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Plasko

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[54] **THERMAL LIMITER FOR ONE OR MORE ELECTRICAL CIRCUITS AND METHOD OF MAKING THE SAME**

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[21] Appl. No.: **565,217**

[22] Filed: **Apr. 4, 1975**

Related U.S. Patent Documents

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Issued: **Mar. 14, 1972**
Appl. No.: **101,848**
Filed: **Dec. 28, 1970**

U.S. Applications:

[63] Continuation-in-part of Ser. No. 62,369, Aug. 10, 1970, abandoned.

[51] **Int. Cl.**[2] **H01H 85/02**

[52] **U.S. Cl.** **337/163**; 337/166; 337/186; 337/222

[58] **Field of Search** 337/163, 164, 165, 166, 337/182, 186, 222; 219/501

[56] **References Cited**

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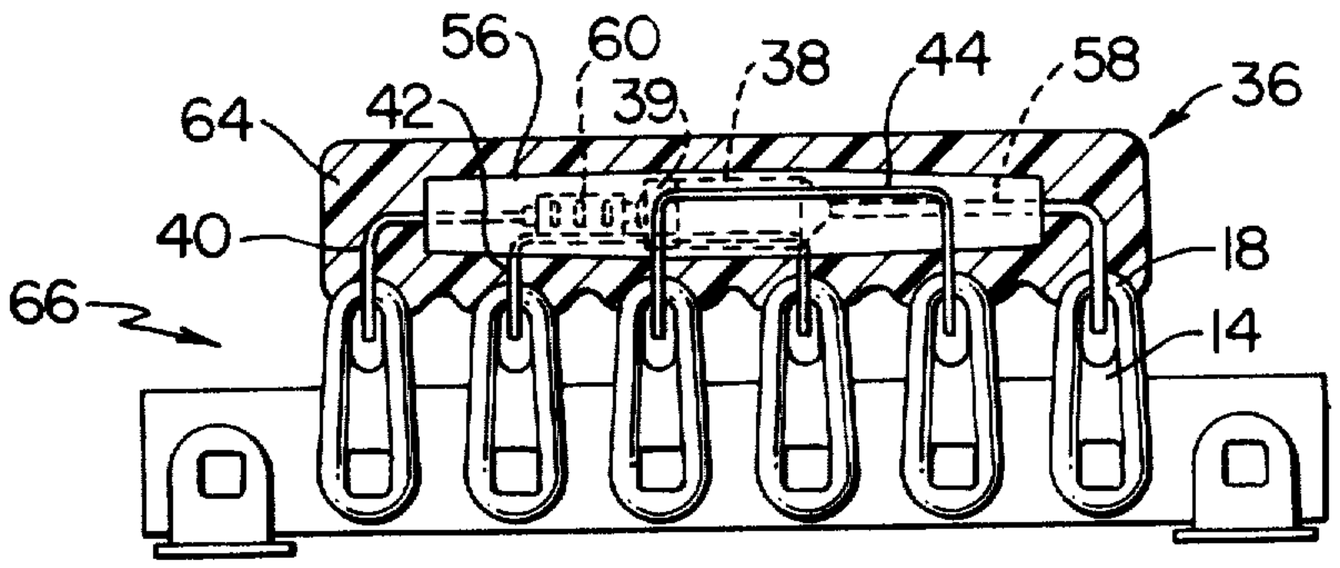
[57] **ABSTRACT**

This invention relates to a thermal limiter which can be used to limit one or more electrical circuits, such as multiple circuits in which one of the circuits is a primary circuit and the other circuits are secondary circuits energized or controlled by the primary circuit. The limiter of this invention is a unitary construction which can be connected to the primary and secondary circuits to control the same. A new method of making the limiter is included in this invention. This invention can be used in combination with a transformer for a television set in combination with its primary and secondary circuits, in combination with an air conditioning system, such as for automobiles, or in combination with other devices, as desired.

