# United States Patent [19]

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[54] **SEALED COAXIAL CONNECTOR**


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**Related U.S. Application Data**

[63] Continuation-in-part of Ser. No. 25,073, April 2, 1970, abandoned.

[52] **U.S. Cl.** ..... **339/177 R,** 174/77

[51] **Int. Cl.** ..... **H01r 17/04**

[58] **Field of Search** ..... 174/20, 22, 23, 31.5, 75 C, 174/77, 88 C, 89; 339/60, 91 P, 89 C, 94, 126 J, 177; 277/168, 169, 178, 214



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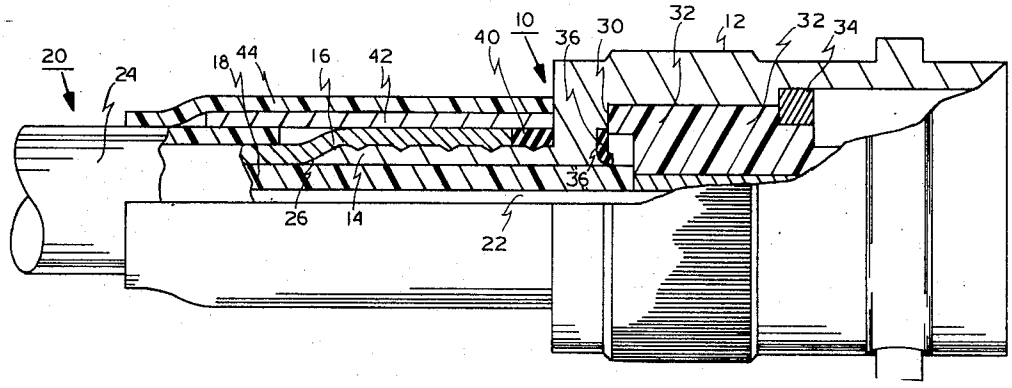
[57] **ABSTRACT**

A sealed coaxial cable connector. A member of a moldable resilient material is provided at the junction between an internal cylindrical opening through the center of a connector body and an enlarged counterbore at the forward end of the body. The member, which may for example be molded to the rear shoulder of the counterbore, has an opening through its center which is sized so that the member coacts with the insulating layer of a coaxial cable, when the cable is inserted into the connector, to seal the opening. An external seal may also be provided by a gasket of a resilient material positioned at the forward end of a ferrule portion of the connector body, ahead of the connector outer conductor. The gasket is adapted to have a crimp ferrule pass over it, and to be compressed by the crimp ferrule when the ferrule is crimped to form a seal between the crimp ferrule and the body member. The rear end of the crimp ferrule is sealed by passing the ferrule over the outer insulating jacket of the cable.


