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(54) **Conductive fiber composite electrical connector and method of making same**

Elektrischer Verbinder aus leitfähigem Faserstoff und Verfahren zur Herstellung

Connecteur électrique composé de fibres conductrices et méthode de fabrication

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- **PATENT ABSTRACTS OF JAPAN vol. 010, no. 214 (C-362)25 July 1986 & JP-A-61 055 168 (MITSUI PETROCHEM IND.LTD.) 19 March 1986**
- **PATENT ABSTRACTS OF JAPAN vol. 011, no. 039 (M-559)5 February 1987 & JP-A-61 206 628 (UNITIKA LTD.) 12 September 1986**

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EP 0 485 991 B1

Description

The present invention relates to an electrical connector fabricated from a conductive fiber composite material; and more particularly to an electrical connector having nickel-coated graphite fibers in a resin providing increased electro-magnetic interference protection.

Self-locking electrical connector assemblies comprising a multi-part connector shell and a coupling nut are well known in the art.

Specifically, US-A-4,500,153 entitled "Self-Locking Electrical Connector", describes a self-locking electrical connector assembly which incorporates a connector shell and coupling nut and provides a means for keeping a retention ring in a retention groove when the connector is subjected to high vibrational forces. A structure is provided by this device, limiting axial movement of the coupling nut relative to the shell on which the coupling nut is mounted.

The inventive concept of US-A-4 500 153 allows the wave spring to maintain a degree of compression such that the permanent deformation of the wave spring does not provide a loss of resiliency. This connector provides an engagement mechanism preventing loosening of the coupling nut in high vibration environments requiring not only the dimples and the clutch plate as provided by the invention but the simultaneous rotation of the coupling nut.

The electrical connector assembly as disclosed in patent cited above is fabricated using tooled metal. Electrical connectors manufactured from metals incorporate expensive materials, are time-consuming to manufacture and extremely heavy in weight. The machine cutting, grinding, polishing and subsequent lengthy complicated manufacturing process necessary to fabricate the metal electrical connectors produce significant electro-magnetic interference protection, but at high per unit cost.

From document EP-A1-0 318 180 an electrical connector apparatus having a plug and a receptacle has come to be known. The body of each of the plug and receptacle are made of a low conductivity material such as composite. This known apparatus has the capability of safely handling short duration relative high current electrical surges such as those produced by lightning strikes and EMP. This capability is provided by elongated conductive elements associated respectively with each of the plug and receptacle. The elements each define a respective contact region, which region is made when the plug is inserted in the receptacle in a predetermined alignment. The opposite ends of the conductive elements are coupled to the outer conductive jackets of adjacent sections of jacketed cable to which each of the plug and receptacle are electrically coupled.

From document US-A-4,585,686 a two-layer structure molded by using thermoplastic resin has come to be known. Said two-layer structure comprises one layer of thermoplastic resin in which no electroconductive fill-

er is mixed, and the other layer of thermoplastic resin in which electroconductive filler is mixed wherein one or more projections which penetrate said layer are formed on said layer.

The concept of incorporating composite materials into electrical connectors has been utilized in the past. But these composite material connectors have failed to provide adequate shielding from the electro-magnetic interference which emanates from adjacent electrical instruments or other power sources.

It is also well known to incorporate glass fibers in combination with a composite material or resin and then coat the composite material with a metal layer thereby providing increased shielding from electromagnetic interference.

By incorporating a glass fiber and a resinous material and then subjecting the completed composite connector molding to a metallic coating, the conductive aspects of the metallic coating provide some electromagnetic interference protection. Through extended connector use or a high vibration environment, these metallic coatings can be easily chipped or abraded because glass fibers and resinous material do not bond well with the metal coating. The resultant abrasion of the metal coated composite connector material produces "windows" in the metallic coatings which facilitate the connector body causing substantial noise and signal disruption for the leads within the electrical connectors.

Therefore, the technical problem underlying the present invention is to provide a lightweight non-tooled electrical connector assembly having outstanding durability qualities.

This technical problem is solved according to the invention by an electrical connector assembly according to the features set out in claim 1. Furthermore, this problem is also solved by an electrical connector assembly exhibiting the features of claim 9. Dependent claims 2 to 6 exhibit further improvements of the subject-matters of the claims to which they refer back, respectively. Claims 7 and 8 refer to a method of making a shell means of an electrical connector according to claim 1.

The present invention, a conductive fiber, composite, electrical connector having a composite mixture including up to 40% by weight conductive fibers in a resinous substance resolves the problem of electromagnetic leakage while providing a lightweight non-tooled electrical connector having outstanding durability qualities.

The invention provides an electrical connector having a receptacle, wherein this receptacle comprises a composite of up to 40% by weight of conductive fibers and up to 60% by weight of a resin. The electrical connector further contains a plug wherein the plug contains a composite of up to 40% by weight of a conductive fiber and up to 60% by weight of a resin. The receptacle has an alignment means or key, and the plug has an alignment or key which slidably interfits the key or alignment means of the receptacle when the receptacle and plug

are mated. Finally, the electrical connector contains a coupling nut which also comprises a composite of up to 40% by weight conductive fiber and up to 60% by weight of a resin. This coupling nut is operable to lockingly interfit and surround the receptacle and plug when the receptacle and plug are matingly engaged.

An electrical connector having up to 40% by weight of a nickel-coated graphite fiber conductively aligned within a matrix of a up to 60% by weight polyetheretherketone resin is also disclosed.

An electrical connector having up to 40% by weight of a conductive graphite fiber conductively aligned within a liquid crystal polymer resin up to 60% by weight is disclosed.

A method of fabrication for an electrical connector having a high fiber, conductive composition shell is disclosed.

A method of fabrication for an electrical connector having a receptacle, plug and coupling nut all comprising a conductive fiber composite mixture of conductive fibers within a resin is disclosed.

Finally, a molding fabrication process involving a multi-part mold and center-loaded sprue for the electrical connector having a conductive fiber composite matrix is also disclosed.

