Coaxial Cable Connector

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This invention relates to electrical connectors, and more particularly, to electrical connectors for joining together coaxial electrical conductors of a coaxial cable.

Hereinafter, the conductive segments of a coaxial cable have been connected to respective conductive segments of a coaxial connector by conventional crimping techniques, and the crimping of the conductive segments of the cable onto the conductive segments of the connector as well as onto the insulation of the coaxial cable have been effected simultaneously. If the coaxial cable has at least two center conductors which are to be connected to respective pins of the connector, this has been heretofore accomplished by means of a pair of crimping die elements engaging each pin from diametrical directions in order to crimp the conductors onto the pins. While this method of crimping has been proved satisfactory, it has on the one hand, complicated the manufacture of parts of the coaxial connector while on the other hand, it has made the crimping tool more complicated by the necessity of having a pair of crimping elements for each pin.

It is, therefore, a primary object of the present invention to provide a coaxial connector which can be economically fabricated and which may be quickly and easily applied to coaxial cables by unskilled personnel.

It is another object of the present invention to provide a coaxial connector which may be securely and firmly attached to the coaxial cable both mechanically and electrically by crimping.

It is a further object of the present invention to provide a coaxial connector device which may be readily applied to the coaxial cable by unskilled personnel in a minimum of time.

It is an additional object of the present invention to provide a coaxial connector which has extremely high electrical efficiency, which has a minimum number of parts that can be rapidly and correctly assembled and which mates with standard sockets currently in use.

It is still another object of the present invention to provide a coaxial connector having features facilitating assembly thereof as well as onto a coaxial cable.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there is shown and described an illustrative embodiment of the invention; it is to be understood, however, that this embodiment is not intended to be exhaustive nor limiting of the invention but is given for purposes of illustration and principles thereof as a manner of applying it in practical use so that they may modify it in various forms, each as may be best suited to the conditions of the particular use.

In the drawings:

FIGURE 1 is a perspective view of the connector of the invention assembled and installed on a coaxial cable; FIGURE 2 is a longitudinal cross-sectional view of a connector of FIGURE 1; FIGURE 3 is a view taken along lines 3-3 of FIGURE 2; FIGURE 4 is a view taken along lines 4-4 of FIGURE 2; FIGURE 5 is an exploded perspective view of the connector; and FIGURE 6 is an end view of the forward dielectric insert taken along lines 6-6 of FIGURE 5.

Referring now to the drawings, there is shown a coaxial connector 1 which as shown in FIGURES 1 and 2 is crimped onto a coaxial cable 2. Connector 1 mates with conventional sockets (not shown) which may be mounted on the chassis of electronic equipment or may be a socket element joined to a further coaxial cable similar to that of cable 1.

Coaxial connector 1 comprises a connecting collar 3, a housing 4, a forward dielectric insert 5, a rear dielectric insert 6, a ferrule member 7, a center conductive pins 8 and a locking spring member 9.

Connecting collar 3 is a metallic tubular member having internal threads 10 and an annular groove 11 located adjacent one end thereof. Diaphragm openings 12 extend through the tubular member and are located within groove 11. The exterior surface of collar 3 is preferably knurled from annular groove 11 to an area proximate the other end of the tubular member.

Housing 4 is a hollow metalic member having a first bore 13, a second bore 14, and a third bore 15. A transition section 16 extends between bores 13 and 14. The part of housing 4 containing bore 13 is defined as a crimping sleeve 17 and contains on the exterior surface thereof annular grooves or slots 18. An annular groove 19 is disposed in the exterior surface of housing 4 toward the inner end of bore 14. Diaphragm holes 20 extend through housing 4 and are located between groove 19 and the beginning of bore 15. A detent 21 is located on the interior surface of bore 14 intermediate holes 20 in alignment therewith. This detent is directed inwardly toward the longitudinal axis of housing 4.

