United States Patent [19]

Fava

[11] 3,852,517

[45] Dec. 3, 1974

[54] **CONDUCTIVE INSERT FOR HEAT RECOVERABLE ELECTRICAL CONNECTOR**

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[73] Assignee: **Raychem Corporation,** Menlo Park, Calif.

[22] Filed: **June 12, 1972**

[21] Appl. No.: **262,084**

[52] **U.S. Cl.** ..... **174/84 R,** 174/88 R, 338/214, 339/275 R, 339/278 C

[51] **Int. Cl.** **H02g 15/08**

[58] **Field of Search** ..... 174/DIG. 8, 84 R, 52 S, 174/88 R; 338/237, 272, 274, 309, 327, 329; 339/275 R, 278 R, 278 C; 285/22

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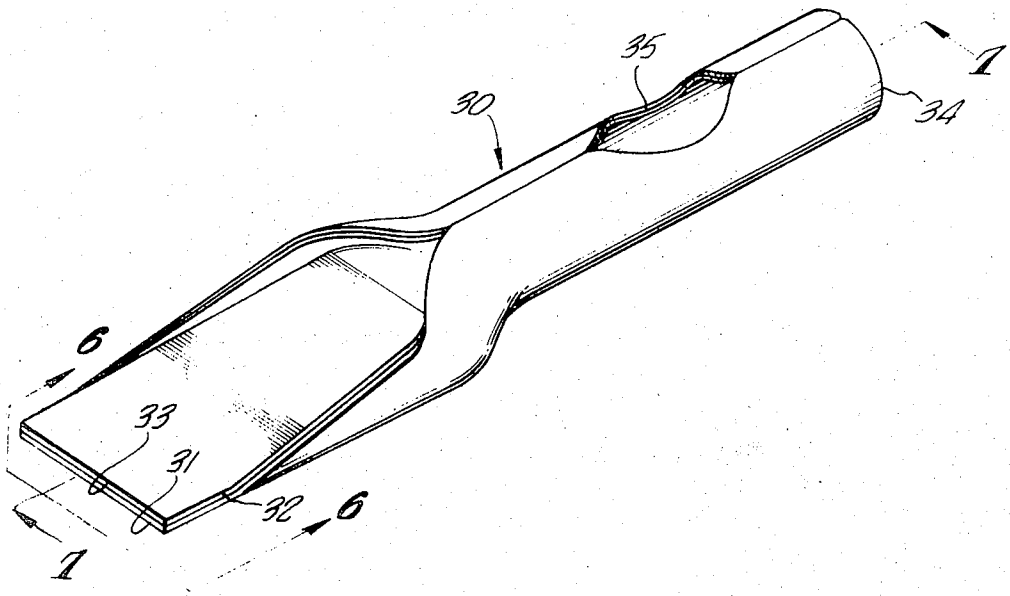
Attorney, Agent, or Firm—Lyon & Lyon

[57] **ABSTRACT**

A conductive insert for placement within a connector capable of forming an electrical and mechanical connection between two or more conductors. The insert is a unitary conductive member which has two open ends. At least a portion of the inner surface of each end of the insert is coated with a solder alloy. In use, a conductor is inserted in each open end of the connector and in contact with the insert and heat applied to cause the connector to shrink, to melt the solder and to join the conductors to the insert. The connector with the conductive insert is particularly useful for joining a flat conductor to a round conductor and for joining a plurality of pairs of conductors.