The invention will now be described by way of example with reference to the accompanying drawings in which:

FIGURE 1 is an exploded perspective view of the conductive fiber composite electrical connector having a receptacle, a plug and a self-locking coupling nut;

FIGURE 2 is a partial cross sectional view of the assembled plug and coupling ring of the conductive fiber composite electrical connector;

FIGURE 3 is a schematic representation cross sectional view taken along line 3-3 of the assembly of Figure 2;

FIGURE 4 is a schematic representation cross sectional view of the alignment means and flat spring interlocking the receptacle and plug and coupling nut;

FIGURE 5 is a partial cross sectional view of the conductive fiber composite connector second shell;

FIGURE 5A is a top plan view of the conductive fiber composite connector second shell;

FIGURE 6 is a partial cross sectional view of the conductive fiber composite connector first shell; and

FIGURE 6A is a top plan view of the conductive fiber composite connector first shell.

The invention is an electrical connector fabricated from a conductive fiber composite mixture of up to 40% by weight conductive fiber such as nickel-coated graphite fiber, non-coated graphite fiber and stainless steel in up to 60% of a resin such as polyetheretherketone or

liquid crystal polymer. In one embodiment, the nickel-coated graphite fibers are aligned and fully interconnected as suspended within the mixture to maintain their conductive nature and to provide an electro-magnetic "shield" operable to prevent electro-magnetic leakage around the mated pins within the inserts of the receptacle and plug.

The conductive particles, in this example nickel-coated graphite fibers, produce a smooth surface molded connector after molding. The molded composite connector is then plated by metals such as nickel and copper to further enhance the electro-magnetic leakage protection capability of this improved lightweight connector. Abrasions on the plated connector will not facilitate electro-magnetic leakage of the transmitted electrical signals. The alignment of the nickel-plated graphite conductive fibers within the mixture also serve as a backup electro-magnetic leakage "shield".

A fabrication process incorporating a multi-part mold and a center-loaded sprue, where the up to 40% by weight conductive fiber composition is center injected within the mold to individually produce the receptacle, plug and coupling nut is also described.

Figure 1 is an exploded perspective view of the conductive fiber composite electrical connector having a receptacle 12, plug 16 and self-locking coupling nut 14. The composite connector 10 has a receptacle 12 which has a receptacle top 13 and a receptacle bottom 15. This receptacle 12 contains a dielectric first insert 18 within the interior surface 52 of the receptacle 12. Alignment means 30 is inscribed within the interior surface 52 of the receptacle 12. An annular surface 50 is formed surrounding the top 13 of the receptacle 12. This annular surface 50 is operable to matingly engage and seal with the plug during mating. A first threaded portion 32 is operable to interlock with the coupling nut 14. A flange portion 46 on the receptacle 12 may be operably mounted to a wall by orifices 48 such that the bottom 33 of the connector 10 would appear on the opposing portion of the wall so that the bottom 15 would be operable to contain the pins within the insert 18 of the receptacle 12.

As further seen in Figure 1, a coupling nut 14 has an interior threaded portion 42 and an exterior portion 36. The interior surface 38 of the coupling nut 14 includes an engagement flange 40 which has a multiplicity of ratchet retaining means 39 inscribed within the annular circumference of the interior surface 38 of the coupling nut 14.

Each ratchet retaining means 39 comprises a pair of slanted surfaces with one surface extending from the engagement flange 40 at an angle of approximately 50° and the second slanted surface extending from the engagement flange 40 at an angle of approximately 10°. The ratchet retaining means 41 engage rounded bars extending from the surface of the engagement plate (not shown here) to inhibit, but not prevent, rotational movement of the coupling nut 14 in one direction, while allowing relatively uninhibited rotational movement of the

coupling nut in the opposing direction.

The interior threaded portion 42 of coupling nut 14 is operable to interlock with the receptacle 12 first threaded means 32. An annular flange 44 is cooperable with retention spring 26 behind shoulder 35 of the plug 16 for retention of ring 14 to plug 16. A multiplicity of protrusions or dimples 56 are evenly interspersed upon the surface of the locking ring 14 providing a means to manipulate the coupling nut 14 so that it interfits over and locks the mated receptacle 12 and plug 16. These protrusions 56 may be spaced regularly about the surface 36 of the coupling nut 14.

As shown in Figure 1, a wave spring 22 is operable while resting upon the surface of the plug 16 to compress against a rearwardly facing interior flange 45 of the coupling nut 14 to interlock the receptacle and plug, 12 and 16, respectively. A flat spring 29 as shown in Figure 1 rests upon the wave spring 22 encircling the plug 16 and is compressible to assist in maintaining zero distance between the mated receptacle 12 and plug 16 upon mating. A key fitting 24 fabricated of, for example, fiberglass is mounted between springs 22 and 29 to further enhance the locking capability of the wave spring, with key member 25 interfitting within the key ways cut within the shoulder 35 of the plug 16.

A second insert 20 and a third insert 21 (Figure 2) are mounted within the plug 16 and are operable to retain within metal sleeves the individual pins from the receptacle which serve as the mating interconnects for the electrical connector 10. The neck 17 of the plug 16 supports a retaining spring 26 which is further operable to interlock the receptacle 12, plug 16 and coupling nut 14.

The electrical connector 10 as shown in Figure 1 contains composite material parts such as the receptacle 12, plug 16 and coupling nut 14 which are not metal and tooled to specific configurations. The molded composite material containing by weight of at least 10% and up to 40% of a conductive fiber, in this instance nickel-plated graphite, produces a connector 10 having an extreme light weight but also durability. Alternative fiber fillers include but are not limited to stainless steel or non-plated graphite fibers. Due to its conductive properties, outstanding electro-magnetic interference protection for the electrical signals transmitted through the pins within the various inserts is provided.

In Figure 1, in this example, the wave spring 22, the retaining ring 26 and the flat spring 29, are metal and the key fitting 24 is a fiberglass material. These and the dielectric inserts are the only elements of the conductive composite connector 10 that are not composite materials. The composite materials from which the receptacle 12 and the plug 16 and coupling nut 14 are fabricated are further protected through the layering of electrically conductive metals which enhance the electromagnetic protection capability of this device.

