Feb. 19, 1963 R. C. BERRY 3,078,436

ELECTRICAL CONNECTOR

Filed Sept. 21, 1960 2 Sheets-Sheet 1

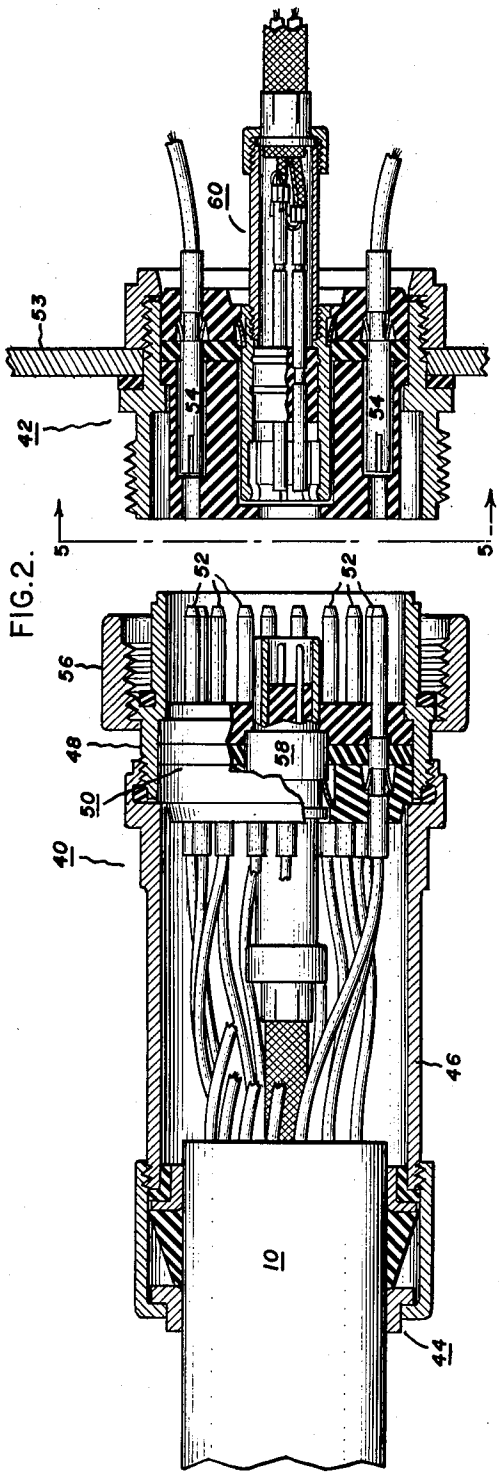

FIG.2.

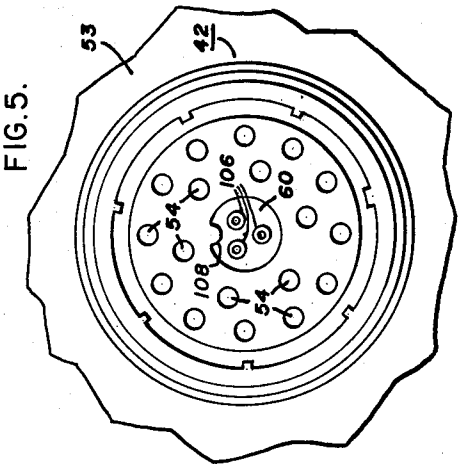

FIG.5.

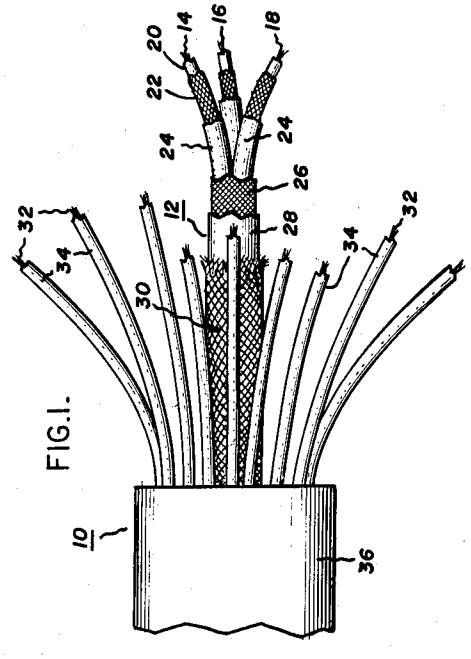

FIG.1.

