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[54] **COAXIAL CABLE CONTACT**

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[58] **Field of Search**..... 339/60 C, 88 C, 89 C, 91 P, 339/94 C, 126 J, 177

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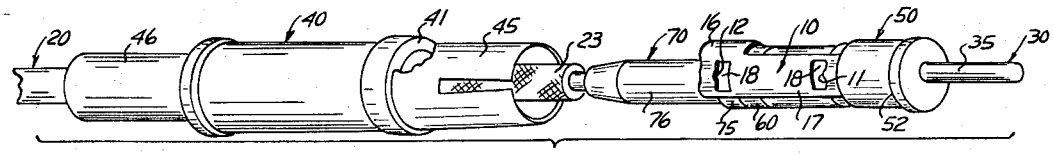
[57] **ABSTRACT**

A contact assembly for the plug and jack portion of a coaxial cable connector assembly. The contact assembly includes a plurality of members which are demountably secured together by a metal retention clip.

5 Claims, 6 Drawing Figures



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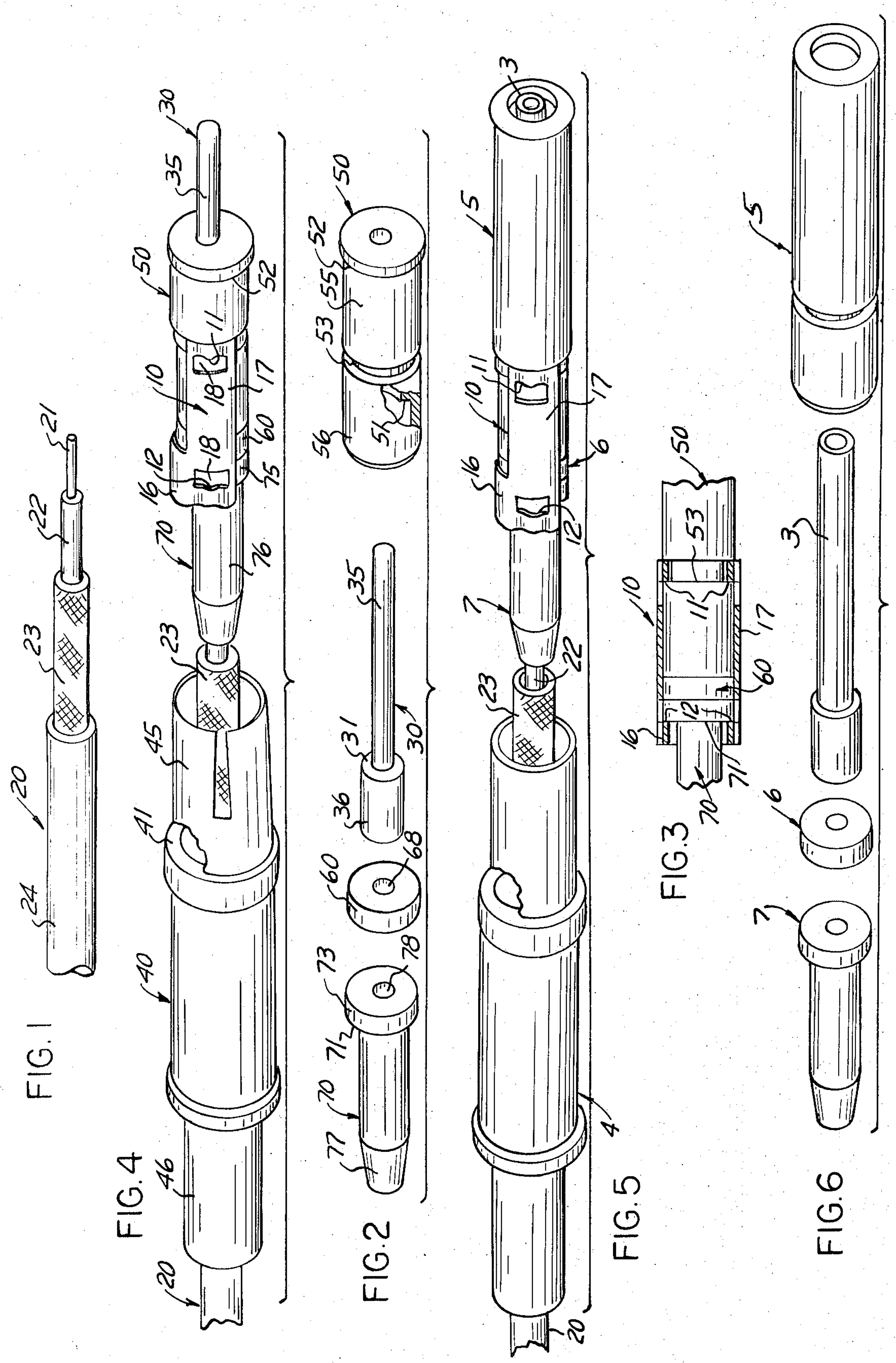