Figure 2 is a partial cross sectional view of the conductive fiber composite electrical connector plug 16 and coupling nut 14 having cross section 3-3.

A cross sectional view about line 3-3 of Figure 2, through the surface of the coupling nut 14, illustrates the layers of conductive material used to protect the composite material composed of up to 40% by weight conductive fibers in a resin material. As is shown in Figure 3, coupling nut 14 has the composite layer 60 which further comprises by weight of up to 60% of a resin 62 which for this example is polyetheretherketone and conductive fibers 64. An alternative example includes liquid crystal polymer as a bonding resin.

For this example, in Figure 3, the conductive fibers 64 are nickel-coated graphite wherein the individual graphite fibers 64 are interconnected and aligned such that their conductive nature is maintained throughout the body of the composite material shell. A first conductive coating of copper 66 is deposited upon the smooth surface of the composite layer 60 using a standard deposition process of metal on a non-metal connector. A second coating of, for example, a nickel layer 68 is then deposited upon the first conductive coating of copper. Subsequent successive coatings such as a third conductive coating 70 of copper and a fourth conductive coating 72 of nickel are made and further enhance the electromagnetic interference capability of the composite connector as shown through the example of the coupling nut 14.

The nature of the conductive composite material and layered conductive depositions upon the surface of the connector provide a barrier to stray electromagnetic leakage which may surround the connector from, for example, extraneous power sources. The composite connector 10 maintains the integrity of the signals passing through the receptacle 12 into the plug 16 as surrounded by the coupling nut 14.

Figure 4 is a schematic representation cross section view of the conductive fiber composite connector 10 showing the alignment means and such as the master key 28 and other individual keys 28' as they are extended upon the exterior surface of the plug 16. As shown here in cross section, the plug 16 slidably interfits within the receptacle 12 and in turn the mated portions are surrounded by the coupling nut 14 which lockingly interfits after alignment due to the position of the various keys 28, 28' including the master key 28 as shown. Also shown (see Fig. 2) is spring 22 which engages shoulder 35 of plug 16 beneath the flange 45 of ring 14.

Figure 5 is a partial cross sectional view of the conductive fiber composite connector second shell 16 immediately after removal from a multi-part mold. The multi-part mold having a top core, bottom core and two cavity halves, incorporates a center loaded sprue through the top or bottom cores. Composite material injected into the multi-part mold through the sprue will produce webs which are removed after molding using a drill, or a single point tool and a lathe. The web 41 formed within the cavity of the second shell 16 does not facilitate EMI leakage because the position of the web is beneath inserts added to the second shell 16.

Figure 5A is a top plan view of the conductive fiber composite connector second shell 16 immediately after removal from a multi-part mold. The web 41 formed from the center-loaded sprue resides beneath any insert that is added after shell fabrication. The center loaded molding of the second shell 16 reduces EMI leakage which occurs due to side injection molding which causes a deformation upon the exterior surfaces of the second shell 16.

Figure 6 is a partial cross sectional view of the conductive fiber composite connector first shell 12 immediately after removal from a multi-part mold. The first shell 12 is fabricated in a manner not unlike the second shell 16. The multi-part mold includes a top core, bottom core and at least two cavity halves, which when locked together form the entire first shell 12 in negative. A center loaded sprue within the top or the bottom core injects composite material without forming excess material upon the exterior surfaces of the first shell 12. Web 43 forms within the body of the first shell 12. Removal of this web 43 using a drill, or single point tool while the first shell 12 turns on a lathe, will not affect the texture and EMI permeability of the exterior surface of the first shell 12.

Figure 6A is a top plan view of the conductive fiber composite connector first shell 12 immediately after removal from a multi-part mold as previously described. The web 43 formed within the cavity of the shell 12 is removed prior to the incorporation of an insert. Removal of the excess composite material in the form of web 43 does not affect the exterior surface of the first shell 12.

This multi-part mold incorporating a center-loaded sprue eliminates the possibility of "flash", web or excess composite material occurring upon the exterior surfaces or the mating interior surfaces of the entire connector 10.

Excess conductive composite material or a lack of conductive composite material on an exterior surface of the receptacle 12, plug 16 or coupling nut 14, facilitates an air gap between the matingly engaged connector shells admitting the electromagnetic leakage of signals through the connector 10. Electromagnetic signal leakage into the connector occurs due to, for example, power sources or electronic devices exterior to the connector. A center-loaded molded sprue fabrication method, produces a receptacle where the only web or "flash" occurs on the center of the receptacle beneath the after applied insert. The receptacle is machined out and excess composite material is removed from underneath the body of the insert where no leakage is likely to occur.

As shown in Figures 5, 5A, 6 and 6A, after the composite material is center-loaded and injected into the multi-part mold and the mold is removed, any additional material or excess flash is removed from the completed connector parts. A series of depositions of conductive material on the composite connector facilitate increased EMI protection.

Claims

1. An electrical connector assembly (10) of the type having a plug and a receptacle;
 - a) said plug and said receptacle being matable and securable by securing means (14) to each other,
 - b) each of them housing a plurality of electrical contacts within dielectric means (18, 20, 21), and
 - c) the plug and receptacle including shell means (12, 16) about and containing therein the dielectric means (18, 20, 21) adapted for shielding the signals transmitted through the connector assembly from electromagnetic interference,

characterized in that:

