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US 5170008 A

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(54) Abstract Title
Cable screen connection method and sleeved cable grommet

(57) A method is provided for EMC screening of a cable connection to an electrical apparatus that includes an enclosure defining an opening for the cable, the enclosure including a conductive internal surface to which a screen of the cable is to be electrically connected. The method comprises (i) folding back a portion of cable screen along the length of the cable; (ii) inserting the cable into a sleeved grommet comprised of a conductive elastomeric material and having an inner surface, the grommet being sized so as to compress the folded back cable portion against the conductive inner surface of the grommet, the grommet further including a circumferential groove in an outer surface thereof sized; and (iii) inserting the grommet into an opening in the enclosure so that the groove holds the grommet in the opening and elastomeric material of the circumferential groove is in contact with the conductive internal surface of the enclosure.

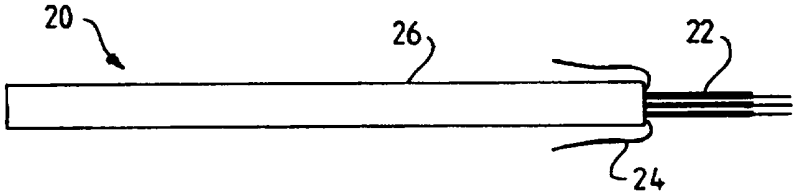

FIG. 2

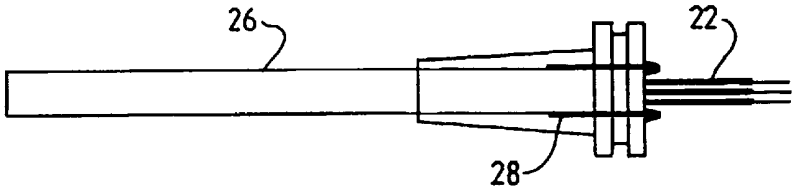

FIG. 3

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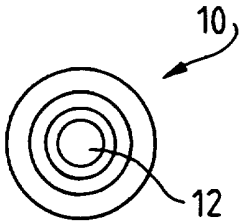

