

## Description

This invention relates to electrical connectors and more particularly to coaxial connectors of the plug or receptacle type.

US Patent Serial No. 210 694 filed 26 November 1980 (equivalent to US-A-4 377 320) discloses a coaxial connector of the SMB type. This connector was found to be difficult to assemble and to terminate for the reasons that the tolerances were difficult to maintain between a stamped and formed spring contact member and a drawn shell member so that when they were assembled together with a dielectric spacer in the spring contact member, these parts would in many cases not remain assembled and would therefore cause terminations not to be easily made when the center contact terminated to the center conductor of a coaxial cable was inserted within the dielectric spacer.

There is disclosed in our EP-A-0001701 a coaxial connector comprising a conductive outer shell member, a conductive spring contact member surrounded by the outer shell member and having spring fingers for coupling to a further coaxial connector, a conductive inner shell member for connection with the outer conductor of a coaxial cable, and a dielectric member coaxially mounted within the inner shell member for receiving a conductive center contact for connection with a center conductor of the cable. In this connector the outer shell is loosely mounted and is rotatable to serve as a mechanical coupling to a complementary connector, and the spring member is of cylindrical form frictionally fitted over a forward portion of the dielectric and a forward portion of the inner shell member.

It is an object to overcome the aforementioned problems experienced in connectors according to our US application SN 210 694 which corresponds to EP-A-0052980.

In a connector having the aforementioned features known from EP-A-0001701 according to the present invention the conductive spring contact member, the conductive outer shell member and the conductive inner shell member have cylindrical parts in overlapping coaxial contiguous relation, each of the conductive members having an inwardly projecting inner portion extending within the outer profile of and engaging the adjacent inner member, and the conductive members being secured together by crimping at the overlapping parts as a conductive unit containing the dielectric member secured therein.

The invention will now be described, by way of example, with reference to the accompanying, partly diagrammatic drawings, in which:—

Figure 1 is an exploded view of the parts of the coaxial connector plug of the present invention,

Figure 2 is a cross-sectional view of a dielectric spacer affixed to the inner shell and these assembled parts inserted into the spring contact member,

Figure 3 is a cross-sectional view of the assembly of Figure 2 crimpably secured in the

outer shell and the center contact terminated on the center conductor of the coaxial cable,

Figure 4 is a cross-sectional view of the coaxial connector plug terminated onto the coaxial cable and the mating jack exploded therefrom.

Figure 5 is an exploded perspective view of the parts of the coaxial jack.

Figure 6 is a perspective view of Figure 5 in an assembled condition.

Figure 7 is a cross-sectional view of a right angle coaxial connector plug and coaxial jack exploded therefrom.

Referring to Figures 1 through 4, the invention comprises a coaxial connector 10 in the form of a receptacle including a dielectric spacer 12, an inner shell 14, a spring contact member 16, an outer shell 18, a center electrical contact 20, and a crimping ferrule 22. The receptacle is intended for termination onto a coaxial transmission cable 24 comprising a center conductor 26, surrounded by a dielectric layer 28, which in turn is surrounded by an outer conductive shield 30 and an outer insulative sheath 32.

Dielectric spacer 12 is molded from a suitable dielectric material and has a generally elongate configuration that unitarily includes a forward cylindrical section 34 and a rear cylindrical section 36. An axial bore extends through spacer 12 and is in communication with annular recess 40 in section 36. Annular recess 42 is located in the exterior surfaces of section 36. The end surface of section 36 is bevelled.

Inner shell 14 is of a unitary drawn construction and includes large diameter section 44 and small diameter section 46. A bevelled transition section 48 connects sections 44 and 46 together. An inwardly-directed annular projection 50 is located in section 44 and annular grooves 52 are located in the exterior surface of section 46. Shell 14 is formed from brass or suitable metal and is bright nickel plated.

Spring contact member 16 is stamped and formed in accordance with common practice from beryllium copper or a metal having suitable spring characteristics. It is nickel plated and has a tubular section 54 in which rectangular openings 56 are located. A plurality of spring contacts 58 are annularly spaced about the forward end of section 54 and extend forwardly therefrom. Each spring contact 58 includes an inner leaf spring 60 and outer leaf spring 62 which is bent back and extends along leaf spring 60 in V-shape configuration. Leaf springs 60 have arcuate projections 64 adjacent outer ends thereof. Leaf springs 62 have increasing width from their jointure with leaf springs 60 to just after their bights 66. The outside surfaces of arcuate projections 64 and bights 66 are gold plated. Inwardly-directed lugs 68 are located between leaf springs 60.