 - d) each said shell means is a shell member (12, 16) moulded of composite material (60) of at least 10% and not more than 40% by weight conductive fiber (64) and at least 60% and not more than 90% by weight of a resin (62).
2. An electrical connector assembly (10) as set forth in claim 1 characterized in that said conductive fibers (64) are selected from the group comprising nickel-plated graphite, non-plated graphite, and stainless steel.
3. An electrical connector assembly (10) as set forth in either of claims 1 and 2 characterized in that said resin (62) is selected from the group comprising polyetheretherketone and liquid crystal polymer resins.
4. An electrical connector assembly (10) as set forth in any of claims 1 to 3 characterized in that said shell means comprises at least one layer (66,68,70,72) of electrically conductive material deposited thereover.
5. An electrical connector assembly (10) as set forth in any of claims 1 to 4 characterized in that said shell means comprises a first conductive layer (66) of copper deposited thereover, a second conductive layer (68) of nickel deposited upon said first conductive layer, a third conductive layer (70) of copper deposited upon said second conductive layer, and a fourth conductive layer (72) of nickel deposited upon said third conductive layer.
6. An electrical connector assembly (10) as set forth in any of claims 1 to 5 characterized in that said securing means comprises a coupling nut (14) molded of composite material (60) of at least 10% and not more than 40% by weight conductive fiber (64) and

at least 60% and not more than 90% by weight of a resin (62), and said coupling nut includes a first conductive layer (66) of copper deposited thereover, a second conductive layer (68) of nickel deposited upon said first conductive layer, a third conductive layer (70) of copper deposited upon said second conductive layer, and a fourth conductive layer (72) of nickel deposited upon said third conductive layer.

7. A method of producing a shell means of an electrical connector as set forth in claim 1 comprising the steps of:

molding a shell member comprising a composite material (60) of approximately 10% to 40% by weight conductive fiber (64) and of approximately 60% to 90% by weight of a resin (62) in a multi-part mold incorporating a center-loaded sprue whereby radially outer surfaces of said shell member (12,16) are smooth; and removing excess composite material (41,43) from the interior surfaces of said shell member (12,16) to define an insert-receiving cavity.

8. A method of producing a shell means of an electrical connector as set forth in claim 7 comprising the further step of:

depositing at least one conductive layer (66,68,70,72) of material thereupon.

9. An electrical connector assembly (10)

a) having a plug and a receptacle matable at a mating interface defined along interior surfaces of the receptacle and exterior surfaces of the plug proximate the mating faces thereof and securable by securing means (14) to each other, b) each housing a plurality of electrical contacts within dielectric means (18,20,21), and the plug and receptacle including shell means (12,16) surrounding and containing therein the dielectric means (18,20,21) adapted for shielding the signals transmitted through the connector assembly from electromagnetic interference,

characterized in that

c) said shell means comprises a shell member (12,16) for each of said plug and receptacle molded of composite material (60) of at least 10 % and not more than 40 % by weight conductive fiber (64) and at least 60 % and not more than 90 % by weight of a resin (62), and d) at least one layer (66,68,70,72) of electrically conductive material deposited thereover upon at least said interior and exterior surface, e) defining interfitted surfaces free of irregularities and providing an effective electromagnetic

interference shield at said mating interface.

Patentansprüche

1. Elektrische Verbinderanordnung (10) des Typs mit einem Steckerelement und einem Buchsenelement;

a) wobei das Steckerelement und das Buchsenelement miteinander verbindbar und durch eine Befestigungseinrichtung (14) aneinander befestigbar sind,

b) wobei in jedem der Elemente eine Anzahl elektrischer Kontakte innerhalb einer dielektrischen Einrichtung (18, 20, 21) untergebracht ist, und

c) wobei das Steckerelement und das Buchsenelement Manteleinrichtungen (12, 16) aufweisen, die um die dielektrischen Einrichtungen (18, 20, 21) herum vorgesehen sind und diese enthalten sowie dazu ausgelegt sind, die durch die Verbinderanordnung hindurch übertragenen Signale gegen elektromagnetische Interferenz abzuschirmen,

dadurch gekennzeichnet,

d) daß es sich bei jeder der Manteleinrichtungen um ein Mantelelement (12, 16) handelt, das aus Verbundmaterial (60) aus wenigstens 10 Gew.-% und nicht mehr als 40 Gew.-% leitfähigem Fasermaterial (64) und wenigstens 60 Gew.-% und nicht mehr als 90 Gew.-% Harz (62) geformt ist.

2. Elektrische Verbinderanordnung (10) nach Anspruch 1,

dadurch gekennzeichnet,

daß die leitfähigen Fasern (64) aus der Gruppe bestehend aus nickelplattiertem Graphit, nichtplattiertem Graphit und nicht-rostendem Stahl ausgewählt sind.

3. Elektrische Verbinderanordnung (10) nach einem der Ansprüche 1 und 2,

dadurch gekennzeichnet,

daß das Harz (62) aus der Gruppe bestehend aus Polyetheretherketon und Flüssigkristallpolymerharzen ausgewählt ist.

4. Elektrische Verbinderanordnung (10) nach einem der Ansprüche 1 bis 3,

dadurch gekennzeichnet,

daß die Manteleinrichtung wenigstens eine darüber aufgebrachte Schicht (66, 68, 70, 72) aus elektrisch leitfähigem Material aufweist.

