United States Patent

Finch

[15] **3,699,306**

[45] **Oct. 17, 1972**

[54] **TEMPERATURE CONTROLLED SOLDERING IRON**

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[73] Assignee: **General Electric Company**

[22] Filed: **March 1, 1971**

[21] Appl. No.: **119,498**

[52] **U.S. Cl.** **219/241,** 219/236, 219/238, 219/533, 219/541, 228/55, 339/58

[51] **Int. Cl.**.....**H05b 1/02,** B23k 3/04, H01r 11/02

[58] **Field of Search**.....219/221–242, 533, 219/541, 241, 240, 236–239; 339/58, 108; 228/51–55

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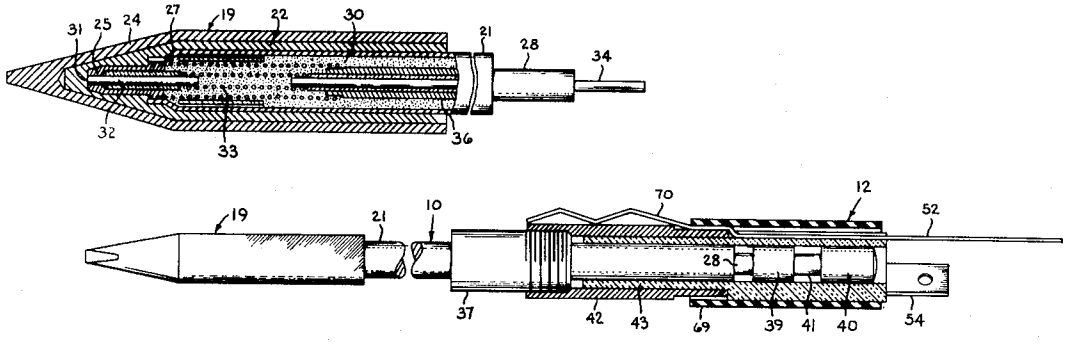
[57] **ABSTRACT**

A temperature controlled soldering iron includes an elongated heater assembly with a hollow soldering tip at one end containing a heating element and a temperature sensing element which is responsive to the temperature of the tip. The heater assembly carries a plurality of longitudinally spaced exposed contacts which are connected to the terminals of the heating element and the temperature sensing element. A connector assembly detachably receives the heater assembly and includes a plurality of spring strip conductors mounted in longitudinally extending slots formed in the exterior surface of a hollow insulator into which the other end of the heater assembly extends. The spring strip conductors are captivated and secured in position on the insulator by an insulating sleeve and have terminal portions exposed beyond the end of the connector assembly and have contact portions which are detachably electrically connected to the contacts on the heater assembly when the latter is inserted into the connector assembly. The connector assembly is releasably retained in a bore of an insulating handle through which extends a power cord having conductors which are connected to the terminal portions of the spring strip conductors.

15 Claims, 10 Drawing Figures



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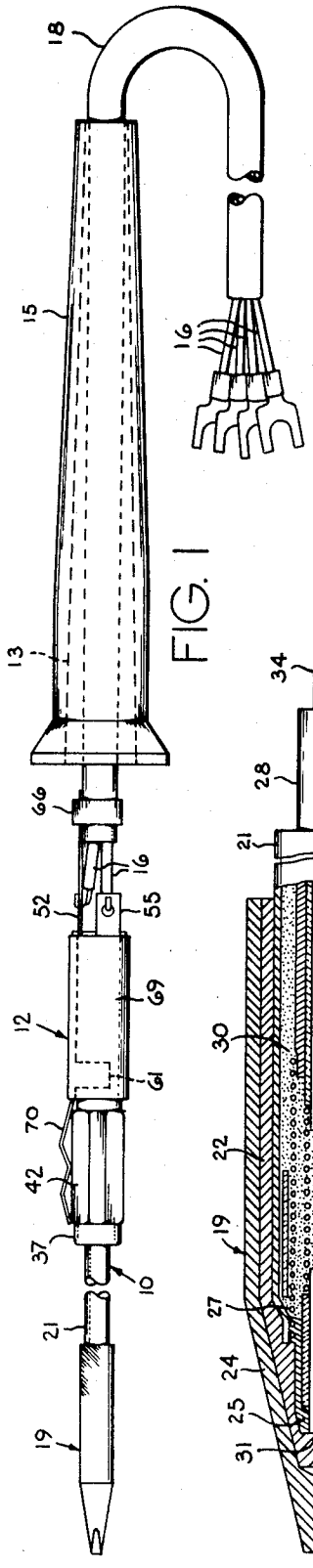