9 Claims, 21 Drawing Figures



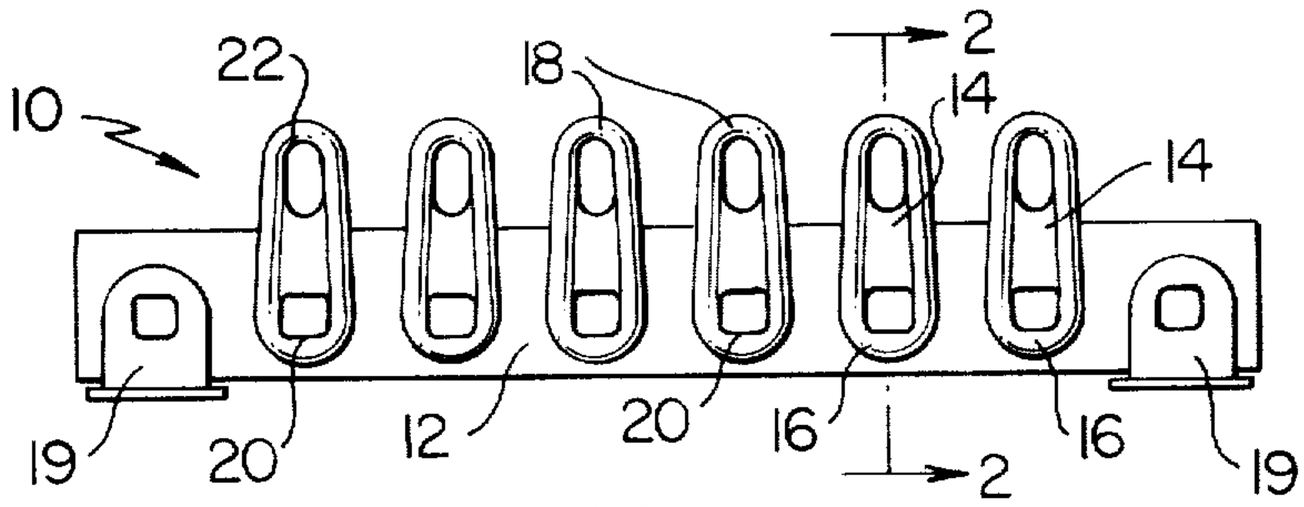


FIG. 1

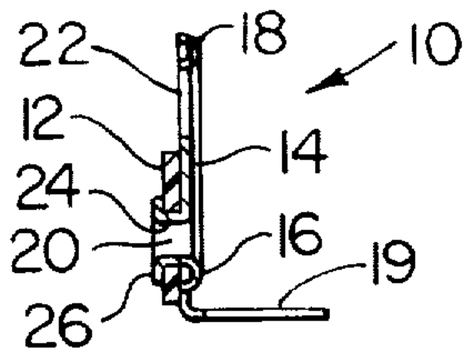


FIG. 2

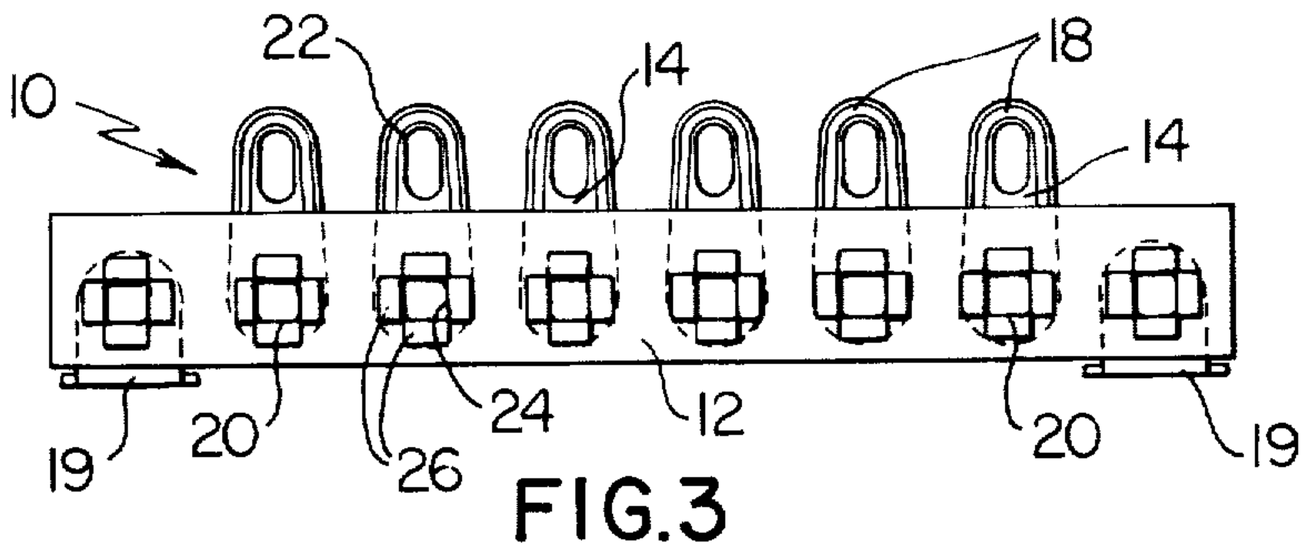


FIG. 3

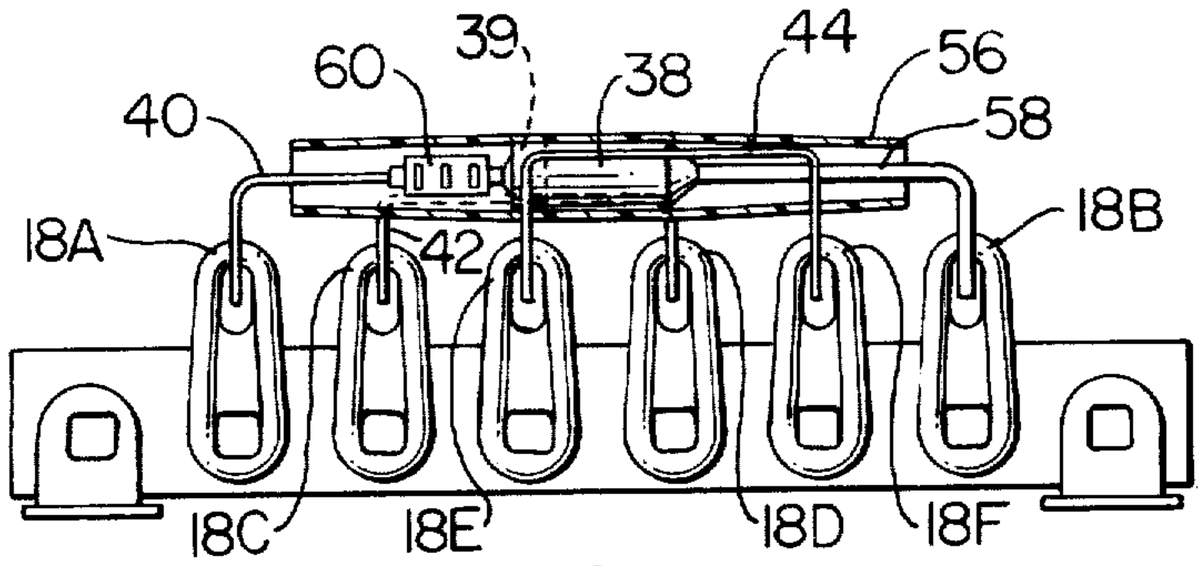


FIG. 4

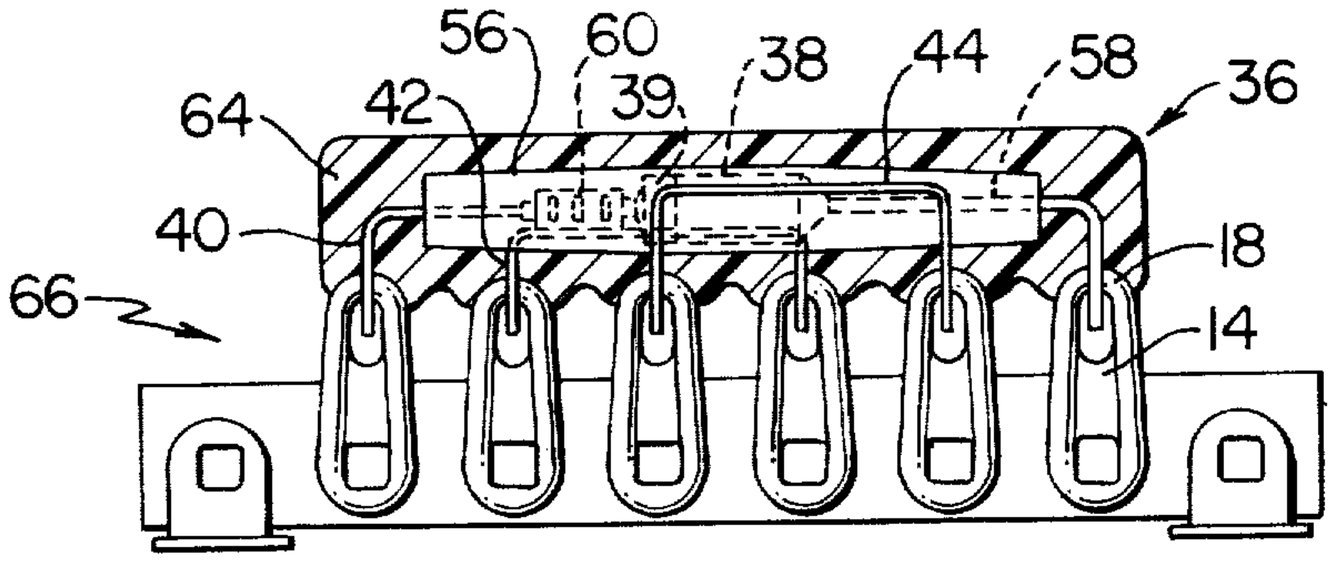


FIG. 5

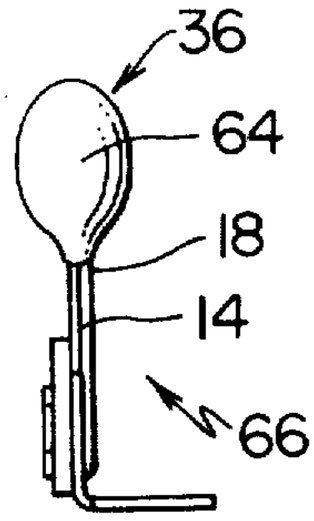


FIG. 5A

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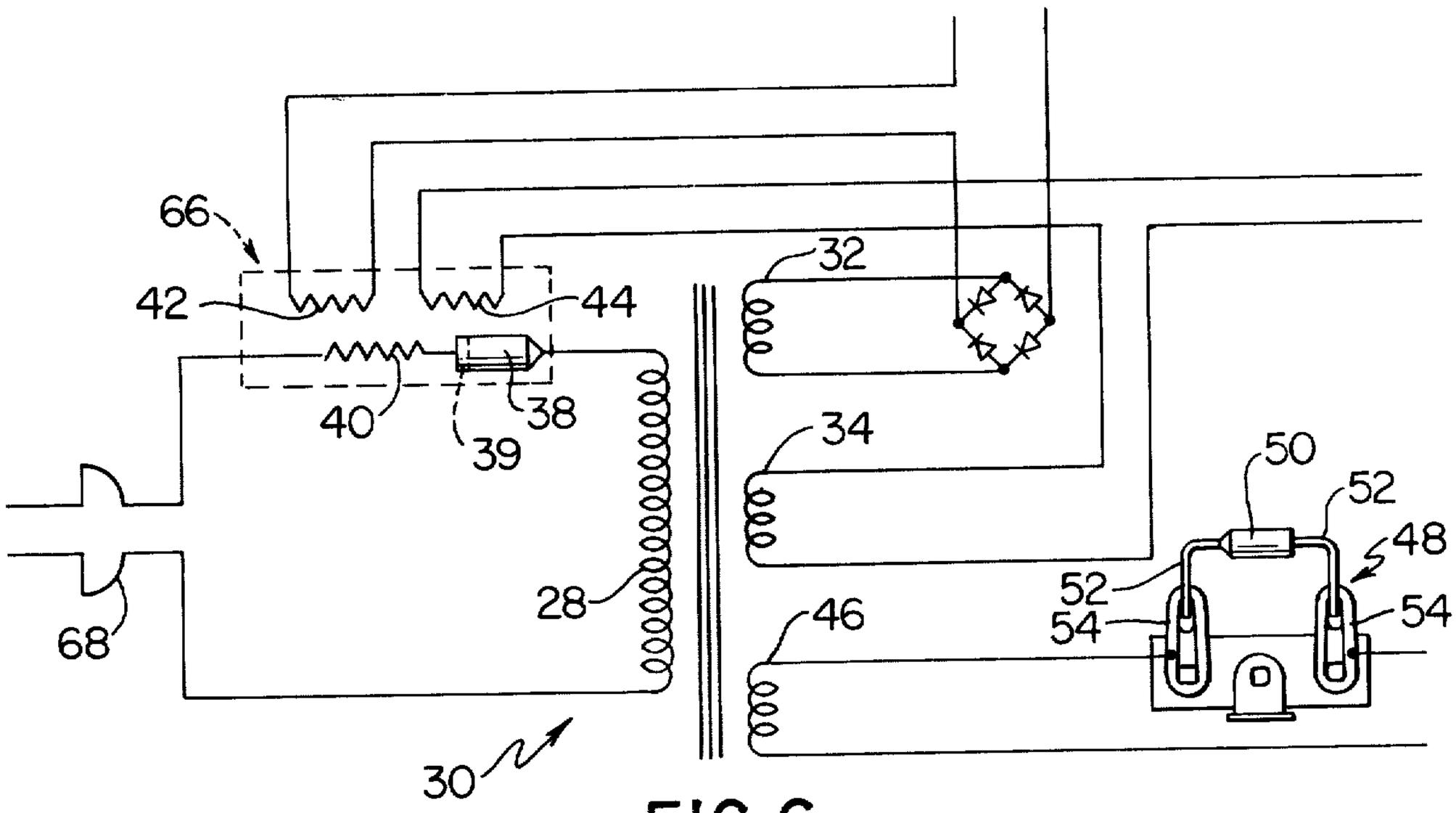