1 Claim, 13 Drawing Figures



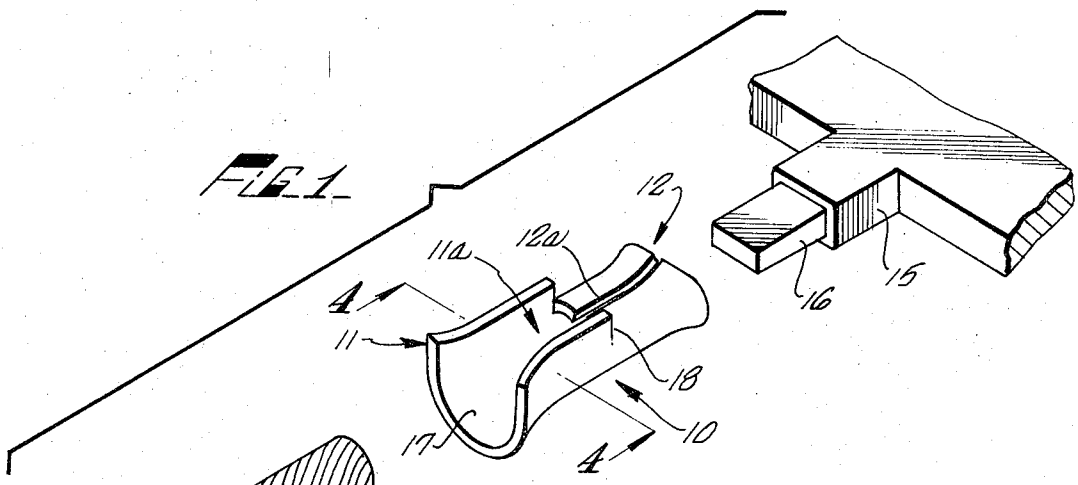


FIG. 1

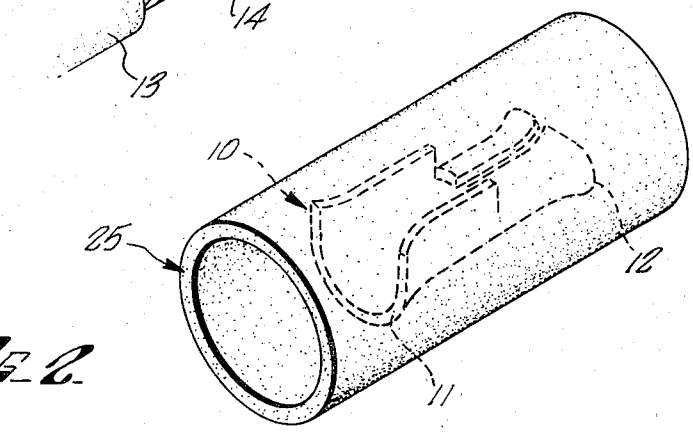


FIG. 2

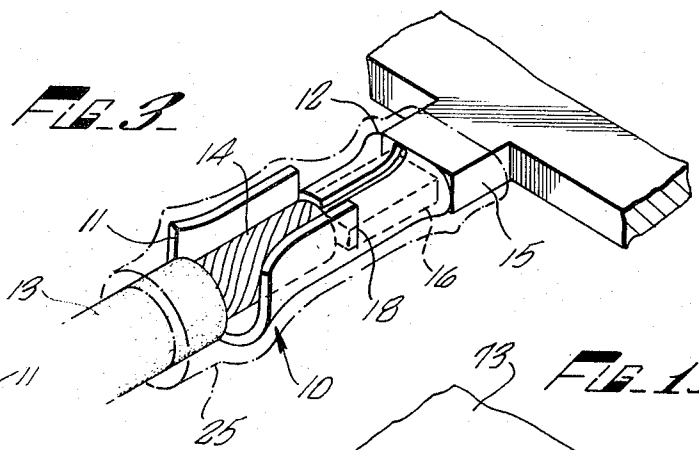


FIG. 3

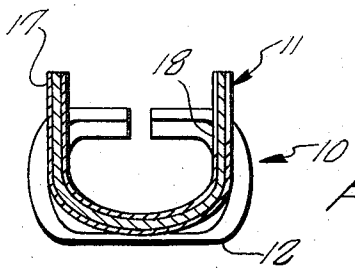


FIG. 4

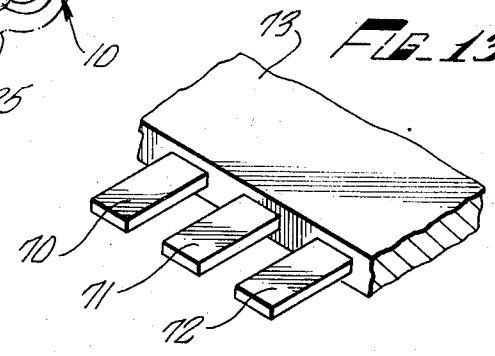


FIG. 13

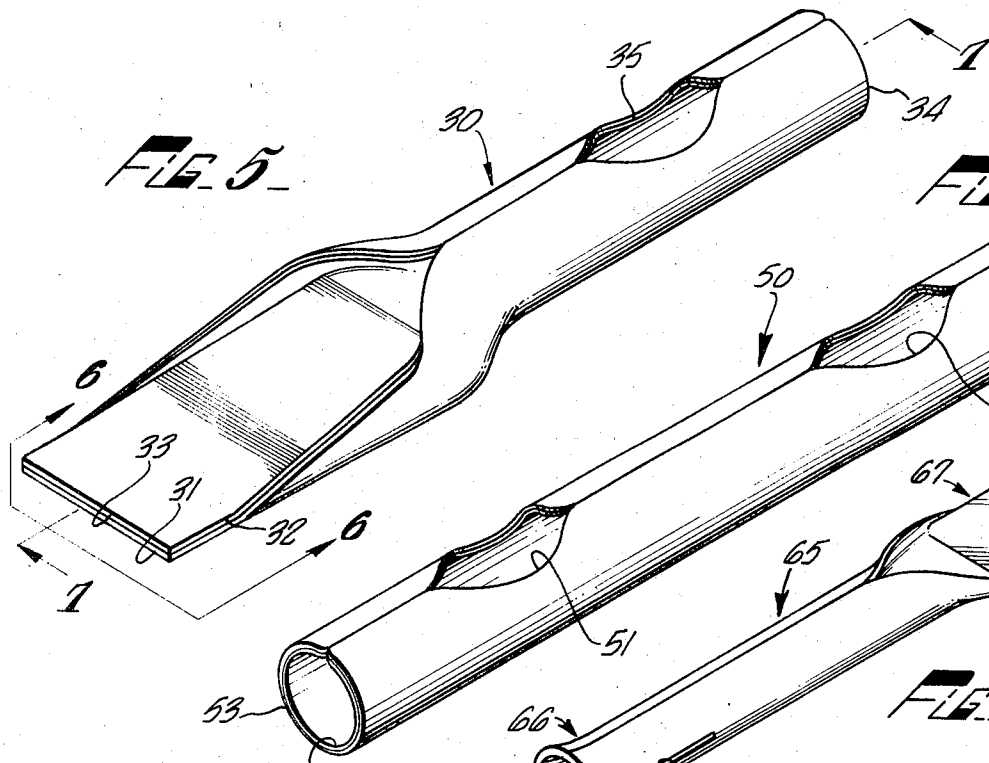


FIG. 5

FIG. 9

FIG. 12

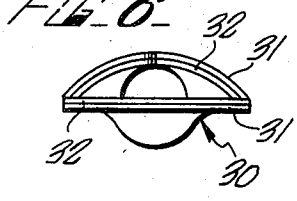


FIG. 6

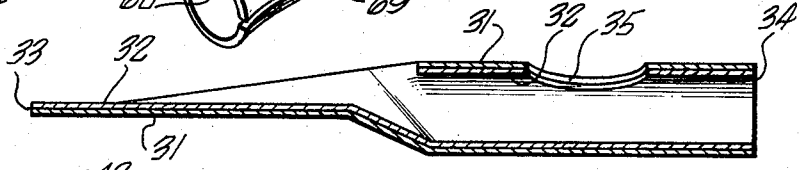


FIG. 7

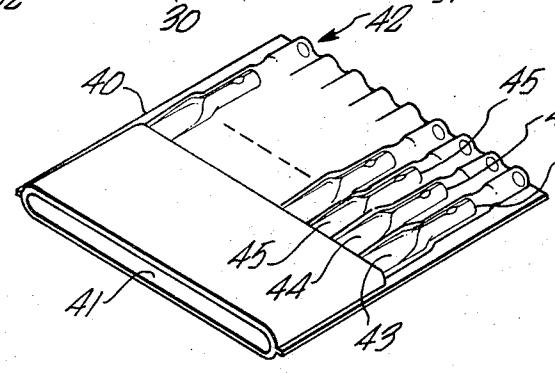


FIG. 8

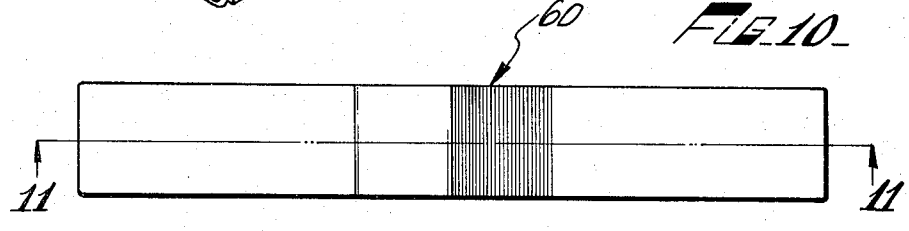


FIG. 10

FIG. 11

CONDUCTIVE INSERT FOR HEAT RECOVERABLE ELECTRICAL CONNECTOR

BACKGROUND OF THE INVENTION

The field of the invention is electrical connectors capable of forming both an electrical and physical connection between two or more conductors. Such connections are commonly made by soldering the overlapped ends of the conductors together or by crimping a connector over the ends of the conductors. In many applications, it is desirable to make a transition from a flat conductor, such as found, for example, in flat cables, to round conductors. In such cases many of the commonly used connectors have been found to be unsatisfactory.