**2 Claims, 2 Drawing Figures**



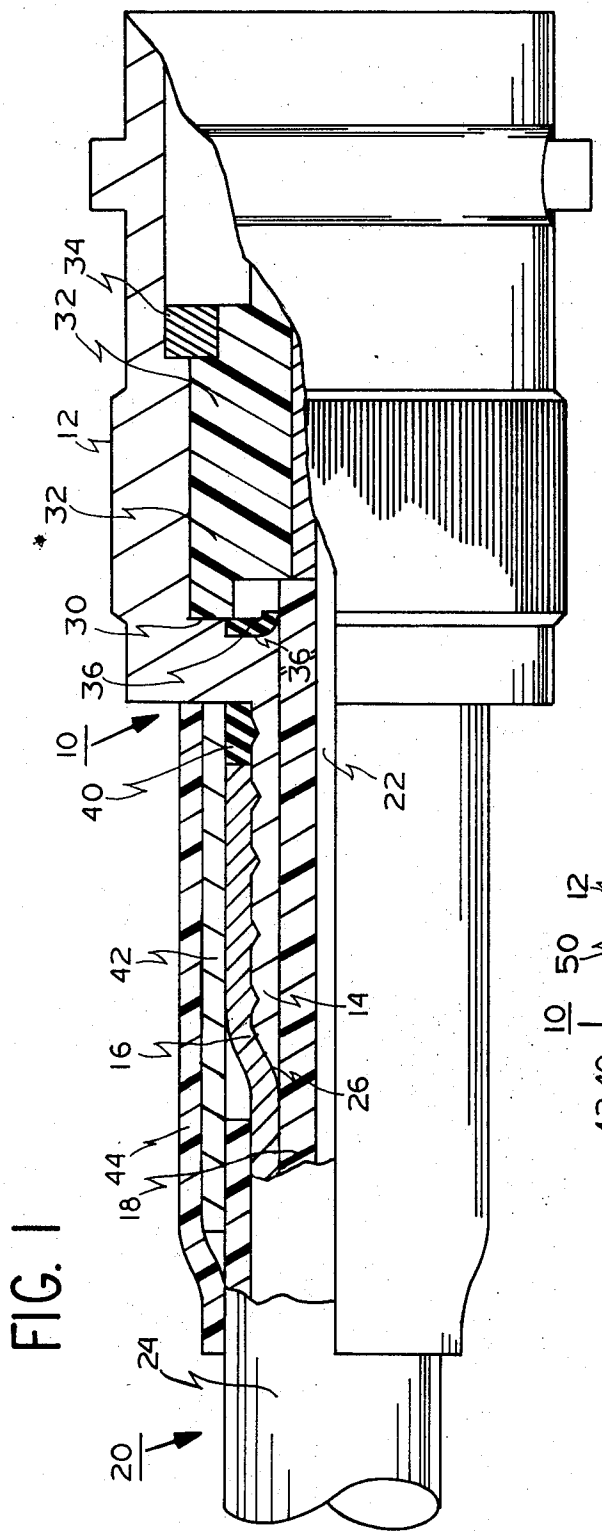



FIG. 1

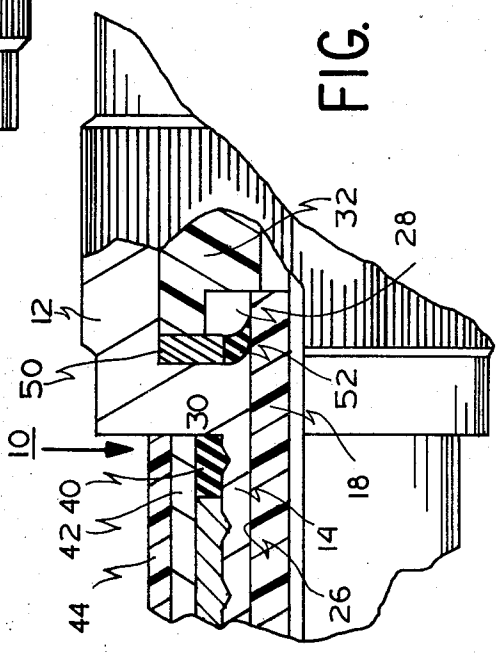



FIG. 2

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# SEALED COAXIAL CONNECTOR

This application is a continuation-in-part of patent application, Ser. No. 25,073 filed Apr. 2, 1970 now abandoned.

The invention relates to a connector for coaxial cable and more particularly to a coaxial connector which is sealed to prevent liquid from seeping from outside into the connector and to prevent liquid from seeping from the connector into the cable.

In many applications of coaxial cables, the cables and connectors for interconnecting the cables are submerged in a fluid such as water or oil. If the fluid in which a cable is submerged seeps into the cable or a connector, it could interfere with the transmission of electrical signals through the cable by either causing a short circuit to be formed between the inner and outer conductors of the cable or the connector or by corroding a conductor so as to cause an open circuit. Proper sealing, particularly at the connectors, is, therefore, important in these applications.