COAXIAL CABLE CONTACT

BACKGROUND OF THE INVENTION

This invention relates to a coaxial type electrical connector which includes a mateable plug and jack. This invention is more particularly related to a contact assembly within the plug and/or jack.

Electrical connectors for coaxial cables are well known in the art and may be seen in U.S. Pats. No. 3,229,241 entitled "Electrical Connectors for Coaxial Cable" issued Jan. 11, 1966 to E. Kao; and 3,184,706 entitled "Coaxial Cable Connector with Internal Crimping Structure" issued May 18, 1965 to S. R. Atkins. In connectors of the aforementioned types, continuous use of the connector assembly, i.e., mating and unmating of the plug and jack wears the engaging portions of the assemblies and/or a failure occurs so that it is necessary to replace plug and jack assembly. Further, plug and jack assemblies of this type are generally sized to receive only one size (diameter) cable so that different diameter cables require different size plugs and jacks.

SUMMARY OF THE INVENTION

This invention provides a plug and jack assembly for a coaxial cable that includes a demountable contact assembly that allows for repair or replacement of defective parts.

The invention also provides the mating of small diameter coaxial cables to large contact sizes so that the use of standard size plug and jack assemblies is encouraged.

The invention is a contact assembly for a coaxial cable connector characterized by a metal retention clip (**10**) that holds together, in fixed position, the elements (**30, 60, 70, 50**) that form the contact assembly.

In one embodiment the invention is an electrical connector member for attachment to an end of a coaxial cable (**20**) having a center conductor (**21**), an inner dielectric layer (**22**) surrounding the center conductor (**21**), a flexible tubular outer conductor (**23**) surrounding the dielectric layer (**22**) and an outer electrically insulating layer (**24**) surrounding said outer conductor (**23**), the connector member of the invention comprising: a tubular shell (**40**) of conducting material having a forward mating portion (**45**) and a rear cable receiving portion (**46**) that is radially deformable, the shell including an internal forwardly facing shoulder (**41**) between the mating end (**45**) and the rear cable receiving end (**46**); a center, electrically conducting, contact member (**30**) having a forward mating portion (**35**) and a rear center conductor receiving portion (**36**) adapted to be attached to a bared end of the coaxial cable center conductor (**21**), the contact (**30**) having a forwardly facing shoulder (**31**) between the mating end (**35**) and the conductor receiving end (**36**); an insulating sleeve (**50**) having a forward portion (**55**), a rear contact receiving portion (**56**), a first rearwardly facing shoulder (**51**) in said rear portion, a forwardly facing shoulder (**53**) and a second rearwardly facing shoulder (**52**) on said forward portion (**55**), the insulating sleeve (**50**) mounted around the contact (**30**) so that the first rearwardly facing shoulder (**51**) of the sleeve (**50**) is in engagement with the forward facing shoulder (**31**) of the contact (**30**) and the contact mating portion (**35**) extends out of the forward end (**55**) of the insulating sleeve (**50**), the insulating sleeve (**50**) mounted within the shell (**40**) so that the second rearwardly facing shoulder (**52**) of the sleeve is in engagement with the internal forwardly facing shoulder (**41**) of the shell (**40**) whereby the insulating sleeve (**50**) is supported within the shell (**40**) with the contact (**30**) insulated from the shell (**40**) and the contact mating end portion (**35**) accessible from the front of the shell (**40**); an insulating bushing (**60**) having a forward face, a rear face and a passage adapted to receive a bared end portion of said inner dielectric layer (**22**) surrounding the center conductor of said coaxial cable (**20**), a bushing mounted with the forward face abutting against the rear ends of the contact (**30**) and said insulating sleeve (**50**); an electrically conducting sleeve (**70**) having a forward portion (**75**) that includes a rearwardly facing shoulder (**51**) and a rear portion (**76**) having a tapered portion (**77**), said conducting sleeve (**70**) adapted to be engaged over the inner dielectric layer (**22**) of said cable (**20**) with said tapered end portion (**77**) in contact with said outer conductor (**23**) and said rear end portion (**76**) of said conducting sleeve (**70**) positioned under said rear deformable portion (**46**) of said shell (**40**) whereby when said deformable portion of said shell (**40**) is crimped radially inwardly, said conducting sleeve (**70**) and said coaxial cable disposed in said sleeve (**70**) are compressed together to prevent movement of said cable (**20**) with respect to said shell (**40**); and means for retaining (**10**) said insulating sleeve (**50**), said contact (**30**), said bushing (**60**), and said conducting sleeve (**70**) in assembled relationship, said retaining means (**10**) comprising a clip having a forward portion (**17**), a rear portion (**16**), an internal rearwardly facing shoulder (**11**) on said forward portion (**17**) and an internal forwardly facing shoulder (**12**) on said rear portion (**16**), said forwardly facing shoulder (**12**) of said clip (**10**) in engagement with said rearwardly facing shoulder (**71**) of said conducting sleeve (**70**) and said rearwardly facing shoulder (**11**) of said clip in engagement with said forwardly facing shoulder (**53**) of said insulating sleeve (**50**) whereby said contact (**30**), said insulating sleeve (**50**), said bushing (**60**) and said conducting sleeve (**70**) are held together by said clip (**10**) and wherein when said rear deformable portion (**46**) of said shell (**40**) is crimped, said electrical connector element in said coaxial cable are assembled together in fixed relationship.

