United States Patent

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[54] **CONNECTOR FOR DOUBLE-SHIELDED CABLE**
7 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** ..... **174/35 C,** 174/75 C, 339/177 R
[51] **Int. Cl.** **H05k 9/00,** H02g 15/08
[50] **Field of Search** ..... 174/35 C, 35 SM, 35 MS, 89, 88 C, 75 C, 65; 339/176, 177, 103, 276 R

[56] **References Cited**

UNITED STATES PATENTS

2,762,025	9/1956	Melcher	174/35 C X
3,142,721	7/1964	Long	174/89 X
3,534,146	10/1970	Fell	174/35 MS

FOREIGN PATENTS

633,190	12/1949	Great Britain	174/35 C

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ABSTRACT: A connector assembly for connecting a double-shielded cable to a double-shielded RFI box employs an inner tubular conductive member for extending through an aperture in the box to connect a first shield of the cable to the inner shield of the box. An insulating ring is mounted on the inner member and an outer tubular conductive member is mounted on the ring. The second shield of the cable and the outer shield of the box are connected to the outer conductive member.

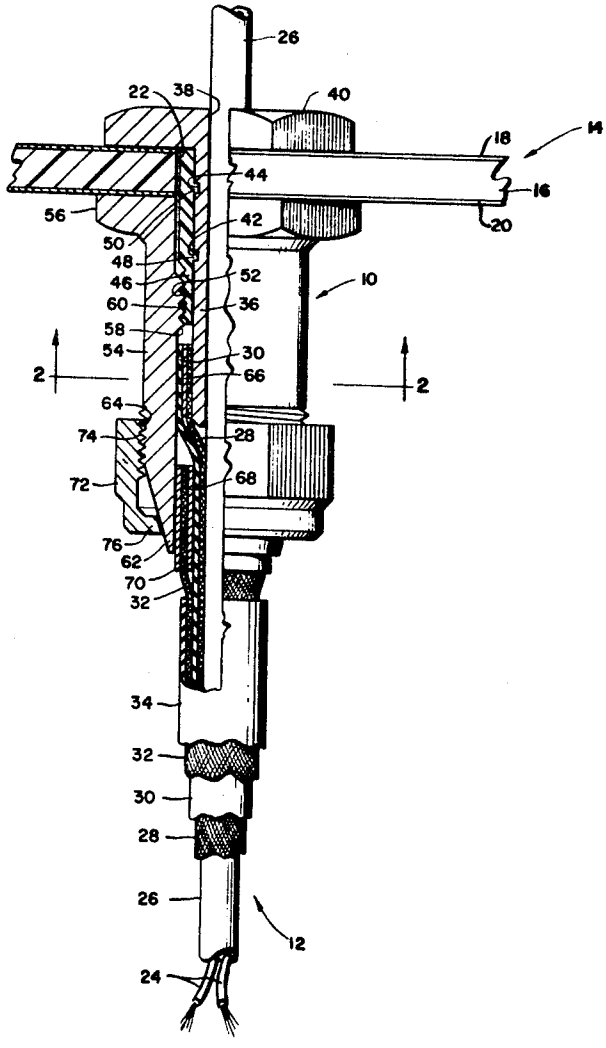


FIG. 1

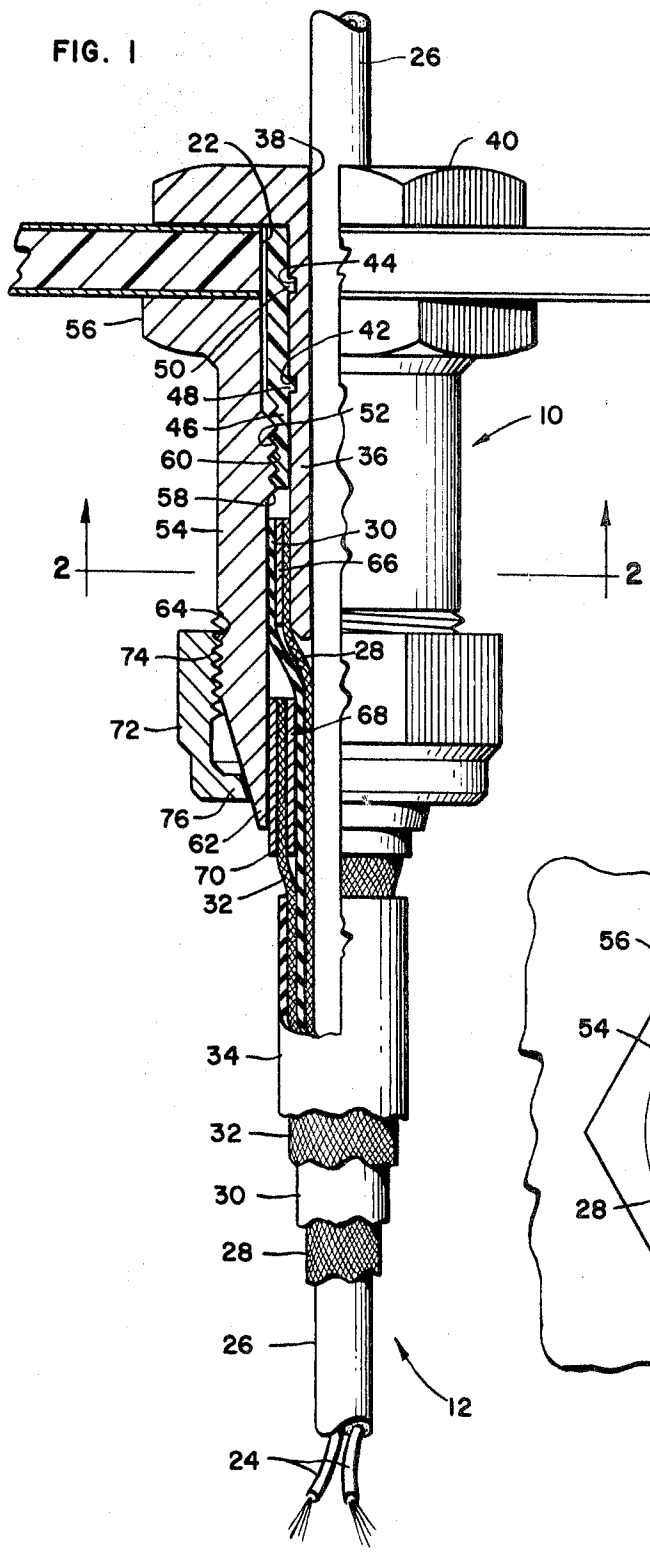
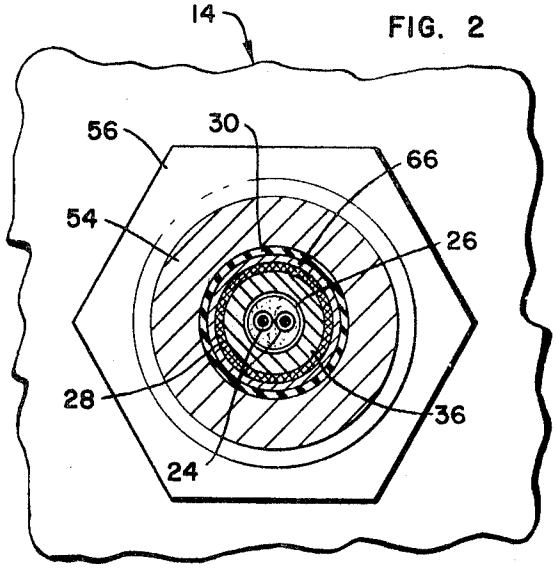


FIG. 2



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CONNECTOR FOR DOUBLE-SHIELDED CABLE

BACKGROUND OF THE INVENTION

The present invention relates generally to connectors for double shielded cables, and in particular to a single composite connector for connecting the inner and outer shields of a double shielded cable to the inner and outer shields, respectively, of a double shielded RFI (radiofrequency interference) box.

Generally, in connecting a double-shielded cable to a double-shielded RFI box, the outer shield of the cable is connected to the outer shield of the box by a first connector at the point where the cable enters the box, and the inner shield of the cable is connected to the inner shield of the RFI box at a point within the box by a second separate and distinct connector. The joining of the inner shield of the cable to the inner shield of the RFI box is typically accomplished by connecting the inner shield of the cable to a raised projection within the RFI box, as disclosed in a pending application by Lowell J. Fell, now U.S. Pat. No. 3,534,146, granted Oct. 13, 1970. This method of connection is time consuming, in that it involves making a shield-to-shield connection with two separate connectors, and is wasteful of space within the interior of the box in that, to accomplish the connection of the inner shield of the cable to the inner shield of the box, a raised projection must be provided within the box.

