

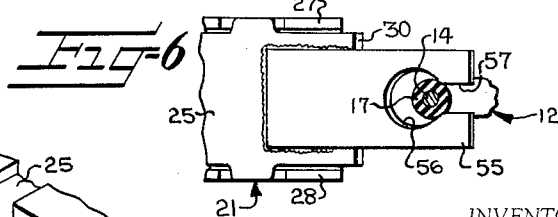
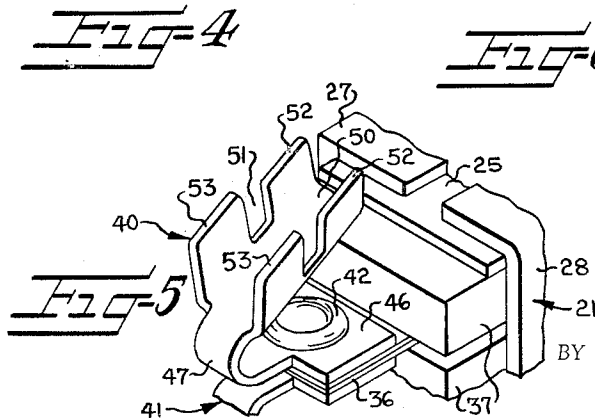
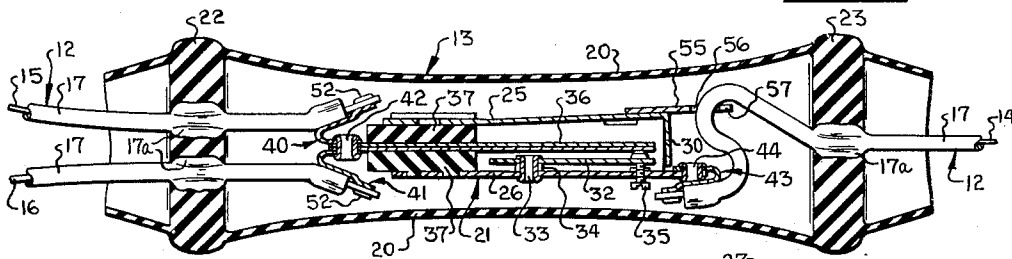
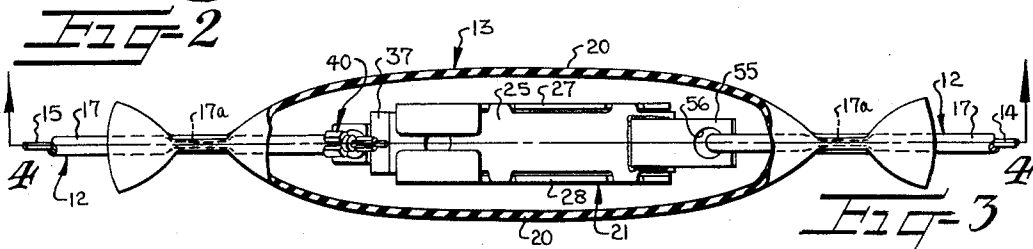
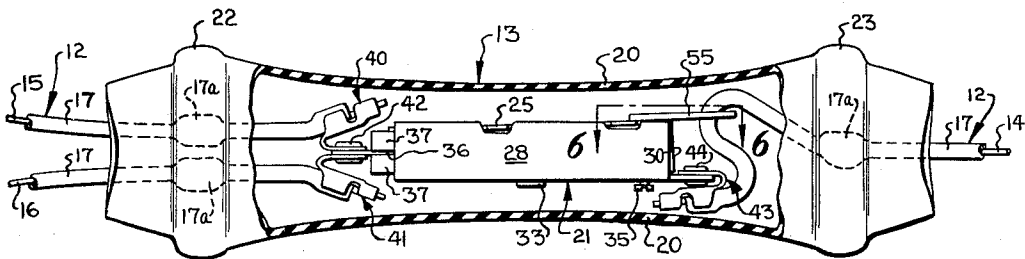
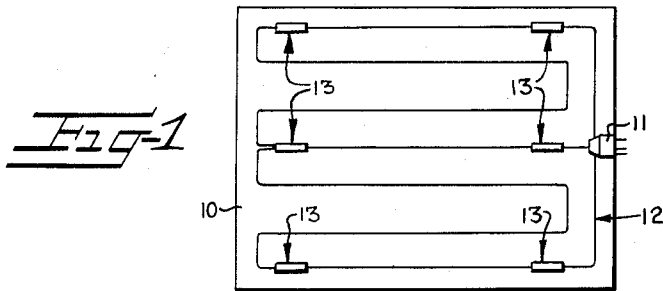
Dec. 13, 1955

