

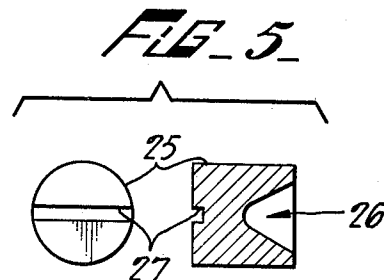
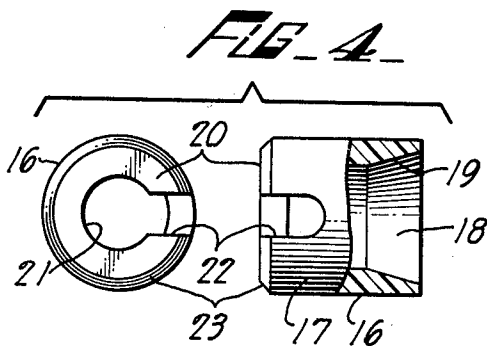
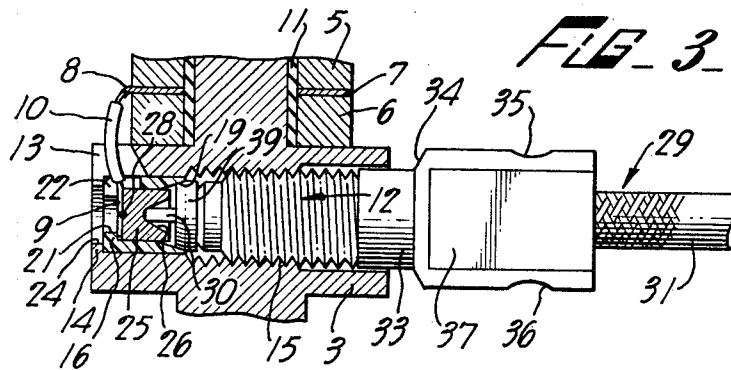
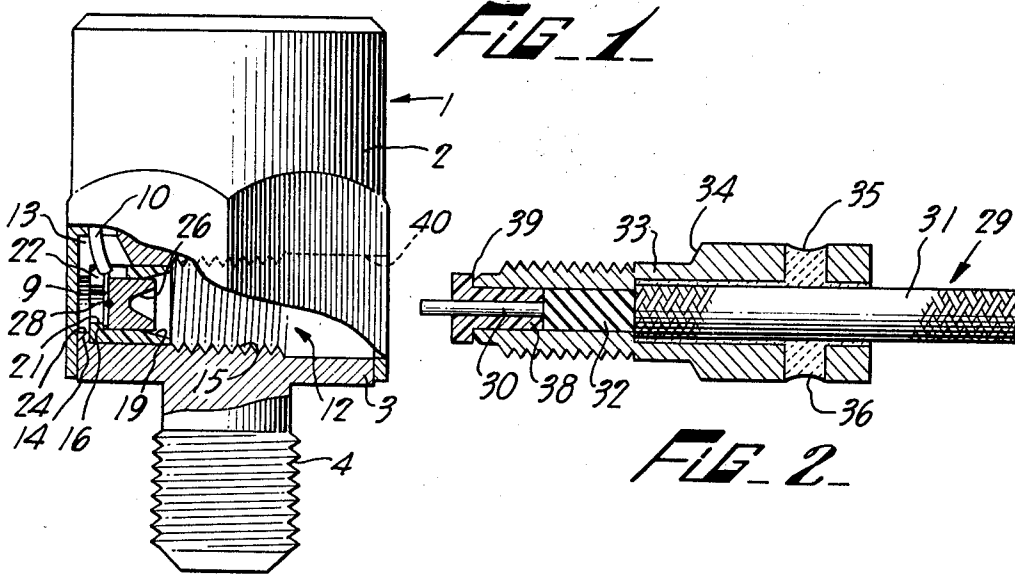
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ELECTRICAL CONNECTOR ARRANGEMENT

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ELECTRICAL CONNECTOR ARRANGEMENT
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12 Claims

ABSTRACT OF THE DISCLOSURE

An electrical connector arrangement for detachably connecting a coaxial cable to an electrical device such as a miniature accelerometer. The coaxial cable is threadably retained within a channel of the electrical device so that the cable's central conductor is releasably maintained in electrical contact with a terminal within the channel.

This invention relates to electrical connector arrangements and more particularly to connector assemblies for detachably connecting a coaxial cable and the like to an electrical device.

