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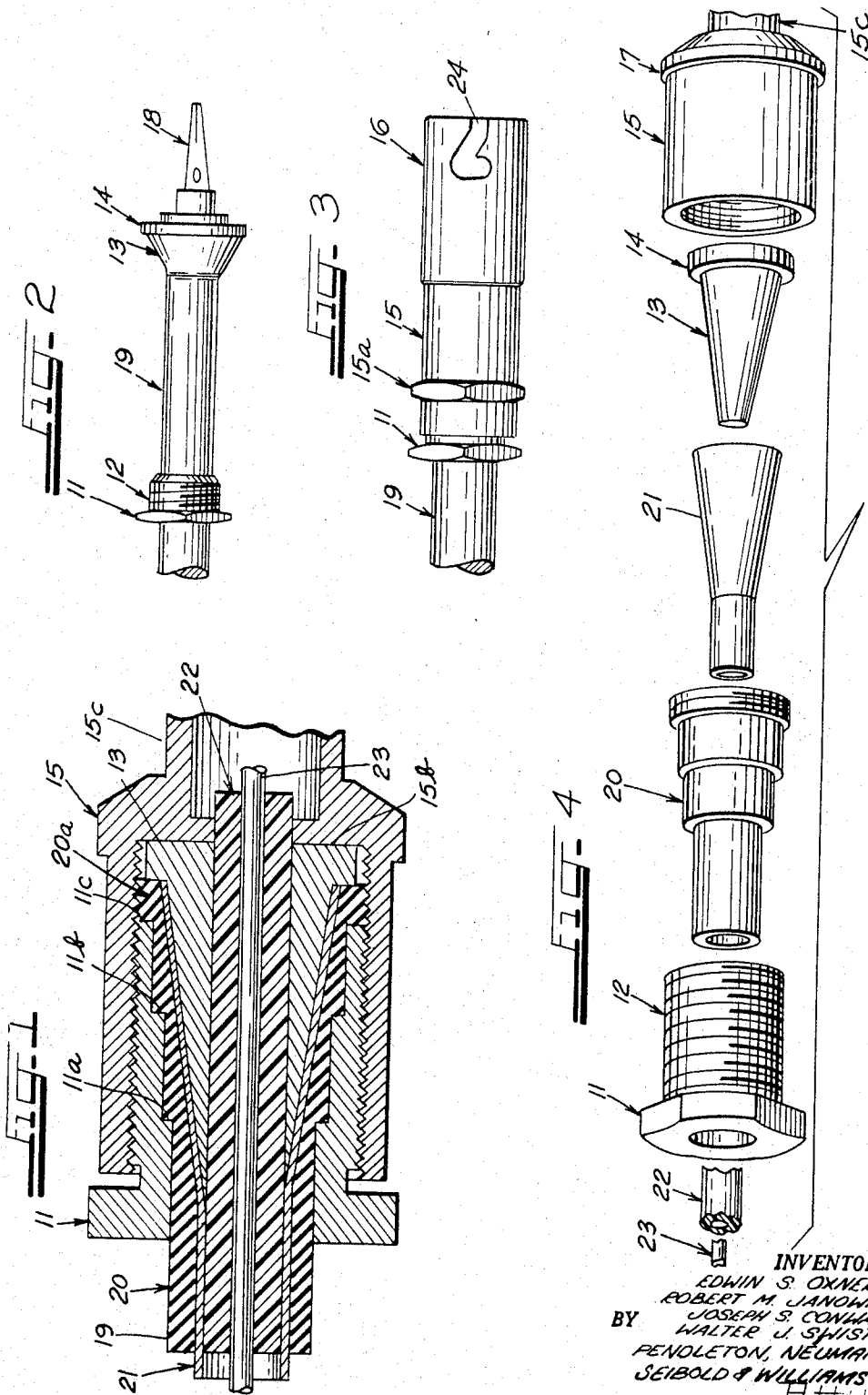
R. M. JANOWIAK ETAL

