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Lloyd et al.

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[54] ELECTRICAL CONNECTOR

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[52] **U.S. Cl.** .....**339/177 E**, 339/28, 339/259 R

[51] **Int. Cl.** **H01r 17/06**

[58] **Field of Search**..339/60, 89 C, 90 C, 91 P, 94 C, 339/177, 28

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[57] **ABSTRACT**

An electrical connector adapted for use on a universal cord for electrically powered hand tools, formed as a female assembly and a male assembly both of a coaxial type of construction. The female assembly comprises a central contact, an outer contact and an insulator member therebetween, the members being nested together so that relative movement in one axial direction is prevented. A centrally apertured second insulator bears against the base ends of the outer contact and other insulator. The rearward end of the central contact extends through the aperture. The second insulator which is retained in position by a lock washer serves to prevent relative movement of the components in the other axial direction. The male assembly also has a central contact, an outer contact and an insulator therebetween. The outer contact and insulator have internal shoulders which nest, and the central contact has a flange thereon which seats against the insulator thereby preventing relative movement in one axial direction. The same lock washer retained second insulator arrangement prevents relative movement in the other direction.

9 Claims, 4 Drawing Figures

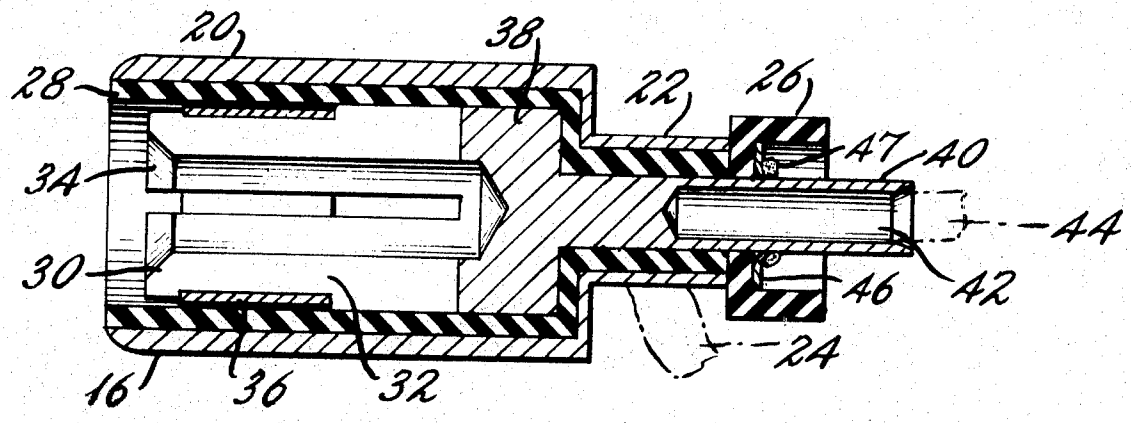


FIG. 1

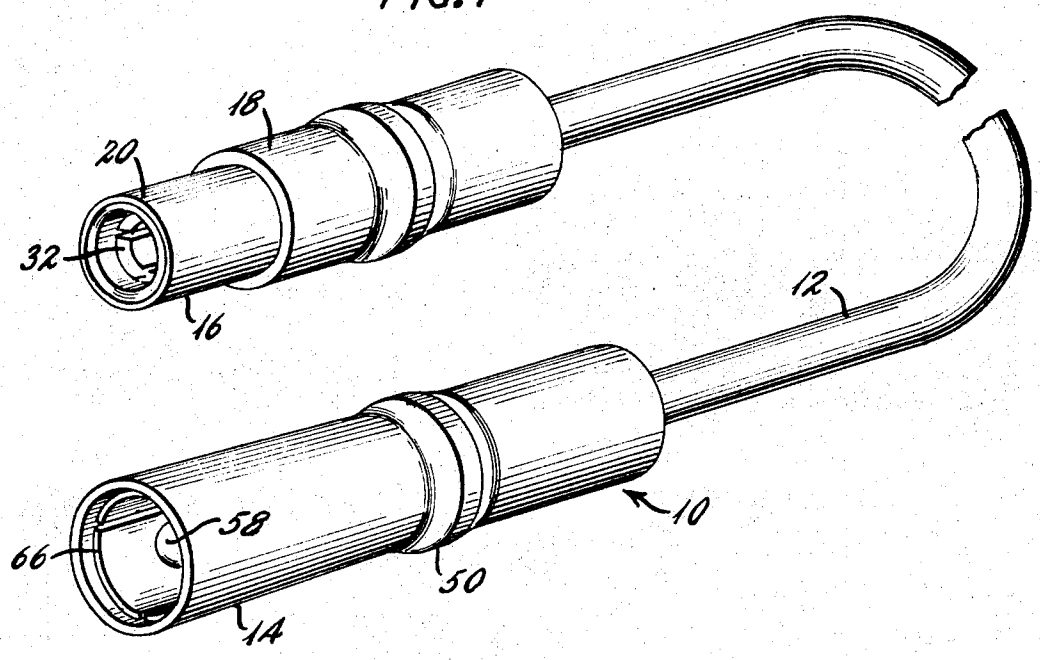


FIG. 2

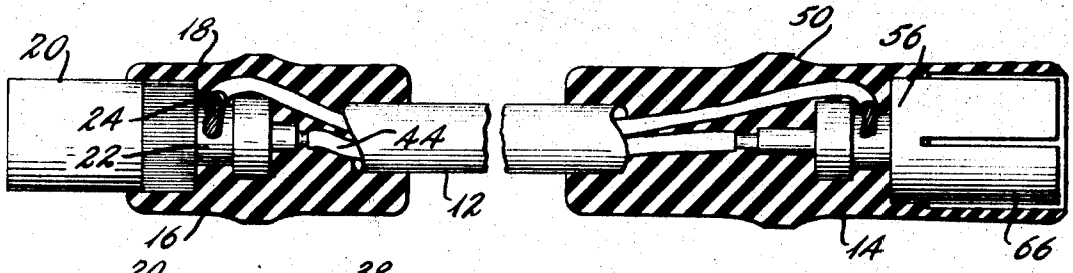


FIG. 3

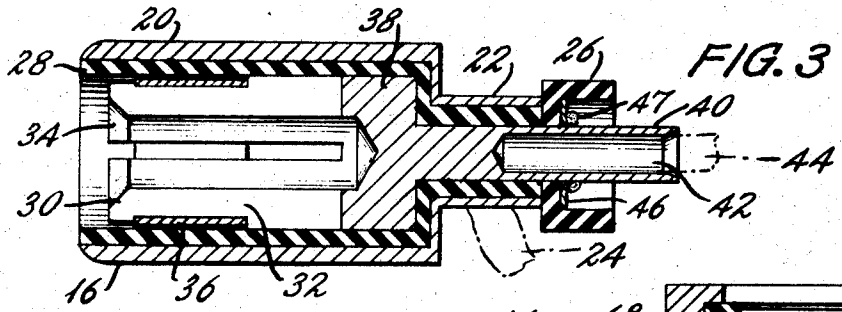
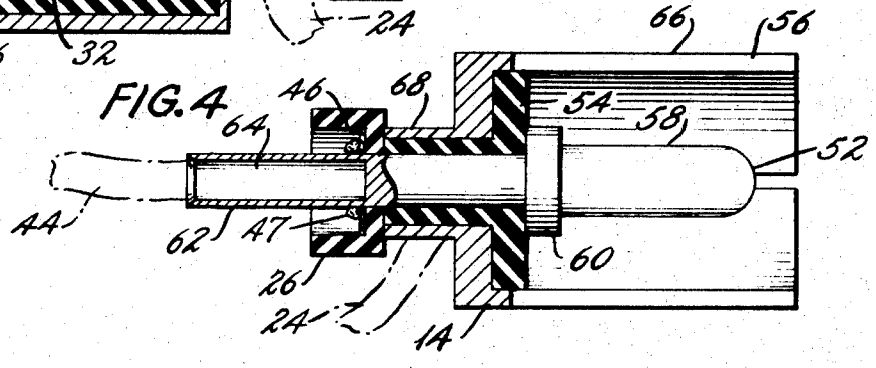


FIG. 4



ELECTRICAL CONNECTOR

This invention relates to an electrical connector and in particular to a connector adapted to be the connection of a power lead and an electrical hand tool.