Outer shell 18 is a drawn part from brass or like material and includes a large diameter section 70, small diameter section 72 interconnected together by beveled section 74.

Center electrical contact 20 is formed from beryllium copper or like metal as a tubular

member which is gold plated and includes arcuate spring contact members 76, bore 78, sight hole 80, and annular flange 82.

Crimping ferrule 22 is formed from copper or like material as a tubular member which is tin plated and has a beveled flange 23 which terminates as a curved end.

In assembly, section 36 of dielectric spacer 12 is inserted into section 44 of inner shell 14 with the end beveled surface of section 36 engaging beveled section 48 and annular projection 50 engaging annular recess 42 thereby securing spacer 12 and shell 14 together. This assembly is inserted into tubular section 54 of spring contact member 16 until the front end of section 44 engages lugs 68.

Outer shell 18 is positioned onto spring contact member 16 with small diameter section 72 engaging tubular section 54 and large diameter section 70 extending along spring contacts 58. Crimping action is applied to section 72 in accordance with conventional crimping practices thereby crimping section 72 onto section 54 which also causes flow of metal 57 of section 72 into openings 56. The front end of section 70 is rolled inwardly forming an entrance into plug coaxial connector 10 as shown in Figure 4 and protecting the leaf spring contact members. The assembled parts of the coaxial connector are ready for termination onto a coaxial cable.

To terminate coaxial connector 10 onto a stripped end of coaxial cable 24, crimping ferrule 22 is placed onto sheath 32, center conductor 26 is inserted into bore 78 of center contact 20 with flange 82 engaging dielectric layer 28 whereafter center contact 20 is crimped onto center conductor 26. Terminated center contact 20 is inserted into bore 38 of dielectric spacer 12 of the assembled connector with flange 82 being disposed in annular recess 40, dielectric layer 28 extends along the inner surface of section 46 of inner shell 14, and outer shield 30 is positioned onto the outer surface of section 46. Crimping ferrule 22 is positioned against beveled section 48 of inner shell 14 and a conventional crimping tool (not shown) crimps ferrule 22 onto shield 30 and sheath 32 thereby terminating coaxial connector 10 onto the inner and outer conductors of coaxial cable 24 as shown in Figure 4.

Connector 10 is electrically connected to coaxial plug 84 as shown in Figure 4 with section 34 of dielectric spacer 12 positioned within recessed area 86 of dielectric member 88 and spring contact members 76 of center contact 20 electrically connected with center contact pin 90 of center contact member 92 secured in dielectric member 88. Outer contact member 94 of plug 84 is disposed in the space between section 34 of spacer 12 and leaf springs 60 of spring contacts 58 with arcuate projections 64 engaging annular recess 96 of outer contact member 94. The beveled leading edge of member 94 and the arcuate configurations of projections 64 enable connector 10 to be easily connected with plug 84. The spring forces of leaf springs 60 coupled with the spring

forces of leaf springs 62 being enhanced by bights 66 engaging section 70 of outer shell 18 provide ease of mating engagement between plug and connector 10 as well as optimum retention and excellent electrical connection.

Plug 84 can take the form illustrated in Figures 4 through 6. Outer conductor 94 is a drawn tubular member with a flange 98 and annular projection 96. Outer conductor 94 is inserted through opening 100 of a stamped and formed contact member 102 containing U-shaped contacts 104 having pointed ends. Flange 98 is soldered to contact member 102 and center contact member 92 is secured in bore 87 of dielectric member 88 via barb 106 and annular projection 107 in annular recess 109 so that center contact pin 90 is positioned within recessed area 86 of member 88 and center pin member 108 is positioned centrally of contacts 104 when dielectric member 88 is secured in outer conductor 94. Dielectric 88 is secured in outer conductor 94 via annular recess 95 engaging annular projection 96.

Contacts 104 are easily inserted into holes 110 in a printed circuit board 112 with the aid of pointed ends of the contacts while center pin member 108 is inserted in hole 114. Flat sections 116 serve to position plug 84 relative to board 112. Contacts 104 and member 108 are soldered respectively to ground plane 118 and signal conductor 120 with the U-shaped configurations of contacts 104 enabling the solder to wick up into engagement with the ground plane.