FIG. 6

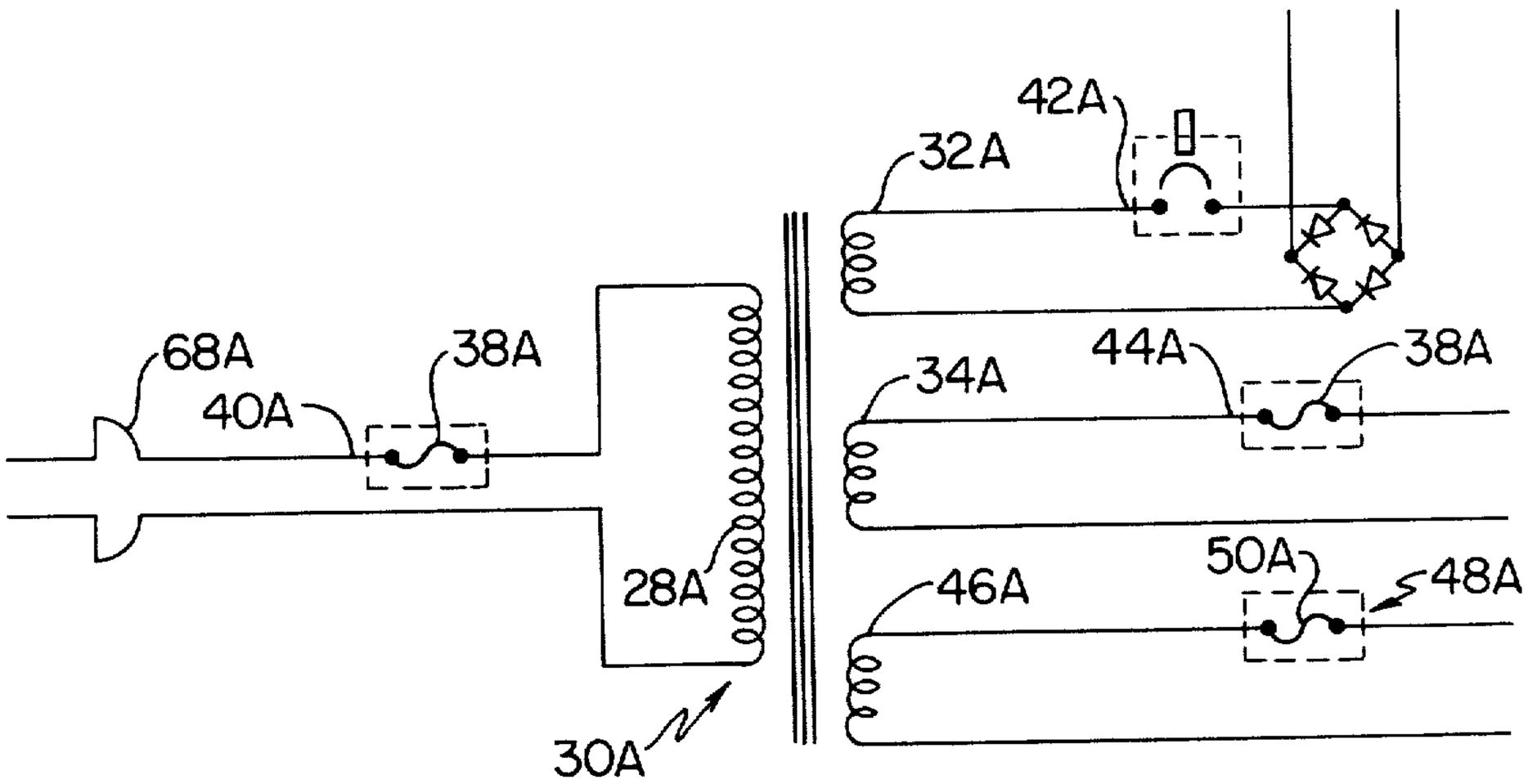

FIG. 7

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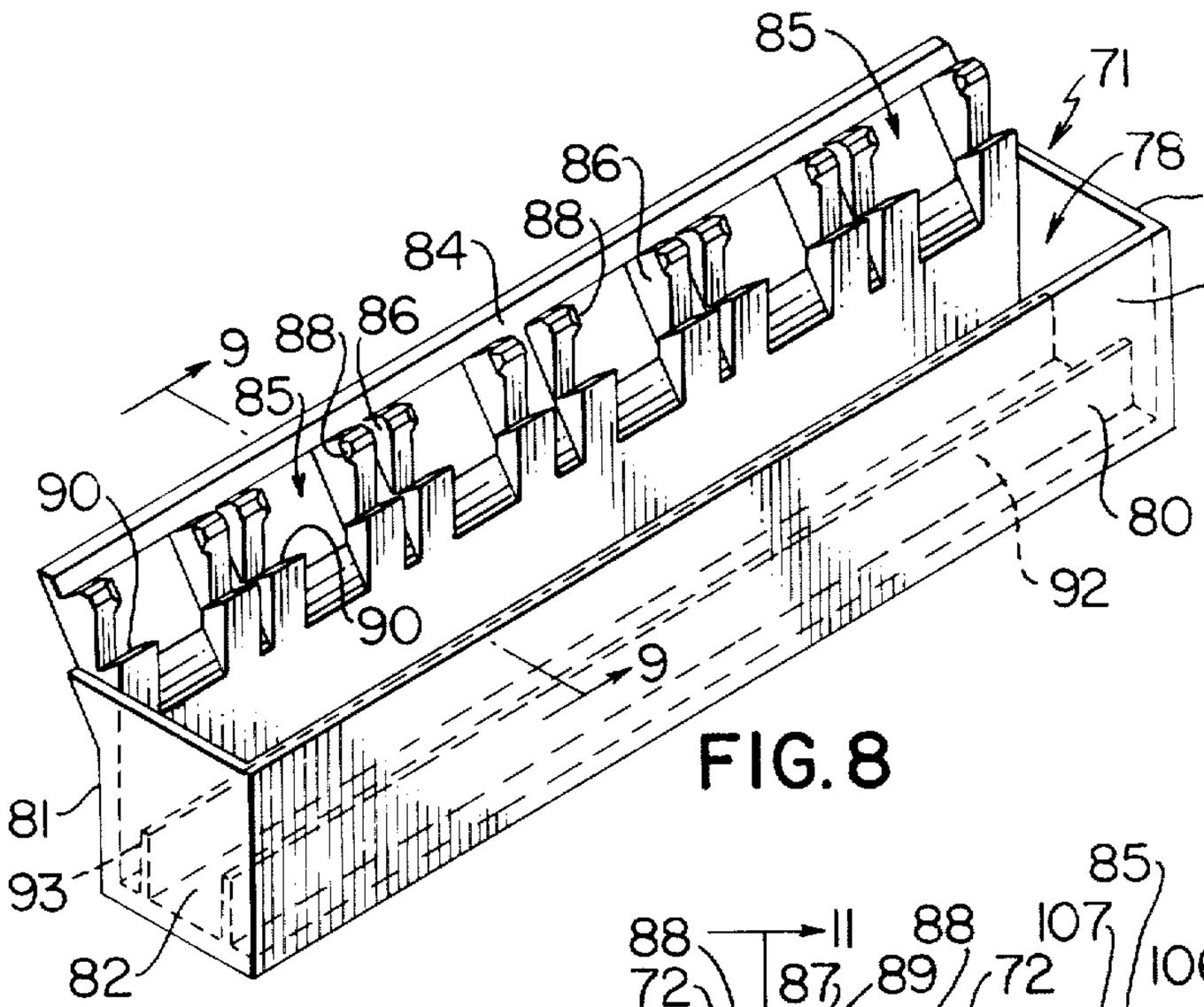