One method of joining a flat conductor to a round conductor utilizes a crimp connector which is in the shape of a hollow cylinder. The end of the flat conductor is bent into a generally U-shaped configuration along its longitudinal axis so that this end is capable of fitting into one end of the hollow cylinder. The round conductor is inserted into the other end of the hollow cylinder and the cylinder is crimped about each conductor. The connection is then commonly potted within a resilient potting material to insulate the connection. The crimping, however, often weakens the physical strength of the conductors and the connection is a relatively bulky and heavy one.

Overlapping and soldering of the two conductors has also been used but this method of connection has the disadvantage of using up extra wire, as well as requiring a time-consuming and skillful operation. Connection methods which employ male and female members connected to the respective conductors have also been used but they may require considerable insertion force which often must be transmitted by the conductors themselves, leading, in many instances, to difficulty in connection, bent conductors or an unsatisfactory connection.

Recently, a new type of heat recoverable connector has been developed which has a plurality of openings at each end. A conductor is inserted into each opening and a matched conductor is inserted into the corresponding opening in the other end of the connector. The connector has a quantity of solder and flux within each opening and after the conductors have been inserted into each opening in each end, the connector is heated causing the heat recoverable material to shrink around the conductors and the solder to melt and flow around the stripped ends of the conductors. A patent application, Ser. No. 89,719 was filed on Nov. 16, 1970 by Donald Del Fava, the present applicant on a device of this nature and that application is incorporated by reference herein for purposes of background information. Another application, Ser. No. 89,742 was also filed on Nov. 16, 1970 by Robin J. T. Clabburn on a device of this type and that application is also incorporated by reference herein. Both of these applications are assigned to the assignee of the present application.

SUMMARY OF THE INVENTION

It is accordingly an object of the present invention to provide an insert for use with a heat recoverable connector for forming an electrical and mechanical connection between at least two conductors.

According to the present invention an insert is provided which overcomes the disadvantages of the prior art devices. This is accomplished by the use of an insert comprising a unitary conductive metallic member having two ends which contain a coating of solder alloy and flux adjacent to at least a portion of its inner surface. Each end of the insert is at least partly open to permit the viewing of the connection after completion. An insert having one round end and one flat open end is particularly useful for joining a round conductor to a flat conductor within the connector. An additional use would be to make the round end a socket contact and plug into a wire wrap pin.

The advantage would be the overall thickness of the terminated device and the ability to play directly from a flat cable with conductors on .100 centers into a wire wrap connector in a printed circuit board with wire wrap pins. The thinness of the connecting device (e. g. approximately 0.070) allows stacking on rows of 0.100.

After insertion of stripped conductor ends, the connector, containing one or more inserts of the present invention, is heated thus causing the connector to shrink about the conductor and to hold the stripped ends against the inserts. The heat further causes the solder and flux to melt and to electrically connect a pair of conductors to each insert thereby electrically joining the pair of conductors. When a plurality of inserts are held within the connector in a parallel and spaced relationship, a particularly useful device results.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an insert of the present invention together with the stripped ends of two insulated conductors.

FIG. 2 is a perspective view of a connector containing an insert of the present invention.

FIG. 3 is a perspective view of the connector of FIG. 2 shown about the ends of two insulated conductors and shown after a heating step and with the plastic sleeve shown in phantom lines.

FIG. 4 is a view taken along line 4—4 of FIG. 1.

FIG. 5 is a perspective view of an alternate embodiment of the insert of the present invention.

FIG. 6 is a view taken along line 6—6 of FIg. 5.

FIG. 7 is a cross-sectional view taken along line 7—7 of FIG. 5.

FIG. 8 is a perspective view of a connector containing a plurality of inserts of the present invention.

FIG. 9 is a perspective view of an alternate embodiment of the insert of the present invention.

FIG. 10 is a plan view of an alternate embodiment of the insert of the present invention.

FIG. 11 is a cross-sectional view taken along line 11—11 of FIG. 10.

FIG. 12 is a perspective view of an alternate embodiment of the insert of the present invention.