A specific object of the present invention is to provide a single connector which will electrically connect the inner and the outer shields of a double-shielded cable to the inner and the outer shields, respectively, of a double-shielded RFI box, while maintaining electrical isolation therebetween.

SUMMARY OF THE INVENTION

The foregoing and other objects of the invention are accomplished by providing a single connector assembly for electrically connecting a first metal shield of a cable to a first electrically conductive surface on a nonconductive member, and for connecting a second metal shield of the cable to a second isolated and electrically conductive surface on the nonconductive member, while maintaining electrical isolation therebetween.

Preferably, the nonconducting member has an aperture extending between the first and the second conductive surfaces, and a first conductive cylindrical member having a flange is extended through the aperture, so that the flange is in conducting engagement with the first electrically conductive surface. An insulating cylindrical member is circumferentially disposed about the first conductive cylindrical member and extends through the aperture, so that the first conductive cylindrical member is spaced from the surface defined by the aperture. The first shield of the cable is connected to the first conductive cylindrical member to establish an electrical connection from the first shield, through the first conductive cylindrical member, and to the first surface.

To connect the second metal shield of the cable to the second conductive surface of the nonconductive member, a second conductive cylindrical member having a flange is circumferentially disposed about the insulating member, so that the flange is in conducting engagement with the second surface, and so that the second conductive member is spaced from the first such member by the insulating member. The second metal shield of the cable is connected to the second conductive cylindrical member so that an electrical connection is established from the second shield, through the second conductive member to the second surface. The first conductive member has an axial bore adapted to permit passage of conductors in the cable through the member and through the aperture in the nonconductive member.

Other objects, advantages and features of the invention will be apparent from the following detailed description of a specific embodiment thereof, when taken in conjunction with the appended drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 of the drawing is a longitudinal view, partly in section, illustrating the connector as it electrically connects the first and the second metal shields of a cable to the first and the second conductive surfaces, respectively, of a nonconductive member.

FIG. 2 is a sectional view taken along the line 2–2 of FIG. 1, and illustrates the shape of certain parts of the connector.

DETAILED DESCRIPTION

The specific embodiment of the invention shown in FIG. 1 of the drawings includes a connector **10** for connecting the shielding of a double-shielded cable **12** to the shielding of a double-shielded insulated member **14**. The double-shielded insulated member **14** may comprise one wall of an RFI enclosure of the type described in the aforementioned Fell patent, and is comprised of an electrically nonconducting material **16**, such as of plastic, covered by two electrically separate layers of shielding **18** and **20**, formed from electrically conductive plating, the first layer **18** covering the entire inner surface of the RFI enclosure and the second layer **20** covering the entire outer surface of the RFI enclosure. The inner shield of the double-shielded cable **12** is connected by the connector **10** to the inner surface of the enclosure, and the outer shield of the cable **12** is connected by the connector **10** to the outer surface of the enclosure, while information-bearing conductors within the cable **12** pass through the center of the connector **10** to the interior of the enclosure to convey electrical signals into and out of the enclosure. Thus, components housed within the enclosure, and the leads extending thereto, are completely surrounded by a double layer of electrical shielding, a technique that has been found effective to suppress radio frequency interference.

More particularly, a bore **22** is provided through the member **14**, and is not plated on its surface to maintain electrical isolation between the interior and the exterior conductive surfaces of the member **14**. The cable **12** is comprised of a pair of inner conductors **24** surrounded by a first insulating layer **26**, which is in turn surrounded by a first shield **28**. The first shield **28** is surrounded by a second insulating layer **30**, which is in turn surrounded by a second shield **32**. The second shield **32** is surrounded by an outer jacket **34** which provides protection for the entire cable **12**.

The connector **10** is comprised of an inner conductive tubular connector **36** having a coaxial bore **38** throughout its length, and having a hexagonally shaped flanged end **40**. Two circumferential rectangular-shaped grooves **42** and **44** are provided around the tubular area of the inner connector **36**. A tubular insulator **46**, such as of nylon, having two inner circumferential rectangular-shaped ridges **48** and **50**, for engagement with the circumferential grooves **42** and **44**, respectively, of the inner connector **36**, is circumferentially disposed around the tubular portion of the connector **36**, and engages at one of its ends the hex-shaped flanged end **40** of the connector **36**, and has at its other end a plurality of threads **52**. The outside diameter of the tubular insulator **46** is approximately the same as the diameter of the bore **22** of the member **14**.