FIG. 8

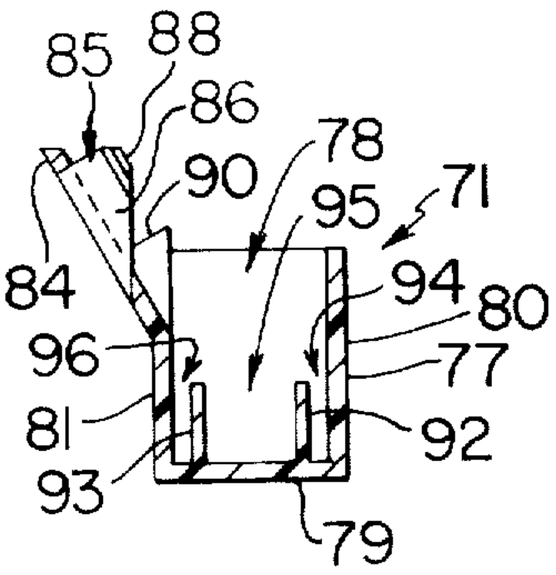

FIG. 9

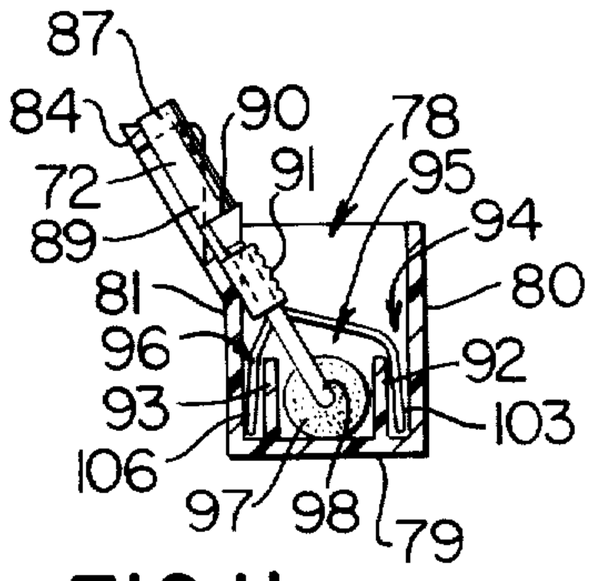

FIG. 11

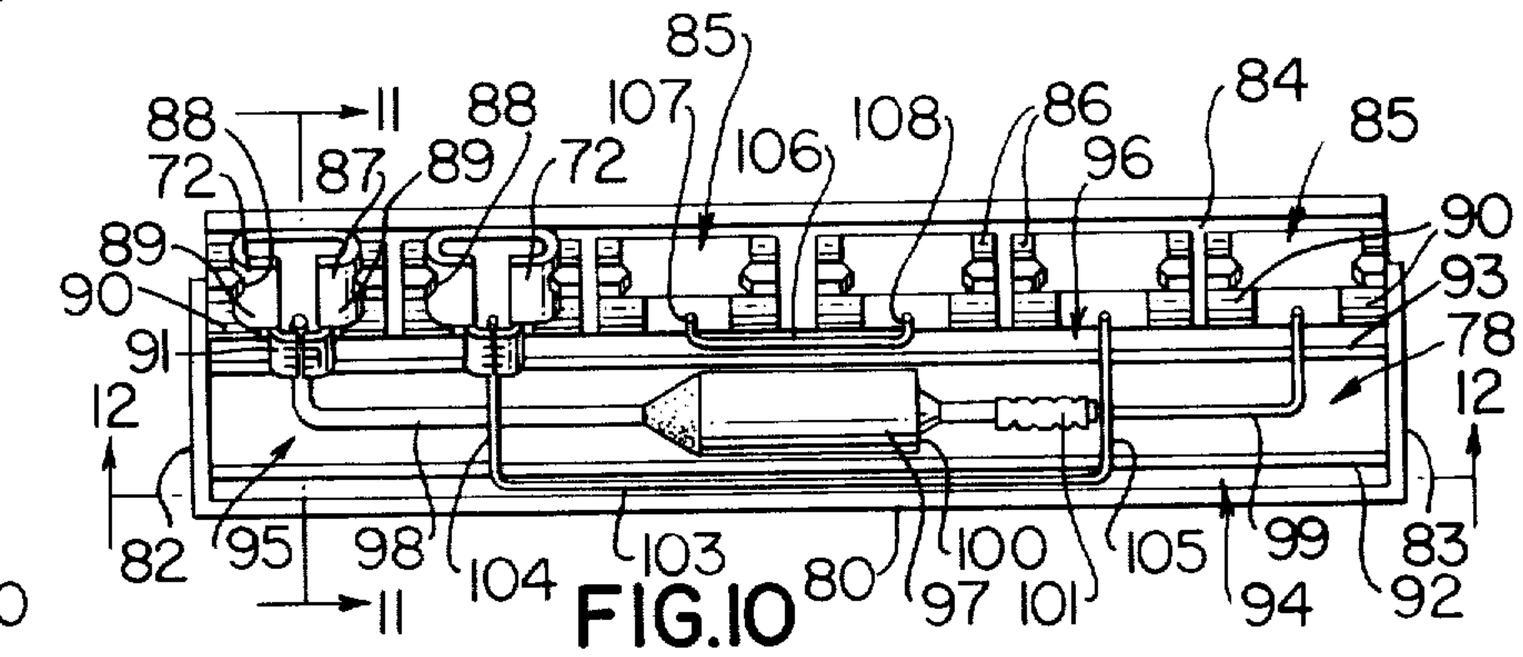

FIG. 10

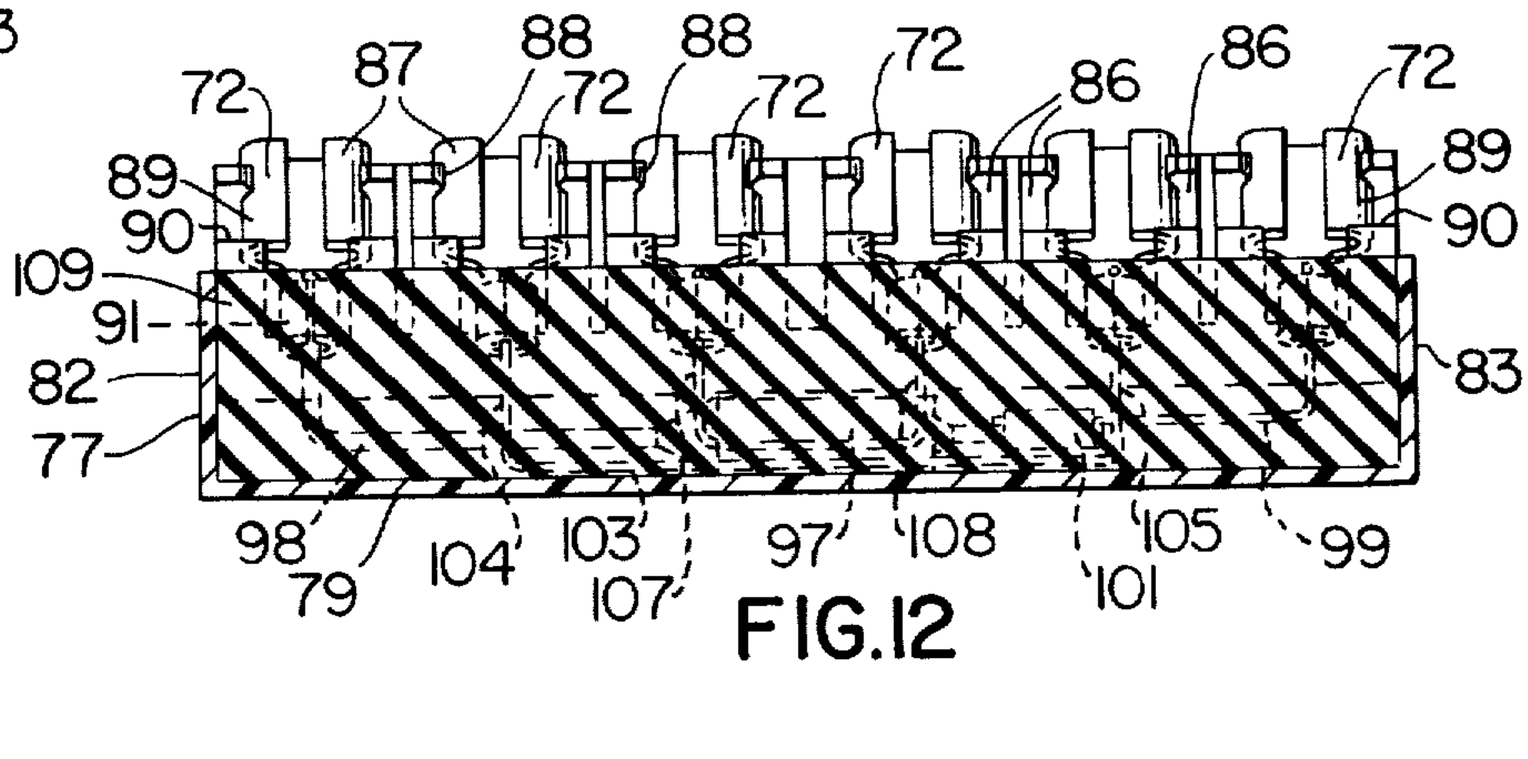

FIG. 12

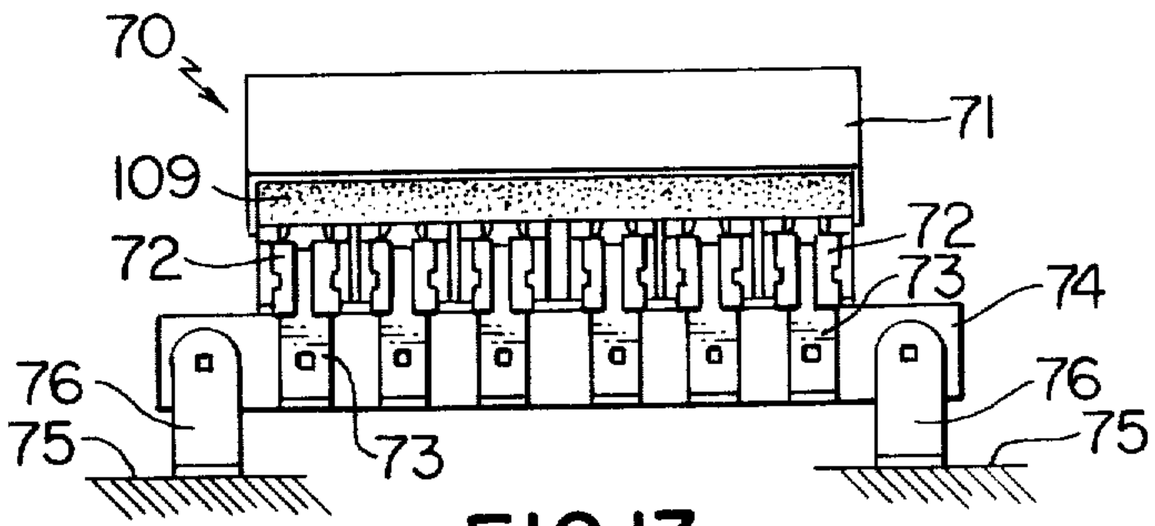

FIG. 13

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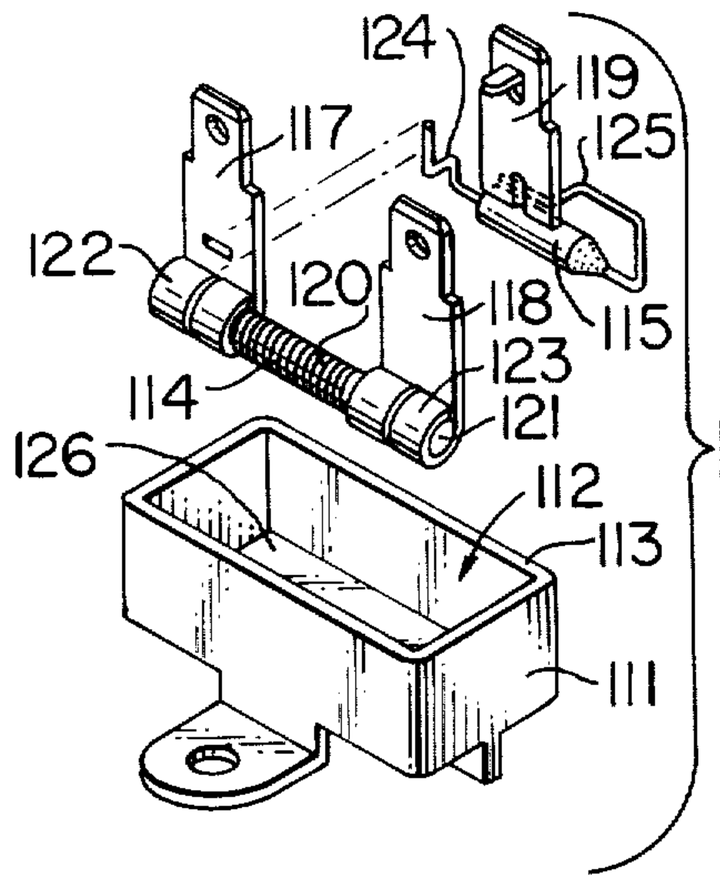