FIG. 1

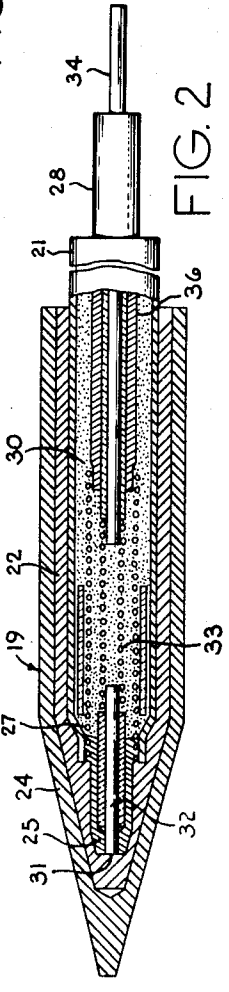

FIG. 2

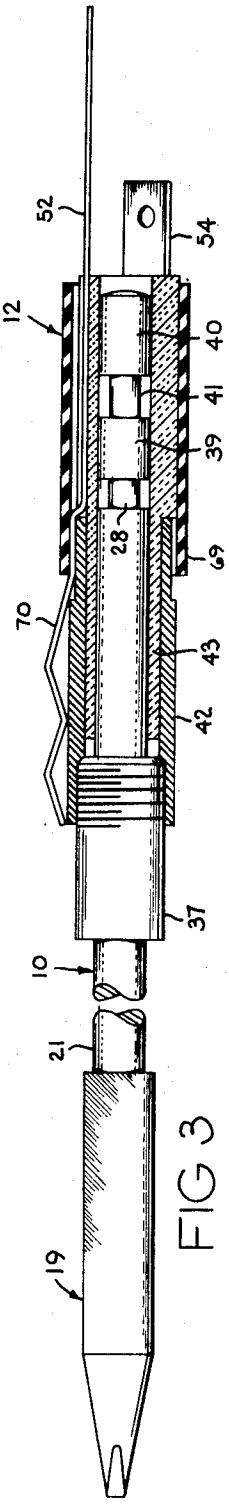

FIG 3

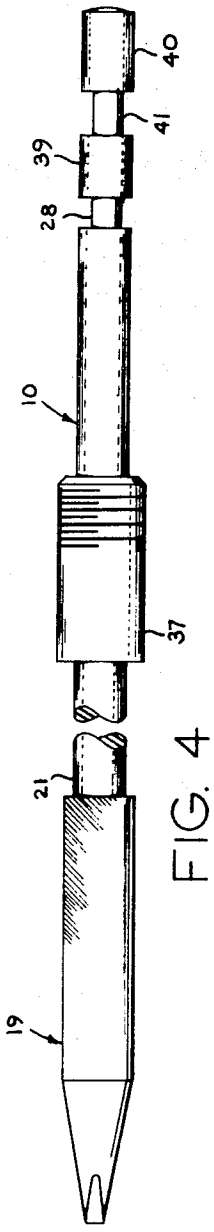

FIG. 4

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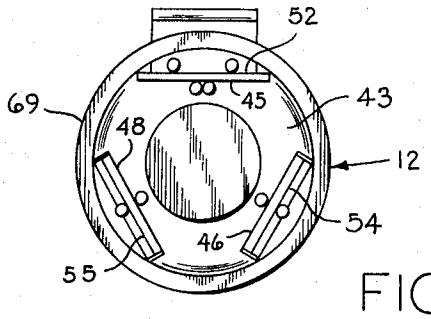