D. L. ALFRED ET AL
THERMOSTATIC SWITCH ASSEMBLY

2,727,116

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2 Sheets-Sheet 1



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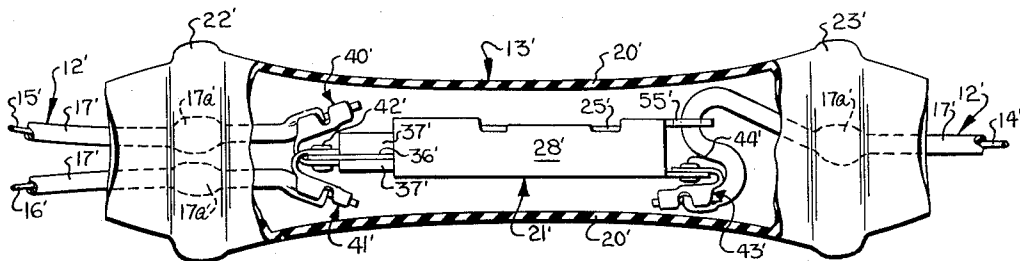


FIG-7

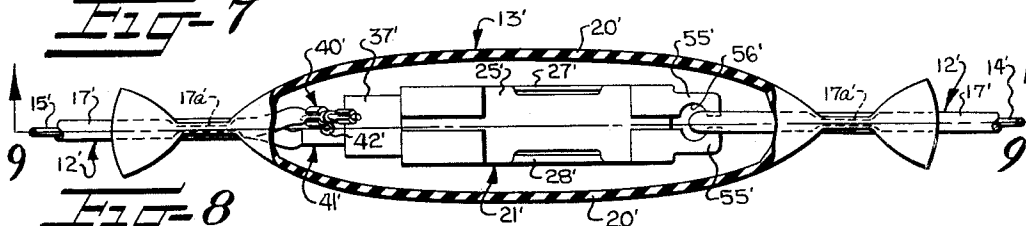


FIG-8

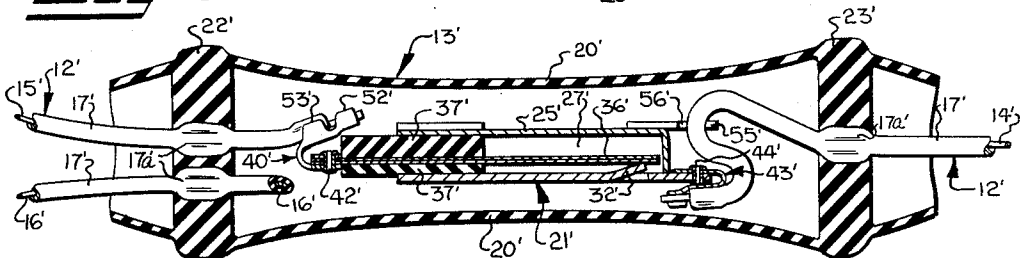


FIG-9

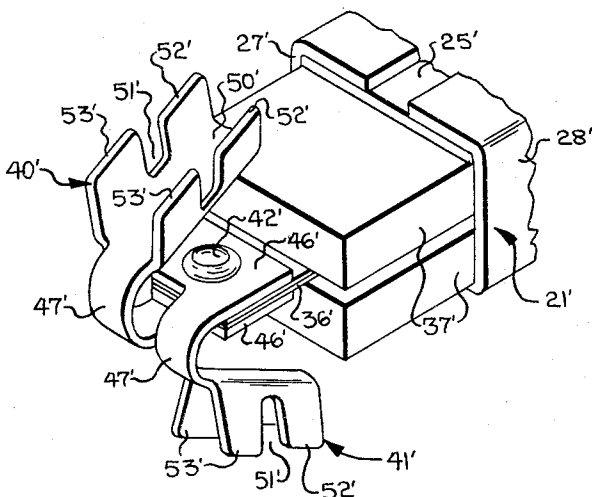


FIG-10

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2,727,116

THERMOSTATIC SWITCH ASSEMBLY

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3 Claims. (Cl. 200—168)

This invention generally relates to thermostatic switches and, more especially, to an improved thermostatic switch assembly particularly adapted to be interposed in the heating element or resistance circuit of an electric blanket or the like.