Accordingly, it is an object of this invention to provide a coaxial cable connector assembly with demountable contact assemblies.

It is another object of this invention to provide a coaxial cable connector assembly that has a contact assembly that is connectable to relatively smaller coaxial cables.

It is still another object of this invention to encourage the use of standard size plug and jacks for coaxial cables of different sizes.

It is a further object of this invention to provide electrical connector for a coaxial cable that allows for repair and replacement of some of the components without replacement of the entire plug or jack.

The above and other objects and features of the invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings and claims which form a part of the specification.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic view of a coaxial cable.

FIG. 2 is an exploded view of the contact assembly elements except for the retention clip.

FIG. 3 is a sectional view of the contact assembly portion of either the plug or jack.

FIG. 4 is an exploded view of the plug portion of the connector assembly.

FIG. 5 is an exploded view of the jack portion of the connector assembly.

FIG. 6 is an exploded view of the contact assembly of the jack except for the retention clip.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring now to the drawings, FIG. 1 illustrates a coaxial cable of the type used in combination with this electrical connector. The coaxial cable (20) has a center electrical conductor (21), an inner dielectric layer (22) surrounding the center conductor (21), a flexible tubular electrical conductor (23) surrounding the dielectric layer (22), and an outer electrically insulating layer (24) surrounding the outer conductor (23).

FIG. 2 illustrates the members of the contact assembly that are to be held together by a retaining means (not shown). The contact assembly comprises an insulating sleeve (50), an electrically conducting elongated contact member (30), an insulating bushing (60), and an electrically conducting sleeve (70).

The electrical conducting sleeve (70) has a forward portion (75) that includes a rearwardly facing shoulder (71) and a rear portion (76) having a tapered end portion (77). The passage (78) in the conducting sleeve (70) is sized to allow the passage of the coaxial cable center conductor (21) and the inner dielectric layer (22) surrounding the center conductor. The tapered end portion (77) of the conducting sleeve is tapered in a manner that facilitates the insertion of the conducting sleeve (70) beneath the flexible electrical conducting layer (23) of the coaxial cable. The rearwardly facing shoulder (71) is designed to engage a forwardly facing shoulder of a retention clip (not shown).