FIG. 1A

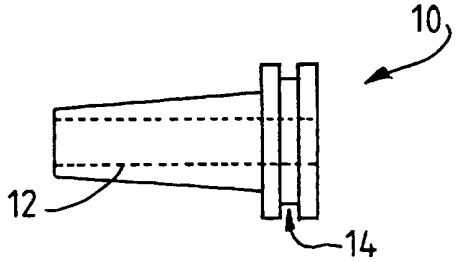

FIG. 1B

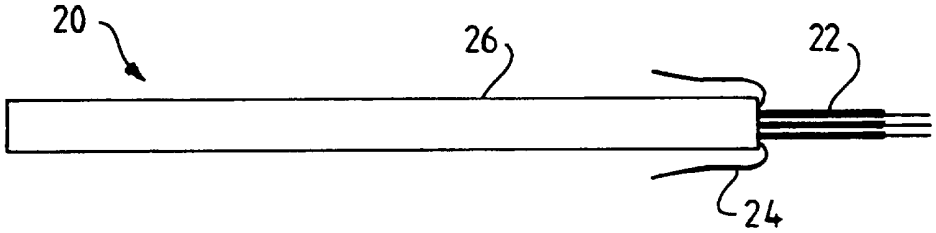

FIG. 2

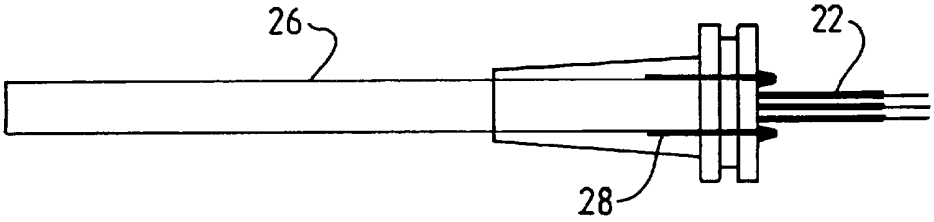

FIG. 3

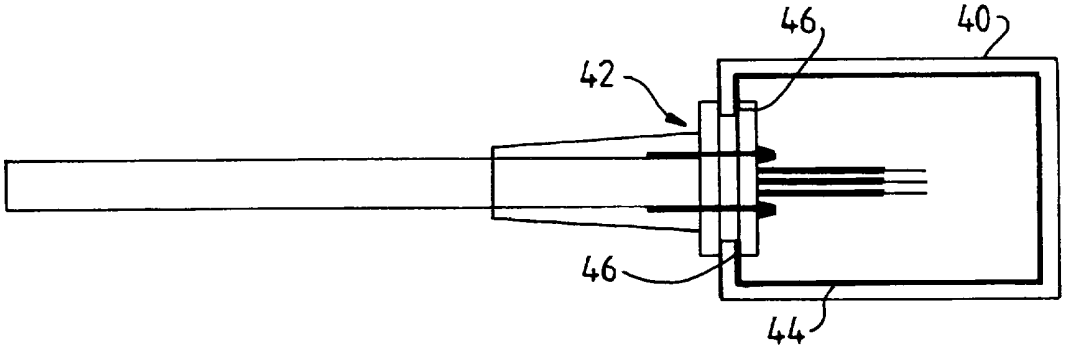

FIG. 4

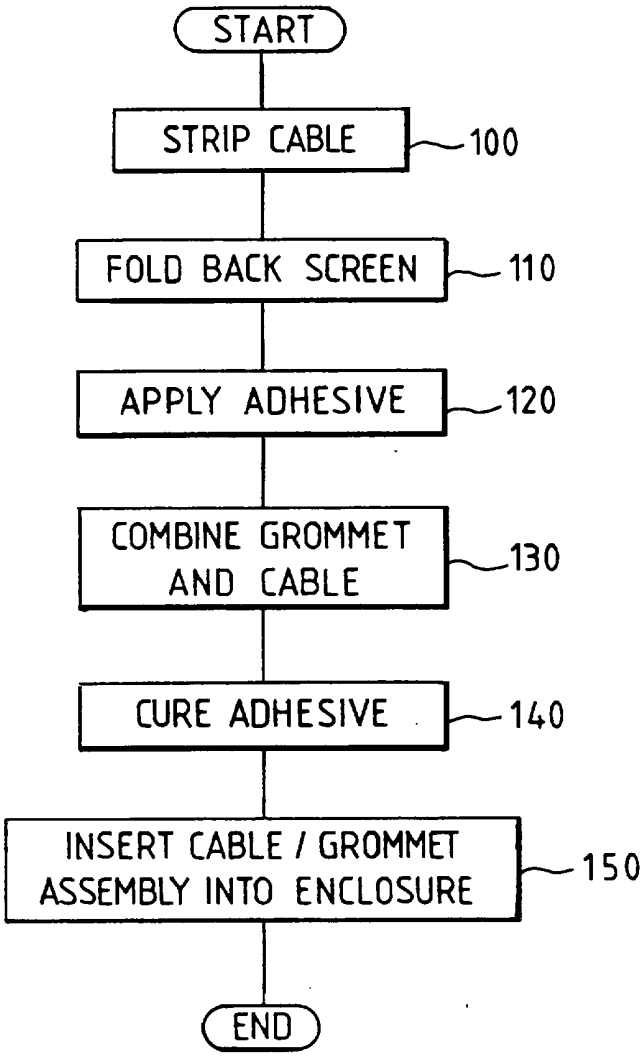
START
STRIP CABLE
100
FOLD BACK SCREEN
110
APPLY ADHESIVE
120
COMBINE GROMMET AND CABLE
130
CURE ADHESIVE
140
INSERT CABLE / GROMMET ASSEMBLY INTO ENCLOSURE
150
END

FIG. 5

CABLE SCREEN CONNECTION METHOD AND SLEEVED CABLE GROMMET

Technical Field of the Invention

The present invention relates generally to the connection of external cables to electrical apparatus and more particularly to a cable screen connection method and sleeved cable grommet for use in such a method.

Background of the Invention

Within electronic products, it is often necessary for equipment to directly connect to cables which then connect to remote equipment. In some applications, it is necessary for the cable to directly pass through the enclosure of the equipment without an intermediate connector and to directly connect to the circuitry within the enclosure. It is often necessary to provide screening for EMC (Electromagnetic Compatibility) performance around both the cable and the enclosure, an example would be using braid or a metallic screen around the cable which then connects to a metallic surface on the inside of the enclosure to provide an overall screen for the equipment.

The conventional solution to the problem of connecting the cable screen to the enclosure screen has been to connect the cable screen onto a printed circuit board, or other electrical connection system, and then to connect onto the enclosure screen through some form of electrical contact. The effectiveness of the screening reduces at high frequencies due to the electrical parasitic components introduced in the connection between the cable screen and the enclosure.

One prior technique is shown in US 5170008 which describes a technique for connecting the braided shielding of a shielded cable to the frame of an EMI shielded metal enclosure by means of a grommet formed of an elastomer which includes a symmetrically formed metal band connecting the shield braid to the enclosure frame.

An improved cable screen connection method would be desirable.