Although many attempts have been made heretofore to perfect a thermostatic switch assembly suitable for use with electric blankets, heating pads and other pliable articles, none of these attempts have proved successful because the thermostatic assemblies were too bulky or the switch units associated therewith would be abnormally heated as compared to the heating element so the switch would close before the article being heated had been heated to the proper temperature and, in many instances, the wires of the heating element would be pulled loose from the terminals of the switch during ordinary usage, with the result that the article would have to be taken apart in order to replace the thermostatic switch assembly. In other instances the thermostatic switch assemblies have not been waterproof and would thus become damaged when washing the electric blanket, heating pad or other article associated therewith.

It is therefore the primary object of this invention to provide an improved thermostatic switch assembly including a switch having a novel "strain-relief" means for attaching heating element wires to opposite ends thereof in such a manner as to obviate overheating of the switch and which assembly is waterproof and requires very little space.

It is another object of this invention to provide a thermostatic switch assembly comprising a switch unit having terminals connected to opposite ends thereof for connecting corresponding wires thereto, each of which terminals is formed from a relatively thin material bent back upon itself and being provided with tabs or ears for clamping the corresponding wire thereto so the wire or wires at each end of the switch unit may extend outwardly in a substantially straight line from the switch unit. The improved switch assembly also includes a stretchable thermoplastic envelope or tube which surrounds the switch unit and is constricted and heat-sealed at opposite ends thereof through which the wires of the heating element extend from the corresponding ends of the switch unit thereby preventing moisture from contacting the switch unit disposed within the thermoplastic envelope or tube.

It is still another object of this invention to provide a "strain-relief" connection between the thermoplastic switch unit disposed within the thermoplastic tube or envelope and the heating element wires and which is so arranged as to permit relative movement between the portions of the wires within the tube and the tube, and also the switch unit, without pulling the wires loose from the terminals and without placing the terminals under excessive stress.

More specifically, it is an object of this invention to provide a thermostatic switch assembly of the character described wherein the terminal or terminals connected

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to the exterior portions of the bi-metallic switch arm are of such length that they may be bent in the form of a letter U without engaging the casing and also wherein the terminals at both ends of the switch unit are formed with relatively short tabs at the outer or free ends thereof and relatively longer tabs disposed inwardly of the free ends thereof so the wire may extend outwardly straight from each terminal, but the insulation on each of the wires is clamped at a point closely adjacent the bend in the terminal, thereby minimizing projection of the terminals relative to the casing.

Further, the terminal at that end of the casing opposite from the end from which the bi-metallic switch arm projects is connected to one side of the casing and the opposite side of the casing therefrom has an auxiliary wire attaching element in the form of a slotted projection thereon provided with a hole therein of slightly greater diameter than the diameter of the insulation on the wire, and communicating with the hole is a slot in the free end of the projection, of less width than the diameter of the yieldable insulation on the wire and through which the wire may be inserted so it passes through said hole. Thus, when the ends of the tube are constricted and heat-sealed, and upon excessive pulling forces being applied to the wires at opposite ends of the assembly, the wire held by the auxiliary attaching element will merely pull out of the hole provided in said projection and a sufficient amount of wire will be disposed within the envelope or tube to insure that the crimped wire connections at the terminals will not be stressed at any time although the elasticity of the envelope or tube may permit the same to be stretched considerably beyond its normal length.