The insulating bushing (60) includes a forward face and a rear face and is designed to isolate the insulating sleeve (70) from the electrical contact (30). A passage (68) is sized to allow the center conductor (21) of the coaxial cable to pass through and into the electrical contact (30).

The electrical contact (30) includes a rear portion (36) having a forwardly facing shoulder (31) and an elongated forward mating portion (35). A bore (not shown) in the rear portion (36) is adapted to receive a bared end of the coaxial cable, i.e. center conductor (21).

Insulating sleeve (50) includes a forward portion (55) having a rearwardly facing shoulder (52), a rear contact receiving portion (56), and a forwardly facing shoulder (53) which is designed to engage a rearward facing shoulder (not shown) of a retention clip. The insulating sleeve (50) includes an internal rearwardly facing shoulder (51) designed to engage the forwardly facing shoulder (31) of the contact (30) so as to prevent further movement of the electrical contact (30) when it is inserted into the insulating sleeve (50) with the elongated end portion (35) extending from the sleeve (50).

FIG. 3 is a cross-sectional view of the contact assembly components assembled in fixed positions with respect to each other by a retention clip (10). The retention clip (10) includes a base portion (16) and one or more arms (17) (preferably two) that extend from the base portion. The base portion (16) has an annular configuration that extends less than 360° so that the base portion is radially expandable to allow the base portion to snap over and around the forward portion (75) of the electrically conducting sleeve (70). The arms (17) are integral with the base portion and are located opposite each other and extend in the same direction. Each of the arms (17) includes a latch which is formed by a depression in a portion of the arm (17) to form a rearwardly facing shoulder (11). The rearwardly facing shoulder (11) is designed to engage the forwardly facing shoulder (53) of the insulating sleeve (50). Similarly, the base portion (16) includes a latch that is formed by a depression in a portion of the base to form a forwardly facing shoulder (12) that is designed to engage the rearwardly facing shoulder (71) of the forward portion (75) of conducting sleeve (70). This figure illustrates how the retaining clip (10) demountably assembles the conducting sleeve (70), the bushing (60), the insulating sleeve (50), and the contact (30) in fixed relationship with respect to each other.

FIG. 4 illustrates the plug half of a coaxial cable connector assembly. The plug comprises: an outer tubular shell (40); an electrically conducting sleeve (70); an insulating bushing (60); an elongated contact member (30); an insulating sleeve (50); and a retaining clip (10). The tubular plug shell (40) receives a cable at one end (20) which is attached to the contact assembly comprised of pieces (10), (30), (50), (60) and (70). The contact assembly telescopes into the shell (40) until the rearward facing shoulder (52) on the insulating sleeve engages the forward facing shoulder (41) of the shell. The plug shell (40) includes a forward mating portion (45) that receives a jack; and a rear cable receiving portion (46) which is radially deformable. Once the contact assembly is located within the shell (40), the rear portion (46) of the shell (40) is crimped or deformed by a suitable tool so that the rear portion (46) is in pressure-tight contact with a portion of the cable (23) which is in pressure contact with the contact assembly so that the contact assembly and cable will remain in a fixed position with respect to the shell (40).

The retention clip (10), when snapped into place, retains the contact assembly members in fixed position relative to each other. To facilitate the formation of the shoulders (11, 12) in the clip (10), apertures (18) are punched into the base (16) and arms (17) of the clip (10).

FIG. 5 illustrates an exploded view of the jack half of the connector assembly for a coaxial cable. The jack half of the connector assembly is assembled in the same fashion as the plug half. The forward mating portion of the shell (4) of the jack portion of the connector assembly is sized to be inserted into the forward mating portion (45) of the plug shell (40). Similarly, the electrical contact (3) of this assembly includes a bore in the front portion that is adapted to receive the elongated member (35) of the plug contact (30). The view of the jack illustrates that the contact assembly of the jack is assembled and held together by a retaining clip (10) in

the same manner as the contact assembly components of the plug.

FIG. 6 illustrates the components of the contact assembly for the jack. The contact assembly includes an electrically conducting sleeve (7), an insulating bushing (6), an electrically conducting contact (3), and an insulating sleeve (5). In this embodiment the mating sleeve (5) includes an internal shoulder (not shown) that locates the electrical contact (3) within the insulating sleeve (5). These components as mentioned before are assembled and maintained in fixed position relative to each other by a retaining clip (10).