FIG.15

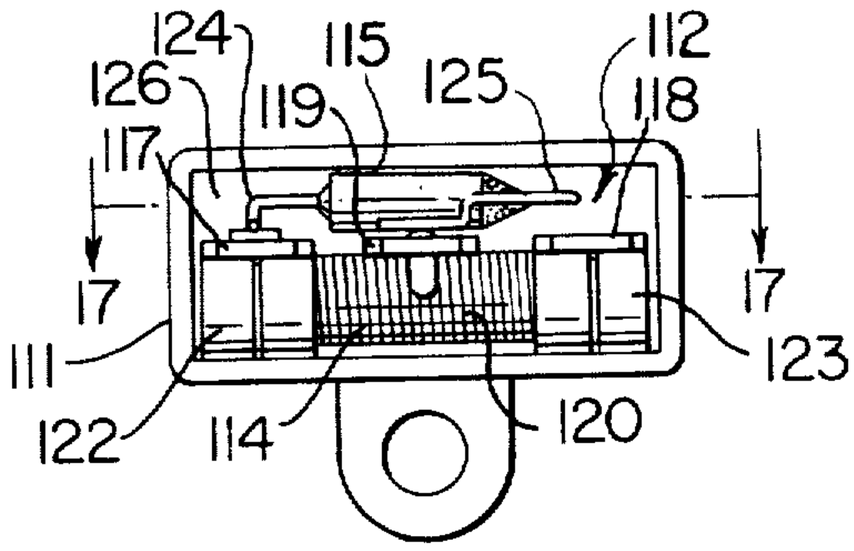

FIG.16

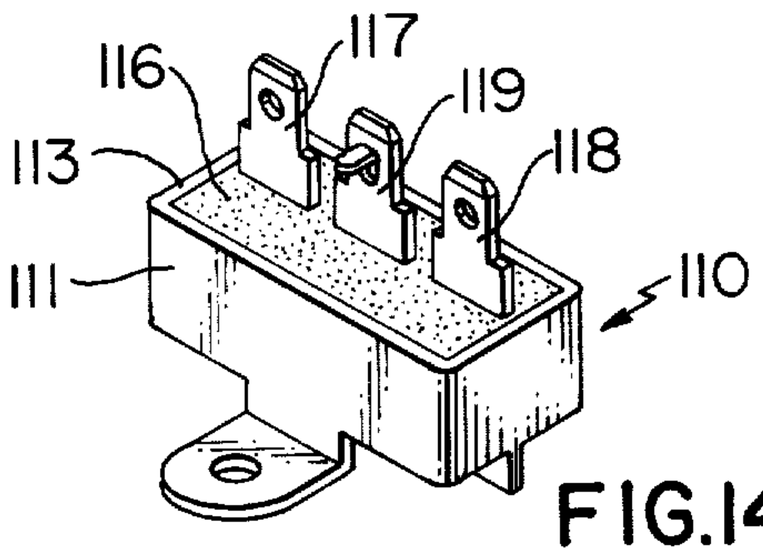

FIG.14

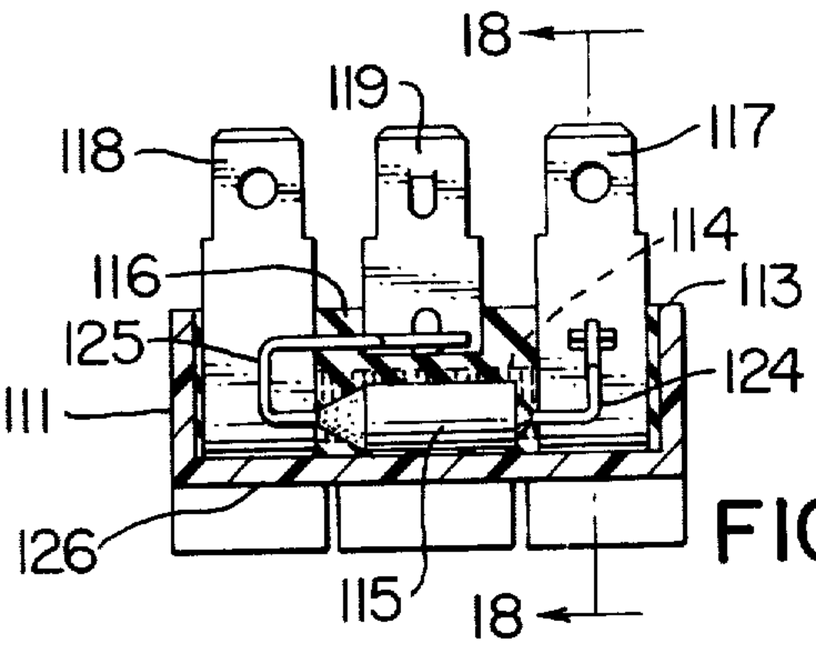

FIG.17

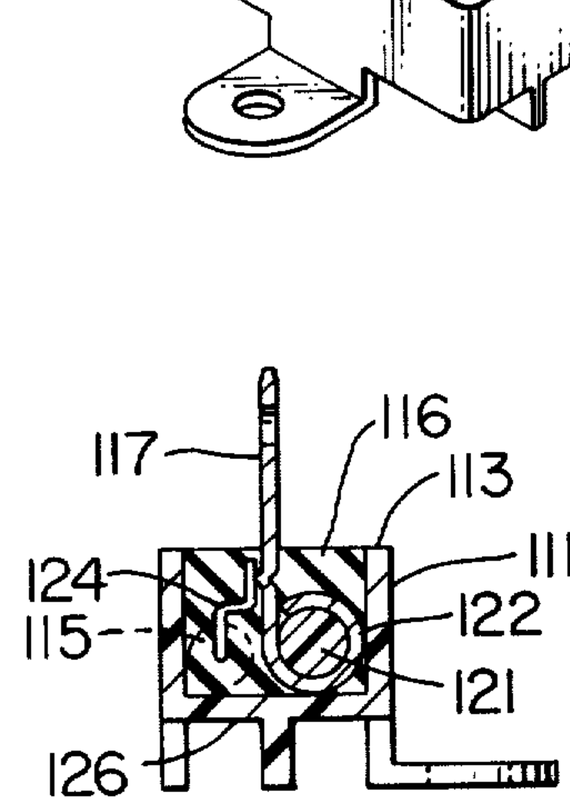

FIG.18

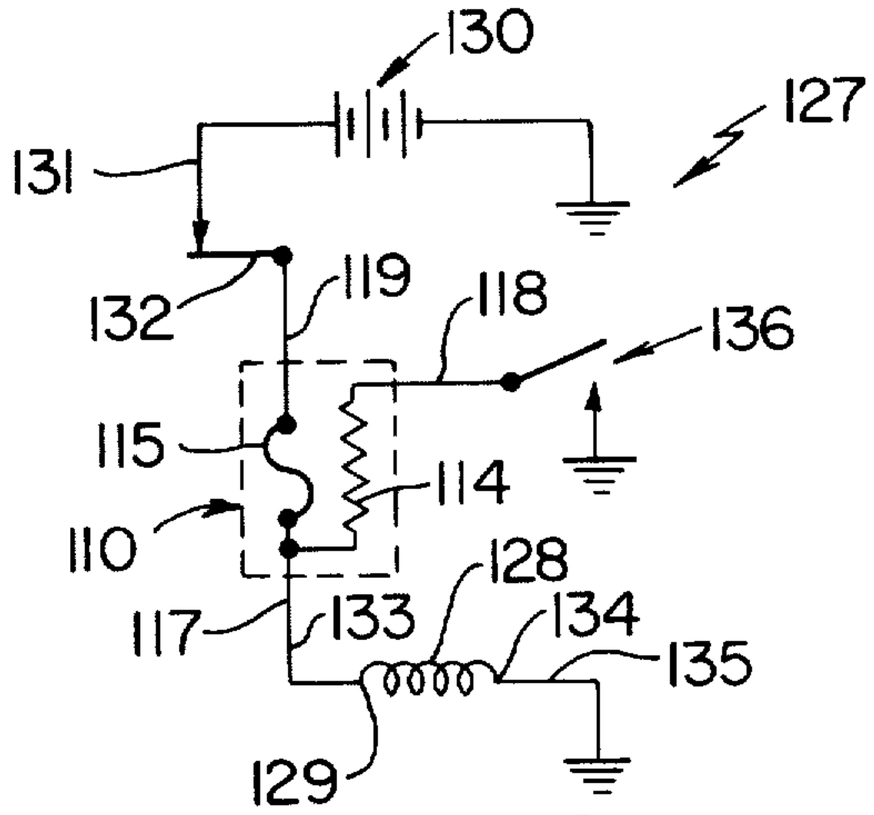

FIG.19

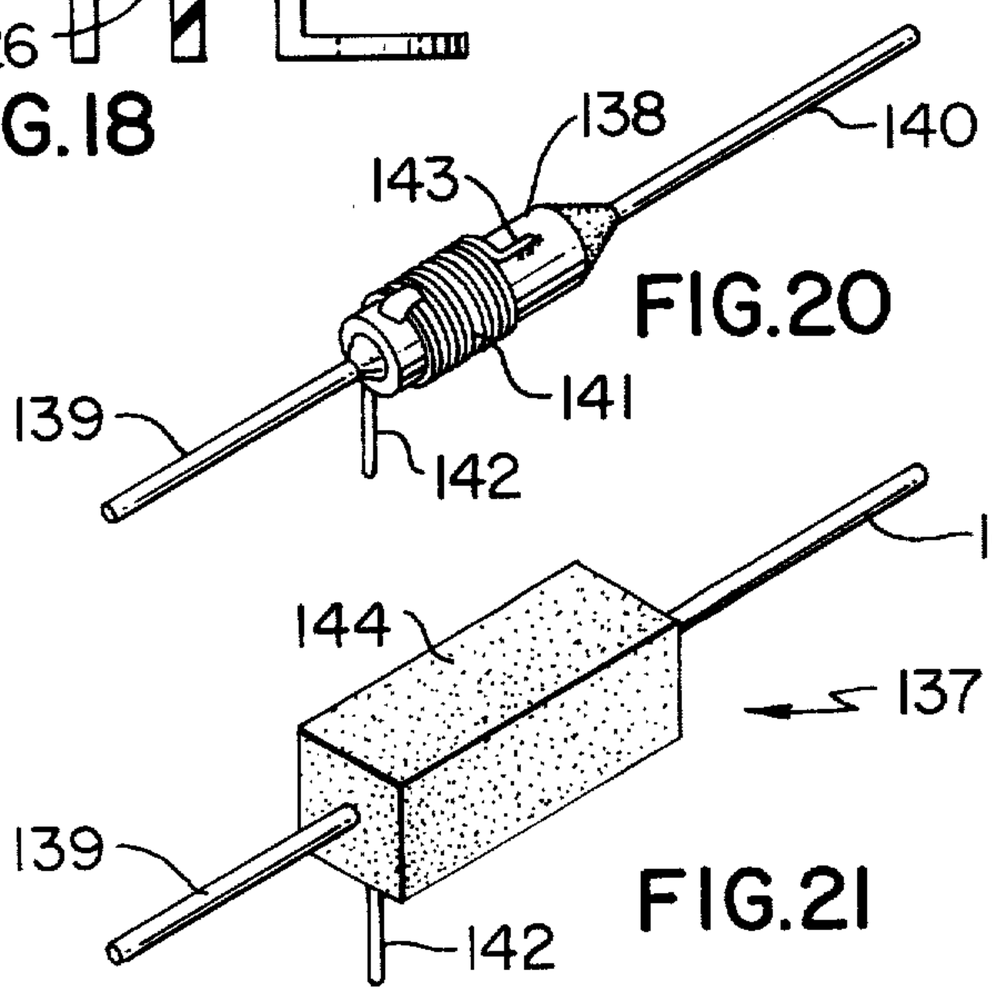

FIG.20

FIG.21

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THERMAL LIMITER FOR ONE OR MORE ELECTRICAL CIRCUITS AND METHOD OF MAKING THE SAME

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This application is a continuation-in-part application of its copending parent patent application, Ser. No. 62,369, filed Aug. 10, 1970, since abandoned and which was assigned to the same assignee to whom this application is assigned.