Just as electronic assemblies become more complex and compact hand tools used for rework or repair of electronic assemblies have become more sophisticated. Such hand tools have become small, pencil-grip instruments of a specialized character. The skilled repair technician needs a kit full of electrically powered hand implements, e.g., a solder remover, a miniature soldering iron (perhaps several), a thermal parting knife, electrically heated tweezers, etc. The number continues to grow. The manufacturer of each such tool commonly includes a power lead with the tool, the lead normally being permanently secured in the base end of the tool and extending for 3, 4, or 6 feet. A permanent power lead is a nuisance even disadvantageous. Real problems are created by presence of permanent leads on the base end of an electrically powered miniature hand tool. As the number of such specialized tools increases, the user discovers he has a substantial storage problem. Where to keep a dozen specialized hand tools? To hand them on a rack takes considerable space, mostly for the leads. The tools, themselves, are small. Stuff them in a drawer, — perhaps. Certainly, the user would prefer hand tools without leads attached thereto. Omitting permanent leads would permit storing a great many small hand tools in a not very large drawer.

Moreover, separating power lead from tool permits the user to employ whatever length power lead may be most advantageous at the moment.

Unfortunately, the almost self-evident answer to this problem, namely, provide a connector at the base end of the individual hand tool is easy to state, difficult to do. The usual two or three-pronged plug or outlet is too bulky for incorporation in relatively sophisticated and small, electrically powered hand tools. Indeed, absence of a good electrical connector is one reason why permanently attached leads are commonly included with the tool.

The object of the present invention is to provide an electrical connector of a size and quality consistent with the construction of sophisticated pencil-grip, electrically powered miniature hand tools.

Inclusion of the present connector structure within the construction of the many different pencil-grip electrically powered hand tools allows the manufacture to supply just the tool itself. Since such tools are used one at a time, connected to the same power source, a limited number of electrical leads, can serve for all of the tools. In effect, a universal cord can be provided.

For further understanding of the present invention, reference is now made to the attached drawing wherein:

FIG. 1 is a perspective view of a universal cord with the male half and the female half of the present connector at the ends thereof;

FIG. 2 is a side section of the cord and connectors;

FIG. 3 is a side section of the female connector assembly; and

FIG. 4 is a side section of the male connector assembly.

As may be seen in the drawing, a power lead **10**, hereinafter identified as the universal cord, would normally include a suitable length of insulated wire **12** (two-conductor) with a male connector assembly **14** permanently mounted at one end thereof, and the female connector assembly **16** permanently mounted at the other end thereof. Since the usual pencil-grip miniature electrical hand tool is constructed with a generally cylindrical body member and can be provided with a cylindrical base end configuration, the present connector structures incorporate the cylindrical configuration present in coaxial connectors. A coaxial connector construction permits the miniature hand tool to terminate in a stubby cylindrical male or female connector assembly which forms an extension of the cylindrical body commonly present thereon.

Referring now to FIGS. **2** and **3**, it may be seen that the female connector assembly comprises an outer insulator jacket **18** which usually is a molded in place rubber member, e.g., of Neoprene, from which protrudes a cylindrical outer conductor **20**. For clarity, the insulator jacket **18** has been omitted in FIG. **3**. Outer contact **20** terminates at its base end in a stepped-down cylindrical base section **22**, to which one of the wire conductors of the cord or lead **12** is attached. Conductor **24** may be soldered to the (pretinned) outer surface of the stepped-down base section **22**.

Nested inside outer conductor **20**, concentric and coextensive therewith is a preformed insulator member **28**.