Summary of the Invention

According to a first aspect of the invention there is provided a method for providing EMC screening of a cable connection to an electrical apparatus, the apparatus including an enclosure defining an opening for the cable, the enclosure including a conductive internal surface to which a screen of the cable is to be electrically connected; the method comprising: folding back a portion of cable screen along the cable;

inserting the cable into a sleeved grommet comprised of a conductive elastomeric material and having an inner surface, the grommet being sized so as to compress the folded back cable portion against the conductive inner surface of the grommet, the grommet further including a circumferential groove in an outer surface thereof; and inserting the grommet into an opening in the enclosure so that the groove holds the grommet in the opening and elastomeric material of the circumferential groove is in direct electrical contact with the conductive internal surface of the enclosure.

In a preferred method, a conductive adhesive is applied to the folded back portion of the cable screen prior to insertion of the cable into the grommet. This adhesive provides mechanical securing of the cable to the grommet and improves electrical connection between the cable screen and the grommet.

According to a second aspect of the invention there is provided a sleeved cable grommet for providing EMC screening of a cable connection to an electrical apparatus, the apparatus including an enclosure defining an opening for the cable, the enclosure including a conductive internal surface to which a screen of the cable is to be electrically connected; the grommet being comprised of a conductive elastomeric material and having an inner surface of the sleeve adapted to engage directly with the cable screen when the screen is folded back along the length of the cable, the grommet further including a circumferential groove in the outer surface thereof, sized so as to slot into the opening defined in the enclosure to hold the grommet in the opening and so that conductive elastomeric material of the grommet is in direct electrical connection with the conductive internal surface of the enclosure.

The method and grommet of the present invention provides for a simpler and cheaper cable connection technique as compared to the prior art as exemplified by US 5170008. The grommet of the present invention is so formed that there is no need to provide a metal band as is shown in the aforementioned patent. By avoiding the need for a metal band, this does away with a point of failure in the electrical connection. In addition, as will be apparent from the following description, the invention provides a convenient means of connection to the internal EMC screen of a plastic or other non-conductive equipment enclosure. The grommet of US 5170008 is designed to be used with a metal enclosure.

A wide range of suitable conductive elastomeric materials are available and the material chosen will depend on the electrical environment in which the grommet is used. For computer applications operating with clock rates of several hundred megahertz, a silicone

elastomer with a silver/glass conductive filler has been successfully used.

Thus in the present invention, the cable screen makes connection to a sleeved grommet component which is itself conductive and the grommet makes contact to the screen of the enclosure of the equipment to which the cable is connecting. In this way, a screen is maintained around the complete cable and equipment system which has the capability to be effective at a very high frequencies i.e. greater than 100 MHz.

A preferred embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings.

Brief Description of the Drawings

Figs. 1A and 1B are schematic representations of side and end-on views of a sleeved cable grommet in accordance with the preferred embodiment of the present invention;

Figure 2 shows a cable prior to insertion in the cable grommet of Figures 1A and 1B;

Figure 3 shows a cable/grommet assembly including the cable of Figure 2 inserted into the grommet of Figs. 1A and 1B;

Figure 4 is a schematic representation of the cable/grommet assembly of Figure 3 mounted within the enclosure of an electronic apparatus; and

Figure 5 is a flow diagram of the method steps involved in attaching the cable to the grommet and attaching the cable/grommet assembly to the enclosure.

Detailed Description of the Preferred Embodiment

With reference first to Figures 1A and 1B there is shown a schematic representation of a conductive sleeved grommet 10 in side and end-on views. As can be seen, the grommet is generally conical in shape with a cylindrical central bore 12 extending the length of the grommet. At one end of the grommet there provided an external groove 14 extending circumferentially around the grommet.

The grommet is comprised of a conductive elastomer material and is designed such that the cable screen can be connected through the internal bore of the grommet. A wide range of conductive elastomer materials are

available and the material chosen will depend on the environment in which the grommet is used. The choice of material will also be a trade-off grommet between cost and performance. For computer applications operating with clock rates of several hundred megahertz, a silicone elastomer with a silver/glass conductive filler has been found to be suitable. This material can typically be manufactured with a volume resistivity of 0.01 ohm-cm and a shielding effectiveness of 100 dB at 500 MHz (electric field). The material can be conveniently moulded and it is possible to produce a sleeved grommet of the type shown in Figure 1 at relatively low cost.

With reference to Figures 2 to 5, next will be described the preferred method for securing a cable to the grommet to form a cable/grommet assembly and for attaching the cable assembly to an opening defined in the electrical equipment.

As is shown in Figure 2 and set out in Figure 5, the cable 20 connecting to the equipment is stripped (step 100) such that the internal wires 22 are of the required length and the cable screen 24 is then pulled back over the sheath 26 of the cable and cut to a length which is covered by the sleeve of the grommet (step 110).