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ELECTRICAL MULTICONDUCTOR CABLE CONNECTING ASSEMBLY

Original Filed March 15, 1965

2 Sheets-Sheet 1



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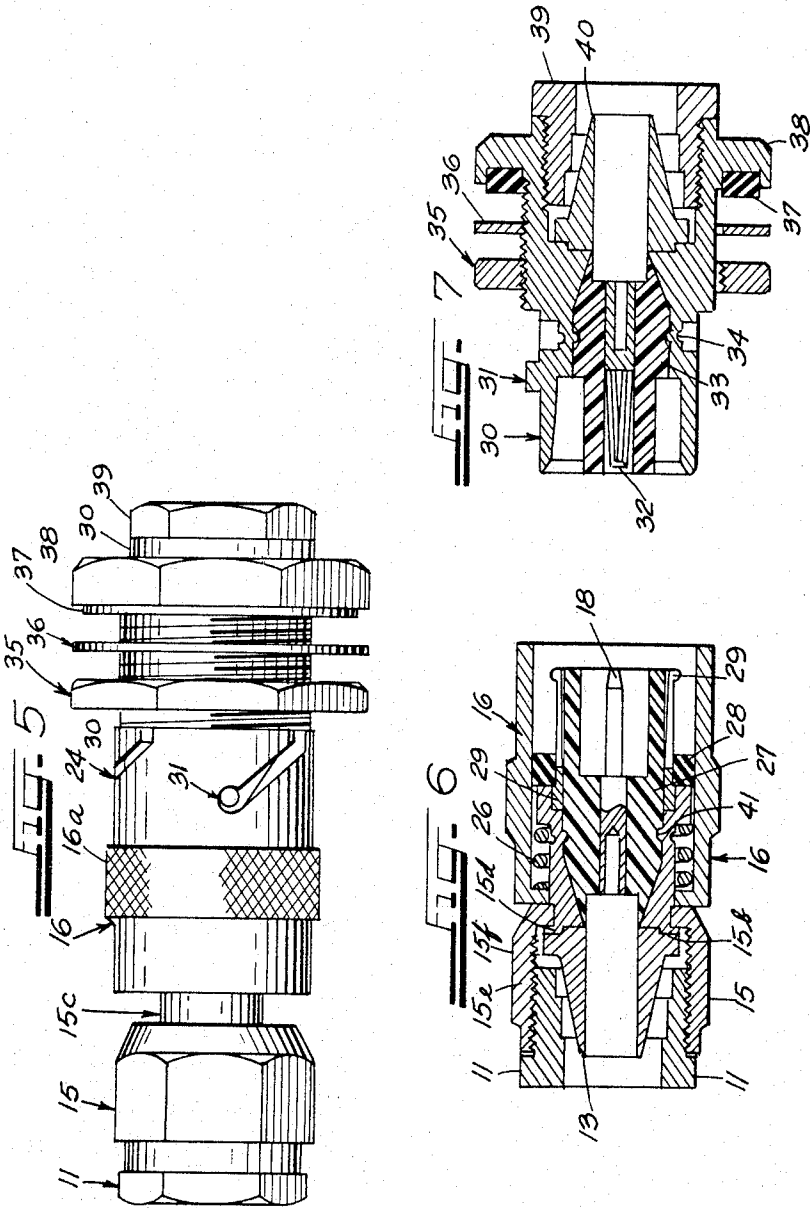
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ELECTRICAL MULTICONDUCTOR CABLE CONNECTING ASSEMBLY

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Continuation of application Ser. No. 451,675, Mar. 15, 1965, which is a division of application Ser. No. 48,534, Aug. 9, 1960, now Patent No. 3,209,287, dated Sept. 28, 1965. This application June 6, 1966, Ser. No. 587,338
6 Claims. (Cl. 174-89)

ABSTRACT OF THE DISCLOSURE

An electrical multi-conductor cable connecting assembly wherein a sleeve and collar coat to compress the jacket and shield of the cable between the collar and a tapered inner ferrule, with the cable inner conductor and di-electric passing centrally through the ferrule.

This application is a continuation of application Ser. No. 451,675 filed Mar. 15, 1965, now abandoned, which was a division of the prior co-pending application, Ser. No. 48,534, filed Aug. 9, 1960, entitled, Electrical Coaxial Cable Connecting with Impedance Matching, which issued on Sept. 28, 1965, as Patent No. 3,209,287.

The present invention deals with electrical connectors and more particularly, is directed to the multi-conductor or co-axial type connector assembly.

Up to the present time most coaxial connectors have required fanning of the cable braid in the normal assembly procedure. A technique to obviate the fanning process is a special clamping device in the form of two sleeves which are passed under and over the cable's outer conductor and then stamped, under extreme pressure, by a stamping machine. In both of the types mentioned a gasket must be included at the rear of the connector to effect a water seal. Furthermore, the second type of connector mentioned is not reusable. That is to say, the stamped sleeve must be replaced since it is permanently affixed to the coaxial cable.

