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Skinner

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[45] **Oct. 28, 1975**

[54] **ELECTRIC HEATER ELEMENT CONNECTION ASSEMBLY**

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[73] Assignee: **Electro-Therm, Inc.,** Laurel, Md.

[22] Filed: **Jan. 15, 1975**

[21] Appl. No.: **541,174**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 444,168, Feb. 20, 1974, abandoned.

[52] **U.S. Cl.** ..... **219/335;** 29/621; 219/336; 219/541; 338/322; 339/95 D

[51] **Int. Cl.²** **F24H 1/00;** H05B 1/00

[58] **Field of Search** ..... 219/315, 316, 318, 320, 219/335, 336, 523, 541; 338/317, 322; 339/95 D; 29/611, 621

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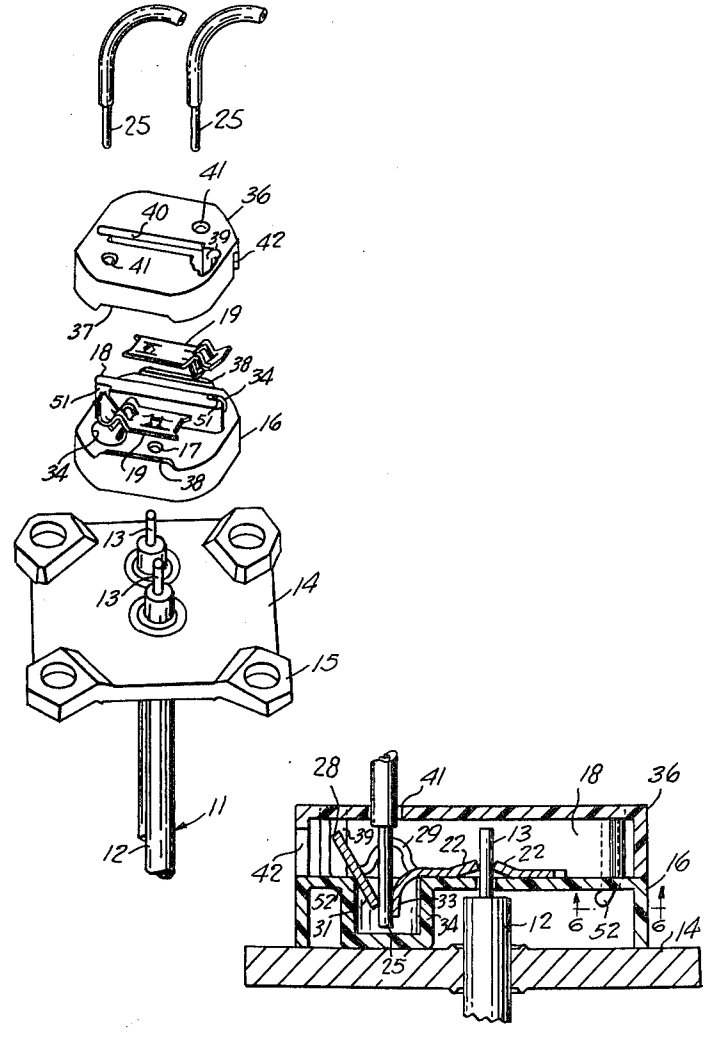
Primary Examiner—C. L. Albritton

Attorney, Agent, or Firm—Richard G. Kinney; Herman L. Gordon; Robert G. Petrinec

[57] **ABSTRACT**

The embodiment of the invention disclosed herein is directed to an electric heater element connection assembly which has a mounting flange for receiving rod-like end terminals of an electric heating unit. An insulating block member is mounted on the flange and the end terminals of the heating unit pass therethrough. The block member has an upstanding separating rib between the terminals, and resilient connection clips are lockingly engaged on the end terminals on opposite sides of the rib. Each clip has outwardly facing female terminal portions provided with gripping means defining a receptacle to receive and grip an inwardly-directed current supply wire. An insulating protective cover is secured over the block member and has apertures located in registry with the female terminal portions so that the current supply wire can be inserted therethrough. The cover has an opening through which a tool can be inserted for releasing the gripping action of the clip to allow the current supply wire to be disengaged.