FIG. 5

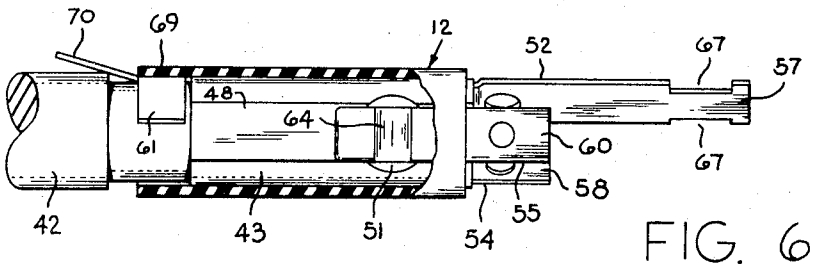

FIG. 6

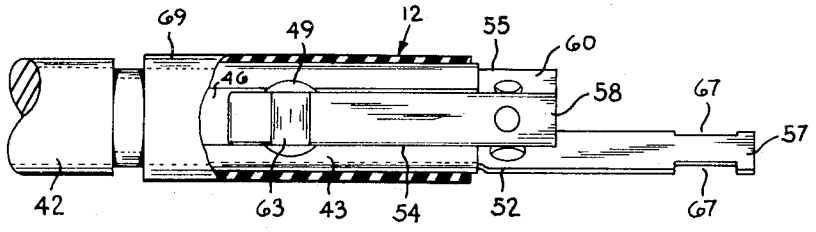

FIG. 7

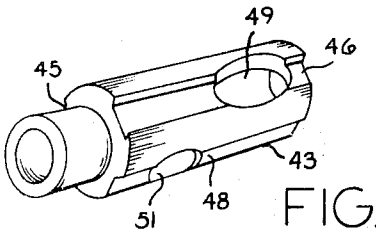

FIG. 9

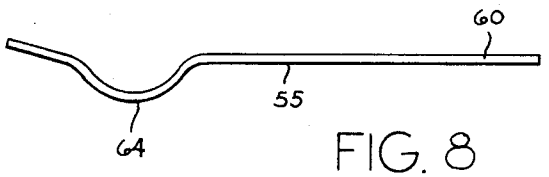

FIG. 8

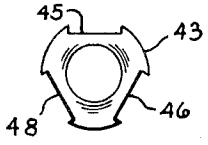

FIG. 10

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TEMPERATURE CONTROLLED SOLDERING IRON

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to temperature controlled electric resistance heating devices and more particularly to temperature controlled soldering irons.

2. Description of the Prior Art

One known construction of a temperature controlled soldering iron comprises a heating assembly including a metallic sheath at one end of which is mounted a hollow soldering tip and within which is positioned a helical resistance heating element extending coaxially of the sheath and which is embedded in suitable electrical insulation. A temperature sensing element, such as a thermocouple, is located within the tip adjacent its front end and provision is made for electrically connecting the terminals of the heating element and the thermocouple to terminals on the heating assembly which in turn are connected to conductors of a power cord. The heating assembly is retained within a bore formed in an insulating handle so as to permit easy manipulation of the soldering iron. An example of such prior art construction is found in U.S. Pat. No. 2,897,335 assigned to the assignee of the present invention.

Previous designs for connecting the terminals of the heating element and the thermocouple to conductors of a power cord, and also for retaining the heater assembly within the handle, have not been entirely satisfactory in that they have resulted in soldering irons of bulky multi-part construction which are difficult to assembly and disassemble. There is therefore a need for an improved arrangement for connecting the terminals of the heating element and the thermocouple to conductors of a power cord and for also retaining the heater assembly within the associated handle.

OBJECTS OF THE INVENTION

It is therefore an object of the present invention to provide a novel and improved temperature controlled electric resistance heating device which is easy to manufacture and assemble and which includes a minimum number of inexpensive parts.

It is another object of the present invention to provide such a heating device including a heating assembly detachably received within a female connector assembly which in turn is releasably retained in a handle, with the heating and connector assemblies being readily assembled and disassembled relative to each other.

It is a further object of the present invention to provide such a heating device wherein the heating assembly is attached to the connector assembly simply by pushing the rear end of the heating assembly into the connector assembly and thereafter rotating the heating assembly to effect a threaded connection, the heating assembly being detached from the connector assembly by reversing the attaching procedure.