It is still another object of this invention to provide one end of a switch unit of the character described with a pair of terminals whose bent portions or neck portions are disposed in offset relation to the longitudinal axis of the switch unit so the free end portions of the terminals may overlie the opposite surfaces of the bi-metallic switch arm from which are engaged by the corresponding portions of the terminals secured to the bi-metallic switch arm and whereby the neck portions formed at the bends of the terminals may extend past each other.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds, when taken in connection with the accompanying drawings, in which—

Figure 1 is a schematic plan view of a blanket or the like showing the heating element or resistance wires therein and also showing a plurality of the improved thermostatic switch assemblies interposed in the heating element;

Figure 2 is an enlarged elevation, with the central portion broken away and in section, showing the improved thermostatic switch assembly disposed in the left-hand central portion of Figure 1, all of the remaining switch assemblies being identical except having only one wire extending from each end thereof;

Figure 3 is a view looking down at the upper side of Figure 2 wherein the central portion thereof is also broken away and shown in section;

Figure 4 is a longitudinal sectional view taken along line 4—4 in Figure 3;

Figure 5 is an enlarged isometric detail of one of the improved terminals, omitting the wire;

Figure 6 is an enlarged view of the auxiliary wire attaching element at one end of the switch unit looking substantially along line 6—6 in Figure 2;

Figure 7 is a view similar to Figure 2, but showing a modified form of terminal for connecting each of the two wires at the left-hand portion of this view to the switch unit;

Figure 8 is a view looking at the upper side of Figure

7 with the central portion of the thermoplastic envelope broken away and shown in section;

Figure 9 is a longitudinal sectional view taken substantially along line 9—9 in Figure 8;

Figure 10 is an enlarged isometric detail showing the modified terminals at one end of the switch unit, omitting the wires.

Referring to Figure 1, an electric blanket or heating pad is designated at 10 and is shown schematically and has a plug 11 suitably attached thereto which is adapted to be connected to a suitable source of electrical energy, not shown. The blanket 10 and plug 11 may be of a type disclosed in U. S. Patent No. 2,317,189 of April 20, 1943. Extending from the plug 11 is a heating element generally designated at 12 and which has a plurality of improved thermostatic switch assemblies interposed therein at strategically spaced points in order to uniformly heat the entire area of the blanket, heating pad or the like.

All of the thermostatic switch assemblies are substantially the same and each is therefore broadly designated at 13. Since the switch assembly illustrated in Figures 2, 3 and 4 is representative of the switch assembly shown in the central left-hand portion of Figure 1, only the wires of that portion of the heating element 12 shall be hereinafter specifically described. The wire at the right-hand end of the thermostatic switch assembly 13 in Figures 2, 3 and 4 is indicated at 14. The two wires at the left-hand end of the assembly 13 are indicated at 15 and 16. Substantially the entire length of each of the wires 14, 15 and 16 is provided with a suitable yieldable or resilient insulation covering indicated at 17.

The thermostatic switch assembly comprises a tubular housing 20 made from a yieldable or stretchable thermoplastic substance which snugly encloses a switch unit comprising a metallic casing broadly designated at 21. In Figures 2, 3 and 4, the wall of the thermoplastic tube or envelope 20 is shown as being spaced from the casing 21 for purposes of clarity, but is to be understood that the wall of the thermoplastic tube or envelope 20 snugly encloses the casing 21 therein. As a matter of fact, the thermoplastic tube or envelope 20 is constricted and heat-sealed at opposite ends thereof, as at 22 and 23, while under tension so the diameter of the central portion of the tube 20 is reduced as compared to its normal diameter whereby the inner surface of the wall 20 lies against, or in close proximity to, the casing 21 due to attenuation of the tube 20.

Of course, before the constrictions 22 and 23 are formed, the proximal ends of the wires 15 and 16 and 14 are connected to opposite ends of the switch unit comprising casing 21, by means to be later described, so the thermoplastic material forming the constrictions 22 and 23 is molded around the insulation material 17 surrounding the respective wires 14, 15 and 16 to thereby hermetically seal the interior of the thermoplastic tube or envelope 20. It is evident that the constrictions 22 and 23 are formed by clamping the corresponding portions of the tube 20 between heated members and the pressure exerted by the heated members causes the yieldable insulation covering 17 on the wires 14, 15 and 16 to be flattened at said constrictions 22 and 23, as at 17a.