20 Claims, 21 Drawing Figures



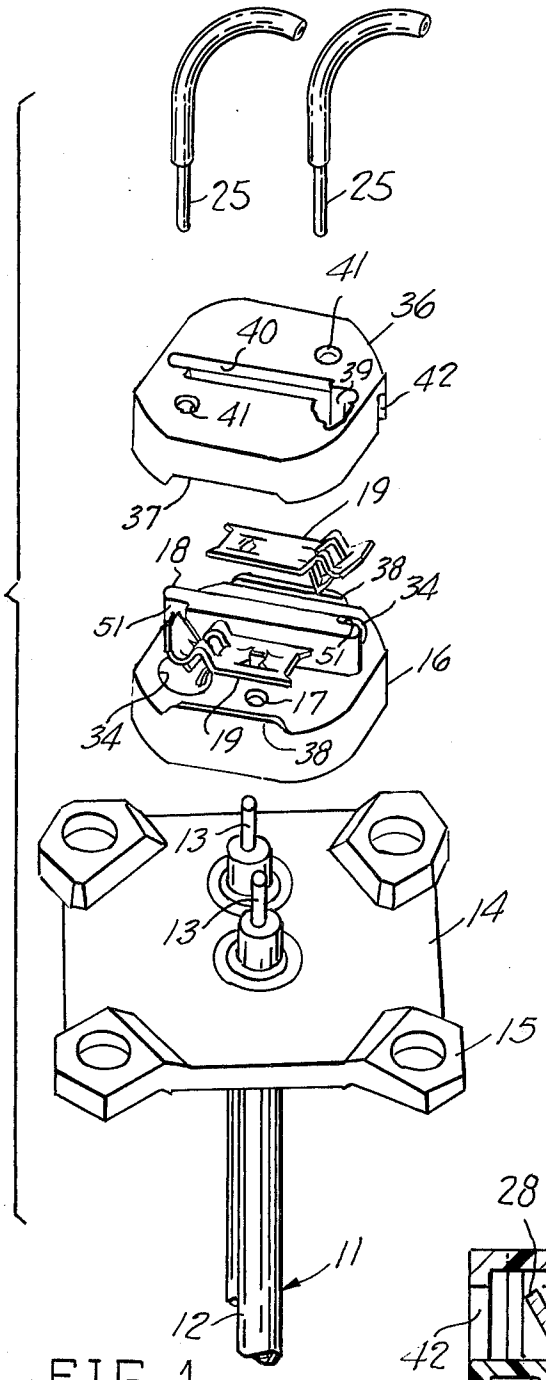


FIG. 1

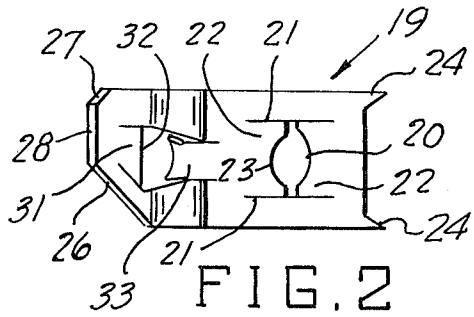


FIG. 2

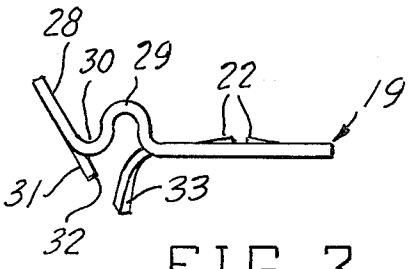


FIG. 3

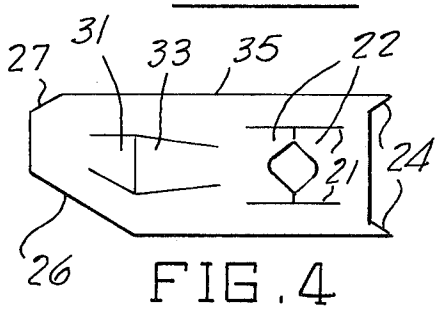


FIG. 4

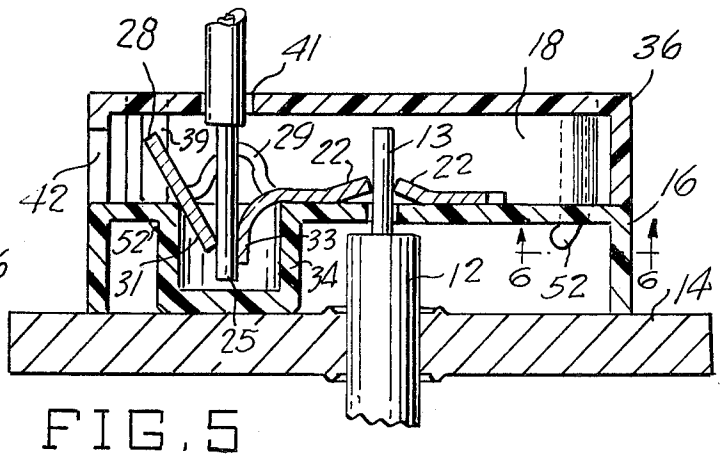


FIG. 5

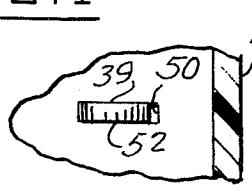


FIG. 6

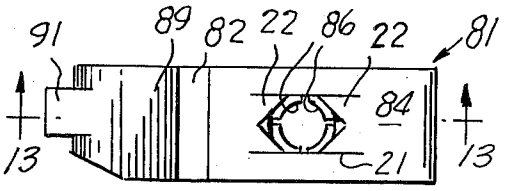


FIG. 12

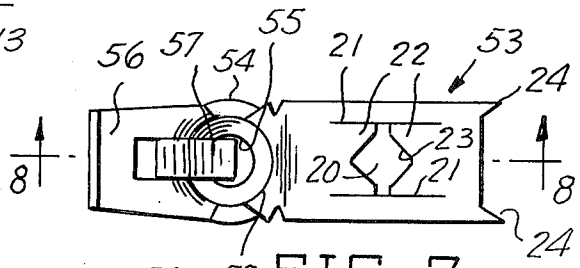


FIG. 7