FIG. 13 is a perspective view of the stripped end of a multi-flat conductor cable.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning now to FIG. 1, a unitary conductive metallic member or insert 10 is shown in perspective view. Member 10 has a round oval end 11 and a flattened oval end 12. A round insulated conductor 13 has a stripped end 14 which will fit within the round oval end

11 of member 10. A flat insulated conductor 15 has a stripped end 16 which likewise is capable of fitting within the flattened oval end 12. Preferably the round oval end 11 is not closed but rather is left with an opening 11a so that the completed soldered joint may be inspected. Similarly, the flattened oval end 12 is provided with an inspection slot 12*a*.

Each end of unitary conductive metallic member 10 is flared outwardly to facilitate the insertion of the stripped ends 14 and 16 within the member 10. The member 10 is coated with a thin layer of a solder alloy 17 and is also provided with a portion of flux. Although the solder layer is shown in the drawings as a continuous coating, it may, instead, cover only a portion of the member 10. For instance, layer 17 could cover only the inner surface of the member 10 or could cover just appropriate parts of the inner surface.

In operation, the stripped end 14 of conductor 13 is inserted in the round oval end 11, preferably so that it extends to the transition 18 between the round and flattened portions of the member 10. The stripped end 16 of conductor 15 is similarly inserted within the flattened oval end 12, also preferably extending to transition 18. The member and stripped ends are then heated by any conventional means such as infrared, hot air or induction heating in order to melt the flux and solder alloy layer 17 which then flows onto stripped ends 14 and 16 thereby creating a secure electrical and mechanical connection. The amount of solder used preferably is sufficient to fill the spaces between the connector and the conductors. Although not necessary, the ends of the conductors may be tinned to facilitate the soldering step.

Turning now to FIG. 2, unitary member 10 is shown within a heat recoverable sleeve 25. The sleeve is preferably formed from an insulating plastic which has been made heat recoverable so that it will tend to shrink when it is heated to its heat recovery temperature. Such heat recoverable sleeves, and their various uses, are disclosed in U.S. Pat. No. 2,027,962 to Currie; No. 3,086,242 to Cook; and No. 3,243,211 to Wetmore; the disclosures of which are incorporated by reference herein to illuminate the background of the present invention. Sleeve 25 should extend beyond the ends of the insert so that it can cover the stripped portions of the conductors which will be inserted within member 10.

Turning now to FIG. 3, the connector device of FIG. 2 is shown after it has been installed on insulated conductors 13 and 15. Heat recoverable sleeve 25 is shown in phantom lines after it has shrunk around the insulated conductors 13 and 15 and the conductive insert.

The unitary conductive metallic member may be formed from a flat sheet of conductive metal. This sheet may be coated with a layer of a solder alloy and flux either before or after it has been formed into its final shape. The coating of solder may be only on a portion of the interior surface, the entire interior surface, or it could be on both the exterior and interior surfaces. The method of forming the member from the flat sheet is conventional and any of the known techniques for performing this step may be utilized.

The flared ends of the connector help to eliminate a potential source of weakness which might otherwise result from contact between the connector ends and the conductors. These flared ends are also beneficial to facilitate the insertion of the conductors into the metallic member. Alternatively, the plastic sleeve may be shaped to guide the conductors into the ends of the insert. The provision of flared ends, although beneficial, is an optional feature. Furthermore, while the solder material is shown as a coating, it is within the purview of the present invention to use an uncoated member with a ring or other shape of a solder preform inserted into the member. The insert should be placed in such a way that it does not interfere with the insertion of the conductors into the open ends of the member.

Turning now to FIG. 5, an alternate embodiment of the insert of the present invention is shown in perspective view and identified by reference character 30. Insert 30 has an outer layer 31 of a conductive material such as copper or berylium copper and an inner layer 32 of a solder alloy. The solder layer 32 extends from the flat end 33 to the rounded end 34 of insert 30. An opening 35 is located midway along the rounded portion of insert 30. Opening 35 permits the viewing of the interior of insert 30 and, when a transparent heat recoverable member is used, permits the visual confirmation of a completed soldered joint.

FIG. 13 shows the stripped end portion of a cable having a plurality of flat conductors 70, 71 and 72 within an insulative material 73. The insert of the present invention can be used to terminate a cable stripped in this manner as described below.

Insert 30 is shown in end view in FIG. 6 and in side cross-sectional view in FIG. 7. Flat end 33 of insert 30 is adapted for electrical connection with a flat conductor such as that shown in FIG. 13 of the drawings and identified by reference character 70. Round end 34 of insert 30 is adapted for electrical connection to a round conductor such as that identified by reference character 14 in FIG. 1 of the drawings.