The casing 21 is generally in the form of an elongated tube which is rectangular in cross-section and comprises spaced side walls 25 and 26 which are suitably connected to corresponding spaced side walls 27 and 28. One end of the wall 25 is bent toward the wall 26 to form an end closure member 30 and the wall 26 extends outwardly substantially beyond the end wall 30. All of the walls 25 to 28, inclusive, are preferably made from metal, although those walls other than the wall 26 may be made from any other desired material. Suitably secured to the inner surface of wall 26, intermediate the ends thereof, is a metallic contact arm 32 which, in this instance, is secured to wall 26 by means of a rivet 33 and is spaced

from the wall 26 by a washer 34 surrounding the rivet 33.

The metallic contact arm 32 is preferably made from a leaf spring material and bears against an adjustment screw 35 which threadably penetrates the wall 26. The free end of the contact arm 32 normally engages a bi-metallic switch arm 36, one end of which is spaced from the end wall 30 of casing 21 and the other end of which extends outwardly between the walls 25, 26, 27 and 28. Screw 35 facilitates predetermination of the temperature at which the bi-metallic switch arm moves to open position.

Improved strain relief means are provided for connecting the wires 14, 15 and 16 to the switch unit disposed within the thermoplastic tube or envelope 20. To this end, the exposed outer portion of the bi-metallic switch arm 36 has a pair of improved terminals or wire connectors 40 and 41 suitably secured thereto, as by a rivet 42, and to which the respective wires 15 and 16 are connected by means to be presently described. The portion of the wall 26, which extends beyond the end closure member or wall 30 of casing 21, also has an improved wire connector or terminal 43 suitably secured thereto, as by a rivet 44. Since all three of the terminals 40, 41 and 43 may be identical, only one of these terminals will be described in detail and, where practicable, like parts associated with the other terminals will bear the same reference characters with the prime notation added.

It is to be understood that one of the terminals 40 or 41 may be omitted in the instance of only a single wire entering the left-hand end of the tube 20 in Figures 2 and 4. Since the terminal 40 is shown most clearly in Figure 5, this terminal will now be described in detail. The terminal 40 is formed from sheet metal and has a relatively broad flat portion 46 on one end thereof which is secured to the bi-metallic switch arm 36, as by the rivet 42 heretofore described. The portion 46 has a relatively narrow neck portion 47 integral therewith which extends outwardly therefrom relative to the casing 21 and then curves back upon itself to form an angularly disposed portion 50 which is of generally U-shaped cross-sectional configuration and is slotted or notched intermediate its ends, as at 51, to form a pair of relatively short wire clamping tabs or ears 52 at the free end thereof and a pair of relatively longer insulation clamping tabs or ears 53 adjacent the neck portion 47.

The tabs 52 are preferably shorter than the tabs 53 because of the relatively small diameter of the wire 15 as compared to the insulation covering 17 thereon and, of course, when the wire 15 is connected to the terminal 40, the relatively short tabs 52 are clamped about the exposed end portion of the wire 15 by means of pliers or the like and the corresponding end of the insulation covering 17 on the wire 15 terminates substantially at the notches 51 and is also clamped between the ears or tabs 53. Since the insulation covering 17 is made from a resilient material, the covering 17 bulges outwardly between the free ends of the tabs or ears 53 when the insulation covering is clamped therebetween as shown in Figure 2.

It is thus seen that the wires 15 and 16 extend straight outwardly from the switch unit disposed within the tube 20 without extending past the casing 21 and are anchored to the corresponding terminals 40 and 41 at points closely adjacent the bends or neck portions 47 thereof so the terminals 40 and 41 cannot bend excessively when a pulling force is applied to the wires 15 and 16 relative to the casing 21.

Now, in order to insure that the wires 14, 15 and 16 are not inadvertently detached from the respective terminals 43, 40 and 41, the wire 14 is maintained substantially in the shape of a letter S between the terminal 43 and the constriction 23 of tube 20 by means of an auxiliary wire attaching element in the form of a projection or plate 55 which may be integral with or

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suitably secured to the wall 25 and is thus disposed in spaced substantially parallel relation to the portion of the wall 26 to which terminal 43 is attached. The auxiliary wire attaching element has a bore, aperture or opening 56 therethrough which is preferably of substantially greater diameter than the normal diameter of the resilient insulation covering 17 on the wire 14. Disposed in the free end of the auxiliary wire attaching element, and communicating with the aperture 56, is a slot 57 which is necessarily of less width than the normal diameter of the resilient covering 17 on the wire 14 (Figure 6).