SUMMARY OF THE INVENTION

In carrying out the invention in one preferred form a temperature controlled electric resistance heating device includes an elongated heater assembly detachably received within a connector assembly

which in turn is releasably retained within the bore of a handle. The heater assembly includes a metallic sheath carrying at one end a hollow tip containing a heating element and a thermocouple which is responsive to the temperature of the tip. The heating assembly carries three longitudinally spaced contact rings exposed at its exterior and connected to the terminals of the heating element and the thermocouple. One of the contact rings is externally threaded for threaded engagement with an internally threaded bushing forming part of the connector assembly. The latter includes a plurality of spring strip conductors positioned on the exterior of a hollow insulator which is coaxial with the bushing and which has openings communicating with its hollow through which extend contact parts of two of the spring strip conductors. When the rear end of the heater assembly is inserted into the connector assembly, the other two contact rings frictionally engage the contact parts of the two spring strip conductors and the one contact ring is threaded into the bushing. The third spring strip conductor engages the bushing and all three spring strip conductors are captivated on the hollow insulator by an insulating sleeve which surrounds the hollow insulator. The spring strip conductors include terminal portions exposed at the rear of the connector assembly and connected to the conductors of a power cord which extends through the bore of the handle. The connector assembly is releasably retained in the handle by frictional engagement between the surface of the bore and an outwardly displaced holding portion of the third spring strip conductor.

The invention will be more fully understood from the following detailed description taken in conjunction with the following drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side elevational view of a temperature controlled electric soldering iron including a heating assembly, a connector assembly and a handle with the heating assembly and connector assembly withdrawn from the handle;

FIG. 2 is an enlarged side elevational view with parts shown in section of the soldering tip of the heating assembly of FIG. 1;

FIG. 3 is a side elevational view of the heating assembly and connector assembly of FIG. 1 with parts of the connector assembly shown in section;

FIG. 4 is a side elevational view of the heating assembly of FIG. 3;

FIG. 5 is a view in end elevation of the connector assembly taken from the right hand end of FIG. 3;

FIG. 6 is a fragmentary side elevational view with parts shown in section and parts broken away of the connector assembly in FIG. 3 rotated about its axis by 30° in a clockwise direction as viewed from the right hand end of FIG. 3;

FIG. 7 is a view similar to FIG. 6 showing the connector assembly in FIG. 3 rotated about its axis by 150° in a clockwise direction as viewed from the right hand end of FIG. 3;

FIG. 8 is a view in side elevation of one of the spring strip conductors in the connector assembly;

FIG. 9 is a view in perspective of a hollow insulator employed to support the spring strip conductors of the connector assembly; and

FIG. 10 is a view in end elevation of the insulator of FIG. 9.

DESCRIPTION OF A PREFERRED EMBODIMENT

The invention contemplates provision of an improved temperature controlled electric resistance heating device which in the illustrated embodiment is shown as comprising a soldering iron.

With reference to FIG. 1 the soldering iron is shown as comprising a heating assembly **10** detachably received within a female connector assembly **12** which in turn is adapted to be releasably retained within a bore **13** of an insulating handle **15**. The connector assembly **12** includes conductor terminals which are connected to conductors **16** of a power cord **18** extending through the bore **13**.

The heater assembly **10** is shown in FIG. **4** and details of the soldering tip **19** carried at one end thereof are illustrated in FIG. **2**. The tip **19** of the heater assembly **10** may be of any suitable construction and preferably is of the design disclosed in the aforementioned U.S. Pat. No. 2,897,335. The heater assembly **10** includes an inner metal tubular sheath **21** which carries the tip **19** at its outer end, the tip **19** including a copper liner **22** engaged over the outer end of the sheath **21** and an outer iron sheath **24** engaged over the liner **22**. The liner **22** is provided with a recess in its tip end forwardly of the outer end of the sheath **21** in which is received a hollow adaptor **25**, preferably of the same material as the sheath **21**. An elongated hollow resistance heating element **27** in the form of a helically wound wire coil is located substantially coaxially within the sheath **21** in radially spaced insulated relation thereto. The adaptor **25** is externally threaded at its inner end for engagement with the outer end of the heating element **27**, and the sheath **21**, heating element **27** and adaptor **25** are brazed or welded at this point to provide a secure mechanical and electrical connection of these parts. In this manner the left hand terminal of the heating element **27** as viewed in FIG. **2** is electrically connected to the sheath **21**. The right hand terminal of the heating element **27** as viewed in FIG. **2** is supported on one end of a metallic tube **28** extending substantially coaxially within the sheath **21** in radially spaced electrically insulated relation thereto. Suitable electrical insulation **30**, such as compacted magnesium oxide, surrounds the heating element **27** and the tube **28** to fill the space between these elements and the inner wall of the sheath **21**. The tube **28** includes an external portion located exteriorly of the sheath **21** for connection to suitable contact means described hereinafter.