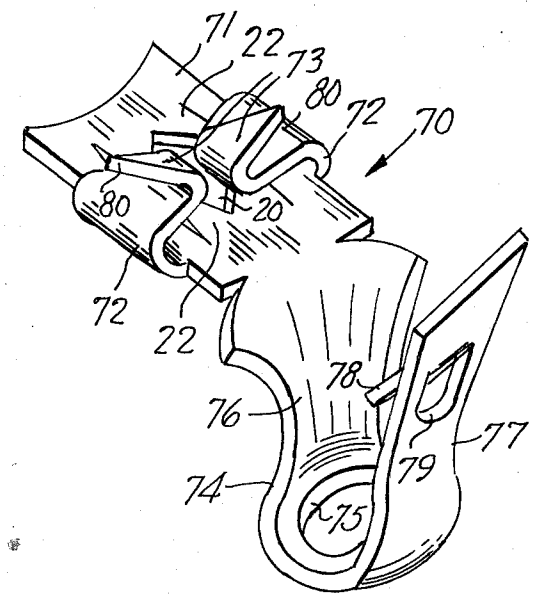


FIG. 11

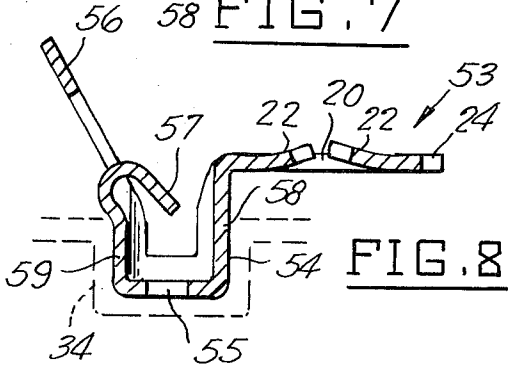


FIG. 8

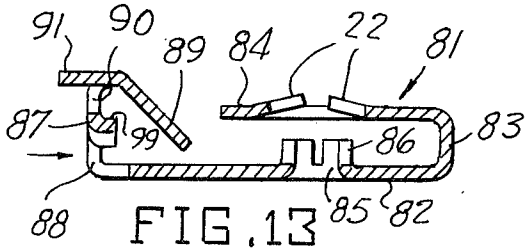


FIG. 13

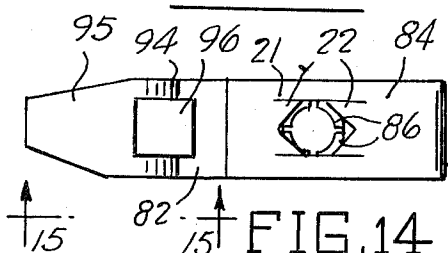


FIG. 14

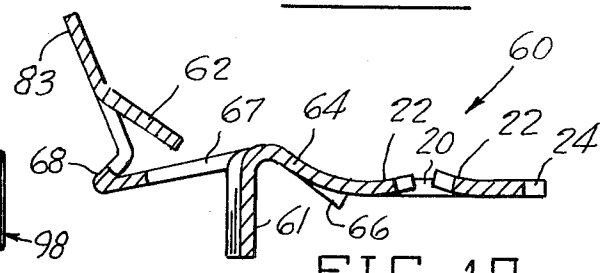


FIG. 10

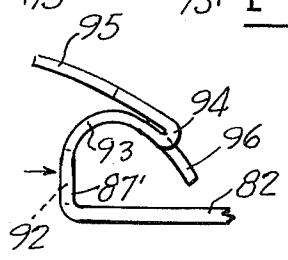


FIG. 15

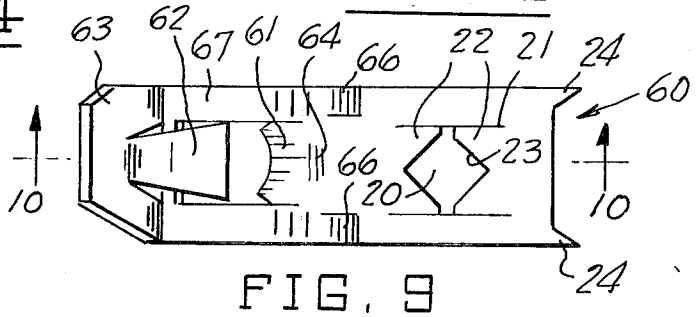


FIG. 9

Fig. 16.

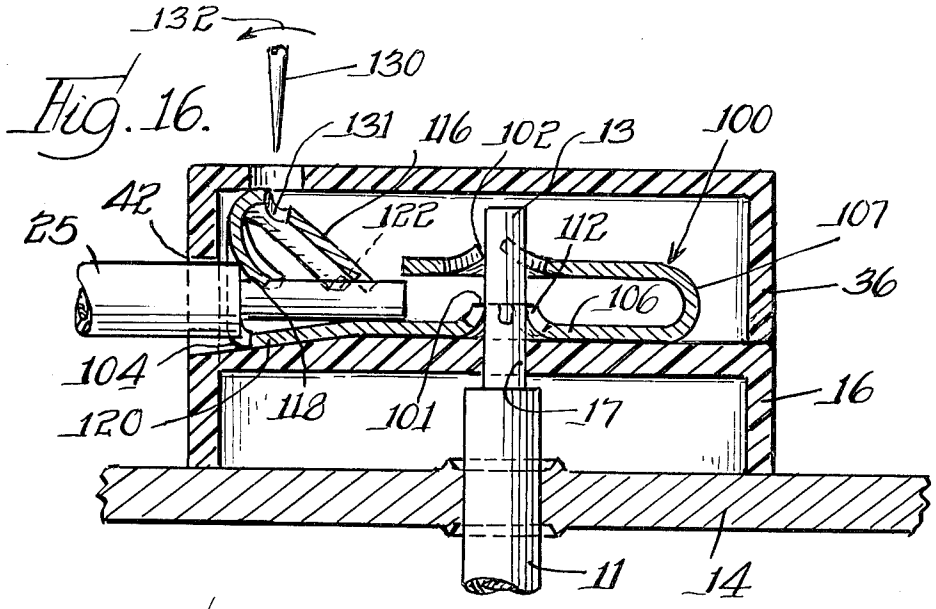


Fig. 17.

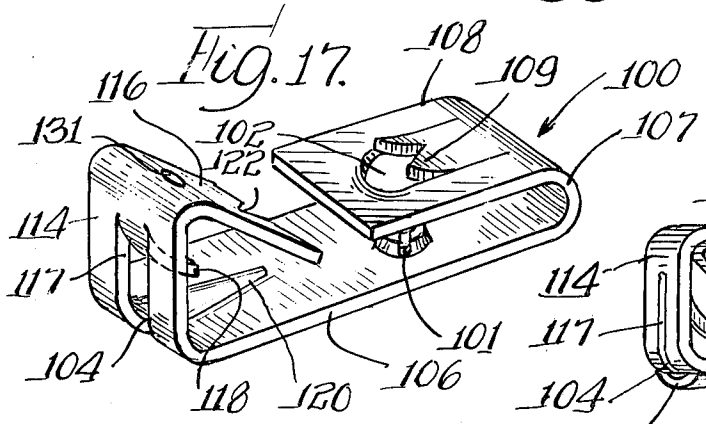


Fig. 18.