This invention relates to a thermal limited for one or more electrical circuits.

For example, one embodiment of the thermal limiter of this invention can be used to limit multiple circuits in which a primary circuit energizes or controls one or more secondary circuits, such as a transformer having a primary circuit and secondary circuits. The limiter of this invention is a unitary construction which can be connected to such primary and secondary circuits in an efficient manner.

One feature of this invention is to provide a thermal limiter having a controlled delay action in the operation thereof to prevent accidental circuit limiting, such controlled delay action being provided by a fixed and controlled location of the heater element relative to the limiter sensing element as will be apparent hereinafter.

In addition, other features of the limiter of this invention is to permit the selection of the heater element in its output temperature, the selection of the sensing element for the required sensed temperature for opening the circuit, and the selection of the desired characteristics of the insulating mass that secures the limiter parts together, such characteristics being the thermal conductivity of the mass material, the size of the mass utilized, etc. Other selectable variables of the limiter of this invention will be apparent hereinafter.

For example, such a thermal limiter of this invention for at least one electrical circuit comprises a thermally responsive fuse and lead means operatively interconnected to the fuse for coupling the fuse in a desired electrical circuit. An electrical circuit heater means is disposed in a selected position relative to the fuse and an insulating mass covers and secures the heater means and the fuse in such selected position thereof with the lead means having at least portions thereof exposed from the mass whereby the insulating mass and the selected positioning of the heater means relative to the fuse, once the desired variables of the fuse, mass and heater have been selected, provides a controlled time delay in the heater means being adapted to cause the fuse to blow and thereby open the one electrical circuit.

This invention also includes a method of making the limiter of this invention.

Many other features, advantages and objects will become obvious from this description, the appended claimed subject matter, and the accompanying drawings in which:

FIG. **1** is a side view of a plural circuit wire attachment toothed comb or comblike member to be used in this invention;

FIG. **2** is a cross section along the line **2—2;**

FIG. **3** is an opposite side view of FIG. **1;**

FIG. **4** is a view showing a partial assembly in the production of this invention and showing circuit wires secured to the free ends of the teeth of the comb members and with a thermally responsive fuse supported by two of said circuit wires;

FIG. **5** is a view similar to FIG. **4,** but showing a completed form of the invention;

FIG. **5A** is an end view of FIG. **5;**

FIG. **6** is a diagrammatic view of the invention used as a multiple circuit temperature limiter in the circuit wires of a part of a transformer circuit;

FIG. **7** is a diagrammatic view showing a transformer circuit somewhat similar to the circuit of FIG. **6** but in which the temperature is limited by separate limiters which can be eliminated by this invention;

FIG. **8** is a top respective view of a housing structure for another multiple circuit thermal limiter of this invention;

FIG. **9** is a cross-sectional view taken on line **9—9** of FIG. **8;**

FIG. **10** is a top view of the housing structure illustrated in FIG. **8** and illustrates the fuse, heater wires and terminals assembled therein;

FIG. **11** is a cross-sectional view taken on line **12—1-1—11** of FIG. **10;**

FIG. **12** is a cross-sectional view taken on line **12—12;** FIG. **10** and illustrates the structure of FIG. **10** after the insulating mass has been received in the housing means;

FIG. **13** is a side view of the completed multiple circuit thermal limiter of this invention as coupled to a plural circuit wire lead attachment means;

FIG. **14** is a top perspective view of another thermal limiter of this invention;

FIG. **15** is an exploded perspective view of the various parts forming the thermal limiter of FIG. **14;**

FIG. **16** is a top view of the parts of FIG. **15** in their assembled position and before the insulating mass has been disposed in the housing thereof;

FIG. **17** is a cross-sectional view taken on line **17—17** of FIG. **16** and illustrates the thermal limiter after the insulating mass has been placed in the housing means of FIG. **16;**

FIG. **18** is a cross-sectional view taken on line **18—18** of FIG. **17;**

FIG. **19** is a schematic view illustrating an electrical circuit which can be utilized in combination with the thermal limiter of FIG. **14;**

FIG. **20** is a perspective view of another thermal limiter of this invention before the same has been covered and secured in position by an insulating mass;

FIG. **21** illustrates the thermal limiter of FIG. **20** in its completed form after the insulating mass has been disposed thereon.

A plural circuit wire attachment toothed comb or comblike member **10,** FIGS. **1, 2** and **3,** may be an article of manufacture now on the market and may have an electrically insulative base **12** carrying a plurality of electrically conductive wire attachment teeth or lead means **14.** These teeth **14** may have wire attaching base supported tooth ends **16** secured to the base **12.** The teeth **14** may also have wire attaching free tooth ends **18** extending away from said base **12.**

The base **12** may be a relatively rigid insulative broad strip made of any suitable material.

The wire attachment teeth **14** may have wire attachment openings **20** embedded in said insulative base **12** and other wire attachment openings **22** at the free ends of the teeth.

The base **10** may be a stiff insulative strip of any suitable material to which the base supported tooth ends **16** are secured by hollow rivets **24.** These hollow rivets may be square tubes punched out of the tooth ends **16** so that the tubes pass through the strip **10** and have their punched ends formed into rivets with outward tongues **26** for attachment of circuit wires thereto. The free ends **18** of the teeth may have the wire attachment openings **22** punched therein.

Suitable L-shaped support brackets **19** may be similarly riveted to the board strip or base **12.**

The article shown in FIGS. **1, 2** and **3** may be used in making the multiple circuit limiter shown in FIGS. **4, 5** and **5A** which is suitable for simultaneously limiting or breaking multiple circuits such as the primary circuit **28** of a transformer arrangement **30** and one or more secondary circuits **32** and **34** of the transformer arrangement **30,** which transformer may be a transformer for a television set.

The multiple circuit limiter or breaker shown in FIG. **5** may include an insulative coating structure **36** which covers and separates the various circuit wires which are mounted on the free ends **18** of the teeth **14.** Such structure **36** may also cover a thermal fuse **38** and other parts to be described. The fuse **38** may be of the thermally collapsible pellet type with the pellet **39** at one end of the fuse, such as disclosed in P. E. Merrill U.S. Pat. No. 3,180,958, patented April 1965. The result is that the mass **36** may be heated by any one of the heating wires **40, 42** and **44** so that the heated mass **36** causes the thermal fuse **38** to open or blow the primary circuit **28** of the transformer **30** and thereby also deenergize the secondary circuits **32** and **34** and prevent damage to the transformer arrangement or the like.

It may be that one or more other secondary circuits **46** may be energized by the primary circuit **28** of transformer **30.** However, such secondary circuit **46** may be of such current characteristics that it cannot be embodied in the mass **36.** Under such conditions, a separate circuit breaker **48** may be provided in the secondary circuit **46** which has a thermal fuse **50.** The wires **52** and/or pins **54** may be made with sufficient resistance to blow the fuse **50** and also break the one or more additional secondary circuits without breaking the transformer circuit arrangement previously described.

The insulative mass **36** may be formed as shown in FIGS. **4, 5** and **5A.**

For example, any suitable insulative heat shrinkable sleeve **56,** FIG. **4,** may be placed around the fuse **38** and the circuit wires **40** and **58** also partly inside the sleeve **56** and extend out of said sleeve. The circuit wire **40** may be electrically resistive sufficiently to blow the fuse **38** when wire **40** is overloaded. The wire **58** is sufficiently conductive not to blow the fuse. A substantially electrically nonresistive splice **60** may connect wire **40** and fuse **38.** The collapsible pellet **39** is sufficiently close to the heating wire **40** to be blown if the wire **40** is overloaded.

Thereafter, the ends of the wires **40** and **58** may be secured to the free tooth ends **18A** and **18B.**

Then a heating circuit wire **42** is placed adjacent to and outside the sleeve **56** and is secured to free tooth ends **18C** and **18D** so that the main body of heating wire **42** is sufficiently close to fuse **38** to blow the fuse if the wire **42** is overloaded.

Thereafter, a heating circuit wire **44** is placed adjacent to and outside sleeve **56** and also spaced from wire **42,** but with its main body adjacent the fuse **38** sufficiently close to the fuse to blow the same if the wire **42** is overloaded. The ends of the wire **44** are secured to the free tooth ends **18E** and **18F.**

The insulative sleeve **56** may be made of any suitable heat shrinkable polyester such as mylar which is wrapped around parts of the wires **42** and **58** and is then lightly heat shrunk, if desired.

The assembly, as so far assembled in FIG. **4,** is then dipped in any well known ceramic or epoxy cement to form the insulative mass **64** around the sleeve **56** and around the wires **40, 42, 44** and **58.** The mass **64** may be somewhat oblong when viewed transversely, as in FIG. **5A,** with parts extending to cover substantially all of said wires **40, 42, 44** and **58** and the free ends **18A, 18B, 18C, 18D** and **18E** of the comb teeth. In this manner, the solidified mass **64** holds the heating wires, **40, 32** and **34** in a fixed position relative to the pellet **39** of the fuse **38** for a purpose hereinafter set forth.

FIG. **7** shows a transformer circuit somewhat similar to that shown in FIG. **6.** However, the limiters in FIG. **7** are individual to their respective primary and secondary circuits. These limiters have been individually mounted within the television cabinet or the like in a manner to require experienced service means to provide service on the parts rather than permit the owner to try and correct a blown circuit by mere fuse replacement and not correct service on the malfunctioning part.