In order to control energization of the heating element **27** to thereby control the temperature of the tip **19** a suitable temperature sensing element, preferably in the form of a thermocouple, is located within the tip **19** to be responsive to the temperature of the tip **19**. In the illustrated embodiment, the thermocouple includes a thermocouple junction **31** provided by a wire or rod **32** formed of a metal or alloy dissimilar from that of the adaptor **25** which extends through an opening in the outer end of adaptor **25** and is trimmed flush with and welded to the outer end of the adaptor **25**. In this manner, the thermocouple junction **31** is electrically connected to the adaptor **25** and thereby to the sheath **21**. The thermocouple junction **31** is also electrically connected to the rod **32** and thereby to a helical wire conductor **33** which engages the right hand end of the rod **32** and which is disposed within the heating element **27** to extend longitudinally thereof in radially spaced relation thereto. The conductor **33** is electrically insulated from the heating element **27** by the compacted magnesium oxide which embeds the heating element and the conductor **33**. The right hand end of the conductor **33** as viewed in FIG. **2** is mechanically and electrically connected to one end of a straight wire or rod **34** which extends longitudinally through the tube **28** and which is electrically insulated therefrom by a ceramic sleeve **36**. The rod **34** includes an external portion located exteriorly of the tube **28** for connection to suitable contact means hereinafter described. The ends of the adaptor **25** and rod **32** which are remote from the thermocouple junction **31** may be designated as the terminals of the thermocouple.

In accord with the invention the terminals of the heating element **27** and the thermocouple are connected to a plurality of contact means arranged on the heating assembly **10** for engagement with contacts of the connector assembly **12** in response to insertion of the rear end of the heating assembly **10** into the connector assembly **12**. To this end a plurality of insulated exposed contact means are carried by the heater assembly **10** spaced longitudinally thereof and electrically connected to the terminals of the heating element **27** and thermocouple. In the illustrated embodiment as best shown in FIG. **4** such contact means comprise three metallic rings **37**, **39**, and **40** surrounding respectively the external parts of the sheath **21**, the tube **28** and the rod **34** with the outer diameters of the rings **39** and **40** being equal to the outer diameter of the sheath **21**. The contact ring **37** engages the sheath **21** for providing a first common contact for one terminal of the heating element **27** and one terminal of the thermocouple. The contact ring **39** surrounds the external portion of the tube **28** to provide a contact for the other terminal of the heating element **27**, and the contact ring **40** surrounds the external portion of the rod **34** to provide a contact for the other terminal of the thermocouple. An insulating sleeve **41** surrounds the tube **28** between the rings **39** and **40**.

In accord with a further aspect of the invention the heater assembly **10** and the connector assembly **12** are detachably mechanically connected by threaded engagement between two cooperating parts of such assemblies. To this end the contact ring **37** is in the form of an externally threaded metallic bushing which is adapted to threadably engage an internally threaded metallic bushing **42** at the front end of the connector assembly **12** when the rear end of the heater assembly **10** is inserted into the connector assembly **12** and is rotated about its longitudinal axis. The connector assembly **12** includes additionally a hollow insulator **43** extending within the bushing **42** and having an external portion located rearwardly of the bushing **42** as best shown in FIG. **3**. The internal diameter of the insulator **43** is slightly larger than the outer diameters of the sheath **21** and the contact rings **39** and **40** of the heater assembly and when the heater assembly is inserted into the connector assembly, the insulator **43** surrounds part of the sheath **21** and the contact rings **39** and **40**.