INVENTOR:
RICHARD C. BERRY,

BY *D. Emmett Thompson*
HIS ATTORNEY.

Feb. 19, 1963 R. C. BERRY 3,078,436

ELECTRICAL CONNECTOR

Filed Sept. 21, 1960 2 Sheets-Sheet 2

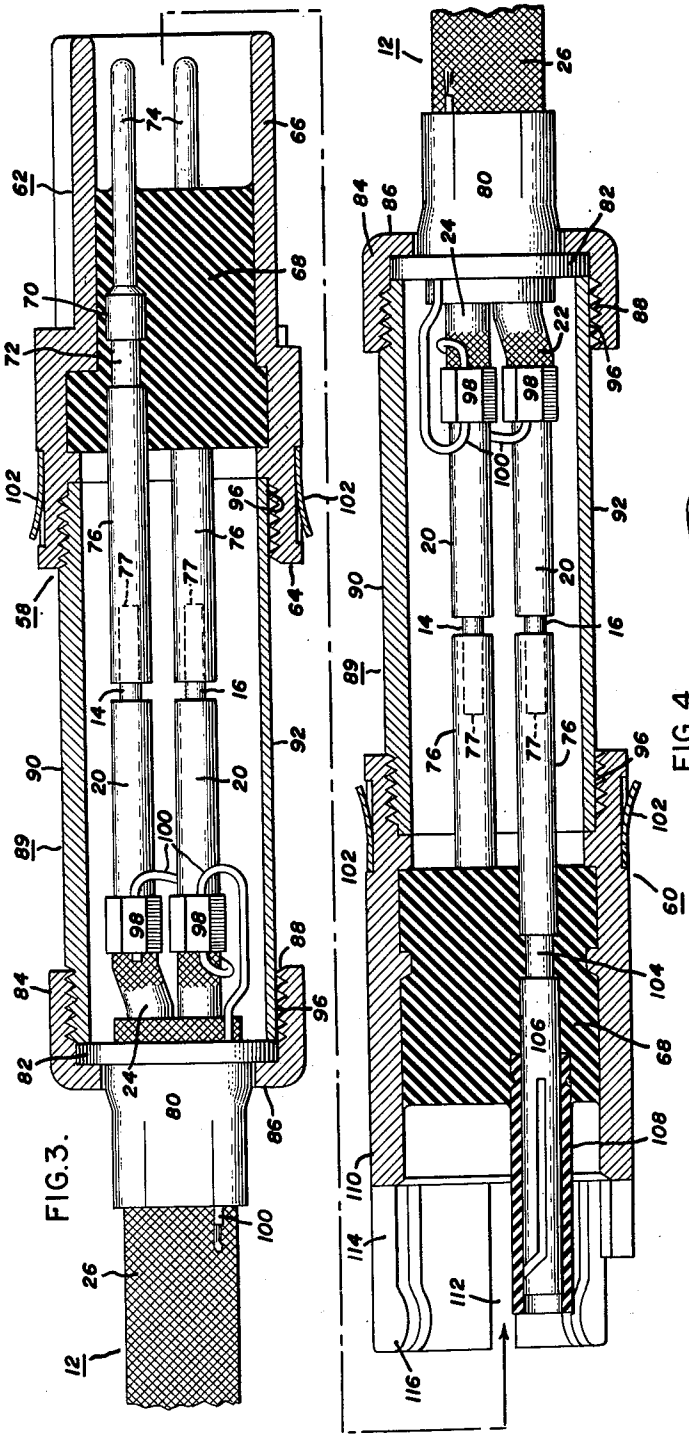

FIG. 3.