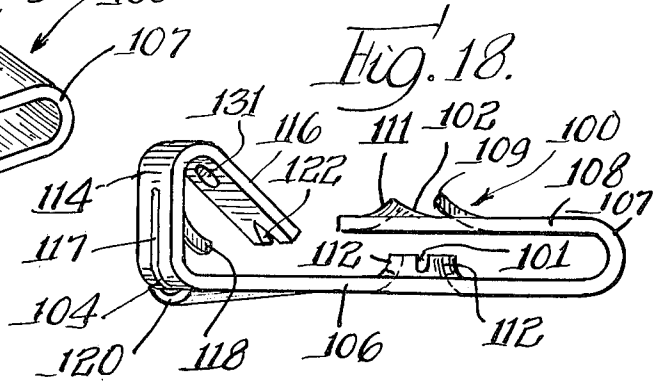


Fig. 20.

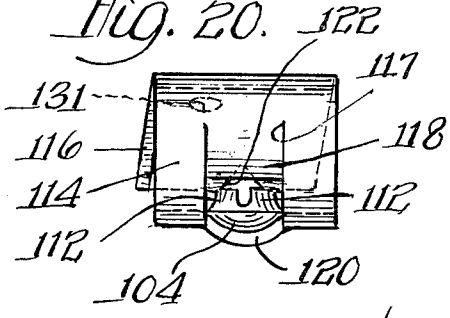


Fig. 19.

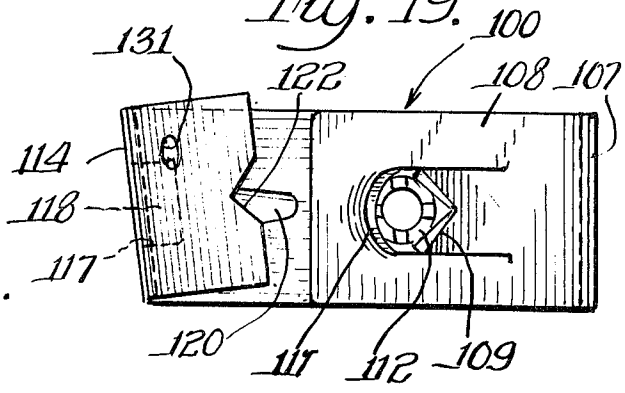
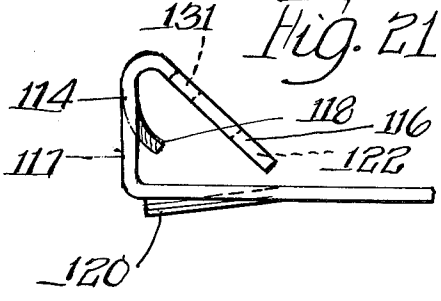


Fig. 21.



ELECTRIC HEATER ELEMENT CONNECTION ASSEMBLY

REFERENCE TO RELATED APPLICATION

This is a continuation-in-part of Ser. No. 444,168 filed Feb. 20, 1974 and now abandoned.

BACKGROUND OF THE INVENTION

This invention relates generally to electric heating elements, and more particularly, to structure for connecting power supply wires to electric heating elements, and the like.

The structure of this invention is provided with means for connecting current supply wires to an electric heating element of the type having resistance wire passing through and insulated from a metal outer sleeve. This type of heating element is commonly used in electric water heaters which are produced in relatively large numbers. The terminal structure used with the heating element arrangement of this invention enables a simplified construction technique and provides ease of mounting of the heating element to its hot water tank or vesse. Also, the connection of current supply wires to the terminal ends of the heating element is simplified, and can be accomplished without the use of a screwdriver or the like.

The electrical contact is provided with connecting lugs for receiving the heating element and holding them in a spaced relation relative to one another to facilitate the assembly of the heating element to its tank or vessel in a minimum of time. The terminal clip arrangement of the present invention is provided with means for receiving a release tool for releasing the current supply wire when necessary.

Briefly, the electric heating element is provided with a mounting flange and a pair of rod-like end terminals secured to and projecting from the flange. An insulating block engages the flange and has apertures to receive the rod-like end terminals. A conductive connecting clip is secured at one end thereof to each of the rod-like terminals and has an opposite end defining an outwardly facing female terminal element which includes spring means defining a yieldable receptacle to receive an inwardly directed current supply line when inserted therein. The current supply line can be readily removed, if necessary, by inserting a tool through an aperture formed in the insulating block to release the conductive clip.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of a portion of an electric immersion heating element and connection terminal structure therefor in accordance with the present invention;

FIG. 2 is an enlarged top plan view of a terminal connection lug employed in the exploded assembly shown in FIG. 1;

FIG. 3 is a side elevational view of the terminal connection lug of FIG. 2;

FIG. 4 is a top plan view of a blank stamping employed to form the terminal connection lug of FIGS. 2 and 3;

FIG. 5 is an enlarged vertical longitudinal crosssectional view taken through the assembled connection terminal structure of FIG. 1, with a power supply wire inserted therein;

FIG. 6 is an enlarged fragmentary horizontal crossectional view taken substantially on line 6—6 of FIG. 5;

FIG. 7 is a top plan view similar to FIG. 2, but showing a modified form of terminal connection lug according to the present invention;

FIG. 8 is a cross-sectional view taken on line 8—8 of FIG. 7;

FIG. 9 is a top plan view of another modified form of terminal connection lug according to the present invention;

FIG. 10 is a cross-sectional view taken on line 10—10 of FIG. 9;

FIG. 11 is an enlarged perspective view of still another modified form of terminal connection lug according to the present invention;