There has been a trend in modern times to miniaturize analytical and other electrical instruments. For example, in determining accelerations of small objects accurate results can only be had by reducing the size and weight of the accelerometer to a point where the instrument doesn't contribute significantly to the weight of the object. An important problem in size and weight reduction is the miniaturization of the effects of mechanical damage to the small, low noise cables required by such instruments. Another problem is the design of a strong, reliable electrical connection between the instrument and the cable which carries the output signal. Cable deterioration has been a major problem with the use of miniaturized instrumentation. The most reliable, strongest and lightest cable connections are soldered or welded, and are so close to vital parts of a small instrument as to require factory replacement of cables.

Frequent cable replacement has proven extremely costly both in time and money, particularly since the entire unit has to be returned to the manufacturer for repair. A cable connector arrangement is needed which is reliable, strong and light, but in which the cable can be detached from the instrument when it is damaged and replaced with a readily available substitute.

Accordingly, it is an object of this invention to provide an electrical connection arrangement whereby a conductive wire can be detachably connected to the internal terminal of an electrical device. It is another object of this invention to provide a connector arrangement whereby a coaxial cable can be readily connected to an instrument to provide a strong, reliable and light cable connection without soldering or welding, but whereby the cable can be readily detached for replacement. Other objects of this invention will become apparent from the following description thereof.

The above and other objects are accomplished by providing a connector arrangement for electrically connecting an internal terminal of an electrical device to a conductive wire. The invention comprises providing a channel in the device to the terminal, to allow open communication with the exterior of the device, retaining an insulating bushing or sleeve within the channel, the terminal extending into the bushing or sleeve, and providing an electrically conductive terminal connector within the bushing in contact with the terminal and adapted to receive the conductive wire.

More particularly, the center and outer concentric conductors of a coaxial cable are detachably connected to the internal terminal and conductive body portion, respectively, of a device by adapting the channel to retainably receive the outer conductor and the connector to receive the center conductor.

These and other aspects of the invention will be more fully understood from the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a longitudinal plan, partially cut away and sectionalized, view of a device incorporating the connector arrangement of this invention; in this case the device is a miniature piezoelectric accelerometer;

FIG. 2 is a view in axial partial section of the connecting portion of a cable used in this invention;

FIG. 3 is a sectional view of a portion of the device of FIG. 1 without a housing and with the cable of FIG. 2, in plan view, inserted therein;

FIG. 4 is an end and partially cut away top view of an insulating sleeve depicted in FIGS. 1 and 2;

FIG. 5 is an end and partially cut away top view of a terminal connector depicted in FIGS. 1 and 2.

Referring to FIGS. 1 and 3, an electrical device 1, in this case a miniature piezoelectric accelerometer, is shown in about 10/1 scale, having a housing 2, an electrically conductive base 3 and a stud 4 for attachment of the device to an object for which acceleration is to be measured. The accelerometer has two piezoelectric crystals 5 and 6 sandwiching a conductive terminal spacer 7, which spacer has a tab 8 to which is attached a terminal wire 9 covered by a protective insulating sheath 10. The crystals and spacer sit on an insulating sleeve 11 surrounding a rod-like extension of the base 3. An inertial mass (not shown) is retained atop the crystal 5.

When an accelerating force is applied the mass inertia causes a compression of the crystals 5 and 6 which causes a corresponding change in the electrical condition of the crystals, generating opposite and approximately equal electric charges on the base 3 and terminal wire 9 via the terminal spacer 7 and terminal spacer tab 8.

A terminal connection arrangement is provided in order to detect the electric charge. A channel 12 is provided through a conductive portion of the device, in this case the base, to the terminal wire 9. A passageway 13 is provided so that the terminal wire 9 and sheath 10 can extend into the channel 12. The channel is provided with an annular shoulder 14 at the terminal wire 9 end thereof and has a threaded portion 15 located somewhat centrally therein.

Referring to FIG. 4, a generally cylindrical insulating bushing or sleeve 16 is shown, having a cylindrical wall 17, fabricated of insulating plastic such as Polypenco (a cross-like polystyrene sold by The Polymer Corp., Reading, Pa.). The bushing 16 has an open end 18 with beveled edges 19. The bushing has an end wall 20 with an opening 21 therein communicating with a passageway 22 in the cylindrical wall 17 and has a slight chamfer 23 at the intersection of the end wall 20 and cylindrical wall 17.

The bushing 16 is retained with adhesive within channel 12 at the terminal wire 9 end thereof, abutting shoulder 14 and with bushing passageway 22 aligned with channel passageway 13 so that the terminal wire 9 extends into the bushing 16. The terminal wire insulating sheath 10 also extends through channel passageway 13 and partially into the bushing 16. The end wall opening 21 communicates with the exterior of the base through the base opening 24 at the end of the channel.