A thin-walled spring sleeve 22 has one end disposed in bore 15 and is secured thereto as by welding or in any other suitable manner. The other end of sleeve 22 extends outwardly from housing 4 and is split into several segments to permit the sleeve to be spread slightly and, thus, establishing a spring force tending to hold the part of sleeve 22 in snug engagement with coaxing contacting surfaces of a mating receptacle or jack (not shown). A polarizing slot 24 is disposed in sleeve 22 which is in alignment with detent 21. This polarizing slot contacts a pin of the mating receptacle to assure alignment of pins 8 with the socket segments thereof. The end of sleeve 22 which is secured in bore 15 contains a series of equally-spaced lines 24. Some of these lines, and preferably every other one, are bent outwardly toward the longitudinal axis of housing 4.

Forward dielectric insert 5 has a first section 25 and a second section 26. First section 25 is of smaller diameter than that of second section 26 so that a shoulder 27 is defined therebetween. Holes 28 extend through insert 5 in parallel relationship with the longitudinal axis thereof as well as equidistantly therefrom. As can be discerned, each hole 28 at its forward end has a smaller diameter than the rest of the holes so that a shoulder 29 is disposed therebetween. At the entrance to the larger part of each hole 28, an eccentric recess 28 is disposed in the inner surface of insert 5 surrounding the hole with the largest part of the eccentricity being directed toward the axis of the insert (see FIGURE 6). Diaphragmatic holes 30 are disposed in section 26, and these holes extend at right angles with respect to the disposition of holes 28. Each hole 30 is in communication with a respective hole 28 and is located in the same plane thereof passing normally through the longitudinal axis of insert 5. A slot 31 is disposed in the exterior surface of insert 5 and extends the length thereof. This slot is located intermediate the disposition of holes 28 and is located in a plane extending normal to the longitudinal axis of insert 5. A projection 32 extends outwardly from the rear sur-
face of section 26 of insert 5 and is disposed in the same plane as that of slot 31 except that it is located opposite thereto.

Rear dielectric insert 6 includes a first section 33 and a second section 34 with the exterior diameters of section 33 being larger than that of section 34. In fact, the exterior diameter of section 33 is equal to that of section 26 of insert 5. A transition section 35 extends between exterior surfaces of sections 33 and 34. A bore 36 extends coaxially along the interior of insert 6 from one end and terminates at the inner end of section 34. Distinct metrical holes 37 extend through this other end and are in communication with hole 26. Each hole 37 is conical with the smaller diameter located at the forward end of insert 6. A slot 39 extends along the exterior surface of section 33 and is in alignment with slot 31 of insert 5. A recess 40 is also disposed in the exterior surface of section 33 and is in alignment with projection 32 of insert 5. While eccentric recesses 28 are located in the rear surface of insert 5 surrounding holes 28, these recesses may be disposed in the front surface of insert 6 surrounding holes 37 and with the largest part of the eccentricity being directed toward the axis of insert 6.

Ferrule member 7 includes a reduced diameter rearward portion 41 and a slightly larger forward portion 42, both having substantially the same metal thickness. The free end of portion 41 is bell-mouthed to facilitate insertion onto cable 2.

Each conductive pin 8 includes a first section 43 and a second section 44. Section 43 has a diameter smaller than that of section 44 which forms a surface 45 therebetween. An opening 46 is disposed in each of sections 44 and is coaxial therewith. The end of section 44 opposite 45 has an eccentric portion 47, and the entrance to opening 46 is preferably beveled in order to facilitate the entry therein of a conductive member. A hole 48 is disposed in section 44 and is in communication with opening 46. The purpose of holes 48 are two-fold: (1) to permit escape of entrapped air during plating process, (2) to permit visual inspection so that the cable center conductors are at proper insertion length. Locking-spring member 9 is a U-shaped member and each leg thereof has an inwardly-directed section 49.