FIG. 12 is a top plan view of still another form of terminal connection lug according to the present invention;

FIG. 13 is a longitudinal vertical cross-sectional view taken substantially on the line 13—13 of FIG. 12;

FIG. 14 is a top plan view of still another form of terminal connection lug constructed in accordance with the present invention;

FIG. 15 is a fragmentary elevational view taken substantially on the line 15—15 of FIG. 14;

FIG. 16 is a side elevational sectional view of an alternate embodiment of the heating element clip structure of this invention;

FIG. 17 is a perspective view of the electrical contact portion of the clip structure shown in FIG. 16;

FIG. 18 is a side view of the conductive clip seen in FIG. 17;

FIG. 19 is a top view of the clip of FIG. 18;

FIG. 20 is an end view of the clip of FIG. 19; and

FIG. 21 is an enlarged fragmentary end view of the clip of FIG. 17.

SUMMARY OF THE INVENTION

Referring to the drawings, and more particularly to FIGS. 1-5, 11 designates a heating element of known design, of the type employed in water immersion heaters. The element 11 has a metal outer sheath 12 containing a heater wire embedded in refractory insulation material, and at the ends of the sheath a pair of rod-like end terminals 13, 13 project axially therefrom for connecting the heater wire to a suitable source of current.

Heretofore, suitable terminal lugs have been welded to the end terminals 13, 13, the terminal lugs being tapped to receive connection screws, or other special connection devices have been welded to said end terminals. The necessity of welding pieces to said end terminals has been a considerable cost factor in the fabrication of the heating element assembly, and the need for employing tapped or threaded fastening elements for connecting the power supply wires thereto has also increased its cost as well as the time and labor involved in its installation.

The element 11 is provided with a metal mounting flange 14, rigidly secured thereto, and having apertured corner lugs 15 for securing the element 11 to the wall of a water heater tank with the element projecting into the tank.

In accordance with the present invention, a hollow insulating block member 16 is engaged over the upwardly protruding end portions of heating element 11 on flange 14, the top wall of block member 16 being formed with apertures 17 located to receive the up-

standing rod-like end terminals **13, 13** so that these project above said top wall.

The insulating block member **16** is integrally formed with an upstanding separator rib **18** extending between the apertures **17.** Respective resilient conduction connection clips **19, 19** are lockingly engaged on the rod-like end terminals **13, 13** and thereby fasten block member **16** onto flange **14,** the clips or lugs **19** fitting snugly on opposite sides of the separator rib **18.**

As shown in FIG. **2,** each clip **19** has an opening **20** at one end portion thereof and is slit longitudinally on parallel lines at **21, 21** to define a pair of opposing spring jaws **22,22** , said jaws being notched out at their inner edges, as shown at **23,** to provide gripping edges conforming generally with the cylindrical contour of the end terminals **13.** The opposing jaws **22, 22** may be somewhat upwardly inclined, as shown in FIG. **3.**

The corners of the clips **19** adjacent the jaws **22, 22** are preferably formed with triangular spurs **24** adapted to improve the holding action of the clip members.

The opposite end portion of each clip **19** is formed to define an upwardly facing female terminal element adapted to receive a downwardly directed power supply wire **25.** Thus, as shown in FIGS. **2** and **3,** the clip body is formed with a large bevel **26** at one side and a small bevel **27** at the opposite side and is sinusoidally shaped inwardly therefrom to thereby define an upwardly and leftwardly inclined end tab **28** and an upwardly convex transverse crest **29,** with a trough **30** therebetween, as viewed in FIG. **3.** The lower portion of tab **28** is struck downwardly to define a downwardly and inwardly inclined gripping jaw **31** with a transverse bottom gripping edge **32.** Opposite jaw **31** the clip is struck downwardly to define a depending tongue **33** which is trough-shaped and is thus arcuately shaped to conformably receive a wire **25** and to provide a relatively rigid bearing for said wire as it is grippingly engaged by the opposing transverse jaw edge **32.**

The block member **16** is integrally formed with respective diagonally opposite cylindrical chambers **34, 34** of sufficient size to freely receive the depending gripping arms **31, 33** of the clips **19** and to thereby assist in properly positioning the clips.

The clips **19** may be formed from flat stampings **35** of suitable spring metal, such as shown in FIG. **4.**

Designated at **36** is an insulating cover cap shaped to fit on the block member **16** and having a slot **40** in its top wall shaped to conformably receive the separator rib **18.** The front and rear walls of cover cap **36** are formed with shallow notches **37** to conformably receive upstanding low position ribs **38** integrally formed on the front and rear edges of the block member **16,** as viewed in FIG. **1.** Cover cap **36** is provided with integral depending, somewhat resilient, opposing locking lugs **39, 39** adapted to be lockingly received through slots provided therefor in the top wall of the block member **16** and to catch under the inner ends of the slots so that the cover cap may be snap-locked over the block member **16** in the covering position thereof shown in FIG. **5.**

The top wall of cover cap **36** is formed with diagonally opposite apertures **41, 41** located to register vertically with the respective upwardly facing female terminal elements defined by the pairs of cooperating gripping members **31, 33** above described. Thus, apertures **41** allow supply wires **25, 25** to be inserted and to be pushed downwardly into gripping engagement between the respective pairs of cooperating gripping members **31, 33.**

The side walls of the cover cap **36** are formed with respective vertical slots **42** located outwardly adjacent the upwardly inclined spring tabs **28** so that, if desired, a tab may be flexed inwardly by inserting a simple tool, such as a screw driver blade, or the like, thereby causing the bottom gripping edge **32** associated therewith to be disengaged from a supply wire **25,** whereby the supply wire may be withdrawn from the female terminal assembly. This provides a simple, rapid and safe means for disconnecting the supply wires from the heater unit when necessary.