In the case where braid fanning is required, a discontinuity may exist at the interface of the cable braid and the connector body resulting in unwanted reflections of transmitted signal. Absent a discontinuity the radius of the outer conductor may change hence, the characteristic impedance would change. The characteristic impedance of a coaxial line is defined as:

$$Z_0 = \frac{60}{\epsilon_r^{1/2}} \log_e b/a$$

wherein, Z_0 is the characteristic impedance, b is the diameter of the outer conductor, a is the diameter of the inner conductor and ϵ_r is the relative dielectric constant of the medium therebetween. An abrupt change in Z_0 , like a discontinuity results in wave reflection along a transmission line.

In contradistinction to the teachings and practices of the prior art we have designed a unique, reusable connector assembly having a self-sealing feature and one that is substantially reflection free.

It is accordingly, a general object of the instant invention to provide an improved connector assembly of the type described.

Another object of the instant invention is to provide a coaxial connector offering good radio frequency performance coupled with ease of assembly.

Another more specific object of the instant invention

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is to provide a coaxial radio frequency connector having excellent cable gripping properties.

Yet another object of the instant invention is to provide a coaxial cable connector wherein fanning of the cable braid is not necessary.

Yet still another more specific object of the instant invention is to provide a radio frequency coaxial cable connector which is reusable and which forms a natural water seal without a gasket.

The invention possesses other objects and features of advantage which, with the foregoing, will become apparent to the reader in the following detailed description of the preferred form of the invention which is illustrated in the accompanying drawings as forming a part of the specification.

Referring to the drawings wherein like reference numerals denote like parts:

FIGURE 1 is a view, in cross section, of the left end of a completely assembled connector plug.

FIGURE 2 is a side view of a coaxial cable with some of the plug components mounted thereon, illustrating the manner of assembly.

FIGURE 3 is a side view of a coaxial cable with a completely assembled connector plug.

FIGURE 4 is an exploded view of the structure shown in FIGURE 1.

FIGURE 5 is a side view of a preferred form of connector assembly comprising a plug and jack.

FIGURE 6 is a view in cross section of the plug illustrated in FIGURE 5.

FIGURE 7 is a view in cross section of the jack illustrated in FIGURE 5.

Briefly stated, the foregoing objects and others are accomplished by a unique design and cooperation of a hollow externally threaded collar, a ferrule having a frusto-conical projection and a sleeve for engaging the collar. The ferrule, in addition to providing excellent electrical contact with the cable braid, provides clamping pressure to outer conductor and insulation of the cable between the ferrule and the inner surface of the threaded collar.

While the invention has been shown and will be described in some detail with reference to a particular, exemplary embodiment thereof, there is no intention that it be limited to such detail. Quite to the contrary, it is intended here to embrace all modifications, alternatives and equivalents falling within the spirit and scope of the invention as defined by the appended claims.

Referring to FIGURES 1 and 4, a coaxial cable 19 comprising center conductor 23, dielectric 22, outer conductor (cable braid) 21 and rubber jacket is shown. A hollow externally threaded collar 11 having a hexagonal flange is provided and adapted to frictionally engage jacket 20. Such engagement is effected by having the minimum diameter of collar 11 nearly equal to the outer diameter of cable 19. In the exemplary arrangement, collar 11 has successively increased internal diameter sections 11a, 11b and 11c along the body thereof which define shoulders. As may be seen, the shoulders are disposed along a tapered plane relative to one another and the collar 11, therefore, substantially defines a tapered, conical inner surface.

Ferrule 13, having an annular flange 14 and a wedge-shaped projection is adapted to be inserted between dielectric 22 and outer conductor 21. The inner diameter of ferrule 13 is nearly equal to the external diameter of dielectric 22. An internally threaded sleeve 15, is provided to receive collar 11. The wedge-shaped portion of ferrule 13 cooperating with collar 11 and sleeve 15 is forced into a position whereby it applies radial pressure to braid 21 and rubber jacket 20. This pressure is of sufficient magni-

tude to insure excellent engagement of cable 19. Likewise, this pressure forces jacket 20 into a confined volume and thereby creates a waterproof seal in addition to providing excellent radio frequency contact between the outer conductor 21 and ferrule 13. Additionally, as may be seen, the ferrule 13 and the collar 11 define an annular chamber therebetween axially adjacent the ferrule into which the section 20a of the jacket 20 is forced into sealing relationship with the sleeve 15. In the exemplary arrangement, the section 20a of the jacket is forced into sealing relationship with the inner threads of the sleeve 15. However, it will be readily apparent to those skilled in the art that the sleeve 15 may be designed so that the jacket section 20a is forced into sealing relationship with a non-threaded portion of the sleeve.