There are several aspects to the connector sealing problem. The first problem is to prevent liquid from seeping through the back of the connector into both the connector and the cable. Most connectors used in these applications employ a crimp ferrule to physically and electrically connect the connector body to the cable conductors. There is at least one crimp ferrule presently on the market which is adapted to provide a seal between the crimp ferrule and the cable connector so as to prevent liquid from seeping in. However, this crimp ferrule is substantially more expensive than standard crimp ferrules and a special crimp tool is required to utilize it. The requirement of a special tool is particularly onerous for field installations. Further, a sealing member utilized with this ferrule requires a distortion of the normal ferrule geometry and thus interferes with the mechanical holding of the crimp. An inexpensive means for providing a seal at the back end of a connector between the outer conductor of a coaxial cable and the crimp ferrule is thus required. This means should permit the use of existing crimp tools, such as, for example the standard hex connection tool, and should not require any distortion of the normal ferrule geometry.

The second aspect of the problem is to seal the front end of the connector. This is required for at least two reasons. First, if a cut develops in the jacket of the cable, the cable developing the cut will be ruined. However, it is desirable that the fluid not be able to leak through the connector to ruin additional cables. Secondly, it is possible that a connector may be left open without being removed from the fluid. Under these conditions, it is important that fluid not be permitted to seep through the open connector into the cable. This is because the connector itself may be easily air dried, while it is almost impossible to dry a cable once fluid has seeped into it. The cable would thus have to be replaced, an expensive operation in most cases. The present approach to sealing the inside of a connector is to hermetically seal the connector with a glass bead which is soldered inside the connector. This is an expensive operation which significantly increases the cost of the connector. Perhaps more serious is the fact that the glass bead itself is also fragile and may be broken in handling or use. A crack in the glass is difficult to detect and may cause circuit failures in use which are also difficult and expensive to detect. Experience has shown that there is a high scrap rate on hermetically sealed connectors of this type.



Another factor to consider when making a sealed connector is that it is far less expensive to mill a number of connector bodies of the same type than it is to mill the same number of connector bodies of different types. It is therefore, desirable that the same connector body be utilizable for both sealed and unsealed versions of a connector type.

It is thus a primary object of this invention to provide an improved sealed coaxial connector.

A more specific object of this invention is to provide an inexpensive external seal for a coaxial connector.

Another more specific object of this invention is to provide an inexpensive internal seal for a coaxial connector.

Another object of this invention is to provide sealed coaxial connectors of the type indicated above which do not require the use of special tools for installation.

A further object of this invention is to provide a sealed coaxial connector which is not subject to breakage as a result of rough handling or use.

A still further object of this invention is to provide a sealed coaxial connector which utilizes the same connector body as a corresponding unsealed coaxial connector.

Another object of this invention is to provide an external seal for a coaxial connector which does not interfere with the mechanical holding of the crimp.

In accordance with these objects, this invention provides a sealed connector for coaxial cables having an inner conductor encircled by an annular insulating layer, an outer conductor, and a jacket of insulating material. The connector has a metallic body member with a cylindrical opening extending through it. The cylindrical opening is sized to accept the inner conductor and insulating layer of the coaxial cable and has an enlarged counterbore coaxial with it at its forward end. A means is provided for sealing the junction between the opening and its counterbore. This sealing means includes a member of a moldable resilient material coaxial with the opening and having an internal diameter sized so that the member coacts with the insulating layer, when the cable is inserted in the opening, to seal the opening. The member may be molded to the rear shoulder of the counterbore or may be, for example, molded to a washer which is inserted in the counterbore.