The insulator 43 is best shown in FIGS. 9 and 10 and includes three slots 45, 46 and 48 formed in the exterior surface of the insulator 43 to extend longitudinally thereof and spaced angularly about its axis. The insulator 43 also includes a pair of openings 49 and 51 located respectively in the bases of the slots 46 and 48 and communicating with the hollow of the insulator 43.

In order to establish electrical connections to the contact rings 37, 39 and 40 of the heater assembly 10 when such is inserted into the connector assembly 12, the connector assembly includes three spring strip conductors 52, 54 and 55 which are connected to the conductors 16 of the power cord 18 and which are disposed to be electrically connected to the contact rings 37, 39 and 40 respectively when the heater assembly 10 is inserted into the connector assembly 12. The conductors 52, 54 and 55 include respectively terminal portions 57, 58 and 60 for connection to the conductors 16 of the power cord 18, and contact portions 61, 63 and 64 for engagement with the bushing 42 and with the contact rings 39 and 40 respectively for completing electrical connections between the heating element 27 and the thermocouple and the conductors 16 of the power cord 18. The conductors 52, 54 and 55 are positioned in the slots 45, 46 and 48 respectively with their terminal portions 57, 58 and 60 extending beyond the rear end of the hollow insulator 43 as best shown in FIGS. 6 and 7. The terminal portion 57 of the conductor 52 is elongated for mechanical attachment to the power cord 18 by a clamp 66 shown in FIG. 1 which encircles the power cord and notches 67 in the conductor 52. At its opposite end the conductor 52 includes its contact portion 61 comprising a pair of tabs which partially surround and are soldered to a reduced section of the bushing 42 to establish an electrical connection between the contact ring 37 and the conductor 52 when the ring 37 is threaded into the bushing 42. As best shown in FIGS. 6 and 7 the conductors 54 and 55 are positioned in the slots 46 and 48 with their curved projecting contact portions 63 and 64 extending through the openings 49 and 51 of the insulator 43 into the hollow thereof for frictional engagement with the contact rings 39 and 40 when the heater assembly 10 is inserted into the connector assembly 12.

In order to captivate and secure the conductors 52, 54 and 55 in position within the slots 45, 46 and 48 an insulating sleeve 69 surrounds the reduced section of the bushing 42 and the portion of the insulator 43 which is external of the bushing 42 as best shown in FIG. 3. The connector assembly 12 is releasably retained within the bore 13 of the handle 15 and to this end the conductor 52 includes a holding portion 70 comprised of an end section having parts displaced outwardly of the plane of the conductor 52 so as to engage the inner wall of the bore 13 when the connector assembly is inserted in the bore. The power cord 18 contains four conductors 16 and two of these are attached to the terminal portion 57 of the conductor 52 with the other two conductors 16 being attached respectively to the terminal portions 58 and 60 of the conductors 54 and 55.

This invention provides a very compact temperature controlled soldering iron which is easily assembled and disassembled. The heating element is mechanically and electrically connected to the connector assembly simply by pushing the rear end of the heating assembly into the bushing 42 and thereafter rotating the heating assembly about its longitudinal axis to screw the ring 37 into the bushing 42. The heating assembly is detached from the connector assembly merely by unscrewing the ring 37 from the bushing 42 and pulling the heating assembly away from the bushing. The connector assembly is releasably retained within the bore of the handle by action of the holding portion 70 of the conductor 52 and when the connector assembly is removed from the bore, the terminal portions of the conductors 52, 54 and 55 are exposed to facilitate power cord replacement. Also, the invention permits assembly and disassembly of the heating assembly and the connector assembly with power accidentally applied without shorting any of the components.