The flat end of ferrule 13 abuts the shoulder 15b in sleeve 15 and insures proper positioning of ferrule 13 when the plug is assembled. Sleeve 15 has an opening, large enough to pass dielectric 22 and center conductor 23 into its tubular portion 15c enabling connection to contact pin 18.

After cable 19 is trimmed, collar 11 is slipped thereover. Next ferrule 13 is inserted between conductor 21 and dielectric 22. Contact pin 18 is passed over a bare projecting end of conductor 23 and soldered thereto. Following this, sleeve 15 is journaled onto the cable passing over ferrule 13. Collar 11 is brought into engagement therewith and the threaded portion 12 thereof is screwed into the body of sleeve 15. A hexagonal head 15a, on sleeve 15, provides a gripping surface for tightening the connection between collar 11 and sleeve 15. Seat 15b urges ferrule 13 under braid 21, and into its proper position, as the connection between collar 11 and sleeve 15 is secured.

In securing collar 11 and sleeve 15, ferrule 13 is properly positioned. In this position the transmission line experiences no discontinuity or change in radius because ferrule 13 is a conductor and its inner radius is equal to that of outer conductor 21. The pressure on jacket 20 provides waterproofing. The internally stepped portions 11a, 11b and 11c of ferrule 11 enhance this characteristic in addition to providing eminently good cable-gripping properties. Furthermore, the section 20a of jacket 20 is forced into sealing relationship with sleeve 15 to prevent water leakage between sleeve 15 and collar 11.

A member 16, concentric with sleeve 15 and passing thereover, is shown in position in FIGURE 3. Member 16 is adapted for locking engagement with a jack having a female contact pin 32 (see FIGURE 7) adapted to mate with contact pin 18.

Reference now to FIGURES 5 and 6, the composite connector assembly including the complementary or right-hand end thereof is shown. The right-hand end of the connector assembly will hereinafter be referred to as the jack. In this embodiment the connector clamp structure is somewhat modified as will be described hereinbelow. Collar 11 and ferrule 13 are substantially identical to those previously illustrated and function in the same manner. On the other hand, sleeve 15 is made up of two separate parts 15d and 15e. This change in design was primarily for ease of manufacturing. In assembly, parts 15d and 15e are mated and stamped together. It is noted that member 15d has a circumferential seat therein adapted to accommodate an annular ridge on ferrule 13 of diameter nearly equal to the seal on member 15d. This arrangement insures proper alignment of ferrule 13.

Member 16 encircles a portion of sleeve 15d and defines a cavity therebetween. Positioned within said cavity is spring 26 which is arranged to urge member 16 to the left as far as it will go, in this particular case, to the point where member 16 abuts a hexagonal flange 15f. Guideway 24 on member 16 is provided for locking engagement with the jack having bayonet type locking fingers 31 projecting radially therefrom. In this particu-

lar embodiment three locking fingers 31 spaced 120° apart were used satisfactorily.

A dielectric insert 27 is secured in position in the connector body by means of crimping at 41 in FIGURE 6. Contact fingers 29 are secured to and spaced around the outer surface of dielectric 27 and provide frictional engagement with the inner surface of sleeve 30 of the jack shown in FIGURE 7. Positioned within the cavity defined by member 16 is an elastomer ring 28 which becomes compressed when the connector plug is in locking engagement with jack and provides a watertight seal therebetween.

Referring next to FIGURE 7, the jack assembly is shown. Female contact pin 32 is soldered to the center conductor 23 of another coaxial cable. Contact pin 32 is adapted to mate with contact pin 18. Dielectric 33 is journaled into the cavity defined by sleeve 30 and is fixed therein by crimping at points 34. When the plug and jack are mated, dielectric inserts 27 and 33 take the form of one continuous dielectric section.

Projecting from sleeve 30 are bayonet prongs 31 for locking engagement in guideways 24 of member 16. Sleeve 30 is both internally and externally threaded. The sleeve's internal threads cooperate with collar 39 exactly as was done in the connector plug body with collar 11 and sleeve 15.