OPERATION OF ASSEMBLY

Assembly of either the plug and jack is as follows: Referring now to FIGS. 1 and 4, the plug half of the coaxial cable connector assembly is assembled as follows: First, the coaxial cable is stripped down in the manner shown in FIG. 1, the coaxial cable (20) being cut in a predetermined manner to allow for the center conductor (21) to extend into the contact (30) and allow the flexible tubular outer conductor (23) to surround the rear portion (76) of the conducting sleeve (70). The cable and appropriate portions thereof are inserted through the tubular shell (40), the electrically conducting sleeve (70) and the bushing (60), with the bared center conductor (21) inserted into and in contact with the electrical contact (30). Using the conducting sleeve (70) the bushing (60) and the electrical contact (30) are pushed into and held in the insulating bushing (50). The retention clip (10) is then snapped onto the conducting sleeve (70) and insulating sleeve (50). The pieces are held together by action of the clip shoulder (11, 12) which engage the rearward facing shoulder (71) of the conducting sleeve (70) and the forward facing shoulder (53) of the insulating sleeve (50) thereby preventing relative movement of the contact assembly elements. The contact assembly is then telescoped into the shell (40) until the rearwardly facing shoulder (52) of the insulating sleeve (50) abuts against the forwardly facing shoulder (41) of the shell (40).

With the rearwardly facing shoulder (52) in abutment against the forwardly facing shoulder (41), the rear portion (76) of the sleeve (70), with the flexible electrical conductor (23) surrounding it, is positioned under the rear portion (46) of the shell (40). A crimping tool, pliers or any other suitable tool is then used to compress the rear portion (46) of the shell (40) so that the rear portion (46) is in pressure contact with the flexible outer conductor (23). Once the contact assembly has been properly positioned and the rear portion (46) of the shell (40) crimped by a suitable tool, the coaxial cable (20) and the contact assembly are fixedly mounted within the shell (40). Assembly of the jack half of the connector assembly is performed in the same manner.

While a preferred embodiment of the invention has been disclosed, it will be apparent to those skilled in the art that changes may be made to the invention as set forth in the appended claims and, in some instances, certain features of the invention may be used to advantage without corresponding use of other features. Accordingly, it is intended that the illustrative and descriptive materials herein be used to illustrate the principles of the invention and not to limit the scope thereof.

Having described the invention, what is claimed is:

1. An electrical connector member for attachment to an end of a coaxial cable having a center conductor, an inner dielectric layer surrounding the center conductor, a flexible tubular outer conductor surrounding the dielectric layer, and an outer electrically insulating layer surrounding said outer conductor, said connector member comprising:

a tubular shell of electrically conducting material having a forward mating portion and a rear cable receiving portion that is radially deformable, said shell including an internal forwardly facing shoulder between said mating end and said rear cable receiving end;

a center, electrically conducting, contact member having a forward mating portion and a rear center conductor receiving portion adapted to be attached to a bared end of said coaxial cable center conductor, said contact having a forwardly facing shoulder between said mating end and said conductor receiving end;

an electrical insulating sleeve having a forward portion, a rear contact receiving portion, a first rearwardly facing shoulder in said rear portion, a forwardly facing shoulder and a second rearwardly facing shoulder on said forward portion, said insulating sleeve mounted around said contact so that said first rearwardly facing shoulder of said sleeve is in engagement with said forwardly facing shoulder of said contact and said contact mating portion extends out of said forward end of said insulating sleeve, said insulating sleeve mounted within said shell so that said second rearwardly facing shoulder of said sleeve is in engagement with said internal forwardly facing shoulder of said shell whereby said insulating sleeve is supported within said shell with said contact insulated from said shell and said contact mating end portion accessible from the front of said shell;

an insulating bushing having a forward face, a rear face, and a passage adapted to receive a bared end portion of said inner dielectric layer surrounding the center conductor of said coaxial cable, said bushing mounted with said forward face abutting against the rear ends of said contact and said insulating sleeve;