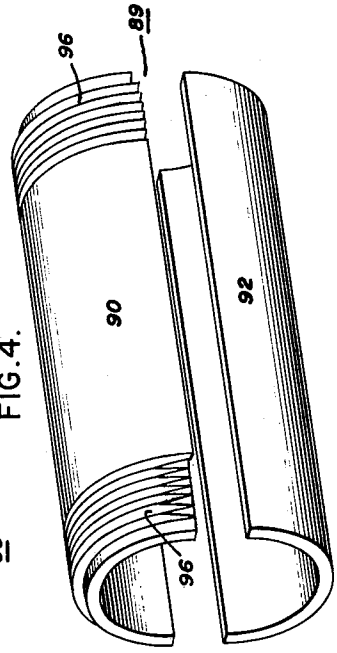

FIG. 4.

INVENTOR:
RICHARD C. BERRY.

BY D. Emmett Thompson
HIS ATTORNEY.

United States Patent Office 3,078,436 Patented Feb. 19, 1963

3,078,436
ELECTRICAL CONNECTOR

Richard C. Berry, Camillus, N.Y., assignor to Crouse-Hinds Company, Syracuse, N.Y., a corporation of New York

Filed Sept. 21, 1960, Ser. No. 57,424
2 Claims. (Cl. 339—143)

This invention relates to and has as a general object a new and improved connector for connecting electrical cable.

Certain types of electrical cable, called co-axial cable, contain power conductors for conducting relatively large currents and communication conductors for conducting relatively small currents. In such cable it is necessary to "shield" the power conductors from the communication conductors in order to prevent "noise" from occurring in the communication conductors. This phenomena, as is well understood by those skilled in the art, takes place due to the magnetic field induced by the transmission of alternating currents over the power conductors and results in a static or the like taking place in the communication conductors. The conventional shielding used to prevent such "noise" taking place is a woven or braided metallic covering which functions in a manner so as to prevent the induced magnetic field of the power conductors from interfering with, or affecting, the communication conductors. As will be obvious it is, therefore, necessary when electrically connecting two pieces of such co-axial cable that the electrical shielding between the power conductors and the communication conductors be carried uninterruptedly through the connector.

Accordingly, it is a more specific object of this invention to provide an electrical connector of the plug and receptacle type for connecting electrical co-axial cable wherein the cable contains both power and communication conductors and wherein an electrical shield is provided in the cable between the power and communication conductors, which shield is carried through the connector.

It is an additional object of this invention to provide a connector of the type described having improved means for facilitating the connection of the communication core part of the co-axial cable to the communication contacts of the connector.

In addition, it is a further object of this invention to provide a means to electrically connect co-axial cable of the type above described, wherein the communication conductors are also provided with a shield and the means for connecting the cable includes means for maintaining all of the shielded conductors at the same electrical potential as the core shield.

The invention resides in the novel features and in the combinations and constructions hereinafter set forth and claimed.

In describing this invention reference is had to the accompanying drawings in which like characters designate corresponding parts in all the views.

In the drawings:

FIGURE 1 is a fragmentary view of an example of co-axial cable with parts of the cable and contacts carried therein stripped back, or bared, to better illustrate the nature of the cable.

FIGURE 2 is a cross-sectional elevational view of a preferred form of a connector embodying the invention shown in the position just prior to engagement for connecting co-axial cable of the type shown in FIGURE 1, together.

FIGURE 3 is a fragmentary view taken on an enlarged scale, of a portion of the connector shown in FIGURE 2.

FIGURE 4 is a perspective view of a portion of the structure shown in FIGURE 3.

FIGURE 5 is a view taken looking in the direction of the arrows 5—5 on FIGURE 2, illustrating the arrangement of the contacts in the connector.

In FIGURE 1 the co-axial cable, generally indicated at **10**, of the type which is intended to be electrically connected by the connector comprising the subject of the invention, is made up of a central core, generally at **12**. The core **12**, comprises a plurality of stranded communications conductors **14**, **16**, **18**, which are covered by a suitable plastic insulation **20**. Surrounding the insulation **20**, is a woven or braided metallic shield **22**, to electrically shield the conductors **14**, **16**, **18**, from each other. The shield **22** is covered by another insulation covering **24** of any suitable plastic material, and the three thus insulated and shielded conductors are covered by a woven or braided metallic shield **26**, which is, in turn, surrounded by another covering of insulation **28**, which may be of any suitable plastic material. Finally the core **12**, is surrounded by a fiber insulation covering of the conventional type indicated at **30**.