The parts on the circuit of FIG. **7** have been marked with reference numerals of FIG. **6** to indicate how the parts are unified by this invention.

In FIG. **6,** the transformer primary circuit may be connected to a plug-in structure **68** so that the primary circuit energizes a plurality of secondary circuits **32, 34** and **46,** or more.

The finished product shown in FIG. **5** may be placed anywhere in the primary circuit so that all the heater wires **40, 42** and **44** can heat the insulative mass **64** which acts as a heat sink in a controlled manner to cause the fuse **38** to blow if any of the heater wires are overloaded.

In particular, the position of the heating wires **40, 32** and **34** as held by the mass **64** in relation to the pellet **39** of the fuse as well as the heat conductive characteristics of the mass **64** are so selected that the fuse **38** will not immediately blow but will blow only after a certain time period from the initial heating of one or more wires **40, 32** and **34** and the continued heating thereof in order to prevent inadvertent blowing of the fuse **38** should the service man accidentally cause a temporary short circuiting by a screwdriver engagement during a service check, etc.

Any isolated secondary circuit such as **46** can be broken by an individual thermal fuse or current breaker **48.**

Thus, it is to be seen that this invention includes an improved multiple circuit thermal limiter **66,** FIG. **5,** which can be combined with a multiple circuit such as a transformer circuit as shown in FIG. **6.** An efficient method of making such limiter is also provided.

Another multiple circuit thermal limiter of this invention is generally indicated by the reference numeral **70** in FIG. **13** and comprises a housing means or base **71** formed of suitable insulating material and carrying a plurality of quick connect and disconnect sleevelike lead members **72** for effectively receiving bayonet type lead strips **73** carried on an electrically insulating base or strip **74** adapted to be mounted to a desired supporting structure **75** by suitable leg means **76** whereby the

thermal limiter **70** of this invention is adapted to be coupled to the lead attachment strips **73** of the board or base **74** by merely having the lead sleeves **72** telescoped over the projecting portions of the lead strips **73** so that the thermal limiter **70** of this invention can be coupled into a desired circuit means interconnected to the lead strips **73** in a conventional manner.

The multiple circuit thermal limiter **70** of this invention has the housing means **71** thereof provided with a substantially rectangular base portion **77** with a cavity **78** formed therein and defining a closed end wall means **79,** opposed side wall means **80** and **81** and opposed end walls **82** and **83** of the housing means **71** with the side wall **81** having an extension **84** angled therefrom in the manner illustrated in FIGS. **8, 9** and **10.** The angled wall **84** has a plurality of pockets **85** formed therein and defined between outwardly extending ridge means **86** utilized for snap fitting and retaining the sleevelike lead means **72** in a preassembled position relative thereto.

For example, each lead means **72** comprises an upper sleevelike portion **87** adapted to slip into a pocket means **85** under inwardly directed ears **88** of the cooperating ridge means **86** so as to be held flat against the angled wall **84** with the lower end **89** of the sleeve **87** abutting against locating shoulder means **90** on the ridge means **86** as illustrated in FIG. **12** whereby a lower wire attaching means **91** of the lead means **72** extends into the chamber or recess **78** of the housing means **71.** In this manner, the sleevelike lead means **72** of the thermal limiter **70** can be disposed in the pocket means **85** of the housing means **71** so that the same will be uniformly positioned relative thereto by the stop means or shoulders **90** and ears **88** of the ridge means **86** whereby the sleevelike lead means **72** will be in proper positions relative to the lead strips **73** of the insulating base **74** when it is desired to couple a thermal limiter **70** of this invention thereto.

If desired, the spacing between the pockets **85** on the angled side wall **84** of the housing means **71** can be so spaced relative to each other that the same will be compatible with like spacing of the strips **73** on the insulating board **74** so that the thermal limiter **70** can be only coupled to the strips **73** on the board **74** when the limiter **70** is held in a certain position relative thereto so that wrong connecting to the board **74** will be prevented. For example, it can be seen that the spacing between the middle two sleeve members **72** of the thermal limiter **71** of this invention is greater than the spacing between any other adjacent pair of lead means **72** so as to be compatible with like spacing between the lead strips **73** on the base **74.**

The end or bottom wall **79** of housing means **71** of the thermal limiter **70** has upwardly extending longitudinal dividers **92** and **93** formed integrally therewith and dividing the recess **78** into three chambers **94, 95** and **96** as illustrated in FIG. **11** whereby the chamber **95** is adapted to receive a temperature responsive fuse **97** formed in the same manner as the fuse **38** previously described and be electrically interconnected to the two outboard lead means **72** by supporting wires **98** and **99** as illustrated in FIG. **10,** the wire **99** being a heater wire in the same manner as the heater wire **40** previously described and being coupled to the right side **100** of the fuse **97** by a substantially electrically nonresistive splice member **101** in the same manner as the splice member **60** previously described.

A heater wire **103** can be disposed in the chamber **94** and have its opposed ends **104** and **105** respectively interconnected to the next two inboard lead means **72.** Another heater wire **106** is adapted to be disposed in the chamber **96** and have its opposed ends **107** and **108** respectively interconnected to the two innermost lead sleeves **72** as illustrated in FIGS. **10** and **12.**

In this manner, it can be seen that the dividers **92** and **93** separate the heating wires **103** and **106** from the thermal fuse **97** as well as the lead attachment wires thereof during the assembly operation as illustrated in FIG. **10.**

Thereafter, the desired insulative mass **109** is disposed in the recess **78** of the housing means **71** to fill the same to the desired level, which in the embodiment illustrated in the drawings is to the top of the end walls **82, 83** and side walls **77,** so as to not only cover and secure the heating wires **99, 103** and **106** in the desired selective positioning thereof relative to the fuse **97** when the mass **109** hardens, but also to cover the lower ends **91** of the lead means **72** so as to secure the lead means **72** in their assembled relation in the pockets **85** so that the same cannot be subsequently moved relative to the housing means **71.**

In this manner the completed thermal limiter **70** of this invention is adapted to be coupled to the lead board **74** in the manner previously described and be uncoupled thereto by merely telescoping or untelescoping the sleeve means **70** thereof to or from the lead strips **73** of the board **74** in a simple and effective manner.

Thus, it can be seen that the thermal limiter **70** of this invention is adapted to have the fuse **97** thereof open a circuit connected to the outermost pair of terminals **72** thereof when any one of the heating means **99, 103** and **106** generates sufficient heat to be conducted to the fuse **97** by the thermal mass **109** to cause the fuse **97** to blow, it being understood that the selection of the positioning of the heating wires relative to the fuse **97** as well as the conductive characteristics of the mass **109** are so selected that accidental blowing of the fuse **97** will not take place until the overloaded or short circuited condition is in existence for a length of time which would require circuit opening.

If desired, the thermal limiter **70** can be utilized in the same manner as the thermal limiter **66** previously described or in other circuit means for like purposes.

Another thermal limiter of this invention is generally indicated by the reference numeral **110** in FIG. **14** and comprises an electrically insulating housing means or base **111** having a recess **112** interrupting the top surface **113** thereof and receiving a heating means **114** and a thermal fuse **115** therein to be selectively positioned therein and subsequently covered and secured in such selective positioning by suitable insulating means or mass **116** so that three lead means **117, 118** and **119** respectively extend outwardly from the mass **116** for coupling the thermal limiter **110** in a desired circuit, such as the electrical circuit illustrated in FIG. **19** and hereinafter described.

The heating means **114** includes a heating wire **120** mounted on a rod **121** and has its opposed ends respectively interconnected to the terminals **117** and **118** having the lower portions **122** and **123** thereof disposed in coiled fashion about the rod **121** to be rigidly secured thereto.

The thermal fuse **115,** similar to fuse **38** previously described, has opposed lead wires **124** and **125** extending therefrom with the lead wire **125** being secured to the terminal means **119** and with the lead wire **124** being interconnected to the terminal **117** as illustrated, the

wires **124** and **125** being of sufficient strength to support the fuse **115** in spaced relation relative to the heating means **114** in the manner illustrated in FIG. **16** when the same are disposed in the housing means **111** against a bottom wall means **126** thereof in the manner illustrated in FIG. **16** so that the insulating mass **116** can be subsequently disposed in the housing means **111** to cover and secure the fuse **115** and heating means **114** in the selected positioning thereof as illustrated, the insulating mass **116** being disposed between the fuse **115** and the heating means **114** as illustrated in FIG. **18** to provide insulation therebetween in the same manner as the divider walls **92** and **93** of the housing means **71.**

The thermal limiter **110** of FIG. **14** is adapted to be utilized in the particular electrical circuit **127** of FIG. **19** in a manner now to be described, but it is to be understood that the thermal limiter **110** can be utilized for other purposes as desired.

As illustrated in FIG. **19,** the electrical circuit **127** is adapted to be utilized for an air conditioner or the like wherein an electrically operated drive clutch **128** is provided for the compressor and is adapted to have its side **129** interconnected to a suitable power source **130** by a lead means **131** interconnected by the conventional air conditioning on-and-off temperature responsive switch **132** to the terminal **119** of the thermal limiter **110** of this invention while the other terminal **117** thereof is interconnected by a lead **133** to the side **129** of the clutch **129** of the clutch means **128.** The other side **134** of the clutch means **128** is interconnected by a lead **135** to ground in the same manner that the other side of the source **130** is interconnected to ground.

The terminal **118** of the terminal limiter **110** is interconnected to a loss-of-charge sensor switch **136** which is in a normally open condition as long as there is no loss of refrigerant of the air conditioning unit utilizing the circuit **127.**

Thus, it can be seen that the electrically operated clutch means **128** is adapted to function as long as the switch **136** is in an open condition since the clutch means **128** is placed across the power source by the thermal limiter **110** of this invention when the switch **132** is closed to demand that the compressor be operating.

However, if the loss-of-charge switch **136** closes due to the refrigerant escaping from the refrigerant system, the compressor would burn out within a few minutes because the same would not receive sufficient lubrication whereby the heating means **114** now operatively interconnected to the source **130** will heat up sufficiently to cause the fuse **115** to blow and, thus, open the circuit that operates the clutch **128** so that the clutch **128** can no longer operate until the thermal limiter **110** is replaced.