5. Elektrische Verbinderanordnung (10) nach einem der Ansprüche 1 bis 4,
dadurch gekennzeichnet,
 daß die Manteleinrichtung eine erste darüber auf-
 gebrachte, leitfähige Schicht (66) aus Kupfer, eine
 auf der ersten leitfähigen Schicht aufgebrachte
 zweite leitfähige Schicht (68) aus Nickel, eine auf
 der zweiten leitfähigen Schicht aufgebrachte dritte
 leitfähige Schicht (70) aus Kupfer sowie eine auf der
 dritten leitfähigen Schicht aufgebrachte vierte leit-
 fähige Schicht (72) aus Nickel aufweist. 5
6. Elektrische Verbinderanordnung (10) nach einem
 der Ansprüche 1 bis 5,
dadurch gekennzeichnet,
 daß die Befestigungseinrichtung eine Kopplungs-
 mutter (14) aufweist, die aus einem Verbundmate-
 rial (60) aus wenigstens 10 Gew.-% und nicht mehr
 als 40 Gew.-% Fasermaterial (64) und wenigstens
 60 Gew.-% und nicht mehr als 90 Gew.-% eines
 Harzmaterials (62) geformt ist, und daß die Kopp-
 lungsmutter eine darauf aufgebrachte erste leitfä-
 hige Schicht (66) aus Kupfer, eine auf der ersten leit-
 fähigen Schicht aufgebrachte zweite leitfähige
 Schicht (68) aus Nickel, eine auf der zweiten leitfä-
 higen Schicht aufgebrachte dritte leitfähige Schicht
 (70) aus Kupfer sowie eine auf der dritten leitfä-
 higen Schicht aufgebrachte vierte leitfähige Schicht
 (72) aus Nickel aufweist. 10 15 20 25 30
7. Verfahren zum Herstellen einer Manteleinrichtung
 eines elektrischen Verbinders nach Anspruch 1,
 wobei das Verfahren folgende Schritte umfaßt:
- Formen eines Mantelelements, das ein Ver-
 bundmaterial (60) aus ca. 10 Gew.-% bis 40
 Gew.-% leitfähigem Fasermaterial (64) und ca.
 60 Gew.-% bis 90 Gew.-% eines Harzmaterials
 (62) aufweist, in einer mehrteiligen Form, in die
 ein in der Mitte eingebrachter Eingußkanal inte-
 griert ist, wodurch radial äußere Oberflächen
 des Mantelelements (12, 16) glatt ausgebildet
 werden; und 35 40
- Entfernen von überschüssigem Verbundmate-
 rial (41, 43) von den Innenflächen des Mantel-
 elements (12, 16) zur Bildung eines Einsatzauf-
 nahmehohlraums. 45
8. Verfahren zum Herstellen einer Manteleinrichtung
 eines elektrischen Verbinders nach Anspruch 7,
 wobei das Verfahren den weiteren Schritt einer Auf-
 bringung wenigstens einer leitfähigen Material-
 schicht (66, 68, 70, 72) darauf beinhaltet. 50
9. Elektrische Verbinderanordnung (10)
 a) mit einem Steckerelement und einem Buch-

senelement, die an einer Verbindungsgrenzflä-
 che verbindbar sind, die entlang von Innenflä-
 chen des Buchsenelements und Außenflächen
 des Steckerelements in der Nähe der Verbind-
 ungsseiten derselben gebildet ist, wobei das
 Steckerelement und das Buchsenelement
 durch eine Befestigungseinrichtung (14) anein-
 ander befestigbar sind,

b) wobei in jedem der Elemente eine Vielzahl
 elektrischer Kontakte innerhalb einer dielektri-
 schen Einrichtung (18, 20, 21) untergebracht ist
 und das Steckerelement und das Buchsenele-
 ment eine Manteleinrichtung (12, 16) aufwei-
 sen, die die dielektrische Einrichtung (18, 20,
 21) umgibt und diese enthält und dazu ausge-
 legt ist, die durch die Verbinderanordnung
 übertragenen Signale vor elektromagnetischer
 Interferenz zu schützen,

dadurch gekennzeichnet,

c) daß die Manteleinrichtung ein Mantelele-
 ment (12, 16) aufweist, das sowohl für das
 Steckerelement als auch für das Buchsenele-
 ment vorgesehen ist und aus einem Verbund-
 material (60) aus wenigstens 10 Gew.-% und
 nicht mehr als 40 Gew.-% leitfähigem Faserma-
 terial (64) und wenigstens 60 Gew.-% und nicht
 mehr als 90 Gew.-% eines Harzmaterials (62)
 geformt ist, und

d) daß wenigstens eine Schicht (66, 68, 70, 72)
 aus elektrisch leitfähigem Material wenigstens
 auf der Innenfläche und der Außenfläche dar-
 über aufgebracht ist,

e) wodurch ineinander passende Flächen ge-
 bildet sind, die frei sind von Unregelmäßigkei-
 ten und eine wirksame Abschirmung gegen
 elektromagnetische Interferenz an der Verbind-
 ungsgrenzfläche schaffen.

Revendications

1. Assemblage (10) de connecteur électrique du type
 ayant une fiche et une douille ;
- a) ladite fiche et ladite douille pouvant être ac-
 couplées et fixées entre elles par des moyens
 de fixation (14),
 b) chacune d'elles logeant plusieurs contacts
 électriques à l'intérieur de moyens diélectri-
 ques (18, 20, 21), et
 c) la fiche et la douille comprenant des moyens
 à coques (12, 16) qui entourent et contiennent
 les moyens diélectriques (18, 20, 21) et qui sont

destinés à protéger des parasites électromagnétiques les signaux transmis par l'assemblage de connecteur,

caractérisé en ce que :

d) chacun desdits moyens à coque est un élément de coque (12, 16) moulé en matière composite (60) formée d'au moins 10 % et pas plus de 40 % en poids d'une fibre conductrice (64) et d'au moins 60 % et pas plus de 90 % en poids d'une résine (62).

2. Assemblage de connecteur électrique (10) selon la revendication 1, caractérisé en ce que lesdites fibres conductrices (64) sont choisies dans le groupe comprenant du graphite plaqué de nickel, du graphite non plaqué et de l'acier inoxydable.

3. Assemblage de connecteur électrique (10) selon l'une des revendications 1 et 2, caractérisé en ce que ladite résine (62) est choisie dans le groupe comprenant des résines du type polyétheréthercétone et du type polymère à cristaux liquides.

4. Assemblage de connecteur électrique (10) selon l'une quelconque des revendications 1 à 3, caractérisé en ce que lesdits moyens à coques comprennent au moins une couche (66, 68, 70, 72) d'une matière électriquement conductrice déposée sur eux.

5. Assemblage de connecteur électrique (10) selon l'une quelconque des revendications 1 à 4, caractérisé en ce que lesdits moyens à coques comprennent une première couche conductrice (66) de cuivre déposée sur eux, une deuxième couche conductrice (68) de nickel déposée sur ladite première couche conductrice, une troisième couche conductrice (70) de cuivre déposée sur ladite deuxième couche conductrice, et une quatrième couche conductrice (72) de nickel déposée sur ladite troisième couche conductrice.