The thus constructed communications core part of the cable **10**, is surrounded by a plurality of radially and circumferentially spaced power conductors of the stranded type, indicated by the reference numeral **32**. These conductors are provided with any suitable covering of insulation **34**. The power conductors and communications core are wrapped together in a rubber insulating cover **36**, thus completing the co-axial cable. The cable shown and described in connection with FIGURE 1 is shown for purposes of illustration only, and is not intended to be limiting in any sense and such cable is readily commercially available as will be obvious.

As set forth above, the power conductors **32** are intended to have a relatively large current carrying capacity for use in power operating devices, while the communications conductors **14**, **16**, **18**, are intended to have a relatively small current carrying capacity for use in communications devices. As is understood by those skilled in the art, it is, therefore, necessary to shield the communications conductors from the power conductors to prevent the phenomena known as "noise" from taking place in the communications conductors. This electrical shielding is accomplished by means of the core shield **26** and the individual conductor shields **22**.

In FIGURE 2 is shown a preferred form of the connector embodying the subject matter of the invention. This connector is similar in some respects in general design to that shown and disclosed in my prior application No. 2,521, filed on January 14, 1960.

The connector shown in FIGURE 2 is composed of a plug-half generally indicated by the number **40**, and a receptacle-half generally indicated by the number **42**. These halves are complemental in all respects except for the contacts, the contacts in the plug-half being of the pin type, while the contacts in the receptacle-half are of the socket type. As shown at the left of FIGURE 2, the plug is made up of a cable clamping assembly generally designated by the number **44**, for clamping the co-axial cable **10** to the rearward end of the sleeve or handle **46** of the plug **40**. The cable clamping assembly **44** is of the type shown and disclosed in my prior application No. 853,107, filed on November 16, 1959, now Patent No. 3,040,120.

As disclosed in application No. 2,521 the forward end of the handle or sleeve **46** is carried to a shell **48** and an insert assembly, generally designated at **50**, is carried by the forward shell and comprises a pair of rigid insulating blocks having a deformable inner disk contained therein. Carried by the insert assembly are a plurality of pin type contacts **52** which extend both forwardly and rearwardly of the assembly **50**.

The receptacle half **42** of the connector is mounted on

a bulkhead or the like 53 and is generally the same as the plug-half 40 just described, with the exception that the insert assembly of the receptacle-half carries a plurality of socket type contacts 54, the forward ends of which are "buried" in the forward piece of rigid insulation. The pin and socket contacts 52, 54, carried by the insert assemblies are positioned or spaced complementally to each other in the manner which comprises the subject of application No. 2,521. The plug-half of the connector is provided with a coupling nut 56 to fixedly secure the halves of the connector together after they have been moved from the position shown in FIGURE 2 into engagement.

Located on the center line in each of the plug and receptacle halves of the connector is a core contact assembly, the reference numeral 58, indicating the plug core contact assembly, while the reference number 60 indicates the receptacle core contact assembly. These core contact assemblies are shown more clearly in the enlarged view of the assemblies shown in FIGURE 3. In that figure the plug contact assembly comprises a body portion 62 which is provided, at its rearward end, with an open internally threaded annular wall 64. The forward end of the body 62 also terminates in an open annular wall 66. A dielectric contact carrying center 68 is moulded into the body 62 and carries a plurality of contacts 70. The contacts 70 are provided at their center portion with a reduced portion 72 which serves to maintain the contacts rigidly in the dielectric center 68 and the contacts have a forwardly extending portion 74 which extends forwardly out of the dielectric 68 and terminates in spaced relation to the annular wall 66. In like manner, the contacts are provided with a rearwardly extending portion 76, which extends rearwardly beyond the internally threaded annular wall 64. In the example shown in the figure, the rearward terminus of the portion 76 is provided with a socket 77 indicated by the dashed line for receiving the communications conductors 14, 16, 18 and the conductors 14, 16, are shown as being affixed to two of the contacts 70 by crimping. It is to be understeood that other suitable manner of connection may be used for affixing the conductors to the contacts.