The tubular portion of the inner connector **36**, with the tubular insulator **46**, is inserted through the bore **22** of the member **14**, such that the flanged end **40** of the connector **36** is adjacent the inner conductive surface **18** of the member **14**, and so that the threads **52** of the insulator **46** are positioned beyond the exterior of the conductive surface **20** of the member **14**. The flanged end **40** of the connector **36** is not positioned to conductively engage the interior conductive surface **18** of the member **14**, and the connector **36** is held spaced from, and is therefore electrically isolated from, the exterior conductive surface **20** of the member **14** by the tubular insulator **46**.

To conductively engage the flange 40 with the surface 18, and to provide a means for conductively engaging the exterior surface 20 of the member 14, an exterior conductive tubular connector 54, having a hex-shaped flanged end 56 and a coaxial bore 58, the bore 58 having a diameter slightly larger than the external diameter of the tubular insulator 46, is provided. A plurality of threads 60 are provided within the bore 58 of the exterior connector 54, and are positioned to be threadably engaged with the threads 52 of the tubular insulator 46. The end of the exterior connector 54, opposite from the hex-shaped flange 56, has a tapered slope 62, and a plurality of threads 64 are provided along the connector 54 just prior to the tapered end 62.

To accomplish a conductive engagement of the flanged end 40 of the inner connector 36 with the conductive surface 18, and of the flanged end 56 of the exterior connector 54 with the conductive surface 20, the exterior connector 54 is threaded into engagement with the tubular insulator 46 to draw the flanged ends 40 and 56 together, and therefore into engagement with their respective surfaces 18 and 20. The ridges 48 and 50 of the tubular insulator 46, extending into the grooves 42 and 44 of the inner connector 36, transmit the lateral force applied to the tubular insulator 46 to the inner connector 36 and prevent the insulator 46 from sliding off the connector 36 when the exterior connector 54 is threaded into engagement with the insulator 46. The connector 10 is now making a separate and secure electrical connection with each of the surfaces 18 and 20, each of which is electrically isolated from the other by the tubular insulator 46.

To provide an electrical connection between the first shield 28 of the cable 12 and the interior surface 18 of the member 14, and between the second shield 32 of the cable 12 and the exterior surface 20 of the member 14, the exterior connector 54 is first removed from its threaded engagement with the tubular insulator 46. The connection between the first shield 28 and the interior surface 18 is accomplished by circumferentially disposing the first shield 28 around the tubular end of the inner connector 36, the tubular insulator 46 being of such a length as to terminate short of the tubular end of the connector 36 to allow such a placing of the first shield 28. A deformable crimp ring 66 is then placed around the first shield 28 at the point where it overlays the inner connector 36, and crimped in conventional fashion into the shield 28 to conductively secure the shield 28 to the inner connector 36. Since the inner connector 36 is electrically common with the flanged end 40, when the flanged end 40 is in conductive engagement with the interior surface 18 of the member 14, the first shield 28 will be electrically connected to the interior surface 18. The second insulating layer 30 is placed over the crimp ring 66 to provide electrical isolation exterior of the crimp ring 66. A cross-sectional view of the relationship of the various components providing the connection of the first shield 28 to the inner connector 36, with the exterior connector 54 in threaded engagement with the tubular insulator 46, may be had by reference to FIG. 2.