Referring to FIG. 5, a terminal connector 25 is shown comprising a generally cylindrical solid plug of conductive metal, such as copper or alloys thereof. Terminal connector 25 has a conical depression 26 in one end and the

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other end may optionally be provided with a slot 27. The terminal connector 25 sits in the insulating bushing 16 with the terminal wire 9 soldered or welded thereto at 28. Slot 27 allows a solder joint 28 not extending beyond the face of connector 25, so that the connector 25 may seat in and bear on end wall 20 of bushing 16. The provision of opening 21 in the bushing end wall 20 and opening 24 in the base allows the terminal wire 9 to be readily passed through bushing passageway 22 and soldered to spacer tab 8.

Housing 2 is layed over the instrument and sealed to the base portion with adhesive or sealing compound. Housing 2 has an opening 40 coincident with the base 3 opening for channel 12.

Referring to FIGS. 2 and 3, a coaxial cable 29 is shown having a central conductor 30 and a concentric outer conductive sheath 31 separated therefrom by insulating casing 32. The insulating casing 32 extends somewhat beyond the conductive sheath 31 and the central conductor 30 extends somewhat beyond the insulating casing 32. An externally-threaded conductive shell 33 concentrically overlays the conductive sheath 31, over extended insulating casing 32 and over a portion of the extended central conductor 30. Conductive shell 33 has a shoulder portion 34 containing two oppositely placed holes 35 and 36 through which the conductive sheath 31 is soldered to the shell 33. A planed depressed portion 37 may be provided on opposite sides of the shoulder portion 34 as a gripping surface for a wrench.

A generally cylindrical insulating bushing 38, fabricated of Teflon or other resilient insulating material, and having a shoulder 39 encases a portion of the central conductor 30 thereby insulatively separating the shell 33 and central conductor 30, the bushing shoulder 39 abutting the outer edge of the shell 33. The central conductor 30 extends somewhat beyond the insulating bushing shoulder 39.

In use, coaxial cable 29 is inserted into the device by threading conductive shell 33 into channel 12 until central conductor 30 abuts the conical depression 26 of terminal connector 25. At that point, shoulder 39 of insulating bushing 38 abuts the beveled portion 19 of insulating bushing 16. The resilience of shoulder 39 assures a solid reliable contact of shell 33 with base 3. The structural arrangement of cable 29 assures a solid reliable contact of conductor 30 with terminal connector 25. In a coaxial cable the central conductor is somewhat slidable within the cable so that pressure against the projecting forward end of the central conductor will cause it to slide back into the cable. Upon release, the central conductor springs forward. By threadably retaining cable 29 within channel 12, the central conductor 30 is biased against terminal connector 25 by its springiness.

From the foregoing description, it is apparent that a connector arrangement and assembly has been provided which achieves the objects of this invention. The connection is strong, reliable and light, and the cable is readily detachable. Although only one particular form of the invention has been specifically disclosed, it will be obvious that the invention is not limited thereto but is capable of a variety of mechanical embodiments. For example, the connector assembly can be located in other portions of the device and other devices besides accelerometers can be benefited by use of such an arrangement. Also, the shell 33 can be further retained in the base 3, e.g., with epoxy resin, so as to reduce spurious response at low frequencies and prevent loosening of the cable under severe vibration; the structural characteristics of the assembly still allow non-factory removal of the cable from the device. The connector arrangement can be used in any miniature instrument or other application where the diameter of the cable to be used is a significant fraction of the dimensions of the instrument or object to which the cable is to be attached. Various changes which will now suggest themselves to those skilled in the art may be

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made in the material, form, details of construction and arrangement of the elements without departing from the spirit of the invention.

I claim:

1. A connector arrangement for electrically connecting an internal terminal wire of an electrical device to a protruding conductive wire of a coaxial cable having an external conductor, comprising a threaded channel in the device to the terminal wire to threadably retain a forward portion of the external conductor in electrical connection therein, an insulating bushing retained within the channel, the terminal wire extending into the bushing, and an electrically conductive terminal connector within the bushing in contact with the terminal wire and adapted to directly receive the conductive wire.

2. The connector arrangement of claim 1 wherein the insulating bushing comprises an insulating sleeve having a passageway in a side wall thereof through which the terminal wire extends into the sleeve, a first portion of the connector in contact with the terminal wire and a second portion adapted to receive the conductive wire.

3. The connector arrangement of claim 1 wherein the insulating bushing includes a shoulder limiting forward movement of the external conductor.