an electrically conducting sleeve having a forward portion that includes a rearwardly facing shoulder and a rear portion having a tapered portion, said forward end abutting against the rear face of said bushing, said conducting sleeve adapted to be engaged over the dielectric layer of said cable with said tapered end portion in contact with said outer conductor, and said rear end portion of said conducting sleeve positioned under said rear deformable portion of said shell whereby when said deformable portion of said shell is crimped radially inwardly, said conducting sleeve and said coaxial cable disposed in said sleeve are compressed together to prevent rearward movement of said cable with respect to said shell; and

means for retaining said insulating sleeve, said contact, said bushing and said conducting sleeve in assembled relationship, said retention means comprising a metal clip having a forward portion, a rear portion, an internal rearwardly facing shoulder on said forward portion and an internal forwardly facing shoulder on said rear portion, said forwardly

facing shoulder of said clip in engagement with said rearwardly facing shoulder of said conducting sleeve, and said rearwardly facing shoulder of said clip in engagement with said forwardly facing shoulder of said insulating sleeve, whereby said contact, said insulator sleeve, said bushing and said conducting sleeve are held together by said clip and wherein when said rear deformable portion of said shell is crimped said electrical connector elements and said coaxial cable are assembled together in fixed relationship.

2. An electrical connector member for attachment to an end of a coaxial cable having a center conductor, an inner dielectric layer surrounding the center conductor, a flexible tubular outer conductor surrounding the dielectric layer, and an outer electrically insulating layer surrounding said outer conductor, said connector member comprising:

a tubular shell of electrically conducting material having a forward mating portion and a rear cable receiving portion that is radially deformable, said shell including an internal forwardly facing shoulder between said mating end and said rear cable receiving end;

a center, electrically conducting, contact member having a forward mating portion and a rear center conductor receiving portion adapted to be attached to a bared end of said coaxial cable center conductor, said contact having a forwardly facing shoulder between said mating end and said conductor receiving end;

an insulating sleeve having a forward portion, a rear contact receiving portion, a first rearward stop means in said rear portion, a forwardly facing shoulder and a second rearwardly facing shoulder on said forward portion, said insulating sleeve mounted around said contact so that said first rearwardly facing stop means of said sleeve is in engagement with said forwardly facing shoulder of said contact and said contact mating portion extends out of said forward end of said insulating sleeve, said insulating sleeve mounted within said shell so that said second rearwardly facing shoulder of said sleeve is in engagement with said internal forwardly facing shoulder of said shell whereby said insulating sleeve is supported within said shell with said contact insulated from said shell and said contact mating end portion accessible from the front of said shell;

an insulating bushing having a forward face, a rear face and a passage adapted to receive a bared end portion of said inner dielectric layer surrounding the center conductor of said coaxial cable, said bushing mounted with said forward face abutting against the rear ends of said contact and said insulating sleeve;

an electrically conducting sleeve having a forward portion that includes a rearwardly facing shoulder and a rear portion having a tapered portion, said forward end abutting against the rear face of said bushing, said conducting sleeve adapted to be engaged over the inner dielectric layer of said cable with said tapered end portion in contact with said outer conductor, said rear end portion of said conducting sleeve positioned under said rear deformable portion of said shell whereby when said deformable portion of said shell is crimped radially inwardly, said conducting sleeve and said coaxial cable disposed in said sleeve are compressed together to prevent rearward movement of said cable with respect to said shell; and

means for retaining said insulating sleeve, said contact, said bushing and said conducting sleeve in assembled relationship, said means comprising a clip having an annularly shaped rear portion, an internal forwardly facing shoulder on said rear portion, said forwardly facing shoulder of said clip in engagement with said rearwardly facing shoulder of said conducting sleeve, and at least one forwardly extending finger extending from said rear portion, each of said fingers having a forward end portion that includes a rearwardly facing shoulder, each of said rearwardly facing shoulders of said fingers in engagement with said forwardly facing shoulder of said insulating sleeve whereby said contact, said insulator sleeve, said bushing and said metal conducting sleeve are held together in fixed relationship by said clip and wherein when said rear deformable portion of said shell is compressed, said electrical connector elements and said coaxial cable are assembled together in fixed relationship.