The jack body may be adapted for panel mounting and in that case sleeve 30 is provided with an outward radial flange 38. A rubber washer 37 seated in hexagonal flange 38 abuts the inner wall of said panel. Washer 36 and nut 35 are passed over the left end of the jack and engaged to the outer threads of sleeve 30 to secure the jack, which has been passed through an opening in the panel, to the equipment. By tightening nut 35, a watertight seal is created between the jack and the panel.

Because of the special cable clamping technique in the design of the instant invention, a discontinuity free path from the cable to the plug body is achieved. In addition to a naturally formed water seal, the connector assembly has good gripping action and is reusable.

In one embodiment, the clamp withstood a static load of seventy pounds for over fifteen minutes and failed after more than one thousand, ninety degree flexures with a five pound load. The failure noted in the flexure test was not in the connector gripping area, but due to a severance of the outer braid at the rear of collar 11.

From the foregoing, it is noted that we have provided a connector having good radio frequency performance, ease of assembly and with excellent cable gripping properties which represents a considerable advance over the prior art.

It will be understood that the invention can be practiced otherwise than has been specifically described and is limited only by the scope of the appended claims. For example, the connector may be utilized to secure other forms of current carrying elements. Also, the connector may be used for splicing cables together as well as connection to panel mountings.

We claim:

1. An electrical cable connecting assembly comprising: a free end of a multiconductor cable which includes a central conductor, an outer conductive shield, a dielectric interposed between said conductor and said shield, and a connector comprising a collar the inside surface of which is made up of a plurality of successively increasing internal diameter sections which define shoulders the edges of which are disposed along a tapered plane relative to one another, said collar being disposed around said jacket with the enlarged portion of said tapered inner surface being adjacent said free end, an electrically conductive tubular wedge-shaped member having an inner diameter corresponding to the inner diameter of said shield and an outer wedge-shaped surface corresponding to the tapered plane defined by the shoulders of said inner surface of the collar, said wedge-shaped member being dis-

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posed on said dielectric with said outer wedge-shaped surface engaging said shield whereby said shield and said jacket are clamped between said collar and said wedge-shaped member and whereby said wedge-shaped member is in electrically conductive relationship with said shield, and hollow sleeve means engaging said wedge-shaped member in abutting relationship and cooperatively engaging said collar to urge said wedge-shaped member into compressive engagement with said collar, said jacket contacting with said collar, said sleeve means, and said wedge-shaped member whereby said jacket seals said assembly against the ingress of moisture.

2. The electrical cable connecting assembly of claim 1 wherein said inner surface of said collar comprises a series of concentric wall portions of increasing stepped internal diameters providing said shoulders which engage said jacket in a clamping relationship.

3. The electrical cable connecting assembly of claim 1 wherein the outer surface of said wedge-shaped member has a gradual taper engaging the inner surface of said shield in opposition to engagement of the outer surface of said jacket by said collar.

4. The electrical cable connecting assembly of claim 2 wherein said collar and said sleeve means are in threaded engagement whereby the compressive force is exerted on said jacket to form a seal with said inner surface of

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said collar and with an inner surface of said sleeve means.

5. The electrical cable connecting assembly of claim 4 wherein an annular wall extends outwardly from the larger end of said wedge-shaped member, said annular wall compressing said jacket and urging said jacket outwardly into sealing engagement with the inner surface of said sleeve means.

6. The electrical cable connecting assembly of claim 4 including a rigid central conductive connector member secured to said cable conductor and a connector dielectric disposed between said central connector member and said sleeve, said connector dielectric abutting the dielectric of said cable.

References Cited

UNITED STATES PATENTS

1,326,250	12/1919	Brown et al.	285—246
2,901,085	8/1937	Scholtes	285—250
2,441,718	5/1948	Parker et al.	285—149
2,805,399	9/1957	Leeper	174—7 X
2,809,056	10/1957	Kaiser	285—149
2,906,809	9/1959	Drenning	174—88 X
3,209,287	9/1965	Oxner	174—89 X

DARRELL L. CLAY, *Primary Examiner*.

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,373,243

DATED : March 12, 1968

INVENTOR(S) : R. M. JANOWIAK ET AL

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 63, after the word and punctuation "shield,"
insert the words --and a resilient insulating jacket
surrounding said shield --

Signed and Sealed this

Twenty-third Day of October 1979

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

LUTRELLE F. PARKER
Acting Commissioner of Patents and Trademarks