4. A connector arrangement for electrically connecting the center and outer concentric conductors of a coaxial cable to an internal terminal wire and conductive body portion, respectively, of an electrical device, comprising a threaded channel in the body portion adapted to threadably receive a forward portion of the outer conductor therein, the terminal wire extending into the channel, an electrically conductive terminal connector in the channel in contact with the terminal wire and adapted to directly receive the center conductor, and insulating means within the channel insulating the connector therefrom and allowing the connector to contact the terminal wire.

5. The connector arrangement of claim 4 wherein the insulating means comprises an insulating sleeve, retained within the channel, having a passageway in a side wall thereof through which the terminal wire extends into the sleeve.

6. The connector arrangement of claim 4 further including a shoulder within the channel limiting forward movement of the outer conductor.

7. A connector arrangement for an electrical device having an electric ground portion, and a terminal wire, whereby a mating coaxial cable, having an externally-threaded outer conductive shell and an inner conductor projecting and insulated therefrom, can be electrically connected to the device, comprising a channel through the ground portion, at least a portion of which is threaded for threadably retaining a forward portion of the conductive shell therein, an insulating sleeve into which at least a portion of the terminal wire extends, and an electrically conductive terminal connector within the sleeve, a first portion of the connector in contact with the terminal wire and a second portion adapted to directly receive the center conductor when the conductive shell is threadably retained within the channel.

8. A connector arrangement for an electrical device having an electrical ground portion, a housing overlaying the ground portion and a terminal wire within one side of the housing, whereby the center and outer concentric conductors of a coaxial cable can be electrically connected to the terminal wire and ground portion, respectively, comprising a channel through the ground portion and a portion of the housing opposite the terminal wire, the channel through the ground portion being adapted to threadably retain a forward portion of the outer conductor in electrical contact therein, an insulating sleeve, retained within the channel, having a passageway in a side thereof through which the terminal wire extends into the sleeve, an electrically conductive terminal connector within the sleeve, a first portion of the connector in contact with the terminal wire and a second portion adapted

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to directly receive the center conductor, and a shoulder within the channel limiting forward movement of the outer conductor.

9. A connector arrangement for an electrical device having an electrical ground portion, a housing overlaying the ground portion and a terminal wire within one side of the housing whereby a mating coaxial cable, having an externally-threaded outer conductive shell separated from a projecting inner conductor by a resilient insulating bushing having an annular shoulder abutting the outer edge of the shell, can be electrically connected to the device, comprising (1) a channel through the ground portion and a portion of the housing opposite the terminal wire, at least a portion of the channel being threaded for threadably retaining the conductive shell therein, (2) an insulating sleeve, retained within the channel, having a passageway in a side wall thereof for the terminal wire, at least a portion of the terminal wire extending into the channel and through the passageway into the insulating sleeve, and (3) an electrically conductive terminal connector within the sleeve, a first portion of the connector in contact with the terminal wire and a second portion adapted to directly receive the center conductor when the conductive shell is threadably retained within the channel, a portion of the insulating sleeve in proximity to the second portion of the terminal connector being adapted to retain the resilient insulating bushing of the coaxial cable.

10. The connector arrangement of claim 9 wherein the insulating sleeve contains a shoulder for the terminal connector, in proximity to the terminal wire.

11. The connector arrangement of claim 9 wherein the terminal connector comprises a solid body of conductive material having a conical depression in the second portion to receive the center conductor.

12. A connection assembly having a detachable cable comprising:

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(1) a coaxial cable comprising central and outer concentric conductors separated by insulating material, an externally-threaded outer conductive shell concentrically and conductively attached to the outer conductor at one end and extending beyond the outer conductor, and an insulating bushing separating the shell and central conductor and having an annular shoulder abutting the outer edge of the shell, the central conductor extending beyond the shoulder of the insulating bushing; and

(2) an electrical device having an electrical ground portion, a housing overlaying the ground portion, a terminal wire within one side of the housing, a channel through the ground portion and a portion of the housing opposite the terminal wire, at least a portion of the channel being threaded for threadably retaining the conductive shell therein, an insulating sleeve retained within the channel into which at least a portion of the terminal wire extends and having a shoulder abutting the insulating bushing, an electrically conductive terminal connector within the sleeve, a first portion of the connector in contact with the terminal wire and a second portion adapted to directly receive the central conductor when the conductive shell is threadably retained within the channel.

References Cited

UNITED STATES PATENTS

3,335,703 11/1967 Alibert et al. ----- 339—177

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U.S. Cl. X.R.

310—8.4; 339—147, 275