Although the invention has been described with reference to certain specific embodiments thereof, numerous modifications are possible and it is desired to cover all modifications falling within the spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A temperature controlled electric resistance heating device comprising in combination,

a. an elongated heater assembly including a metallic sheath,

b. a heating element within said sheath adjacent one end of said heater assembly, said heating element having a pair of terminals,

c. a temperature sensing element responsive to heat produced by said heating element and having a pair of terminals,

d. a plurality of at least three contact means carried by said heater assembly in insulated relation spaced longitudinally of said heater assembly and exposed at the exterior thereof,

e. one of said contact means comprising a first externally threaded metallic bushing positioned closer to said one end of said heater assembly than the remaining contact means,

f. connecting means electrically connecting said plurality of at least three contact means to the terminals of said heating element and to the terminals of said temperature sensing element,

g. a female connector assembly detachably receiving through its front end the other end of said heating assembly to establish electrical connections to said plurality of at least three contact means,

h. said connector assembly including at its front end a second metallic bushing having internal threads which threadably engage the external threads of said first bushing when said heating assembly is inserted into said second bushing and is rotated about its longitudinal axis,

i. a hollow insulator coaxial with and extending rearwardly of said second bushing and having a plurality of openings communicating with the hollow thereof,

j. a plurality of at least three spring strip conductors each having a contact portion and a terminal portion and positioned in spaced parallel relation along the exterior surface of said hollow insulator with their terminal portions extending rearwardly beyond said hollow insulator, the contact portion

of one of said spring strip conductors engaging said second bushing and the contact portions of the remaining spring strip conductors extending through said openings to frictionally engage said remaining contact means when said heating assembly is inserted into said connector assembly, and

k. an insulating sleeve surrounding at least part of said hollow insulator to captivate and secure said spring strip conductors in position on said insulator.

2. A device as defined in claim 1 wherein said heating element comprises an elongated helically wound wire coil extending longitudinally of said heater assembly, said temperature sensing element comprising a thermocouple including a part extending coaxially of said helically would wire coil.

3. A device as defined in claim 1 wherein said connecting means includes means electrically connecting one terminal of said heating element and one terminal of said temperature sensing element to said sheath, said first bushing surrounding part of said sheath in conductive engagement therewith.

4. A device as defined in claim 1 wherein said connecting means includes a metallic tube within said sheath insulated therefrom and engaging one terminal of said heating element, said tube having an external portion beyond the other end of said sheath which engages one of said remaining contact means.

5. A device as defined in claim 1 wherein said hollow insulator extends within said second bushing and includes an external portion extending rearwardly of said second bushing, said hollow insulator including a plurality of at least three longitudinally extending slots in its exterior surface spaced angularly about its axis each receiving a separate one of said spring strip conductors, and an insulating sleeve surrounding the external portion of said hollow insulator to captivate said spring strip conductors.

6. A device as defined in claim 1 wherein said connecting means includes conductor means within said sheath insulated therefrom and engaging one terminal of said temperature sensing element, said conductor means having an external portion beyond the other end of said sheath which engages one of said remaining contact means.

7. A temperature controlled electric resistance heating device comprising in combination,

a. an elongated heater assembly including a metallic sheath,

b. a heating element within said sheath adjacent one end of said heater assembly, said heating element having a pair of terminals,

c. a temperature sensing element responsive to heat produced by said heating element and having a pair of terminals,

d. means electrically connecting one terminal of said heating element and one terminal of said temperature sensing element to said sheath,

e. first externally threaded metallic ring means surrounding part of said sheath in conductive engagement therewith for providing a first common contact for said one terminal of said heating element and said one terminal of said temperature sensing element,

f. a metallic tube extending within said sheath insulated therefrom and having one end engaging the other terminal of said heating element, said tube having an external portion beyond the other end of said sheath,

g. second metallic ring means surrounding part of the external portion of said tube in engagement therewith to provide a second contact for said other terminal of said heating element,

h. a metallic rod extending within said tube insulated therefrom and electrically connected to the other terminal of said temperature sensing element, said rod having an external portion beyond the other end of said tube,

i. third metallic ring means surrounding part of the external portion of said rod in engagement therewith to provide a third contact for said other terminal of said temperature sensing element,

j. a female connector assembly detachably receiving through its front end the other end of said heating assembly to establish electrical connections to said first, second and third ring means,

k. said connector assembly including at its front end a metallic bushing having internal threads which threadably engage the external threads of said first ring means when said heating assembly is inserted into said bushing and is rotated about its longitudinal axis,

l. three spring strip conductors each having a contact portion and a terminal portion with the terminal portion of one of said spring strip conductors engaging said bushing,

m. a hollow insulator coaxial with and extending rearwardly of said bushing mounting said spring strip conductors on its exterior surface in generally parallel relation spaced angularly about its axis with their terminal portions located rearwardly beyond said hollow insulator, and with the contact portions of two spring strip conductors being positioned to frictionally engage said second and third metallic ring means when said heater assembly is inserted into said connector assembly, and

n. an insulating sleeve surrounding the external portion of said hollow insulator to captivate and secure said spring strip conductors in position on said insulator.