A conductive adhesive 28 is used to secure the cable to the grommet and this is applied to the area of the cable screen and sheath that is covered by the grommet sleeve (step 120). There are may suitable conductive adhesives available, a one part adhesive using a silicone binder and silver/glass conductive filler has been found to offer satisfactory electrical and mechanical performance and is convenient to apply in a manufacturing environment. The grommet is then pushed over the end of the cable (step 130) and any excess adhesive is pushed to the end of the grommet where it can be removed prior to curing of the adhesive. The adhesive is then cured (step 140). The cable/grommet assembly so-formed is shown in Figure 3.

The cable/grommet assembly is then installed into the electronic equipment as shown in Figure 4. The equipment includes an enclosure 40 which is provided with an opening 42 for receiving the cable/grommet assembly. The opening is dimensioned such that it compresses the grommet to enable a satisfactory electrical connection to be made around the circumference of the grommet. As is known in the art, the enclosure is made of a non-conductive material such as plastic and is provided with an internal EMC screen 44 which is typically formed of a plated or sprayed conductive finish on the inside of the enclosure.

The cable/grommet assembly is inserted (step 150) into the opening until the groove 14 slots into the opening and holds the assembly in

place whereby the grommet is compressed to provide a tight fit between the grommet and the opening. As is indicated in Figure 4 by reference numeral 46, an electrical connection is provided between the forward wall of the grommet groove and the internal screen of the enclosure. The dimensions of the wall can be chosen to provide the required connective surface area.

It can be seen from Figure 4 that there is provided an effective Faraday screen round the whole of the cable and connecting equipment. By using the elasticity of the grommet material, the grommet can be made to contact a relatively large surface area of the internal screen as compared with other methods of connection such as spring connections. This has the advantage of making the electrical contact more reliable and also reduces the impedance of the connection which can provide improved performance in electromagnetic screening.

The conductive grommet also provides advantages during manufacturing testing. If the internal screen of the enclosure is not accessible externally then, under other methods of connecting the cable screen to the enclosure screen, it would be difficult to ensure that this connection was in place. However with the technique described above, the continuity can easily be measured between the cable screen at the far end of the cable and the grommet itself using a resistance measurement. Since the grommet is in mechanical contact with the enclosure and its internal screen, it follows that the internal screen is connected.

It will be appreciated from the foregoing description that the present invention provides a number of advantages. First, the use of a sleeved conductive grommet allows simple connection between the cable screen and the inside surface of the grommet. Second, the use of conductive elastomer technology allow the production of a low cost, moulded grommet with a high conductivity for screening applications. Third, the grommet of the present invention provides for simpler connection onto the internal plating screen of a non-conductive enclosure.

CLAIMS

1. A method for providing EMC screening of a cable connection to an electrical apparatus, the apparatus including an enclosure defining an opening for the cable, the enclosure including a conductive internal surface to which a screen of the cable is to be electrically connected; the method comprising:

folding back a portion of cable screen along the cable;

inserting the cable into a sleeved grommet comprised of a conductive elastomeric material and having an inner surface, the grommet being sized so as to compress the folded back cable portion against the conductive inner surface of the grommet, the grommet further including a circumferential groove in an outer surface thereof; and

inserting the grommet into an opening in the enclosure so that the groove holds the grommet in the opening and elastomeric material of the circumferential groove is in direct electrical contact with the conductive internal surface of the enclosure.

2. A method as claimed in claim 1, further comprising, prior to inserting the cable into the grommet, applying a conductive adhesive to the folded back portion of the cable screen.

3. A sleeved cable grommet for providing EMC screening of a cable connection to an electrical apparatus, the apparatus including an enclosure defining an opening for the cable, the enclosure including a conductive internal surface to which a screen of the cable is to be electrically connected; the grommet being comprised of a conductive elastomeric material and having an inner surface of the sleeve adapted to engage directly with the cable screen when the screen is folded back along the length of the cable, the grommet further including a circumferential groove in the outer surface thereof, sized so as to slot into the opening defined in the enclosure to hold the grommet in the opening and so that conductive elastomeric material of the grommet is in direct electrical connection with the conductive internal surface of the enclosure.

4. A cable grommet as claimed in claim 3 wherein the conductive elastomer material is comprised of a silicone elastomer with a silver/glass conductive filler.

Application No: GB 9903732.7
Claims searched: 1-4

Examiner: A J RUDGE
Date of search: 17 May 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): H2E(EDD,EDGX,EEMX,EGAC)

Int Cl (Ed.6): H01B-1/20;H01R-3/04;3/06;4/64;F16L-5/00;59/12

Other: Online databases: WPI,EPODOC

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	US 5,170,008 (IBM)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.