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(54) Title: GROUNDING MODULE FOR A CABLE AND GROUNDING SYSTEM FOR CABLES

(57) Abstract: A grounding module for a cable comprises a base portion including a channel for receiving a cable, a sharp protrusion disposed within the channel for puncturing a sheath of the cable disposed in the channel, an attaching member for enabling the grounding module to be attached to a frame, and a conductive member for connecting the sharp protrusion to the attaching member such that the sharp protrusion is electrically coupled to the frame. The grounding module further comprises a securing member for securing the cable within the channel of the base portion.

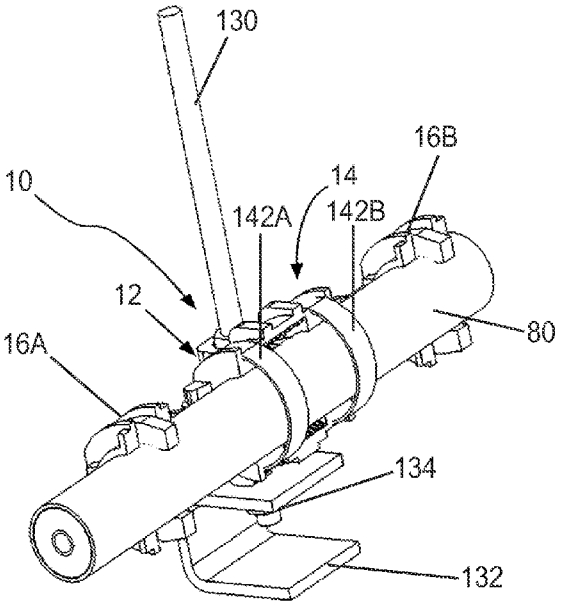

FIG. 1

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GROUNDING MODULE FOR A CABLE AND GROUNDING SYSTEM FOR CABLES

Field of the Invention

The disclosure relates generally to a grounding module for a cable and a grounding system for cables, and particularly relates to a grounding module and a grounding system which enables the cable(s) to be installed onto a frame, and be connected to the earth.

Background of the Invention

Cables, for example coaxial cables, are widely used in telecommunication system for signal transmission. For instance, coaxial cables (i.e. feeder cables) are generally used between a Base Transceiver Station (BTS) and an antenna to transmit base band signals. The coaxial cables between the BTS and the antenna are required to be installed along a frame, for example a support bracket, and to be well grounded for the purpose of good signal transmission performance and electrical performance.

In order to realize the installation of the coaxial cables onto the support bracket and to provide adequate grounding of the coaxial cables, in conventional approaches, separate cable clamps and grounding kits are required. The cable clamps are used to receive the coaxial cables and install them onto the support bracket, while the grounding kits are used to connect the coaxial cables to earth through separate grounding wires. For the grounding of the coaxial cables, first, part of the sheath of the coaxial cable is removed by a tool, for example a skinner, to expose the grounding layer, then a grounding wire or a conductor having the grounding wire is attached to the grounding layer to connect the grounding layer to earth, and last, the connection of the grounding layer and the grounding wire is sealed by a sealing member, for example a sealing box or a sealing tape to provide a environmental protection.

In conventional approaches, the cable clamp and the grounding kit are two separate modules respectively utilized to realize functions of installation and grounding, resulting in high cost and a waste of time.

Furthermore, the grounding wire included in the grounding kit is commonly stolen due to its high copper value. Once the grounding wire is cut off and then stolen, the function of grounding cannot be achieved any more, which will influence signal transmission performance and electrical performance of the coaxial cable.

In view of the above concerns, there is a need of an improvement for the above-mentioned conventional grounding and cable attachment approaches.