However, in a normally performing air conditioning system, the loss-of-charge switch **136** can close for a minute or so under some unusual weather conditions whereby it would not be desired for the thermal limiter **110** to blow and, thus, require a serviceman to replace the same before the air conditioner can be operated. Thus, the thermal limiter **110** of this invention has been so constructed and arranged in the positioning of the heating means **114** relative to the fuse **115** as well as in the selection of the thermal mass **116** to permit the loss-of-charge switch **136** to be temporarily closed only for a minute or so without causing the fuse **115** to blow during the unusual weather conditions, but will assure that the fuse **115** will blow should the loss-of-charge

switch **136** be closed for a time short of an adverse situation wherein the compressor would burn out or the like.

Thus, it can be seen that the thermal limiter **110** of this invention is adapted to protect an air conditioning system in the manner illustrated in FIG. **9** through a controlled time delay thereof.

Another thermal limiter of this invention is generally indicated by the reference numeral **137** in FIG. **21** and is formed of the parts illustrated in FIG. **20** wherein a thermal fuse **138,** similar to the fuse **38** previously described, has opposed leads **139** and **140** extending from opposed sides thereof for completing a circuit therethrough and has a heating wire **141** coiled upon the same with the opposed ends **142** and **143** of the heating wire **141** so disposed that the lead **143** is coupled to the fuse **138** in the same manner as the lead wire **139** whereas the lead wire **142** extends away from the fuse **138** as illustrated. Subsequently, an insulating mass **144,** formed in any suitable shape, is disposed about the assembly illustrated in FIG. **20** so as to secure and cover the fuse **138** and heating wire **141** to hold the same in the selected positioning illustrated in FIG. **20** so that the lead means **139, 142** and **140** extend outwardly from the mass **144** for coupling into a desired circuit. For example, the thermal limiter **137** is adapted to be utilized in place of the thermal limiter **110** in FIG. **19** and serve the same function thereof wherein the lead **142** is interconnected to the loss-of-charge switch **136** and the leads **139** and **140** are adapted to be respectively interconnected to the on/off switch **132** and the electrical clutch **128.**

In view of the above, it can be seen that this invention not only provides an improved thermal limiter wherein a controlled time delay thereof is provided by selective positioning of the heating means and the fuse together with the desired heat conductive characteristics of the securing mass, but also this invention provides an improved method of making such a thermal limiter or the like.

What is claimed is:

[1. A thermal limiter for at least one electrical circuit comprising a thermally responsive fuse, lead means operatively interconnected to said fuse for coupling said fuse in said circuit, an electrical circuit heater means disposed in a selected position relative to said fuse, and an insulating coating mass covering and securing said heater means and said fuse in said selected positioning thereof with said lead means having at least portions thereof exposed from said mass whereby said mass and said selected positioning provides a controlled time delay in said heater means being adapted to cause said fuse to blow and thereby open said one electrical circuit.**]**

[2. A thermal limiter as set forth in claim **1** wherein said heater means comprises a plurality of separate heater wires.**]**

[3. A thermal limiter as set forth in claim **1** wherein said heater means is spaced from said fuse, said mass being disposed between said heater means and said fuse and acting as a heat conductor therebetween.**]**

[4. A thermal limiter as set forth in claim **1** wherein said heater means comprises a heater wire coiled on said fuse.**]**

[5. A thermal limiter as set forth in claim **1** wherein said heater means comprises a heater wire disposed in series between one of said lead means and said fuse.**]**

[6. A thermal limiter as set forth in claim 1 wherein a housing means receives said heater means and said fuse therein in said selected positioning therebetween, said mass being disposed in said housing to cooperate with said housing to cover and secure said heater means and said fuse in said selected positioning thereof.]

[7. A thermal limiter as set forth in claim 6 wherein said heater means comprises a coiled heater wire having its opposed ends electrically interconnected to two lead means respectively having portions thereof exposed from said mass and from said housing means, said fuse having opposed sides thereof respectively electrically interconnected to said first mentioned lead means one of which is also one of said lead means electrically interconnected to said heater wire.]

[8. A thermal limiter as set forth in claim 1 wherein said lead means comprise a first pair of lead means respectively and electrically interconnected to opposed sides of said fuse, a second pair of lead means being respectively and electrically interconnected to opposed sides of said heater means and having portions thereof exposed from said mass.]

[9. A thermal limiter as set forth in claim 8 wherein said lead means comprise the teeth of a plural circuit wire attachment comb having an electrically insulative base carrying a plurality of electrically conductive wire attachment teeth with wire attaching base supported tooth ends secured to said base and with wire attaching free tooth ends extending away from said base and into said mass.]

10. A thermal limiter as set forth in claim [9] *26* wherein two supporting wires oppositely extend from said fuse to two of said free tooth ends which define said first pair of lead means, a sleeve of insulative shrink tubing surrounding said fuse with said two supporting wires extending from said sleeve, said tubing being embedded in said mass.

[11. A thermal limiter as set forth in claim 8 wherein said heater means comprises another electrical heater disposed in series between one of said first pair of lead means and said fuse.]

[12. A thermal limiter as set forth in claim 6 wherein said housing means has means locating said exposed parts of said lead means relative to each other.]

13. A thermal limiter as set forth in claim [12] *28* wherein said locating means space said lead means with at least one different spacing between adjacent lead means.

14. A thermal limiter as set forth in claim [12] *28* wherein said locating means comprise a wall of said housing means having a plurality of aligned and spaced pocket means therein respectively receiving said exposed portions of said lead means therein.

[15. A method making a thermal limiter for at least one electrical circuit comprising the steps of providing a thermally responsive fuse, operatively interconnecting lead means to said fuse for coupling said fuse in said circuit, disposing an electrical circuit heater means in a selected position relative to said fuse, and covering and securing said heater means and said fuse in said selected positioning thereof with an insulating mass so that said lead means have at least portions thereof exposed from said mass whereby said mass and said selected positioning provides a controlled time delay in said heater means being adapted to cause said fuse to blow and thereby open said one electrical circuit.]

[16. A method of making a thermal limiter as set forth in claim 15 and including the step of forming said heater means for a plurality of separate heater wires.]

[17. A method of making a thermal limiter as set forth in claim 15 wherein said step of disposing said heater means includes the step of spacing said heater means from said fuse, and disposing said mass between said heater means and said fuse to act as a heat conductor therebetween by said step of covering and securing.]

[18. A method of making a thermal limiter as set forth in claim 15 and including the step of forming said heater means from a heater wire and coiling said heater wire on said fuse.]

[19. A method of making a thermal limiter as set forth in claim 15 and including the step of forming said heater means from a heater wire and disposing said heater wire in series between one of said lead means and said fuse.]

[20. A method of making a thermal limiter as set forth in claim 15 and including the step of providing a housing means to receive said heater means and said fuse therein in said selected positioning therebetween, said mass being disposed in said housing to cooperate with said housing to cover and secure said heater means and said fuse in said selected positioning thereof.]

21. A thermal limiter for at least one electrical circuit comprising a thermally responsive fuse of generally cylindrical configuration; lead means operatively interconnected to said fuse for coupling said fuse in said circuit; an electrical circuit heater means disposed in a selected position adjacent said fuse in substantially parallel relation therewith and comprising a coiled heater wire having its opposed ends respectively electrically interconnected and securely attached to two lead means comprising blade-like leads positioned in line with the axis of said coil and wrapped at least partially around the ends thereof; a housing means receiving said heater means and said fuse therein in said selected position; and an insulating coating mass disposed in and cooperating with said housing to cover and secure said heater means and said fuse in said selected positioning with all of said lead means having at least portions thereof exposed from said mass; whereby said mass and said selected positioning provides a controlled delay in the time between activating of said heater means and the blowing of said fuse to open said one electrical circuit.

22. A thermal limiter according to claim 21 wherein one of said blade-like leads is electrically interconnected to one side of said fuse.

23. A thermal limiter according to claim 22 wherein the end of said fuse which is remote from electrical connection to said heater means is connected to a blade-like lead, and said blade-like lead is disposed intermediate aforesaid two blade-like leads and is in alignment therewith.

24. A thermal limiter according to claim 22 wherein said mass is disposed between said heater means and said fuse to act as a heat conductor therebetween.

25. A thermal limiter for at least one electrical circuit comprising a thermally responsive fuse, a first pair of lead means electrically interconnected to opposed sides of said fuse, an electrical heater means disposed in a selected position relative to said fuse, a second pair of lead means electrically interconnected to opposed sides of said heater means, an insulating coating mass covering and securing said fuse in said selected positioning, and a plural circuit wire attachment comb comprising an electrically insulative base supporting a plurality of electrically conductive wire

attachment teeth, said base being spaced apart from said insulating coating mass and said teeth extending away from said base and into said mass for connection to said leads, whereby said mass and said positioning provides a controlled delay in the time between activating of said heater means and the blowing of said fuse to open said one electrical circuit.

26. A thermal limiter for at least one electrical circuit comprising a thermally responsive fuse, lead means operatively interconnected to said fuse for coupling said fuse in said circuit, an electrical heater means disposed in a selected position relative to said fuse, housing means for

receiving and positioning said heater means and said fuse and including locating means for exposed parts of said lead means, and an insulating coating mass cooperating with said housing to cover and secure said heater means and said fuse in said selected positioning with all of said lead means having at least portions thereof exposed from said mass whereby said mass and said selected positioning provides a controlled delay in the time between activating of said heater means and the blowing of said fuse to open said one electrical circuit.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : RE 29,430
DATED : October 4, 1977
INVENTOR(S) : Emil Robert Plasko

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 17, "limited" should be --limiter--.

Column 2, line 24, "12-1-1-11" should be --11-11--.

Column 2, line 26, delete ";" and insert --of--.

Column 2, line 63, "broad" should be --board--.

Column 9, line 31, "26" should be --25--.

Column 9, line 45, "28" should be --26--.

Column 9, line 49, "28" should be --26--.

Signed and Sealed this

Twenty-third Day of *May 1978*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

LUTRELLE F. PARKER
Acting Commissioner of Patents and Trademarks