The center or central contact **30** of the female connector assembly is of a split pronged construction, normally four-pronged, where each prong **32** is slightly spaced apart from the other prongs with the prongs set in an overall cylindrical configuration. Each of the prongs **32** is provided with a beveled face **34** so that a corresponding male central contact member can be inserted inside the pronged female center contact **30** readily. In order to provide a resilient spring like grip for good male-female electrical contact, part of the outer surfaces of the individual prongs **32** are stepped down somewhat to provide a recess into which a C spring **36** fits. Presence of the C spring **36** facilitates the desired male-female electrical contact and helps prevent permanent deformation of prongs **32** by the repetitive making and breaking of an electrical connection therewith. The base end of the prongs **32** merge into a solid cylindrical center mid-section **38** of central contact **30**. Center section **38** fills the region inside the adjacent portion of insulator **28** including the stepped-down section thereof.

Integral with the remainder of central contact **30** is a base end portion **40** which extends rearward beyond the base ends of insulator **28** and of outer contact **20** as is shown in FIG. **3**. A blind hole **42** is drilled or otherwise formed in the back face of center contact **30** at the end of base portion **40**. Suitably, the second conductor **44** of cord **12** is soldered in hole **42** (the surfaces of which may be pretinned).

It may be noted how the female connector assembly **16** comprises three concentric elements nested together in a fashion which prevents relative axial movement in one direction, i.e., rearward displacement. Center contact **30**, insulator member **28**, and

outer contact or conductor 20 can be slipped, one into the other, and nested together during assembly of the female connector assembly 16. Thereafter, a centrally apertured insulating cup 26 can be slipped onto the base end 40 of the center contact 30 to bear against the base face of insulator 28 and of outer conductor 20. A lock washer 46 then serves to lock the entire female assembly 16 together against axial relative movement or displacement in the other (forward) direction. Optionally, the washer 46 may be soldered at 47 to the contact base end 40. After wire conductors 24 and 44 are attached, e.g., by soldering, to the female connector assembly, the insulator jacket 18 is molded around the assembly. For the instance where a female connector assembly 16 is included on the rear end of a pencil grip electrical hand tool, the rear end of the body portion of the tool (or a separable rear section thereof) constitutes a surrounding insulating jacket comparable to insulator jacket 18. In either instance, a significant portion of outer conductor 20 is exposed and the rest of female connector assembly 16 is insulated and hidden.

The male connector assembly 14 which mates with female connector assembly 16 is illustrated in FIGS. 2 and 4. The entire male connector assembly is concealed and electrically shielded by a molded in place insulator jacket 50. Like female connector assembly 16, the male connector assembly 14 includes three concentric members i.e., center contact 52, an outer contact 56, and an insulator member 54 therebetween. The center contact 52 comprises a solid plug portion 58 at the front end thereof (adapted for insertion into the prongs 32 of female connector assembly 16). An integral flange 60 formed at the base of plug 58 serves as a stop element against which insulator 54 bears. The center contact member 52 extends rearward of flange 60 through the assembly to terminate ultimately in a base end portion 62 having a blind hole 64 in the rear face thereof. Wire conductor 44 may enter blind hole 64 for joinder to center contact 52 (the surfaces of blind hole 64 being pretinned if desired for a better solder contact with conductor 44).

In the male connector assembly 14, the outer contact 56 may be a split pronged construction, e.g., four spaced-apart prongs 66 disposed in a cylindrical configuration. As is shown in FIG. 4, the prongs 66 are joined at their base end, and the base end portion 68 of outer contact 56 is a stepped-down in diameter cylinder, so that the insulator 54 seats on the annular face present at the base end of prongs 66, and nests between the base portion 68 of outer contact 56 and the center contact member 52. The nesting configuration of contact 52, 56 and insulator 54 structure prevents relative axial movement in one direction, i.e., rearward displacement. The base faces of outer contact 56 and of insulator 54 seat against centrally apertured insulator cup 26. (The insulator cups are identical.) A lock washer 46 (identical with the lock washer of the female assembly) may be employed to secure the component elements of the male connector assembly together, against relative axial movement, i.e., forward displacement.