It is thus seen that, after the wire 14 has been connected to the terminal 43 in the manner heretofore described, the resilient nature of the covering 17 on the wire 14 facilitates forcing the wire 14 through the slot 57 into the aperture 56 in the auxiliary wire attaching element 55 to thereby maintain a length of relatively slack wire within the tube 20 between the constrictions 22 and 23 thereof.

Now, as heretofore stated, the thermoplastic tube 20 is made from a resilient stretchable or yieldable material and upon the wires 14, 15 and 16 being placed under tension, the fact that the wires 14, 15 and 16 are firmly attached at the constrictions 22 and 23 causes the tube 20 to stretch beyond its normal length and, when the tube 20 is stretched sufficiently to place the portions of the wires 14, 15 and 16 disposed within tube 20 or between the constrictions 22 and 23 thereof under excessive stress, the wire 14 is merely pulled out of the aperture 56, in the auxiliary wire attaching element 55, through the notch 57 and there is then a sufficient amount of slackened wire 14 disposed within the tube or envelope 20 to permit the tube 20 to be stretched to its maximum elastic limits without placing the wires under stress at the points at which they are connected to the terminals 40, 41 and 43 thereby insuring that the terminals will not break during handling and washing of the blanket and also insuring that the wires 14, 15 and 16 will not become detached from the respective terminals 43, 40 and 41.

Although the switch unit 21 is specifically described, it is to be distinctly understood that many different forms of switch unit structures may be used, without departing from the spirit of the invention.

Modified form of terminal construction

Referring to Figures 7 to 10, inclusive, a modified form of terminal construction is shown on the left-hand end of the switch unit and, since the parts shown in Figures 7 to 10, inclusive, are very similar to those shown in Figures 1 to 6, inclusive, the same reference characters shall apply with the prime notation added. Although both the switch units 21 and 21' in the two forms of the invention may be identical, the switch unit 21' differs from the switch unit 21 in that the metallic contact arm 32' is formed integral with the wall 26', the wall 26' being cut away to form the contact arm 32' which is in the form of a tab portion bent inwardly to engage the metallic switch arm when the ambient temperature is below a predetermined minimum. Of course, in this instance, elements, such as elements 33 and 35 (Figure 4) are omitted from the switch unit 21' shown in Figures 7, 8 and 9. Also, the auxiliary wire attaching element is formed integral with the side walls 27' and 28' of casing 21', the portions of the walls 27' and 28' forming said auxiliary wire attaching element being indicated at 55' and being provided with notches in their proximal edges defining an aperture 56'. The proximal edges of the projections or portions 55' are spaced from each other to define a slot or notch 57' therebetween of less width than the diameter of the insulation covering 17' on wire 14'.

The terminals shown in the left-hand portions of Fig-

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ures 7, 8 and 9 and in Figure 10 are particularly arranged for use when two wires are to be connected to the exposed portion of the bi-metallic switch arm 36'. The terminals 40' and 41' differ from the terminals 40 and 41 in that the neck or stem portions 47' thereof are offset relative to the longitudinal center of the switch unit 21' so they are connected to the respective relatively broad flat portions 46' adjacent one edge thereof. This offsetting of the neck or stem portions 47' of the terminals 40' and 41' facilitates securing the broad flat portions 46' thereof to the surfaces of the bi-metallic switch arm opposite the surfaces thereof adjacent which the corresponding angularly disposed or free end portions 50', having the tabs or ears 52' and 53' thereon, are disposed.

