nut 51 and the original mounting nut for the bushing 40A. In this manner, not only does the lead 49 electrically interconnect the thermal limiter construction 10A in series with the heater element 15A for the purpose previously described, but also such lead 49 and its single opening 50 can be utilized as the sole means for fastening the thermal limiter construction 10A to the frame means 14A as it is not necessary to utilize a fastening member in the opening 32A of the body member 11A. Of course, the opening 32A in the body member 11A could be utilized in addition to the fastening opening 50 of the lead 48, if desired. However, because of the relatively long projecting portion 12A of the body member 11A being received in the frame opening 13A, the securement of the lead 48 to the post 38A is sufficient to hold the thermal limiter construction 10A to the frame 14A without having the same shake loose during subsequent vibrations and shocks imposed on the frame 14A.

Another thermal limiter construction of this invention is generally indicated by the reference numeral 10B and is utilized in an electrical control system 16B, the parts of the thermal limiter construction 10B and circuit 16B similar to the construction 10 or 10A and circuit 16 or 16A are provided with like reference numerals followed by the reference letter "B."

As illustrated in FIG. 5, the thermal limiter construction 10B is formed in substantially the same manner as the thermal limiter construction 10A except that the lead 22A has been replaced by another lead 52 of this invention which is fastened in the body member 11B in the same manner as the lead 22A but has a straight end 53 projecting out of the slot 18B and is provided with a threaded opening 54 passing therethrough and to which a bus bar type lead 55 can be fastened by a threaded fastening member 56 passing through a selected opening 57 in the bus bar lead 55 and into the threaded opening 54 of the lead 52 so as to interconnect a plurality of thermal limiter constructions 10B in parallel or in series with one another, if desired, while the same are mounted to the frame 14B in the same manner.

In any event, it can be seen that the thermal limiter construction 10B of this invention is adapted to be fastened to the frame means 14B by the single fastening opening 50B in the lead 48B thereof in the manner previously described for the thermal limiter construction 10A.

Since the thermal limiter constructions 10A and 10B are adapted to be mounted respectively to the frame means 14A and 14B by the single opening 50 and 50B in the leads 48 and 48B thereof, the triangular portion 31 of the body member 11 could be eliminated since the opening 34 thereof is not being utilized for such mounting purposes, unless desired.

Therefore, another thermal limiter construction 10C of this invention is illustrated in FIGS. 6 and 7 for controlling an electrical circuit means 16C in the same manner as the constructions 10A and 10B previously described so that like parts are indicated by like reference numerals followed by the reference letter "C."

As illustrated in FIGS. 6 and 7, the body member 11C of the thermal limiter construction 10C is formed in a larger cylindrical shape than the projecting cylindrical portion 12C thereof while being concentric therewith so as to abut against the side of the frame means 14C outboard of the opening 13C passing therethrough while the opening 50C through the lead 48C thereof is being utilized as the sole means for mounting the body member 11C to the frame means 14C at the terminal post 37C in the manner previously described.

While the thermally responsive element or fuse 28 for the various thermal limiter constructions 10 of this invention have been illustrated as being located in one position relative to the projecting portion 12 thereof, it is to be understood that the thermally responsive fuse 28 could be disposed in other positions, as desired.

For example, reference is now made to FIG. 9 wherein another thermal limiter construction of this invention is generally indicated by the reference numeral 10D and parts thereof similar to the thermal limiter construction 10 of this invention are indicated by like reference numerals followed by the reference letter "D."

As illustrated in FIG. 9, the thermally responsive fuse 28D is mounted in substantially a vertical fashion relative to the lead 21D while the leads 29D and 30D thereof respectively electrically interconnect the opposed electrical sides of the fuse 28D to the leads 21D and 22D, as illustrated, whereby the fuse 28D functions in the manner previously described.

Therefore, it can be seen that in all of the embodiments of this invention the thermal limiter construction is adapted to be mounted to a supporting frame by a single fastening member passing through a single fastening opening of the thermal limiter construction, such opening being formed either in the body member of the thermal limiter construction or through a rigid lead means thereof.

While the form of the invention now preferred has been disclosed as required by the patent statute, other forms can be utilized, all coming within the scope of the appended claims.

What is claimed is:

1. A thermal limiter construction for at least one electrical circuit comprising a body member formed of electrical insulating material and having a relatively long reduced portion projecting therefrom adapted for insertion in an opening of a frame while said body member is adapted to abut one side of said frame outboard of said frame opening, said long reduced projecting portion having a longitudinal axis, a pair of lead means carried by said body member and projecting from said body member remote from said projecting portion for lead attachment thereto, and a thermally responsive device carried by said reduced portion and being interconnected in series with said lead means, said construction having a single fastening opening passing therethrough and being adapted to fasten said body member to said frame solely by a single fastening member passing through said fastening opening when said projecting portion of said body member is fully inserted in said frame opening, said fastening opening

passing through said body member in offset relation to said projecting portion thereof and being substantially parallel to said longitudinal axis of said projecting portion whereby said fastening member and said reduced projecting portion cooperate to prevent pivoting of said projecting portion out of said frame opening.