6. Assemblage de connecteur électrique (10) selon l'une quelconque des revendications 1 à 5, caractérisé en ce que lesdits moyens de fixation comprennent un écrou (14) d'accouplement moulé en matière composite (60) formée d'au moins 10 % et pas plus de 40 % en poids d'une fibre conductrice (64) et d'au moins 60 % et pas plus de 90 % en poids d'une résine (62), et ledit écrou d'accouplement comprend une première couche conductrice (66) de cuivre déposée sur lui, une deuxième couche conductrice (68) de nickel déposée sur ladite première couche conductrice, une troisième couche conductrice (70) de cuivre déposée sur ladite deuxième couche conductrice, et une quatrième couche conductrice (72) de nickel déposée sur ladite troisième couche conductrice.

7. Procédé de production d'un moyen à coque d'un connecteur électrique selon la revendication 1, comprenant les étapes dans lesquelles :

on moule un élément de coque comprenant une matière composite (60) formée d'environ 10 % à 40 % en poids d'une fibre conductrice (64) et d'environ 60 % à 90 % en poids d'une résine (62) dans un moule à pièces multiples comprenant une carotte chargée centralement de façon que des surfaces radialement extérieures dudit élément de coque (12, 16) soient lisses ; et
on enlève la matière composite excédentaire (41, 43) des surfaces intérieures dudit élément de coque (12, 16) pour définir une cavité de réception d'un prisonnier.

8. Procédé de production d'un moyen à coque d'un connecteur électrique selon la revendication 7, comprenant encore l'étape dans laquelle :

on dépose au moins une couche conductrice (66, 68, 70, 72) de matière sur ce moyen.

9. Assemblage de connecteur électrique (10)

a) ayant une fiche et une douille pouvant être accouplées à une interface d'accouplement définie le long de surfaces intérieures de la douille et de surfaces extérieures de la fiche à proximité de leurs faces d'accouplement et pouvant être fixées l'une à l'autre par des moyens de fixation (14),

b) chacune d'elles logeant plusieurs contacts électriques à l'intérieur de moyens diélectriques (18, 20, 21), et la fiche et la douille comprenant des moyens à coques (12, 16) entourant et contenant les moyens diélectriques (18, 20, 21) et destinés à protéger des parasites électromagnétiques les signaux transmis à travers l'assemblage de connecteur,

caractérisé en ce que

c) lesdits moyens à coques comprennent un élément de coque (12, 16) pour chacune desdites fiche et douille, moulé en une matière composite (60) formée d'au moins 10 % et pas plus de 40 % en poids d'une fibre conductrice (64) et d'au moins 60 % et pas plus de 90 % en poids d'une résine (62), et

d) au moins une couche (66, 68, 70, 72) de matière électriquement conductrice déposée sur eux, au moins sur lesdites surfaces intérieures et extérieures,

e) définissant des surfaces d'assemblage sans irrégularité et constituant un blindage efficace contre les parasites électromagnétiques à ladi-

te interface d'accouplement.