Figure 7 illustrates an alternative embodiment of the coaxial connector 10A which is substantially identical to that of coaxial connector 10 except that connector 10A is a right angle coaxial connector and inner shell 14A has an annular section 122 from which depends integral ferrule 124 having knurls 126 in its external surface. Dielectric spacer 12A has center-electrical contact 20A secured in bore 38A by barb 128 and clinched section 129. Ferrule section 130 of contact 20A is located in bore 132 of section 122 and receives center conductor 26 of coaxial cable 24 therein when dielectric layer 28 is positioned in ferrule 124 and conductive shield 30 is positioned onto the external surface of ferrule 124. Crimping ferrule 22A is crimped onto ferrule 124, shield 30, and sheath 32, and ferrule section 130 is crimped onto center conductor 26 in accordance with the disclosure of U.S. Patent Application Serial No. 364,191 filed March 31, 1982, corresponding to EP-A-905387. If desired, center conductor 26 can be soldered to ferrule section 130. After coaxial cable 24 has been terminated to connector 10A, metal closure member 134 is force fit into recess 136 to seal the cavity containing the center conductor termination.

#### Claims

1. A coaxial connector comprising a conductive outer shell member (18), a conductive spring contact member (16) surrounded by the outer shell member (18) and having spring fingers (58)

member which is gold plated and includes arcuate spring contact members 76, bore 78, sight hole 80, and annular flange 82.

Crimping ferrule 22 is formed from copper or like material as a tubular member which is tin plated and has a beveled flange 23 which terminates as a curved end.

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Outer shell 18 is positioned onto spring contact member 16 with small diameter section 72 engaging tubular section 54 and large diameter section 70 extending along spring contacts 58. Crimping action is applied to section 72 in accordance with conventional crimping practices thereby crimping section 72 onto section 54 which also causes flow of metal 57 of section 72 into openings 56. The front end of section 70 is rolled inwardly forming an entrance into plug coaxial connector 10 as shown in Figure 4 and protecting the leaf spring contact members. The assembled parts of the coaxial connector are ready for termination onto a coaxial cable.

To terminate coaxial connector 10 onto a stripped end of coaxial cable 24, crimping ferrule 22 is placed onto sheath 32, center conductor 26 is inserted into bore 78 of center contact 20 with flange 82 engaging dielectric layer 28 whereafter center contact 20 is crimped onto center conductor 26. Terminated center contact 20 is inserted into bore 38 of dielectric spacer 12 of the assembled connector with flange 82 being disposed in annular recess 40, dielectric layer 28 extends along the inner surface of section 46 of inner shell 14, and outer shield 30 is positioned onto the outer surface of section 46. Crimping ferrule 22 is positioned against beveled section 48 of inner shell 14 and a conventional crimping tool (not shown) crimps ferrule 22 onto shield 30 and sheath 32 thereby terminating coaxial connector 10 onto the inner and outer conductors of coaxial cable 24 as shown in Figure 4.

Connector 10 is electrically connected to coaxial plug 84 as shown in Figure 4 with section 34 of dielectric spacer 12 positioned within recessed area 86 of dielectric member 88 and spring contact members 76 of center contact 20 electrically connected with center contact pin 90 of center contact member 92 secured in dielectric member 88. Outer contact member 94 of plug 84 is disposed in the space between section 34 of spacer 12 and leaf springs 60 of spring contacts 58 with arcuate projections 64 engaging annular recess 96 of outer contact member 94. The beveled leading edge of member 94 and the arcuate configurations of projections 64 enable connector 10 to be easily connected with plug 84. The spring forces of leaf springs 60 coupled with the spring

forces of leaf springs 62 being enhanced by bights 66 engaging section 70 of outer shell 18 provide ease of mating engagement between plug and connector 10 as well as optimum retention and excellent electrical connection.