2. A thermal limiter construction as set forth in claim 1 wherein said body member has a generally triangular profile in one viewing direction thereof with said fastening opening passing through an apex area thereof.

3. A thermal limiter construction as set forth in claim 2 wherein said projecting portion of said body member has a generally cylindrical configuration.

4. A thermal limiter construction for at least one electrical circuit comprising a body member formed of electrical insulating material and having a relatively long reduced portion projecting therefrom adapted for insertion in an opening of a frame while said body member is adapted to abut one side of said frame outboard of said frame opening, said long reduced projecting portion having a longitudinal axis, a pair of lead means carried by said body member and projecting from said body member remote from said projecting portion for lead attachment thereto, and a thermally responsive device carried by said reduced portion and being interconnected in series with said lead means, said construction having a single fastening opening passing therethrough and being adapted to fasten said body member to said frame solely by a single fastening member passing through said fastening opening when said projecting portion of said body member is fully inserted in said frame opening, one of said lead means that projects from said body member remote from said projecting portion thereof having said fastening opening passing therethrough substantially parallel to said longitudinal axis of said projecting portion whereby said fastening member and said reduced projecting portion cooperate to prevent pivoting of said projecting portion out of said frame opening.

5. A thermal limiter construction as set forth in claim 4 wherein the projecting part of said one lead means is bent at a right angle relative to said body member so that the free end of said one lead means is disposed in offset relation relative to said body member.

6. A thermal limiter construction as set forth in claim 5 wherein said fastening opening passes through said free end of said one lead means.

7. A thermal limiter construction as set forth in claim 4 wherein the projecting part of the other lead means has an internally threaded opening passing therethrough for lead attachment purposes.

8. A thermal limiter construction as set forth in claim 6 wherein said projecting portion of said body member has a generally cylindrical configuration.

9. In combination, a frame having an opening passing therethrough and defining an internal peripheral surface of said frame, an electrical heater element carried by said frame, a thermal limiter construction comprising a body member formed of electrical insulating material and having a relatively long reduced portion projecting therefrom into said opening of said frame while said body member abuts one side of said frame outboard of said frame opening, said reduced projecting portion having an external peripheral surface disposed closely adjacent said internal peripheral surface of said frame, said reduced projecting portion having a longitudinal axis, a pair of lead means carried by said body member and projecting from said body member remote from said projecting portion for lead attachment thereto, one of said lead means being electrically interconnected in series with one end of said heater element, a thermally responsive device carried by said reduced portion of said body member and being interconnected in series with said lead means and, thus, in series with said heater element, said construction having a single fastening opening passing through said body member in offset relation said projecting portion thereof and substantially parallel to said longitudinal axis of said projecting portion, and a single fastening member fastening said body member to said frame solely by passing through said fastening opening and being secured to said frame for holding said projecting portion of said body member fully inserted in said frame opening whereby said fastening member and said reduced projecting portion cooperate to prevent pivoting of said projecting portion out of said frame opening.

10. A combination as set forth in claim 9 wherein said body member has a generally triangular profile in one viewing direction thereof with said fastening opening passing through an apex area thereof.

11. A combination as set forth in claim 10 wherein said projecting portion of said body member has a generally cylindrical configuration and said frame opening is circular.

12. In combination, a frame having an opening passing therethrough, an electrical heater element carried by said frame, a thermal limiter construction comprising a body member formed of electrical insulating material and having a relatively long reduced portion projecting therefrom into said opening of said frame while said body member abuts one side of said frame outboard of said frame opening, a pair of lead means carried by said body member and projecting from said body member remote from said projecting portion for lead attachment thereto, one of said lead means being electrically interconnected in series with one end of said heater element, a thermally responsive device carried by said reduced portion of said body member and being interconnected in series with said lead means and, thus, in series with said heater element, said construction having a single fastening opening passing therethrough, and a single fastening member fastening said body member to said frame solely by passing through said fastening opening and being secured to said frame for holding said projecting portion of said body member fully inserted in said frame opening, one of said lead means that projects from said body member remote from said projecting portion thereof having said fastening opening passing therethrough whereby said fastening member and said reduced projecting portion cooperate to prevent pivoting of said projecting portion out of said frame opening.

13. A combination as set forth in claim 12 wherein the projecting part of said one lead means is bent at a right angle relative to said body member so that the free end of said one lead means is disposed in offset relation relative to said body member.

14. A combination as set forth in claim 13 wherein said fastening opening passes through said free end of

said one lead means and wherein said fastening member also fastens part of said heater element to said frame.

15. A combination as set forth in claim 12 wherein the projecting part of the other lead means has an internally threaded opening passing therethrough for lead attachment purposes.

16. A combination as set forth in claim 12 wherein said projecting portion of said body member has a generally cylindrical configuration.

17. A thermal limiter construction as set forth in claim 1 wherein said thermally responsive device comprises a fuse element.

18. A thermal limiter construction as set forth in claim 4 wherein said thermally responsive device comprises a fuse element.

19. A combination as set forth in claim 9 wherein said thermally responsive device comprises a fuse element.

20. A combination as set forth in claim 12 wherein said thermally responsive device comprises a fuse element.

* * * * *