A connector containing a plurality of inserts is shown in perspective view in FIG. 8. A heat recoverable insulative member 40 has an open end 41 adapted to receive a plurality of flat conductors, the ends of which have been stripped, as shown in FIG. 13. Member 40 has a second open end 42 which is adapted to receive a plurality of round conductors or a plurality of wire-wrapped conductors or the like the ends of which have also been stripped. The extent of stripping should be such that the conductor insulator is within member 40 but should not extend into the conductive inserts. Member 40 may be provided with a heat activated adhesive, or other softenable material which serves to insulate and seal a conductor from the adjacent conductors. This provices maximum voltage break down and insulating resistance values after member 40 has been heated.

In operation, a plurality of flat conductors are stripped and inserted into open end 41. One conductor is inserted against each flat end of the conductive inserts such as those indicated by reference characters 43, 44 and 45. Similarly, a stripped end of a round insulated conductor is inserted into each opening along open end 42. The stripped ends of the conductors may be tinned to further facilitate the soldering step. The insertions should be such that the insulation of the conductors extend within insulative member 40. Member 40 is then heated by any conventional means such as infrared, hot air or induction heating in order to cause heat recoverable member 40 to recover against the inserted conductors and further to cause the flux and sol-

der layers of the conductive inserts to melt and electrically connect the conductors to the inserts.

A particularly simple and yet effective electrical connection results from the combination of an insert of the type described above within a heat recoverable member. The insert may have a completely open end such as end 33 of FIG. 5 and yet an excellent electrical contact results. This excellence of connection is a result of the fact that the conductor is held tightly against the insert at a time when the solder is heated to a temperature sufficient to cause it to melt and cooled to solidify.

Turning now to FIG. 9, an alternate embodiment of the insert of the present invention is indicated by reference character 50. Both ends of insert 50 are identical and a viewing port is located near each end as indicated in the drawings by reference characters 51 and 52. An outer layer 53 of a conductive material such as berylium copper provides structural strength and electrical conductivity to the insert. An inner layer of flux and a solder alloy 54 is provided in the interior of insert 50.

An alternate embodiment is shown in FIG. 12 where insert 65 has a socket end 66, described below and a flat end 67 which functions in a manner analogous to the flat end of device 30 in FIG. 5. Socket end 66 is flared outwardly at its terminous to facilitate the insertion of a conductive pin therein. A pair of slits 68 and 69 are located in the side wall of insert 65 to provide a spring action which tends to hold a pin of an appropriate diameter which has been inserted into end 66. Insert 65 is preferably fabricated from a metal having good resiliency and strength such as berylium copper.

An alternate configuration of insert is shown in FIGS. 10 and 11. Insert 60 is shown in plan view in FIG. 10 and in cross-sectional side view in FIG. 11. A layer of flux and solder alloy 61 and a layer of a conductive material such as copper 62 are in intimate contact. A protuberance 63 is located midway between the ends of insert 60. This protuberance serves to hold the insert within a heat recoverable insulative member.

The solder alloy need not be provided in a uniform layer but instead could be selectively coated on portions of the interior of the inserts of the present invention. The opening shown in the inserts which are useful for connection with a round conductor need not be shaped in the manner shown in the drawings but instead could be a uniform slot, a square hole or other opening as long as it permits viewing a conductor which has been placed within the insert.

The outer layer of conductive material is preferably formed from a metal which is both a good electrical conductor and also readily accepts solder. Copper such as oxygen free copper, electro tough pitch copper and copper alloys such as berylium copper are preferred.

The present embodiments of this invention are to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency therefore are intended to be embraced therein.

I claim:

1. A connector including a conductive insert disposed within a heat recoverable member for forming an electrical and mechanical connection between conductors, said insert comprising; a heat recoverable member having disposed therein an elongated layer of a conductive material, each end of said layer having an inner surface for receiving a conductor; and

a layer of electrically conductive solder means disposed on at least a portion of one of said inner surfaces of said conductive elongated layer, recovery of the heat recoverable member after positioning at least one conductor proximate to each of said inner surfaces resulting in the melting of said solder means and in the electrical and mechanical connection between the conductors, said insert being adapted to connect a flat conductor to a round conductor wherein one end of said layer of conductive material is formed into a cylindrical shape having a viewing port located in the side thereof and the other end of said layer of conductive material being formed into a generally flat shape.

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