In assembling the unit, the block member **16** is positioned on the flange **14** with the heater end terminals **13, 13** extending through the apertures **17, 17** and the clips **19** are then pushed onto the terminals **13, 13,** with said terminals grippingly received between the respective pairs of gripping jaws **22, 22** and the clips disposed on opposite sides of the separator rib **18,** with the pairs of cooperating gripping arms **31, 33** received in the chambers **34.** The cover cap **36** is then snap-locked over the block member **16** as above described, with rib **18** received in slot **40** and the lugs **39, 39** lockingly engaged through the slots provided therefor in the top wall of block member **16.**

The assembled unit may thereafter be mounted in a water heater tank in a well known manner, being fastened thereto by bolts, or the like, engaged through the apertured corner lugs **15.** The supply wire connections may then be made by merely inserting the supply wires **25** through the apertures **41** to engage the wires between the respective pairs of cooperating gripping arms **31, 33** in the manner above described.

As previously mentioned, the cover cap **36** has the depending resilient locking lugs **39, 39** lockingly engaging through slots in the top wall of block member **16,** one of said slots being shown at **50** in FIG. **6.** To facilitate the mounting of the cover cap, the separator rib **18** is provided at its ends with opposite vertical guide recesses **51, 51** in which said locking lugs **39** are slidably engageable as the cover cap is pushed downwardly onto the block member **16.** The locking lugs have enlarged detent elements **52** at their bottom ends which catch beneath the inner ends of the slots **50** as the cover cap reaches its final position.

In the modification shown in FIGS. **7** and **8,** the connection clip, shown at **53,** has structure for grippingly engaging a heater end terminal **13** similar to that of FIGS. **2** and **3,** but is provided with an upwardly facing depending female terminal element **54** which is generally cup-shaped and U-shaped, having inner and outer substantially rigid side arms **58** and **59** and having a bottom circular aperture **55.** At its outer side arm **59,** namely, its left side, as viewed in FIGS. **7** and **8,** the female terminal element is formed with an upwardly and outwardly inclined resilient tab member **56** which has an inwardly struck resilient jaw portion **57** extending downwardly and rightwardly in the cup-shaped terminal element. The resilient jaw portion **57** and the opposing rigid concave gripping arm portion **58** of member **54** define a receptacle therebetween to receive a downwardly directed supply wire **25** in the same manner as with the previously described embodiment shown in FIGS. **2** and **3.**

The cup-shaped terminal elements **54** are nestingly receivable in the insulating chambers **34** of the associated hollow insulating block **16.**

In the modification shown in FIGS. 9 and 10, the connection clip, shown at 60, has structure for grippingly engaging a heater end terminal similar to that previously described in connection with FIGS. 2, 3 and 7, 8, but is provided with an upwardly facing female terminal element defined by a substantially rigid downwardly struck leftwardly concave gripping arm 61 and a downwardly and rightwardly extending resilient gripping jaw 62 struck rightwardly from an upwardly and leftwardly inclined resilient tab member 63 provided at the left end of the body of the clip. As shown in FIG. 10, the intermediate portion of the clip slopes upwardly and leftwardly at 64, the leftwardly concave vertical rigid arm depending from the crest of the intermediate portion of the clip. Respective anchoring spurs 66, 66 are struck downwardly at opposite sides of the sloping portion 64. The body of the clip slopes downwardly and leftwardly from its crest, as shown at 67, and is formed at 68 with a sharp U-bend, with the resilient tab member 63 extending upwardly and leftwardly from the top arm of said U-bend, as viewed in FIG. 10. The resilient jaw 62 and the rigid opposing concave gripping arm 61 define a receptacle therebetween to receive a downwardly directed supply wire 25. The members 61 are receivable in the insulating chambers 34 of the associated insulating block 16.

In the embodiment illustrated in FIG. 11, the connection clip, shown at 70, has a flat portion 71 formed with a pair of opposed gripping jaws 22, 22 and with a pair of upwardly and inwardly extending, cooperating, resilient, outwardly pointed contact arms 72, 72 of sinuous shape and having opposingly convex contact portions 73, 73 located immediately above the aperture 20 between the gripping jaws 22, 22. The clip is formed rightwardly of portion 71, as viewed in FIG. 11, with an upwardly facing depending female terminal element 74 which is generally cup-shaped and which has a bottom aperture 75. The member 74 has the inwardly concave inner rigid arm portion 76 and the outer upstanding inwardly concave portion 77. The top portion of member 77 is inwardly struck at 79 to define a downwardly and inwardly extending resilient gripping jaw 78. The resilient gripping jaw 78 and the rigid opposing concave gripping arm 76 define a receptacle therebetween to receive a downwardly directed supply wire 25.

When the arms 72, 72 are flexed outwardly by the engagement of a heater terminal element 13 therebetween, the pointed top ends thereof, shown at 80, 80, which are laterally directed, will bite into the adjacent wall portions of cap 36 and rib 18 and act to securely anchor the clip at this region. The cup-shaped elements 74 are receivable in the chambers 34 as in the previously described embodiments of the invention.

In the embodiment shown in FIGS. 12 and 13, the connection clip, shown at 81, comprises a strip of spring metal formed to define a flat bottom element 82, with a U-bend 83 at one end to define an arm 84 overlying and parallel to bottom element 82. Bottom element 82 is upwardly struck at 85 to define a circular aperture with upstanding quarter-cylindrical flanges 86 defining an integral guide collar for a heater element terminal rod 13. Above aperture 85 the upper arm 84 is struck out and formed with the opposing pair of gripping jaws 22, 22, as in the previously described connection clips. At its other end the strip is formed with the upstanding arm 87, struck inwardly at 88 to define a wire-receiving aperture, with a top inwardly extending guide flange 99. The upper portion of arm 87 is bent inwardly to define the inwardly and downwardly inclined resilient gripping tongue 89 cooperable with the bottom non-yielding support element 82 to resiliently grip a wire inserted through aperture 88. The top corner portion of arm 87 is struck outwardly at 90 to define a release lug 91. In this embodiment the supply wire is inserted substantially horizontally instead of vertically, and the adjacent wall of the associated cover cap, when used, is formed with a slot or aperture for allowing the supply wire to be inserted through the aperture 88.