Coaxial cable 2 is a conventional cable utilized to carry communication signals between points, such as, between the antenna and television, radar, telephone equipment, or the like. In certain uses of coaxial cable, the outer conductor serves as a shielding means to protect signal conveyed on the inner conductor and in other uses, the outer and inner conductors serve to channel signal energy transferred in higher frequency modes. Typical construction of coaxial cable 2 includes an outer and protective insulating sheath 50, an outer conductor 51 of metallic braid or thin metallic tubing, a dielectric or insulating spacer 52 and center conductors 53. A frequently employed cable construction features a polyvinylchloride protective sheath, a braided copper or aluminum outer conductor, a polyvinylchloride or Teflon dielectric spaced and stranded or solid center conductors of copper or aluminum. Center conductors 53 may be surrounded by one another within insulating spacer 52. In connecting cables, such as 2, it is important that the connection achieves a mechanical integrity exceeding that of or at least approaching that of the cable itself, and it is preferable for the connector to provide a transmission path having characteristics similar to that of the cable so as to preclude signal degradation.

Inserts 5 and 6 are preferably made from hard plastic materials such as nylon, melamine, or the like; however, insert 6 may be made from a softer plastic than that of insert 5, if desired.

In assembly, conductive pins 8 are disposed in holes 28 of insert 5 until surfaces 45 engage shoulders 29. This limits the forward movement of pins 8 within holes 28 and allows sections 43 to extend beyond the forward surface of insert 5. Eccentrics 47 extend slightly inwardly toward the center and are disposed within respective recesses 28 within the rear surface of insert 5. Insert 6 is brought into engagement with the rear surface of insert 5 and projection 32 seats within recess 40. This causes slot 31 of insert 5 and slot 39 of insert 6 to be in alignment and holes 48 in conductive pins 8 to be in alignment with respective holes 30 of insert 5.

The dielectric insert and conductive pin assembly is now ready to be inserted within housing 4. In order to insert this assembly within housing 4, aligned slots 31 and 39 are brought into alignment with detent 21 of housing 4. The assembly is now pushed into housing 4 with insert 6 centering the housing first and aligned slots 31 and 39 mating with detent 21.

The dielectric insert and conductive pin assembly is then pushed completely within housing 4 until shoulder 27 of insert 5 moves slightly thereby with the inwardly-directed tines 24 which then lock the dielectric insert and conductive pin assembly within housing 4. At this point, section 34 of insert 6 is disposed within bore 13, transition section 45 is in alignment with transition section 35, section 42 of insert 6 is disposed within an insert 5 and section 33 of insert 6 are disposed within bore 14 and holes 30 of insert 5 are in alignment with respective holes 26 of housing 4. Now, coaxial connector 1 is ready to receive coaxial cable 2 for engagement therewith.

Coaxial cable 2 is stripped by a suitable stripping tool (not shown) in order to properly bear outer conductor 51 and center conductors 53, as illustrated in FIGURE 2. The inside diameter of rearward portion 41 of ferrule member 7 is slightly larger than that of insulating sheath 50 so that ferrule member can readily be inserted onto the cable. The inside diameter of forward portion 42 of the ferrule member is large enough so that it can encompass the crimping sleeve and outer conductor 51 to be disposed therebetween. The diameter of bore 36 is large enough to receive insulating spacer 52 therein.

After cable 2 has been properly stripped, ferrule member 7 is inserted onto this cable and center conductors 53 and insulating spacer 52 are pushed into bore 36 so that center conductors 53 extend through holes 37 and are disposed in respective openings 46 of conductive pins 8. Holes 48, as has been indicated, serve as inspection holes in order to ascertain the disposition of center conductors within the conductive pins. Outer crimping sleeve 17 is placed over engaging over 18. Ferrule member 7 is then pushed along cable 2 until the forward edge of portion 42 abuts against the exterior surface of transition section 16 of housing 4.

With center conductors 53 properly disposed in respective conductive pins 8 and with ferrule member 7 overlying crimping sleeve 17, coaxial connector 1 is now ready to be crimped at portions 41 and 42 of ferrule member 7 and sections 44 of pins 8. These locations are preferably crimped simultaneously, and the crimping operation can be effected by a coaxial crimping tool completely disclosed in U.S. patent application, Serial No. 252,590, filed November 21, 1963, nser No. 32,421,919 and assigned to the present assignee. While it is desirable to use this coaxial crimping tool, it is to be understood that any other suitable crimping tool can be utilized to effect the desired crimping operation.