An electrical connection between the second shield and the exterior surface 20 of the member 14 is accomplished by cutting away the second shielding 32 so that it will not extend to the crimp ring 66, and placing a deformable crimp ring 68 around the second insulating layer 30 and under the second shield 32. A deformable conductive crimp ring 70 is then placed around the second shield 32 at the point where it surrounds the crimp ring 68, and is crimped into the second shield 32 to conductively engage the shield and to secure the shield between the conductive crimp ring 70 and the crimp ring 68. The exterior connector 54 is then threaded into engagement with the tubular insulator 46 as described above to accomplish an electrical connection between the flanged end 40 and the interior surface 18, and between the flanged end 56 and the exterior surface 20. The crimp ring 68, the second shield 32 and the conductive crimp ring 70 are spaced within the bore 58 of the exterior connector 54 at the end of the connector 54 opposite from the hex-shaped flanged end 56 at this time. A jamnut 72, having a plurality of threads 74 positioned for engagement with the threads 64 of the exterior connector 54, and having an extension 76 for engaging the slope 62 of the connector 54, is threaded into engagement with the connector 54. When the jamnut 72 is threaded into engagement with the exterior connector 54, the extension 76, as it travels along the slope 62 (which is slotted), deflects the end of the connector 54 into engagement with the conductive crimp ring 70, thereby establishing electrical connection between the conductive crimp ring 70 and the exterior connector 54. In this manner an electrical connection is established from the second shield 32, through the conductive crimp ring 70, the exterior connector 54 and the flanged end 56, to the exterior surface 20 of the member 14. This electrical connection is maintained electrically isolated from the electrically common first shield 28, inner connector 36 and interior surface 18, by the second insulating layer 30 and the tubular insulator 46. The first shield 28 has now been electrically connected to the interior surface 18, and the second shield 32 has been electrically connected with the exterior surface 20, of the member 14, with electrical isolation being maintained therebetween.

While one specific embodiment of the invention has been described in detail it will be obvious that various modifications may be made from the specific details described without departing from the spirit and scope of the invention.

What we claim is:

1. A composite connector assembled with an electrically nonconductive member having first and second isolated and electrically conductive surfaces, and a cable having a central conductor, a first layer of insulation surrounding the conductor, a first metal shield concentric with and external of the first layer of insulation, a second layer of insulation concentric with and external of the first shield, and a second metal shield concentric with and external of the second layer of insulation, which comprises:

a first connector member of electrically conductive material having one portion electrically connected to the first metal shield and another portion in electrical contact with the first electrically conductive surface, the first connector member being electrically isolated from the second shield and the second conductive surface;

an insulating member mounted on the first connector member; and

a second connector member of electrically conductive material mounted on the insulating member and being electrically isolated from the first connector member by the insulating member, one portion of the second connector member being electrically connected to the second metal shield and another portion being in electrical contact with the second electrically conductive surface, the second connector member being electrically isolated from the first shield and the first conductive surface.

2. A connector assembly as recited in claim 1, wherein:

the nonconductive member has an aperture extending between the first and the second conductive surfaces;

the first connector member comprises a first tubular cylindrical member having a flange at one end, positioned with the cylindrical member extending through the aperture with the flange is in conductive engagement with the first surface;

the insulating member comprises a cylindrical sleeve circumferentially disposed about a portion of the first cylindrical member and extending through the aperture, so that the first cylindrical member is spaced from the surface defined by the aperture.

3. A connector assembly as recited in claim 2, wherein;

the second connector member comprises a second tubular cylindrical member having a second flange at one end and being circumferentially disposed about the insulating member with the second flange being in conductive engagement with the second surface and the second cylindrical member being spaced from the first by the insulating member.

4. A connector assembly as recited in claim 3, wherein the first shield is circumferentially disposed about a portion of the first cylindrical member; and

wherein the first shield is connected to the first cylindrical body by a first deformable crimp ring surrounding the first shield, and crimped on the first shield securing the first shield in conducting engagement with the first cylindrical member.

5. A connector assembly as recited in claim 4, wherein the second shield is connected to the second cylindrical member by:

a second deformable crimp ring, spaced between the second layer of insulation and the second shield;

a third deformable and conductive crimp ring surrounding the second shield and crimped on the second shield conductively engaging the second shield and confining the second shield between the second and third rings; and

means conductively engaging the third deformable ring and

a portion of the second conductive cylindrical member.

6. A connector assembly as recited in claim 5, wherein the means conductively engaging the third ring and the second conductive cylindrical body comprises:

a jamnut in engagement with the second conductive cylindrical member to deflect a portion of the member into engagement with the third ring.

7. A connector as recited in claim 6, wherein:

the cable is arranged with the central conductors passing through the bore in the first cylindrical member; and

the second cylindrical member is concentric with the first cylindrical member, and has a axial bore throughout its length permitting passage of the central conductors and permitting entry of the first shield, the first insulative layer, the second deformable crimp ring, the second shield, and the third deformable crimp ring into the bore.