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Figure 7 illustrates an alternative embodiment of the coaxial connector 10A which is substantially identical to that of coaxial connector 10 except that connector 10A is a right angle coaxial connector and inner shell 14A has an annular section 122 from which depends integral ferrule 124 having knurls 126 in its external surface. Dielectric spacer 12A has center electrical contact 20A secured in bore 38A by barb 128 and clinched section 129. Ferrule section 130 of contact 20A is located in bore 132 of section 122 and receives center conductor 26 of coaxial cable 24 therein when dielectric layer 28 is positioned in ferrule 124 and conductive shield 30 is positioned onto the external surface of ferrule 124. Crimping ferrule 22A is crimped onto ferrule 124, shield 30, and sheath 32, and ferrule section 130 is crimped onto center conductor 26 in accordance with the disclosure of U.S. Patent Application Serial No. 364,191 filed March 31, 1982, corresponding to EP-A-905387. If desired, center conductor 26 can be soldered to ferrule section 130. After coaxial cable 24 has been terminated to connector 10A, metal closure member 134 is force fit into recess 136 to seal the cavity containing the center conductor termination.

## Claims

1. A coaxial connector comprising a conductive outer shell member (18), a conductive spring contact member (16) surrounded by the outer shell member (18) and having spring fingers (58)



for coupling to a further coaxial connector, a conductive inner shell member (14) for connection with the outer conductor (30) of a coaxial cable (24), and a dielectric member (12) coaxially mounted within the inner shell member (14) for receiving a conductive center contact (20) for connection with a center conductor (26) of the cable (24) characterised in that the conductive spring contact member (16), the conductive outer shell member (18) and the conductive inner shell member (14) have cylindrical parts (72, 54, 44) in overlapping coaxial contiguous relation, each of the conductive members (72, 54, 44) having an inwardly projecting inner portion (50, 68, 57) extending within the outer profile of and engaging the adjacent inner member (16, 14, 12), and the conductive members (16, 18, 14) being secured together by crimping at the overlapping parts (72, 54, 44) as a conductive unit containing the dielectric member (12) secured therein.

2. A coaxial connector as set forth in claim 1 characterized in that said inner shell member (14) and said dielectric member (12) have an inwardly-directed projection (50) and an annular recess (42) engaging each other thereby securing said dielectric member (12) in said inner shell member (14).

3. A coaxial connector as set forth in claim 1 characterized in that said tubular section (54) includes openings (56) in which parts of said outer shell member (18) extend when said outer shell member (18) is crimpably secured onto said tubular section (54).

4. A coaxial connector as set forth in claim 1 characterized in that said ferrule section (46) is coaxial relative to said inner shell member (14), said center contact member (20) is crimped onto an end of a center conductor (26) of the coaxial cable (24) and enclosed within a bore (38) of said dielectric member (12).

5. A coaxial connector as set forth in claim 1 characterized in that said ferrule section (124) is at right angles to the axis of said inner shell member (14A) said center contact member (20A) is secured in a bore (38A) in said dielectric member (12A) and includes a conductor-receiving section (130) in axial alignment with the axis of said ferrule section (124) to receive an end of a center conductor (26) of the coaxial cable (24) therein.

#### Revendications

1. Connecteur coaxial comprenant un élément de coque extérieur conducteur (18), un élément de contact à ressort conducteur (16) entouré de l'élément de coque extérieur (18) et comportant des doigts à ressorts (58) destinés à s'accoupler à un autre connecteur coaxial, un élément de coque intérieur conducteur (14) destiné à une connexion avec le conducteur extérieur (30) d'un câble coaxial (24), et un élément diélectrique (12) monté coaxialement dans l'élément de coque intérieur (14) afin de recevoir un contact central conducteur (20) pour une connexion avec un conducteur central (26) du câble (24), caractérisé en ce que l'élément de contact à ressort conducteur (16),

l'élément de coque extérieur conducteur (18) et l'élément de coque intérieur conducteur (14) comportent des parties cylindriques (72, 54, 44) en chevauchement coaxial contigu, chacun des éléments conducteurs (72, 54, 44) comportant une partie intérieure (50, 68, 57) faisant saillie vers l'intérieur, pénétrant dans le profil extérieur de et s'enclenchant avec l'élément intérieur adjacent (16, 14, 12), et les éléments conducteurs (16, 18, 14) étant fixés ensemble par sertissage des parties chevauchantes (72, 54, 44) en un bloc conducteur dans lequel est fixé l'élément diélectrique (12).

2. Connecteur coaxial selon la revendication 1, caractérisé en ce que ledit élément de coque intérieur (14) et ledit élément diélectrique (12) comportent une saillie (50) dirigée vers l'intérieur et un évidement annulaire (42) s'enclenchant mutuellement afin de fixer ledit élément diélectrique (12) dans ledit élément de coque intérieur (14).