The wire conductor 24 may be joined to the outer contact 56, being soldered to the outer surface of the stepped-down cylindrical base 68 thereof (pretinning being provided thereon if desired).

Assembly of the male connector assembly 14 is virtually self-evident. The insulator member 54 and the outer contact 56 are, in succession, slipped on center contact 52 from the rear thereof then cup 26 is slipped on the base of inner contact 52 from the rear and urged against the base face of insulator 54 and of outer contact 56. Then lock washer 46 is added to lock the assembled elements in place. Optionally, washer 46 may be soldered to base end 62 to form a solder joint 47. Then, after conductors 44 and 24 have been soldered or otherwise joined to the assembly, the insulator jacket 50 can be molded around male connector assembly 14. The front end of insulator jacket 50 barely overlaps and shields the forward edges of outer conductor 56. The C spring 36 expedient included in the construction of the pronged contact 32 of female connector assembly 16 may, of course, be employed to reinforce prongs 66 of the male connector assembly and to insure good contact between outer contacts 56, 20. However, the forward end of insulator jacket 50 provides adequate resilient reinforcement for prongs 66 since, as is shown in FIG. 2, and in FIG. 1, the forward end of insulated jacket 50 does completely surround and overlap the prongs 66. If desired, a small degree of clearance may be provided between the insulator jacket and prongs 66, as shown in FIG. 2.

The male connector assembly may, of course, be the connector assembly permanently mounted at the rear end of electrically powered hand tools. For such construction, then a rear end configuration comparable to that of insulator 50 may be molded on the base end of the hand tool.

In passing, it may be noted that in male assembly 14 the forward plug end 58 of the center contact 52 is recessed relative to the forward edge of outer contact 56, and in female assembly 16 the inner contact 30 is recessed relative to outer contact 20.

Overall, it may be seen that the male connector assembly 14 and the female connector assembly 16 each comprises a small number of parts, five and six, respectively, of which two, namely insulator cup 26 and lock washer 46, are the same in both assemblies. In addition, the universal cord may carry substantial amounts of power, the two conductor power cord 12 being, for example, a 14 wire or heavier. Accordingly, the connector assemblies of the present invention are well adapted to their purposes as the terminal ends of a universal cord for electrically operated tools. In addition, inclusion of the present connector at the base end of the tool does not adversely affect the size, shape, feel or balance of even miniature electrically powered hand tools.

What is claimed is:

1. A female electrical connector assembly comprising a plurality of concentric, generally cylindrical members as follows: a central contact open at its forward end for insertion therein of a mating prong contact of a male connector assembly; an insulator; and an outer contact, said generally cylindrical members each having a reduced external diameter cylindrical rear portion and said insulator and said outer contact also having reduced internal diameters; forming thereby internal shoulders, the insulator seating on the outer contact shoulder and the central contact seating on the insulator shoulder, preventing thereby rearward displace-

ment relative to said outer contact; a centrally apertured second insulator member positioned against an end of said outer contact's and said first insulator's cylindrical rear portions, the cylindrical rear portion of said central contact extending through the aperture; an annular locking element disposed around the cylindrical rear portion of said central contact member bearing said second insulator against said end of said outer contact's and said first insulator's cylindrical rear portion, thereby preventing forward displacement of the above described contacts and insulators relative to each other.

2. The female electrical connector assembly of claim 1 wherein said central contact has an opening in its rearward end for insertion and joinder thereto of one wire conductor and wherein the outer surface of the reduced diameter cylindrical rear portion of said outer contact is adapted for joinder thereto of a second wire conductor.

3. The female electrical contact connector assembly of claim 1 wherein the forward end of said central contact further comprises a multiplicity of spaced apart prongs and a C spring reinforcement means disposed peripherally around the prongs.

4. The female electrical connector assembly of claim 1 wherein an insulating jacket is disposed therearound, said jacket leaving the forward end of said outer contact exposed for mating insertion connection with an outer contact of a male connector assembly.