5

10

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25

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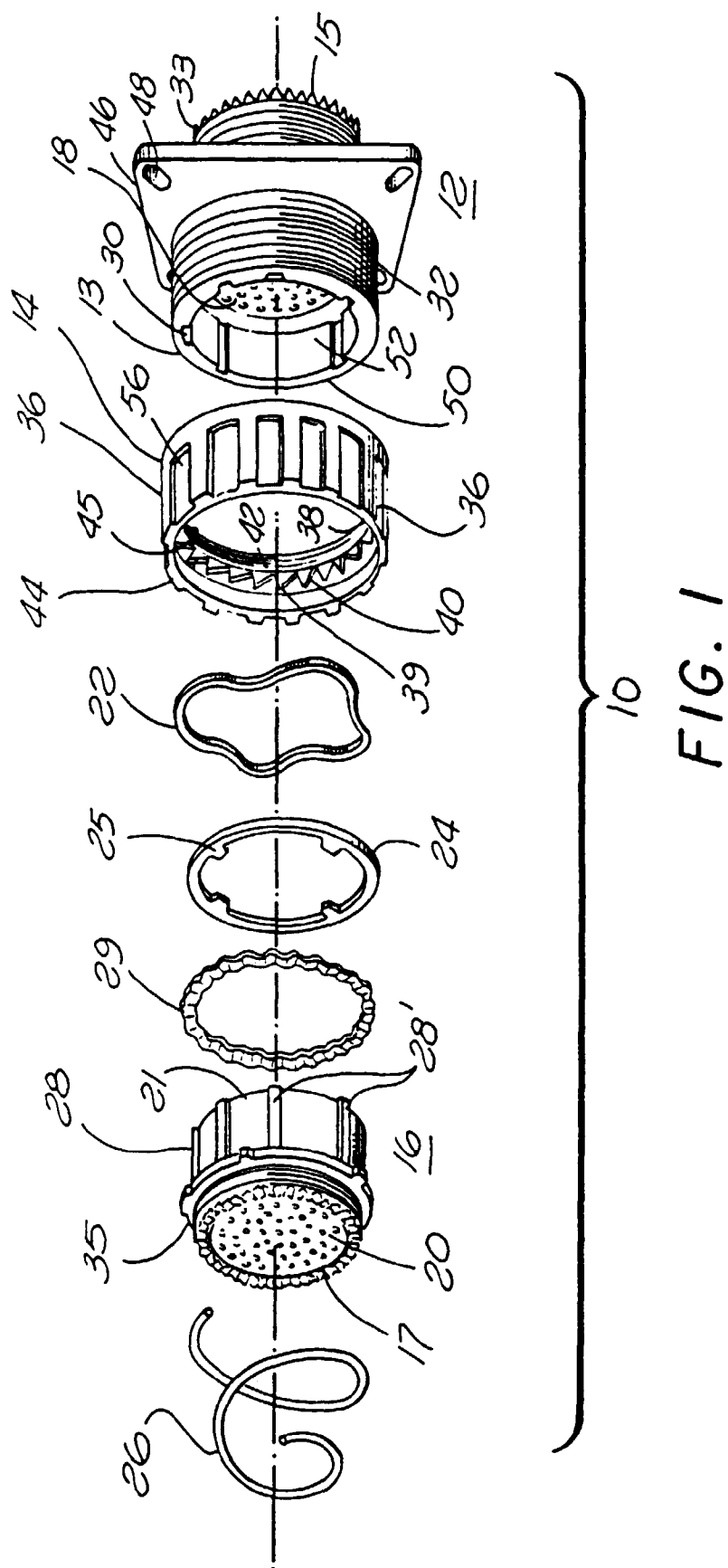
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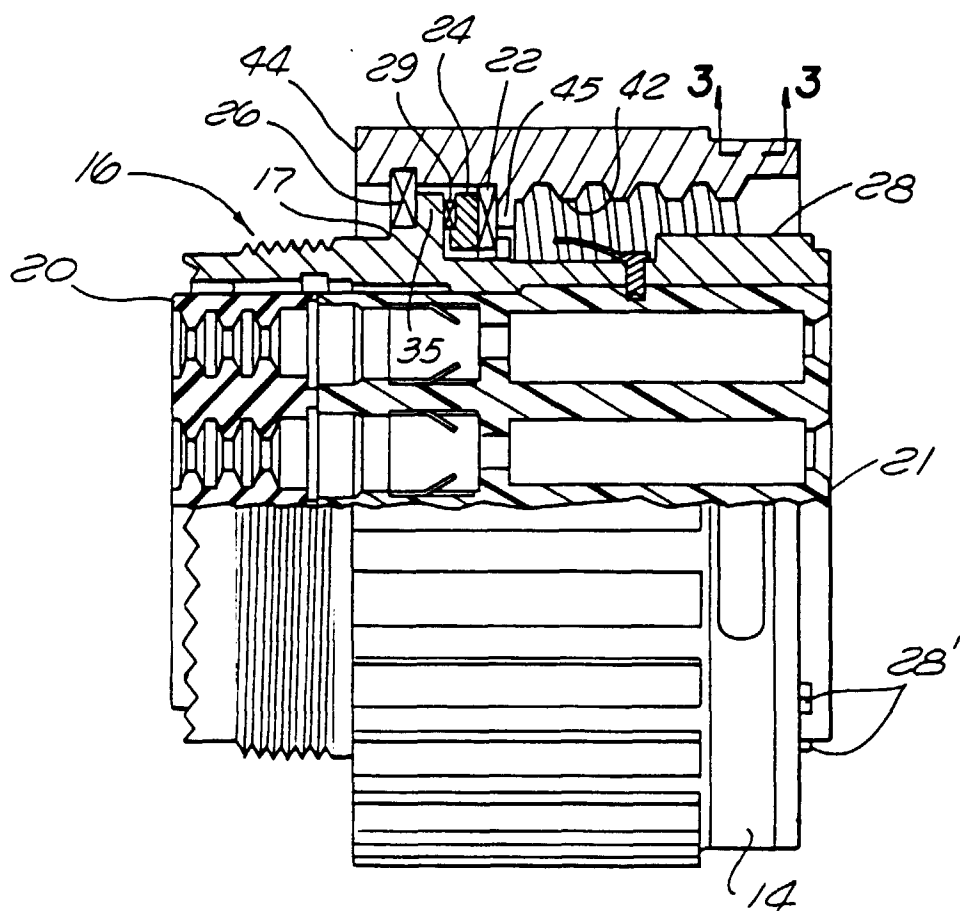