One of the unique features of the present invention is the fact that the crimping elements that are aligned through aligned holes 28, as to engage sections 44 of conductive pins 8, engage these pins at only one location, and the back-up pressure to effect a crimping operation is provided by the dielectric material of insert 5. After conductive pins 8 have been crimped onto respective center conductors 53, an excellent mechanical and electrical connection is obtained and the conductive pins are maintained in proper alignment. Moreover, the crimps applied at portions 42 and 41 of ferrule member 7 establish excellent torque and tensile characteristics.
While it has been disclosed that only two center conductors 53 are disposed in conductive pins 8, it is to be understood that three or more center conductors and conductive pins can be provided. If this be the case, conductive pins 8 will have to be disposed in equal angular disposition around and from the longitudinal axis of insert 15. Of course, for every conductive pin 8 disposed in insert 15, there will be aligned holes 20 and 30 in housing 4 and insert 5, respectively, which are directed toward the longitudinal axis of insert 5. This is to assure that the crimping forces exerted on sections 44 of conductive pins 8 meet at the longitudinal axis of insert 5. It is, therefore, to be understood that the coaxial cable 2, connecting collar 3 is now ready to be disposed on housing 4. This is best accomplished by first sliding collar 3 along the exterior surface of housing 4 until annular groove 11 is spaced just slightly forward of annular groove 19 in housing 4. Locking-spring member 9 is then inserted into annular groove 11 until inwardly-directed sections 49 engage openings 12.

Connecting collar 3 is then slid further along housing 4 until grooves 11 and 19 are in alignment whereupon an inwardly-directed sections 49, as a result of the spring characteristics of locking-spring member 9, extend into annular groove 19 thereby locking connecting collar 3 onto housing 4. This arrangement also allows connecting collar 3 to be rotated relative to housing 4. This also maintains connecting collar 3 in position on housing 4 as well as being freely rotatable relative thereto as well as being readily removed if such is necessary. While connecting collar 3 has threads 10 for connection to a mating member, other connection means, such as, a bayonet-type connection, or the like, may be used.

Utilizing the teachings as outlined hereinabove, a wide variety of coaxial connector sizes can be made in order to accommodate mating socket connectors as well as the different sizes of coaxial cables. As described, there has been disclosed a novel and unique coaxial connector for connection with a coaxial cable having at least two center conductors. This coaxial connector is also unique because of the fact that when the connector is connected to a coaxial cable, crimping operations are effected simultaneously at spaced locations in addition to the fact that one of the crimping locations utilizes the dielectric insert material as a back-up member during the crimping operation.

It will, therefore, be appreciated that the aforementioned and other desirable objects have been achieved; however, it should be emphasized that the present embodiment of the invention, which is shown and described herein, is intended as merely illustrative and not as restrictive of the invention.

What is claimed is:

1. A connector comprising a housing having diametrical holes and a sleeve, dielectric insert means carried within said housing, said insert means having openings extending longitudinally therethrough and diametrical holes, each in communication with a respective opening, means on said housing and said insert means to lock said insert means within said housing and to align each diametrical hole of said housing with a respective diametrical hole of said insert means, conductive pin means in said openings, each conductive pin means having a hollow section for receiving inner conductive means of an insulated conductor means, and ferrule means for fitting over said sleeve, said conductive pin means being adapted to be crimped onto said inner conductive means through said diametrical hole of said insert means and said ferrule means being adapted to be crimped onto said sleeve with an outer conductive means of said insulated conductor means therebetween.

2. A connector according to claim 1 wherein said insert means includes a first and second part, each part having said longitudinal openings therein.

3. A connector according to claim 2 wherein one of said parts includes a projection and the other of said parts includes a recess which maintain said longitudinal openings in alignment within said housing.