FIGS. 14 and 15 illustrate a further form of connection clip, shown generally at 98, generally similar to that of FIGS. 13 and 14, but wherein the upstanding wire-entry end arm, shown at 87', is formed with a wire-receiving aperture 92 and is inwardly arcuately curved at its top portion, as shown at 93, and then is reversely bent, as shown at 94, to define the upwardly and outwardly inclined end tab 95. The portion adjacent bend 94 is struck inwardly to define the downwardly and inwardly extending spring gripping lug 96 cooperable with the non-yielding bottom element 82 to resiliently grip a supply wire inserted through aperture 92.

Referring now to FIGS. 16, 17, 18, 19, 20 and 21 there is seen an alternate embodiment of the resilient conductive connection clip used in accordance with the principles of this invention and is here designated generally by reference numeral 100. The resilient conductive connection clip 100 is mounted on the block member 16 and covered by the cover cap 36 substantially in the same manner as set forth hereinabove with regard to the resilient conductive connection clip 19 of FIG. 1.

In this embodiment, the cold pin 13 of the heating element 11 passes through the aperture 17 of the block member 16 and is inserted into a pair of vertically spaced-apart aligned spring portions 101 and 102 forming a pair of gripping means about the periphery of the cold pin. This feature substantially increases the mechanical and electrical connection made between the resilient conductive connection clip 100 and the cold pin 13.

The current supply wire 25 is inserted through the aperture 42 and into the other end of the resilient conductive connection clip 100 through a tapered passage 104. This passage provides an increase in contact surface area between the resilient conductive connection clip 100 and the bare end portion of the current supply line 25. At the high current flow required for heating elements of the type disclosed herein this maximum surface contact arrangement reduces the resistance of the connection and hence, increases the efficiency of the heater element.

The resilient conductive connection clip 100 is provided with a first flat run portion 106 leading into a bight portion 107 which, in turn, leads into a second flat run portion 108. The first and second flat run portions 106 and 108, respectively, combine to form a first spring means, which includes the two spring portions 101 and 102, for receiving the cold pin 13. In this particular embodiment, the flat run portion 108 is provided with a single jaw element 109 which cooperates with an angularly disposed arcuately shaped opposite edge 111 to form the spring portion 101. The straight run portion 106, on the other hand, is provided with a plurality of upwardly turned portions 112 preferably defining an inner diameter which is less than the diame-

ter of the cold pin **13.** Therefore, forceful insertion of the cold pin **13** through the spring portion **102** formed by the upwardly turned portions **112** will cause firm electrical and mechanical connection therewith.

The other end of the resilient conductive connection clip **100** has a turned-up portion **114** leading into an angularly disposed downwardly directed spring portion **116.** An aperture **117** is provided through the turned-up portion **114** and includes spring contact **118** formed by a struck-out and bent portion of the end **114.** An arcuately shaped trough section **120** is provided to form the tapered passage **104.** This trough section preferably is of a configuration to conform substantially to the cylindrical surface of a conductive lead **25** inserted therein. The trough section **120** provides for maximum electrical contact area along the length of the bared portion of the electrical lead.

The spring portion **116** has a notch **122** formed at the terminating edge **123** thereof. The bared portion of the lead **25** is inserted so as to be straddled by the notch **122** which, in turn, makes electrical contact therewith. Therefore, the end of the resilient conductive connection clip **100** receiving the current supply line provides two spaced-apart electrical spring contact elements or portions **116** and **118** and provides maximum contact surface area along the trough **120.**

As best seen in FIGS. **20** and **21,** the spring portion **116** has an initial configuration on which extends toward the flat run **106** a distance greater than the top edge portion of the bared conductive wire to be inserted therein. Therefore, the bared portion of the wire must be forced into the aperture **117** against the spring pressure provided. The relatively sharp edges formed by the notch **122** and the spring portion **118** cause a digging or galling action into the bared portion of the conductive lead to form a good electrical connection and prevents removal of the wire.

In accordance with another aspect of this alternate embodiment, a tool, FIG. **16,** designated generally by reference numeral **130,** may be inserted through the opening **41** to pass into a relatively small aperture **131** formed in the spring portion **116.** After the tool is inserted, it can be pivoted in the direction of the arrowed line **132** to release the notch **122** and the bottom edge of the spring portion **118** from engagement with the conductive wire. This will enable the wire to be removed if necessary for repairs.

While several specific embodiments of the present invention have been illustrated herein for providing an improved heating element assembly, it will be understood that variations and modifications may be effected without departing from the spirit and scope of the novel concepts as set forth in the following claims. For example, the cold pin or rod terminal connection construction of one of the specific embodiments detailed herein may be used with the current wire receiving construction of another of the embodiments and, in at least its broader aspects, the present invention includes the use of conventional connecting means for the cold pin clip connection and the inventive connection for the current wire and vice versa.

Thus it is the intent of the following claims to define the present invention as broadly as permitted and commensurate with its contribution to this art.

What is claimed is:

1. An electric heating element having a mounting flange and a pair of rod-like end terminals rigidly secured in and projecting from said mounting flange, an insulating block member engaged on said flange and having spaced apertures through which said rod-like end terminals extend, and respective conductive connection clips, each clip having at one end portion thereof an opening receiving a respective rod-like end terminal and spring jaws at opposite sides of the opening grippingly engaging the end terminal and having an opposite end portion defining an outwardly facing female terminal element having a pair of opposing cooperating inwardly converging gripping arms defining a yieldable receptacle to receive an inwardly directed supply wire, said opposing gripping arms being formed to grippingly engage and establish electrical contact with said inwardly directed supply wire and to resist withdrawal of said supply wire.