8. A device as defined in claim 7 wherein said heating element comprises an elongated helically would wire coil extending longitudinally of said heater assembly, said control element comprising a thermocouple including a part extending coaxially of said helically would wire coil.

9. A device as defined in claim 7 wherein said hollow insulator extends within said bushing and includes an external portion extending rearwardly of said bushing, said hollow insulator having a plurality of longitudinally extending slots in its exterior surface spaced angularly about its axis each receiving a separate one of said spring strip conductors.

10. A device as defined in claim 9 wherein the external portion of said hollow insulator has a pair of openings communicating with its hollow and through which extend the contact portions of said other spring strip conductors.

11. A temperature controlled electric resistance soldering iron comprising in combination:

a. an elongated heater assembly including a metallic sheath,

b. a hollow soldering tip carried by said sheath at one end of said heater assembly.

c. a heating element within said tip having a pair of terminals,

d. a temperature sensing element within said tip adjacent its working end to be responsive to the temperature of said tip, said temperature sensing element having a pair of terminals,

e. a plurality of at least three contact means carried by said heater assembly in insulated relation spaced longitudinally of said heater assembly and exposed at the exterior thereof,

f. one of said contact means comprising a first externally threaded metallic bushing positioned closer to said one end of said heater assembly than the remaining contact means,

g. connecting means electrically connecting said plurality of contact means to the terminals of said heating element and to the terminals of said temperature sensing element,

h. a female connector assembly detachably receiving through its front end the other end of said heating assembly to establish electrical connections to said plurality of at least three contact means,

i. said connector assembly including at its front end a second metallic bushing having internal threads which threadably engage the external threads of said first bushing when said heating assembly is inserted into said second bushing and is rotated about its longitudinal axis,

j. a hollow insulator within said second bushing and having an external portion extending beyond the other end of said second bushing, said external portion having a plurality of at least three longitudinally extending slots in its exterior surface spaced angularly about its axis and having a plurality of openings communicating with the hollow thereof,

k. a plurality of at least three spring strip conductors each having a contact portion and a terminal portion and positioned in the slots of said hollow insulator with their terminal portions located rearwardly beyond said hollow insulator, with the contact portion of one of said spring strip conductors engaging said second bushing and with the contact portions of the remaining spring strip conductors extending through said openings for frictional engagement with said remaining contact means when said heater assembly is inserted into said connector assembly,

l. said connector assembly having an insulating sleeve surrounding the external portion of said hollow insulator to captivate and secure said spring strip conductors in position on said insulator,

m. an insulating handle having a bore,

n. a power cord extending through said bore and having conductors terminating in said bore, and

o. said connector assembly releasably retained within said bore with said second bushing adjacent one end of said bore and with the terminal portions of said spring strip conductors connected to the conductors of said power cord.

12. A device as defined in claim **11** wherein said heating element comprises an elongated helically wound wire coil extending longitudinally of said heater assembly, said temperature sensing element comprising a thermocouple including a part extending coaxially of said helically wound wire coil.

13. A device as defined in claim **11** wherein said connecting means includes means electrically connecting one terminal of said heating element and one terminal of said temperature sensing element to said sheath, said first bushing surrounding a part of said sheath in conductive engagement therewith.

14. A device as defined in claim **11** wherein said connecting means includes a metallic tube within said sheath insulated therefrom and engaging one terminal of said heating element, said tube having an external contact ring portion beyond the other end of said sheath which carries one of said remaining contact means.

15. A device as defined in claim **11** wherein said connecting means includes rod conductor means within said sheath insulated therefrom and engaging one terminal of said temperature sensing element, said conductor means having an external contact ring portion beyond the other end of said sheath which carries one of said remaining contact means.

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