4. A connector according to claim 1 wherein each pin means has an opening therein which is normal to the longitudinal axis thereof and in communication with the hollow section of the connector, for visual inspection to indicate that the inner conductive means is properly placed within said hollow section.

5. A connector according to claim 4 wherein said insert means and said conductive pin means include means to align said openings in said conductive pin means with respective diametrical holes in said insert means and housing.

6. A connector according to claim 1 wherein connecting collar means is mounted on said housing, means on said connecting collar means and said housing for preventing said connecting collar means from moving axially along said housing but to rotate relative thereto.

7. In a connector, a housing member having a conductor-receiving section and diametrical holes therethrough, first dielectric insert means and second dielectric insert means, said first insert means having a bore therein, said second insert means having longitudinal openings therethrough and dialaxial holes each in communication with a respective one of said longitudinal openings, conductive pin means adapted to be disposed in said longitudinal openings of said second insert means and having a hollow section for disposition opposite said diametrical holes and a pin section extending outwardly from said second insert means, means on said housing member and said insert means to lock said insert means within said housing member so that the diametrical holes of said second insert means and said housing member are in alignment for crimping access to said conductive pin means and said conductive pin means are maintained within said second insert means by said first insert means and ferrule means adapted to be crimped onto said conductor-receiving section.

8. In a connector according to claim 7 wherein said conductive pin means includes a hole normal to the axis thereof and in communication with said hollow section, means on said conductive pin means and one of said insert means to align said holes in said conductive pin means with respective aligned holes in said second insert means and said housing member.

9. In a connector according to claim 7 wherein a connecting collar means is disposed on said housing member and said housing member including means to maintain said connecting collar means on said housing member and to permit said connecting collar means to move relative to said housing member.

10. A connector for a cable having inner conductors, a flexible outer conductor, inner insulation between said inner and outer conductors, and outer insulation surrounding said outer conductor, said connector comprising a housing member having a cable-receiving section for receiving said outer conductor thereon and diametrical holes, dielectric insert means in said housing member and having a bore for receiving said inner conductors and said inner insulation, and diametrical holes, conductive pin means carried by said insert means, each pin means having a bore to receive a respective inner conductor, each pin means being in communication with a respective diametrical hole of said insert means, means on said insert means and said housing member to align said holes of said housing member and said insert means, said pin means adapted to be crimped onto said inner conductors through said aligned holes in said housing member and said insert means and against said insert means, and ferrule means for encompassing said cable-receiving section, said outer conductor thereon and engaging said outer insulation, said ferrule means adapted to be crimped onto said
cable-receiving section and outer conductor and onto said outer insulation.

11. A connector according to claim 10 wherein a connecting collar is disposed on said housing member, means on said connecting collar and housing member to prevent said connecting collar from moving axially therealong but being capable of rotating relative thereto.

12. A method for assembling a connector onto a cable having inner conductors, an outer conductor, inner insulation between said conductors, and outer insulation around said outer conductor, said method comprising the steps of inserting a dielectric insert carrying conductive pins each having a bore within a housing member to a position where the insert is locked within said housing member, said housing member and insert having diametrical aligned holes in communication with a respective conductive pin, stripping said cable to expose said inner conductors and said insulation, placing a ferrule member on said connector, feeding said stripped cable into a bore in said insert so that said inner conductors are disposed in respective bores of said conductive pins and said outer conductor is placed into engagement with a cable-receiving section on said housing member, placing said ferrule member over said outer conductor and cable-receiving section, and crimping said conductive pins onto said inner conductors through the aligned holes in said housing member and insert and on said insert, and said ferrule member on said outer conductor and cable-receiving section.

13. In a method according to claim 12 wherein the crimping of the conductive pins onto the inner conductors and the ferrule member onto the outer conductor and cable-receiving section is done simultaneously.

14. In a method according to claim 12 including the further step of placing a connecting collar on said housing member, and inserting a spring-locking member on said connecting collar which engages an annular groove in said housing member to prevent axial movement of said connecting collar but allows same to rotate relative to said housing member.

No references cited.

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