2. The heating element assembly of claim **1,** and wherein said female terminal element has a flexible free end, and means to release the gripping arms responsive to flexure of said free end.

3. The heating element assembly of claim **1,** and wherein said female terminal element has a flexible free end and one of the gripping arms is formed as part of said free end, and the other gripping arm is located opposite said one gripping arm and is substantially unyielding.

4. The heating element assembly of claim **3,** and wherein said unyielding gripping arm is concave to substantially conform with the contour of the inwardly directed supply wire.

5. The heating element assembly of claim **1,** and wherein one of the pair of gripping arms is concavely formed to conformably receive the inwardly directed supply wire and the other gripping arm is resilient and has a transversely extending gripping end edge to hold the supply wire against the concavely formed arm.

6. The heating element assembly of claim **5,** and wherein said other gripping arm is provided with a free end portion which can be engaged to flex said other gripping arm in a direction to release the associated supply wire.

7. The heating element assembly of claim **1,** and an insulating cover cap having respective apertures registering with said pairs of gripping arms for receiving said respective inwardly directed supply wires inserted between the pairs of gripping arms.

8. The heating element assembly of claim **7,** and wherein said block member is formed with an upstanding separator rib extending between said first-named apertures, said cover cap being formed with a slot to comformably receive said separator rib.

9. The heating element assembly of claim **8,** and wherein the female terminal elements have resilient free end portions formed to release the supply wires responsive to flexure, and wherein said cover cap is formed with apertures located adjacent said free end portions for at times receiving a releasing tool for flexing said free end portions.

10. The heating element assembly of claim **9,** and wherein said block member is formed with positioning means receiving at least one of each pair of gripping arms.

11. The heating element assembly of claim **1,** and wherein said block member is formed with an upstanding separator rib extending between said first-named apertures, said connection clips being disposed on opposite sides of the separator rib with their inner longitudinal edges located adjacent the separator rib.

12. An electric heating element having a mounting flange and a pair of rod-like end terminals rigidly secured in and projecting from said mounting flange, an insulating block member engaged on said flange and having spaced apertures through which said rod-like end terminals extend, and respective conductive connection clips, each clip having at one end portion thereof opening means receiving a respective rod-like end terminal and first spring means adjacent said opening for grippingly engaging the end terminal and having an opposite end portion defining an outwardly facing female portion having second spring means defining a yieldable receptable to receive an inwardly directed current supply wire for grippingly engaging and establishing electrical contact with said inwardly directed current supply wire and to resist withdrawal of said current supply wire.

13. An electric heating element as set forth in claim 12 wherein said one end portion has a first flat run leading into a bight portion which, in turn, leads into a second flat run spaced from said first flat run, and said opening means is formed by a pair of spaced-apart aligned apertures formed in said first and second flat runs for providing two discrete areas of electrical contact with said rod-like end terminal.

14. An electrical heating element as set forth in claim 13 wherein said first flat run has a turned-up portion at said opposite end thereof, said turned-up portion having a second bight portion formed therein and extending downwardly toward said first flat run to form said second spring means for releasably securing said current supply wire.

15. An electric heating element as set forth in claim 13 wherein said opposite end portion has an opening formed in said turned-up portion and wherein said first flat run has a concave portion in alignment with said opening, said concave portion having a radius substantially equal to the radius of said current supply line to provide maximum surface area contact with said current supply line.

16. An electric heating element having a mounting flange and a pair of rod-like end terminals rigidly secured to and projecting from said mounting flange, an insulating block member engaged on said flange and having spaced apertures through which said rod-like end terminals extend, and respective conductive connection clips, each clip having at one end portion thereof means for connecting a respective one of said rod-like end terminal thereto, and having an opposite end portion defining an outwardly facing female terminal element having spring means defining a yieldable receptacle to receive an inwardly directed current supply wire for grippingly engaging and establishing electrical contact with said inwardly directed current supply wire and to restrict withdrawal of said current supply wire.

17. An electric heating element as set forth in claim 16 wherein said spring means is formed by a pair of spaced-apart resilient portions formed integral with said opposite end and arranged to define said outwardly facing female end terminal.

18. An electric heating element as set forth in claim 17 wherein one of said pair of spaced-apart resilient portions is formed from a struck-out portion formed within said opposite end and wherein the other of said pair of spaced-apart resilient portions is formed by the terminating edge of said opposite end.

19. An electric heating element as set forth in claim 18 further including trough means formed along said clip means and terminating immediately adjacent said one of said pair of spaced-apart resilient portions to form a gradually tapering entrance between said pair of spaced-apart resilient portions.

20. An electric heating element comprising a mounting flange; a pair of rod-like end terminals rigidly secured to and projecting from said mounting flange; insulating block means for mounting on and coupling to said flange and said pair of rod-like end terminals, said block means defining aperature means into and through which said rod-like terminals are inwardly received, and a pair of conductive connection clips on said block means, each of said clips having one end portion defining means for connection with an inwardly directed current supply terminal and another end portion defining means for connection with one of said rod-like end terminals, and wherein at least one of said means for connection of said clip is a yieldable receptacle for receiving its terminal as the terminal is inwardly directed and for grippingly engaging and establishing electrical contact with said terminal and for restricting withdrawal of said terminal, whereby the terminal is both electrically and mechanically connected to the clip and also thereby mechanically secured to the clip and block means.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,916,149 Dated October 28, 1975

Inventor(s) Charles A. Skinner

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

Column 7, line 28, delete "on".

Column 9, line 26, delete "electrical" and insert -- electric -- .

Signed and Sealed this

Twenty-fourth Day of August 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks

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