3. Connecteur coaxial selon la revendication 1, caractérisé en ce que ledit tronçon tubulaire (54) présente des ouvertures (56) dans lesquelles pénètrent des parties dudit élément de coque extérieur (18) lorsque ledit élément de coque extérieur (18) est fixé par sertissage sur ledit tronçon tubulaire (54).

4. Connecteur coaxial selon la revendication 1, caractérisé en ce que ledit tronçon de virole (46) est coaxial par rapport audit élément de coque intérieur (14), ledit élément de contact central (20) est serti sur une extrémité d'un conducteur central (26) du câble coaxial (24) et est logé dans un alésage (38) dudit élément diélectrique (12).

5. Connecteur coaxial selon la revendication 1, caractérisé en ce que ledit tronçon de virole (124) est à angle droit avec l'axe dudit élément de coque intérieur (14A), ledit élément de contact central (20A) est fixé dans un alésage (38A) dudit élément diélectrique (12A) et comprend un tronçon (130) de réception de conducteur en alignement axial avec l'axe dudit tronçon de virole (124) afin de recevoir une extrémité d'un conducteur central (26) du câble coaxial (24).

#### Patentansprüche

1. Koaxialverbinder mit einem leitenden äußeren Hülselement (18), einem leitenden Federkontaktelement (16), das von dem äußeren Hülselement (18) umgeben ist und Federfinger (58) zur Kopplung mit einem weiteren Koaxialverbinder besitzt, ferner mit einem leitenden inneren Hülselement (14) zur Verbindung mit dem äußeren Leiter (30) eines Koaxialkabels (24), und mit einem koaxial innerhalb des inneren Hülselements (14) montierten dielektrischen Element zur Aufnahme eines leitenden Mittelkontakts (20) zur Verbindung mit einem Mittelleiter (26) Kabels (24), dadurch gekennzeichnet, daß das leitende Federkontaktelement (16), das leitende äußere Hülselement (18) und das leitende innere Hülselement (14) zylindrische Teile (72, 54, 44) in überlappender koaxialer aneinander-



grenzender Beziehung besitzen, daß jedes der leitenden Elemente (72, 54, 44) einen einwärtsragenden inneren Abschnitt (50, 68, 57) besitzt, der sich innerhalb des äußeren Profils des benachbarten inneren Elements (16, 14, 12) erstreckt und mit diesem im Eingriff steht, und daß die leitenden Elemente (16, 18, 14) durch Quetschen an den überlappenden Teilen (72, 54, 44) als leitende Einheit aneinander befestigt sind, welche das darin befestigte dielektrische Element (12) enthält.

2. Koaxialverbinder nach Anspruch 1, dadurch gekennzeichnet, daß das innere Hülselement (14) und das dielektrische Element (12) einen einwärtsgerichteten Vorsprung (50) und eine ringförmige Ausnehmung (42) aufweisen, die miteinander im Eingriff stehen und dadurch das dielektrische Element (12) in dem inneren Hülselement (14) befestigen.

3. Koaxialverbinder nach Anspruch 1, dadurch gekennzeichnet, daß der rohrförmige Abschnitt (54) Öffnungen (56) besitzt, in welche Teile des

äußeren Hülselements (18) hineinragen, wenn das äußere Hülselement (18) durch Quetschen auf dem rohrförmigen Abschnitt (54) befestigt ist.

4. Koaxialverbinder nach Anspruch 1, dadurch gekennzeichnet, daß der Ringabschnitt (46) koaxial bezüglich des inneren Hülselements (14) liegt, und daß das Mittelkontaktelement (20) auf ein Ende eines Mittelleiters (26) des Koaxialkabels (24) aufgequetscht und innerhalb einer Bohrung (38) des dielektrischen Elements (12) eingeschlossen ist.

5. Koaxialverbinder nach Anspruch 1, dadurch gekennzeichnet, daß der Ringabschnitt (124) im rechten Winkel zur Achse des inneren Hülselements (14A) angeordnet ist, daß das Mittelkontaktelement (20A) in einer Bohrung (38A) in dem dielektrischen Element (12A) festgelegt ist und einen Leiteraufnahmeabschnitt (130) umfaßt, der axial mit der Achse des Ringabschnitts (124) ausgerichtet ist, um ein Ende eines Mittelleiters (26) des Koaxialkabels (24) darin aufzunehmen.

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