FIG. 2

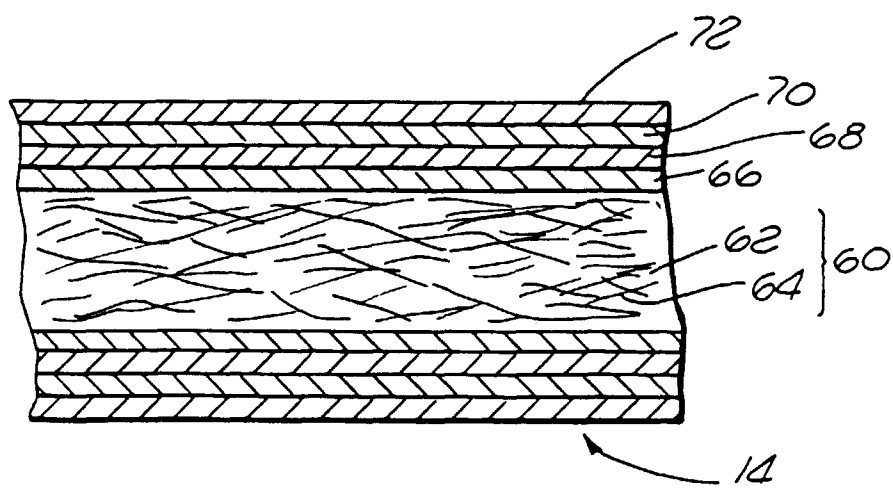


FIG. 3

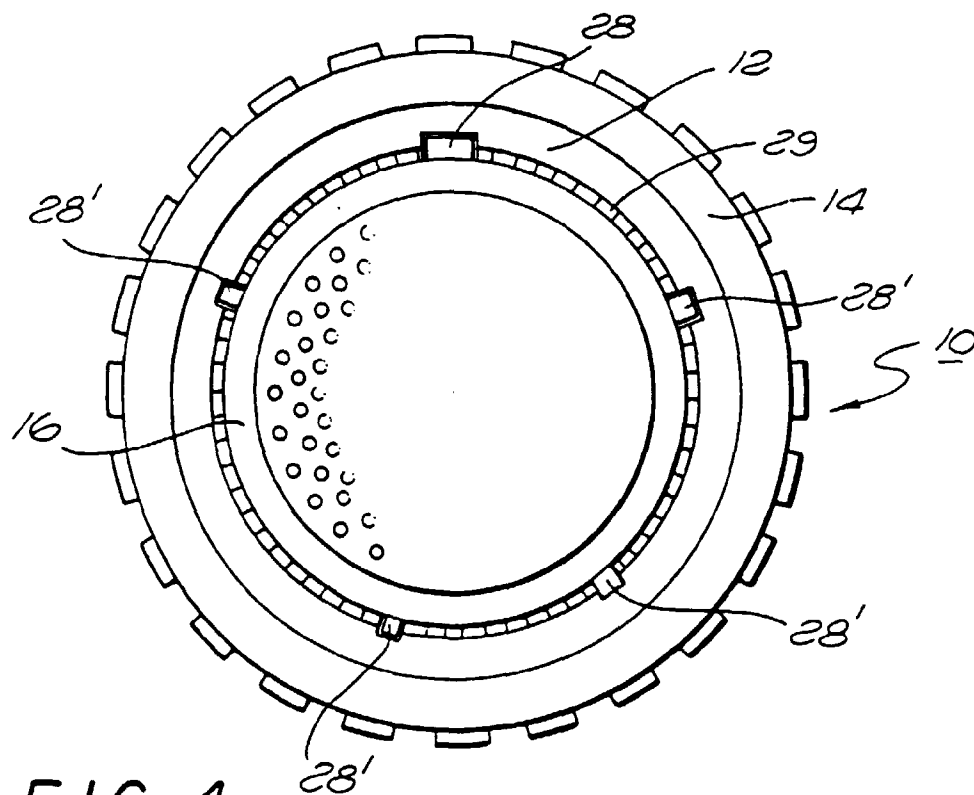


FIG. 4

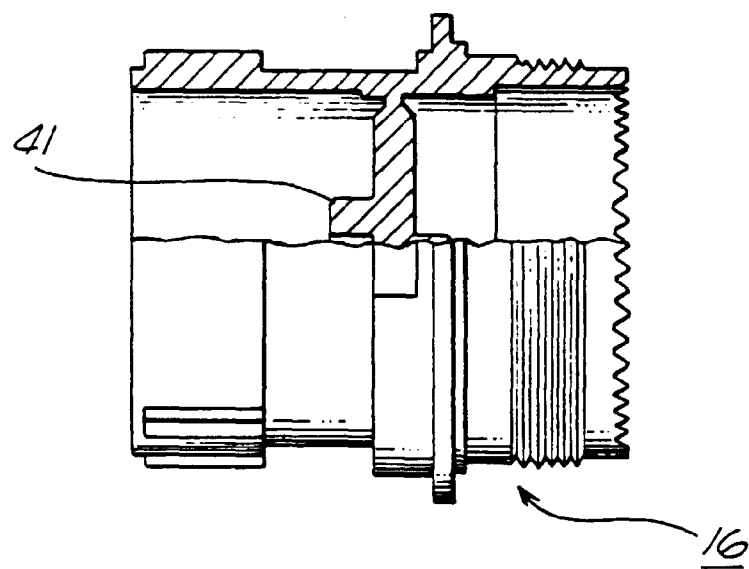


FIG. 5

FIG. 5A

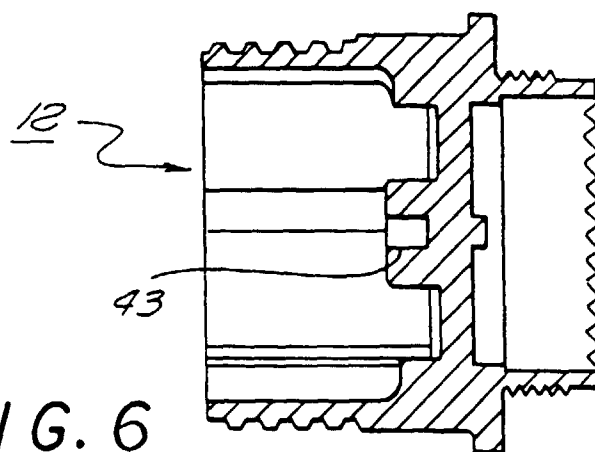
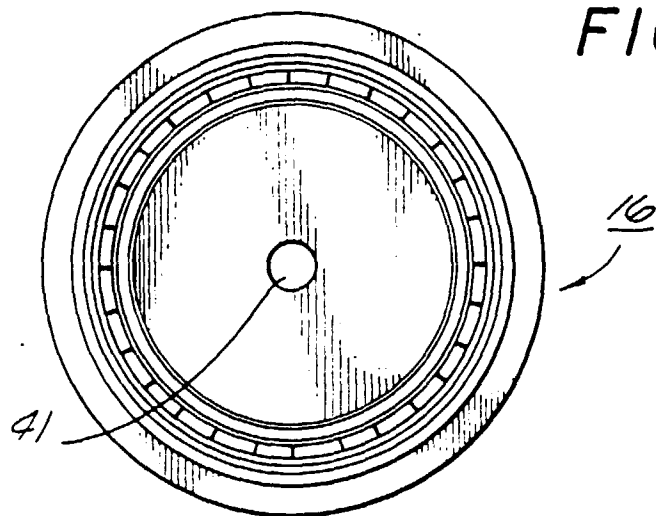


FIG. 6

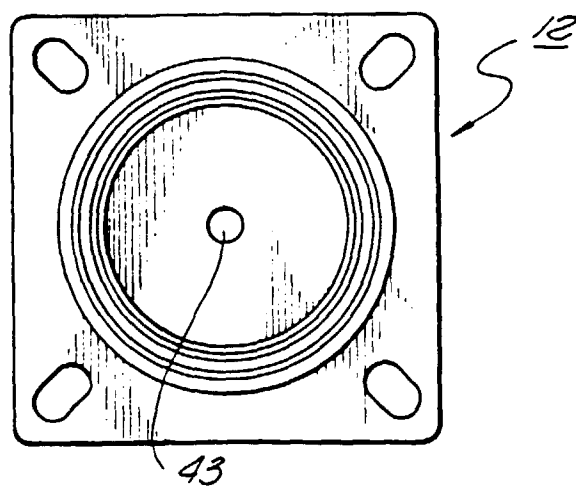


FIG. 6A