5. A male electrical connector assembly comprising an elongated central contact having a flange disposed at a mid section portion thereof; a generally cylindrical outer contact spaced apart radially from said central contact, said outer contact having a reduced internal and external diameter cylindrical rear portion thereof forming an internal shoulder therein; an insulator member disposed inside the reduced diameter cylindrical rear portion of said outer contact between said two contacts having an enlarged rim at its forward end, said rim being disposed between the flange on said central contact and the internal shoulder in said outer contact, preventing thereby rearward displacement of insulator and central contact relative to said outer contact, a centrally apertured second insulator member positioned against an end of said outer contact's cylindrical rear portion and of said mentioned insulator and with the rearward portion of said central contact extending through the aperture; and an annular locking member disposed around the rearward portion of said contact member bearing said second insulator against said end of said outer contact's cylindrical rear portion and of said first mentioned insulator, preventing thereby forward displacement of the above described contacts and insulators relative to each other; an insulating jacket disposed around the entire connector assembly, said jacket extending at least to the forward edge of said outer contact.

6. The male electrical connector assembly of claim 5 wherein said central contact has an opening in its rearward end for insertion and joinder thereto of one wire conductor and wherein the outer surface of the reduced diameter cylindrical rear portion of said outer contact is adapted to joinder thereto of a second wire conductor.

7. An electrical connector comprising a female electrical connector assembly formed as a plurality of concentric, generally cylindrical members as follows: a central contact open at its forward end for insertion therein of a mating prong contact of a male connector assembly; an insulator; and an outer contact, said generally cylindrical members each having a reduced diameter external cylindrical rear portion forming thereby internal shoulders and said insulator and said outer contact also having reduced internal diameters, the insulator seating on the outer contact and the central contact seating on the insulator, preventing thereby rearward displacement relative to said outer contact; a centrally apertured second insulator member positioned against an end of said outer contact's and said first insulator's cylindrical rear portion, the rear portion of said central contact extending through the aperture; an annular locking element disposed around the rear portion of said central contact member bearing said second insulator against said end of said outer contact's and said first insulator's cylindrical rear portion, preventing thereby forward displacement of the above described contacts and insulators relative to each other, said connector comprising also a male electrical connector assembly formed as follows: an elongated second central contact having a flange disposed at a mid section portion thereof; a generally cylindrical second outer contact spaced apart radially from said central contact, said second outer contact having a reduced internal and external diameter cylindrical rear portion thereof forming an internal shoulder therein; a third insulator member disposed inside the reduced diameter rear portion of said second outer contact between said two second contacts having an enlarged rim at its forward end, said rim being disposed between the flange on said second central contact and the internal shoulder in said second outer contact, preventing thereby rearward displacement of said third insulator and said second central contact relative to said second outer contact; a centrally apertured fourth insulator member positioned against said second outer contact's cylindrical rear portion and said third insulator and with the rearward portion of said second central contact extending through the aperture; and an annular locking member disposed around the rearward portion of said second central contact member bearing said fourth insulator against said second outer contact's cylindrical rear portion, preventing thereby forward displacement of said second central and second outer contacts and said third and fourth insulators relative to each other, said male and female connector assemblies connecting through insertion of the second central contact of the male connector assembly into the forward opening of the central contact of the female connector assembly to form an electrical connection, and insertion of the outer contact of the female connector assembly into the second outer contact of the male assembly to form an electrical connection.

8. The electrical connector of claim 7 wherein the second insulator member of the female electrical connector assembly and the fourth insulator of the male electrical connector assembly are identical and wherein the locking members are identical.

9. The electrical connector of claim 7 wherein an insulating jacket is disposed around the male connector

assembly, said jacket extending at least to the forward edge of the second outer contact thereon, and wherein an insulating jacket is disposed around the female assembly, said jacket leaving the forward end of the outer contact of the female assembly exposed for the mating insertion contact with the second outer contact of the male connector assembly.

* * * * *