An external seal is provided in part by a gasket of resilient material positioned at the forward end of a ferrule portion of the metallic body member and ahead of the outer conductor. A crimp ferrule is provided which is sized to fit over the outer conductor of the cable when it is positioned on the ferrule portion and is adapted to be crimped to secure the outer conductor to the ferrule portion. The gasket has an inner diameter which is substantially the same as that of the ferrule portion and an outer diameter substantially the same as, but not quite as great as, the inner diameter of the crimp ferrule. The gasket is adapted to have the crimp ferrule pass over it when the crimp ferrule is positioned over the ferrule portion of the connector body and to be compressed by the crimp ferrule, when the ferrule is crimped, to form a seal between the ferrule and the body member. The rear end of the ferrule is sealed by

passing the ferrule over the jacket so that the jacket is also compressed by the crimped ferrule.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of preferred embodiments of the invention, as illustrated in the accompanying drawings.

In the drawings:

FIG. 1 is a partially cut-away view of a connector utilizing the teachings of this invention.

FIG. 2 is a partially cut-away view of a portion of a connector utilizing an alternative internal sealing means.

Referring now to FIG. 1, it is seen that the connector includes a body member 10 having a forward contact extension 12 and a rearwardly extending ferrule portion 14 which is adapted to be fitted between the external conductor braid 16 and the insulating layer 18 of a coaxial cable 20. Coaxial cable 20 also has an inner conductor 22 and an insulating jacket 24.

Ferrule portion 14 has an opening 26 through its center which is sized to accept insulating layer 18 of coaxial cable 20 while contact extension 12 has an opening 28 through its center which is larger than the opening 26 and coaxial therewith. Opening 28 terminates at its rearward end in a shoulder 30. A contact support block 32 of an insulating material such as Teflon is supported in opening 28 and secured therein by ring 34.

A coating 36 of a moldable resilient material such as Buna rubber is molded into a counterbore 37 in shoulder 30. The height of counterbore 37 is sufficient to provide good adherence of coating 36 to body 10. In some applications counterbore 37 may be dispensed with and coating 36 molded directly to shoulder 37. The inner opening of seal coating 36 is coaxial with opening 26 and has a smaller than that of opening 26 diameter (it may, for example, be a pin hole). The exact size of the opening in coating 36 is not critical and may vary depending on moldable material utilized and other factors. The opening may be formed during the molding operation or punched out afterwards. Seal 36 is thus compressed and displaced by insulating layer 18 when the layer is inserted through opening 26 to provide an inner seal for the connector. Thus, if a crack should develop in jacket 24 of cable 20, fluid getting into the cable between outer conductor 16 and insulating layer 18 would not be able to pass beyond sealing coating 36 into the connector or beyond the connector into a mating cable. Also, if the connector is left in an unmated condition, sealing coating 36 prevents fluid from passing through the connector into cable 20.

In order to provide an outer seal for the connector, a gasket 40 which is of rubber or some other resilient material, is slipped over ferrule portion 14 of connector body 10 before cable 20 is mounted on the connector body. Outer conductor 16 of the cable is cut back slightly to accommodate gasket 40. The inner diameter of gasket 40 is substantially the same as the outer diameter of ferrule portion 14 and the outer diameter of gasket 40 is substantially the same but not quite as great as the inner diameter of a standard crimp ferrule 42. Thus, after connector body 10 has been mounted on cable 20, the crimp ferrule may be slipped into place over outer conductor 16 and gasket 40. Since the gasket is slightly smaller than the ferrule, the ferrule may slip over it with relative ease. A slight taper on the leading edge of the gasket may be provided to assist in permitting the ferrule to pass over it. The rear end of ferrule 42 passes over a portion of insulating jacket 24. When ferrule 42 is then crimped in a standard manner, pressure is applied both to gasket 40 and the portion of jacket 26 under the ferrule compressing them as shown in FIG. 1 to prevent fluid from flowing under ferrule 42 or between ferrule 42 and outer conductor 16 into the connector. The crimp, for example a hex crimp, is for the preferred embodiment of the invention not directly over either gasket 40 or gasket 42 but is instead between them. The compressed ferrule thus has a substantially circular cross section in the areas over these elements. This provides superior sealing without requiring a special circular crimp tool. In some applications, however, an adequate seal may be obtained with a hex crimp directly over the sealing element. Further protection for the rear joint of the connector may be provided by slipping an insulating, fluid-resistant boot 44 over ferrule 42 after the crimping operation has been completed.