The core shield 26 is shown in FIGURE 3 as being provided at its forward end with a ferrule, generally indicated by the reference number 80. The ferrule is made up of an outer sleeve terminating at its forward end in an outwardly extending annular flange 82 and an inner sleeve (not shown) which is received within the outer sleeve 80. The core shield 26 is then crimped between the flanged outer sleeve 80 and the inner sleeve, thus effecting an electrical, as well as a mechanical bond between the core 12 and the ferrule 80. The ferrule 80 is also provided with a coupling nut 84 which has a flange 86 extending radially inwardly to prevent the nut 84 from passing over the flange 82 on the ferrule 80. The nut 84 is internally threaded, as at 88, to draw the ferrule 80 and thus the core 12, into engagement with the means for connecting the core 12 to the body 62 of the core contact assembly. This means comprises an axially extending longitudinally split sleeve, generally indicated by the numeral 89, having an upper half 90, and a lower half 92. The upper half 90 of the sleeve is threaded adjacent its forward and rearward ends, so as to threadedly engage the internally threaded annular wall 64, on the body 62, and the threads 88, on the coupling nut 84. The threads formed at the left-hand end of the threaded upper half 90 of the split sleeve, as best seen in FIGURE 4, are flattened down to the minor diameter of the threads adjacent to the parting line between the halves 90 and 92 of sleeve 89. These threads are milled down or flattened by any suitable operation to facilitate the assembly of sleeve 89, as will be herein described. The other half 92 of the sleeve 89, however, is formed along its entire length with a reduced diameter, the diameter of the sleeve 92 being equal to the minor diameter 96 of the threaded wall 64 and the nut 84, so as to be received within the wall 64, and the nut 84, when the halves of the sleeve are placed together.

The conductors 14, 16, and 18 are stripped at their forwardmost ends to permit connection to the contacts 70. The individual shields 22 of these conductors are laced together by ferrules 98, which are similar in construction to ferrule 80, and the metallic lacing 100 which is connected, as is indicated in FIGURE 3, to the core shield 26 under the crimped ferrule 80 in order to maintain each of the conductor shields 22, and the core shield 26, at the same electrical potential, this being necessary in order to prevent any difference in potential between the individual shields which operates to create "noise."

To connect the cable 10 to the plug 40, the co-axial cable 10 is stripped in the manner shown in FIGURE 1, and the ferrule 80, and coupling nut 85, are crimped to the core shield 26, after the shields 22 of the individual conductors have been electrically connected together, as just described, and the conductors 14, 16, 18, are then connected to the contacts 70. Thereafter, the coupling nut 84 is moved rearwardly while just the threaded half 90, and then the unthreaded half 92 of the sleeve 89, are inserted straight into the annular wall 64 on the body 62. The flattened threads on the left-hand end of piece 90, as shown in FIGURE 4, permits the sleeve half 90 to be inserted straight into the annular wall 64 on the body 62 without the necessity for rotating piece 90 to permit this insertion. This is an advantageous feature because without flattening the threads the sleeve half 90 would have to be rotated to threadedly engage it with wall 64 and such rotation would be difficult after the connections between the conductors and the contacts, previously described, have been made. As will be obvious, the threads at both ends of the sleeve 90 could be flattened if piece 90 were to be made by die casting or the like. The coupling nut 84 is next slid forwardly until the threads in the nut 84 engage the threads on the sleeve half 90, the nut 84 then being rotated to threadedly engage the threads on the sleeve half 90. When this threaded connection has been completed, both halves of the sleeve 89 are fixedly maintained between the coupling nut and the annular wall 64. Thereafter, the body 62 of the plug core assembly which has been provided with the snap ring 102 similar to that shown and described in application No. 2,521, is inserted into the insert assembly 50. The power conductors 32 have been previously connected to the rearwardly extending portions of the pin contacts 52, thus completing the connection of the plug-half 40 of the connector to the co-axial cable 10.