3. In combination with an electrical connector member for attachment to an end of a coaxial cable having a center conductor, an inner dielectric layer surrounding the center conductor, a flexible tubular outer conductor surrounding the dielectric layer, and an outer electrically insulating layer surrounding said outer conductor, said connector member comprising:

a tubular shell of electrically conducting material having a forward mating portion and a rear cable receiving portion that is radially deformable, said shell including stop means between said mating end and said rear cable receiving end;

a center, electrically conducting, contact member having a forward mating portion and a rear center conductor receiving portion adapted to be attached to a bared end of said coaxial cable center conductor, said contact having stop means between said mating end and said conductor receivzng end;

an insulating sleeve having a forward portion, a rear contact receiving portion, a first stop means, a second stop means and third stop means on said forward portion, said insulating sleeve mounted around said contact so that said first stop means of said sleeve is in engagement with said stop means of said contact so that said contact mating portion extends out of said forward end of said insulating sleeve, said insulating sleeve mounted within said shell so that said third stop means of said sleeve is in engagement with said stop means of said shell so that said insulating sleeve is supported within said shell with said contact insulated from said shell and said contact mating end portion accessible from the front of said shell;

an insulating bushing having a forward face, a rear face and a passage adapted to receive a bared end portion of said inner dielectric layer surrounding the center conductor of said coaxial cable, said bushing mounted with said forward face abutting against the rear end of said contact disposed in said insulating sleeve;

an electrically conducting sleeve having a forward portion that includes a first stop means and a rear portion having a tapered portion, said forward end abutting against the rear face of said bushing, said conducting sleeve adapted to be engaged over the dielectric layer of said cable with said tapered end portion in contact with said outer conductor, and said rear end portion of said conducting sleeve positioned under said rear deformable portion of said shell whereby when said deformable portion of said shell is crimped radially inwardly, said conducting sleeve and said coaxial cable disposed in said sleeve are compressed together to prevent rearward movement of said cable with respect to said shell; and

means for demountably retaining said insulating sleeve, said contact, said bushing and said conducting sleeve in assembled relationship, said means comprising a clip having a forward portion, a rear portion, a first stop means on said forward portion and a second stop means on said rear portion, said second stop means of said clip in engagement with said first stop means of said conducting sleeve, said first stop means of said clip in engagement with said second stop means of said insulating sleeve, whereby said contact, said insulator sleeve, said bushing, and said metal conducting sleeve are held together by said clip and wherein when said rear deformable portion of said shell is compressed said electrical connector elements and said coaxial cable are assembled together in fixed relationship.

4. In combination with an electrical connector of the type having a plug housing having a forward portion and a rear portion, a forward electrical contact, an insulator disposed to support said forward contact within but electrically insulated from said housing, a rear contact disposed within said shell, said rear contact including means for electrically connecting said rear contact to said shell and for electrically isolating said rear contact from said forward contact, and means for retaining said insulator, said forward contact and said rear contact in fixed relationship, the improvement wherein said retaining means comprises:

a base portion having an annular configuration that extends less than 360° so that said base portion is radially expandable, said base portion adapted to receive and latch onto a portion of said rear contact and prevent rearward movement thereof; and

two arms, integral with said base portion, located opposite each other and extending in the same direction, each of said arms adapted to receive and latch onto a portion of said insulator and prevent forward movement thereof whereby when said base portion latches onto said rear contact and said arms latch onto said insulator, said insulator, said forward contact and said rear contact are retained in fixed relationship with respect to each other.

5. In combination with an electrical connector of the type having a plug housing having a forward portion and a rear portion, a forward electrical contact, an insulator disposed to support said forward contact within but electrically insulated from said housing, a rear contact disposed within said shell, said rear contact including means for electrically connecting said rear contact to said shell and for electrically isolating said rear contact from said forward contact, and means for retaining said insulator, said forward contact and said rear contact in fixed relationship, the improvement wherein said retaining means comprises:

a sleeve, resiliently expandable in a radial direction, said sleeve adapted to snap over a portion of said rear contact and a portion of said insulator, said sleeve having forward means for latching onto said insulator and rear means for latching onto said rear contact whereby when said metal sleeve is snapped onto said rear contact and said insulator, said rear contact and said insulator are retained by said sleeve in fixed position with respect to each other.

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