While the embodiment of the invention shown in FIG. 1 is the least expensive way of obtaining an internal seal for the connector at the factory, it would be difficult to obtain a sealed connector in the field by modifying a standard connector in this way. FIG. 2 illustrates an alternative means for obtaining an internal seal in a connector which, while probably slightly more expensive than the embodiment shown in FIG. 1 does not require the presence of molding equipment at the connector in order to effect the seal. Referring to this figure, it is seen that in place of molded coating 36, a metal washer 50 having a resilient coating 52 of a moldable material such as Buna rubber molded around its inner surface, it positioned in opening 28 adjacent to shoulder 30. As with coating 36, the internal opening formed in coating 52 is normally coaxial with opening 26 but has a smaller diameter. The insertion of cable 20 into opening 26 thus causes coating 52 to be compressed and distorted as shown in FIG. 2, to form a seal.

The function of washer 50 is to provide rigidity to the inserted sealing member so that the sealing member will be properly positioned with its opening coaxial without opening 26. If the openings are not initially coaxial, a non-uniform seal will be obtained. The washer 50 may be made of the same size as counterbore 28 or a smaller counterbore such as counterbore 37 of FIG. 1, may be provided in shoulder 30 to act as a seat for the washer to assure proper positioning.

It is thus seen that a completely sealed connector has been provided, the two seals of which may both be provided at very low cost. The selling cost of the connector may be further reduced by permitting washer 40 to be field installed. Since the sealing element, rubber, is not breakable, the connector may be subjected to rough handling and use without fear that the seal will be broken. A standard crimp ferrule is used and thus a standard crimping tool may also be utilized. Further, since the seal requires no change in the normal ferrule geometry, the sealing does not in any way interfere with the normal holding action of the ferrule. Finally, a standard connector body may be utilized and, in fact, a standard connector may be converted into a sealed connector by adding the seals in the field.

Thus, while the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those

skilled in the art that the foregoing and other changes in form and detail may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A sealed connector for a coaxial cable having an inner conductor encircled by an annular insulating layer, an outer conductor, and an insulating jacket comprising:

a metallic body member having extending therethrough a cylindrical opening sized to accept said inner conductor and insulating layer, said opening having an enlarged counterbore coaxial therewith formed at its forward end which counterbore terminates in a shoulder at its rear end, said shoulder having a counterbore provided therein coaxial with said opening and having a diameter greater than that of said opening but less than that of said enlarged counterbore; and

means for providing a seal at the junction between said opening and said enlarged counterbore, said means including a resilient seal seated within and adhered to the walls of said counterbore of said shoulder, said seal being coaxial with said opening and having an internal opening with a diameter chosen sufficiently smaller than that of said insulating layer so that said member is compressed and displaced by said insulating layer, when said cable is inserted in said opening, to seal said opening.

2. A sealed connector for a coaxial cable having an inner conductor encircled by an annular insulating layer, an outer conductor, and an insulating jacket comprising:

a metallic body member having extending therethrough a cylindrical opening sized to accept said inner conductor and insulating layer, said opening having an enlarged counterbore coaxial therewith formed at its forward end which counterbore terminates in a shoulder at its rear end, said shoulder having a counterbore provided therein coaxial with said opening and having a diameter greater than that of said opening but less than that of said enlarged counterbore; and

means for providing a seal at the junction between said opening and said counterbore, said means including a washer seated in said counterbore of said shoulder, said washer having a resilient seal adhered to the wall of its inner opening, said seal being coaxial with said opening and having an internal opening with a diameter chosen sufficiently smaller than that of said insulating layer so that said member is compressed and displaced by said insulating layer when said cable is inserted in said opening to seal said opening.

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