Referring now to the lower portion of FIGURE 3, the receptacle core assembly is identical in all respects to that shown and described in connection with the plug core assembly 58, with the exception that the contacts 104 of the receptacle core assembly 60, are formed at their forward end 106, with sockets to receive the forward pin portion 74 of the contacts 70. The sockets 106 are surrounded with a dielectric insert 108 to electrically insulate the forward portion of the contacts 104. Also the forward portion 110 of the receptacle core assembly body is provided with a plurality of axially inwardly extending slots 112, so as to provide a plurality of fingers 114, which are formed at their forward end with enlarged portions 116, to grip the annular wall 66 of the plug core assembly body 62. The remainder of the plug core assembly 60 is identical to the receptacle core assembly 58, and the core contacts 104 are connected to the conductors of the core portion of the co-axial cable in exactly the same manner as above described in connection with the plug-half 40. In like manner, the receptacle core assembly 60 is inserted into the insert assembly in the receptacle-half 42 of the connector by means of the ring 102, as described in application No. 2,521.

FIGURE 4 is a perspective view showing the two halves 90, 92, of the sleeve 89.

FIGURE 5 is a view taken looking in the direction of the arrows on line 5—5 of FIGURE 2, showing the receptacle core assembly 60, located centrally in the receptacle-half 42, of the connector wherein the power con-

ductor contacts **54** are arranged in radially and circumferentially spaced relation to the communication conductor contacts **106**, carried in the receptacle core assembly **60**. Reference numeral **108** indicates cooperable polarizing means formed on the core assemblies **58** and **60** and the insert assemblies **50**, respectively, in order to polarize the core assemblies with respect to the insert assembly and the other contacts **52**, **54** carried by the insert assemblies.

It is to be understood that the core contact assemblies **58** and **60** may be separately used if so desired, in which case they would comprise complete connector parts by themselves.

As will be obvious, the amount or length that the cable **10** may be stripped back from the core **12** is limited. This amount of stripping is critical in that the cable cannot be stripped back from the core beyond the point where the cable clamping assembly **44** is to grip the cable **10**. This requirement thus limits the space available for connecting the communication conductors to their apppropriate contacts. The split sleeves **89** permit this connection to be made within this limited space.

What I claim is:

1. A co-axial connector assembly for connecting the ends of a co-axial cable having one or more electrically shielded relatively low current carrying conductors, an electrical core shield for said low current carrying conductors, a plurality of relatively high current carrying conductors surrounding said core shield, said connector assembly comprising a plug half and a receptacle half, each of said halves being capable of being field assembled in moisture proof fashion and comprising an exterior two-piece body member, a multiple piece contact assembly carried between two pieces of said body member, said contact assembly having a plurality of contacts including a core contact mounted in a dielectric assembly and extending rearwardly therefrom into said body member, certain of said contacts being connected to said high current carrying conductors, and said core contact being formed of a pair of interconnected sleeves and having a second contact assembly mounted in the forwardmost sleeve, the contacts of said second contact assembly extending rearwardly into said rearwardmost sleeve and being connected to said shielded low current carrying conductors, fastening means being electrically and mechanically connected to said core shield, said rearwardmost sleeve being split axially to form two pieces to facilitate the connection of said low current conductors to said contacts of said second contact assembly, one of said axially split pieces being formed with attachment means at its opposite ends cooperable with said fastening means mounted on said core shield and complemental attachment means formed at the rearward end of said forwardmost core sleeve, the other axially split piece being received between said complemental attachment means and said fastening means to provide a continuous uninterrupted core shield through said conductor.

2. The co-axial connector of claim 1, wherein said attachment means formed on one of said axially split pieces comprises screw threads cooperable with complemental screw threads formed on said fastening means, and the rearward end of said forwardmost core sleeve.

References Cited in the file of this patent

UNITED STATES PATENTS

2,286,952	Cannon et al.	June 16, 1942
2,306,821	Markey	Dec. 29, 1942
2,383,926	White	Aug. 28, 1945
2,443,975	Baker	June 22, 1948
2,804,601	Harthman et al.	Aug. 27, 1957
2,827,618	Chapman et al.	Mar. 18, 1958