The primary purpose of the terminal arrangement shown in Figure 10 as compared to that shown in Figure 5, is to more readily facilitate attaching the wires 15' and 16' to the respective terminals 40' and 41', since the wires 15' and 16' are attached to the respective terminals 40' and 41' while these terminals extend outwardly in a plane parallel to the longitudinal axis of the switch units 21'; that is, the wires 15' and 16' are connected to the respective terminals 40' and 41' before they are bent back toward the switch unit as shown in Figure 10. Thus, before the terminals 40' and 41' are bent back so the free ends face toward the casing 21' of the switch unit, the tabs or ears 52' and 53' of the terminal 40' extend outwardly away from the tabs 52' and 53' of the terminal 41'. On the other hand, it will be noted that when the two terminals 40 and 41 in Figures 2, 4 and 5 extend outwardly parallel to the longitudinal axis of the casing 41, the tabs 52 and 53 on the respective terminals 40 and 41 face toward each other making it difficult to attach the wires 15 and 16 thereto and also making it difficult to bend the tabs 52 and 53 as compared to the arrangement of the terminals 40' and 41' in Figures 7 to 10, inclusive.

After the wires 15' and 16' and the corresponding ends of the resilient covering 17' have been attached to the respective terminals 40' and 41', the neck portions 47' of the terminals 40' and 41' are bent past each other, as most clearly shown in Figure 10, and this is the reason why the neck portions 47' of the terminals 40' and 41' are offset with respect to each other and with respect to the longitudinal axis of the casing 21' and the bi-metallic switch arm 36'. Thus, the broad flat portion 46' of each terminal 40' and 41' is secured to one side of the exposed portion of the bi-metallic switch arm 36' and the free end or angularly disposed portion 50' overlies the opposite side of the exposed portion of the bi-metallic switch arm 36' from that which is engaged by the corresponding relatively broad flat portion 46'. This also facilitates forming the neck portions 47' with a relatively large radius when the free ends of the terminals 40' and 41' are bent back toward the casing 41', as compared to the radius of the neck portion 47 of each of the terminals 40 and 41 shown in the original form of the invention (Figures 2 to 5, inclusive).

In the drawings and specification, there has been set forth a preferred embodiment of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only, and not for purposes of limitation, the scope of the invention being defined in the claims.

We claim:

1. In a thermostatic switch assembly to which insulation covered wires of a heating element may be connected, comprising a thermoplastic stretchable tube heat-sealed and constricted at opposite ends thereof and through which constricted portions the wires extend, a switch unit disposed within said tube, at least one first terminal connected to a first end of said switch unit and at least one second terminal connected to a second end of said switch unit adjacent one side of the switch unit, the combination of an auxiliary wire attaching element spaced from the second terminal and connected to the side of the

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switch unit opposite from the side thereof to which the second terminal is connected, said auxiliary wire attaching element being in the form of a relatively thin plate provided with an aperture therein which is larger than the diameter of the insulation cover on the corresponding wire, said plate also having a slot in its free end communicating with said aperture and being of less width than the aperture and also being of less width than said insulation cover and through which the corresponding portion of a wire whose end is connected to the second terminal may be pressed to thereby loosely extend through the aperture whereby, upon excessive pulling force being placed on the wires extending from opposite ends of the tube and stretching said tube, the corresponding wire may be pulled outwardly through the slot in the auxiliary wire attaching element to thereby relieve stress on the terminals connected to opposite ends of the switch unit.

2. In a thermostatic switch assembly including a stretchable tube, wires entering opposite ends of said tube and having a resilient covering thereon, heat-sealed constrictions adjacent opposite ends of said tube, said wires being attached to said constrictions, a switch unit disposed within said tube and clamping means securing the wire attached to each constriction to the proximal end of said switch unit; the combination of a plate extending longitudinally from at least one end of said switch unit and being spaced

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from an open-ended wire clamping means at said one end, said plate having a wire receiving slot in its end adjacent the nearest constriction of said tube and being of slightly less width than the diameter of said covering whereby a medial portion of the wire attached to said nearest constriction may be frictionally retained in said slot to relieve stress in the clamping means upon placing said wires under sufficient tension to stretch said tube and pull the latter wire out of said slot.

3. An improved terminal for at least one end of a thermostatic switch assembly of the type which is enclosed in a heat-sealable tube and has insulated wires attached to opposite ends thereof and extending through sealed opposite ends of the tube; said improved terminal comprising a slotted member carried by and projecting from said end of the switch assembly and having an open-ended slot therein of less width than the insulation on the corresponding wire for frictionally retaining therein a medial portion of the corresponding wire.

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