Summary of the Invention

In one aspect, an embodiment of the disclosure provides a grounding module for a cable. The grounding module comprises a base portion including a channel for receiving a cable, a sharp protrusion disposed within the channel for puncturing a sheath of the cable disposed in the channel, an attaching member for enabling the grounding module to be attached to a frame, and a conductive member for connecting the sharp protrusion to the attaching member such that the sharp protrusion is electrically coupled to the frame. The grounding module further comprises a securing member for securing the cable within the channel of the base portion.

In another aspect, an embodiment of the disclosure provides a grounding system for cables comprising a plurality of stackable grounding modules and a mounting screw. Each grounding module includes a base portion having a channel for receiving a cable, a sharp protrusion disposed within the channel for puncturing a sheath of the cable disposed in the channel, an orifice through the base portion, substantially perpendicular to the channel, for the mounting screw to pass through, and a conductive member for connecting the sharp protrusion to the mounting screw; and each grounding module further includes a securing member for securing the cable within the channel of the base portion. The mounting screw is intended for attaching the plurality of stackable grounding modules to a frame by passing through orifices in the plurality of stackable grounding modules such that they are disposed adjacent to one another.

The above summary of the present invention is not intended to describe each disclosed embodiment or every implementation of the present invention. The Figures and detailed description that follow below more particularly exemplify illustrative embodiments.

Brief Description of the Drawings

Embodiments of the disclosure are better understood with reference to the following drawings. The elements of the drawings are not necessarily to scale relative to each other.

FIG. 1 illustrates an isometric view of an exemplary embodiment of a grounding module for a cable according to one aspect of the disclosure;

FIG. 2a illustrates an isometric view of an exemplary embodiment of a base portion of the grounding module in FIG. 1;

FIG. 2b illustrated a left view of the base portion in FIG. 2a;

FIG. 3a illustrates an isometric view of an exemplary embodiment of a sharp protrusion of the grounding module in FIG. 1;

FIG. 3b illustrates a front view of the sharp protrusion in FIG. 3a;

FIG. 4 illustrates an isometric view of an exemplary embodiment of a combination of a sharp protrusion and a conductive member of the grounding module in FIG. 1;

FIG. 5 illustrates an isometric view of another exemplary embodiment of the base portion of the grounding module in FIG. 1, the base portion having two positioning members disposed on either end;

FIG. 6 illustrates an isometric view of still another exemplary embodiment of the base portion of the grounding module in FIG. 1, the base portion having two positioning members disposed on either end;

FIG. 7 illustrates an isometric view of another exemplary embodiment of a grounding module for a cable according to one aspect of the disclosure;

FIG. 8 illustrates an isometric view of an exemplary embodiment of a base portion of the grounding module in FIG. 7;

FIG. 9 illustrates an isometric view of an exemplary embodiment of a securing member of the grounding module in FIG. 7;

FIG. 10 illustrates an isometric view of still another exemplary embodiment of a grounding module for a cable according to one aspect of the disclosure;

FIG. 11 illustrates an isometric view of an exemplary embodiment of a base portion of the grounding module in FIG. 10;

FIG. 12 illustrates an isometric view of an exemplary embodiment of a securing member of the grounding module in FIG. 10;

FIG. 13 illustrates an isometric view of an exemplary embodiment of a combination of a conductive member and a sharp protrusion of the grounding module in FIG. 10;

FIG. 14 illustrates an isometric view of another exemplary embodiment of a grounding module for a cable according to one aspect of the disclosure;

FIG. 15 illustrates an isometric view of an exemplary embodiment of a grounding system for cables according to another aspect of the disclosure;

FIG. 16 illustrates an isometric view of an exemplary embodiment of a cable received by the exemplary grounding modules of the current disclosure.

Throughout the above drawings, like reference numerals will be understood to refer to like, similar or corresponding features or functions.

Detailed Description

In the following detailed description of the preferred embodiments, reference is made to the accompanying drawings that form a part hereof. The accompanying drawings show, by way of illustration, specific embodiments in which the disclosure may be practiced. The illustrated embodiments are not intended to be exhaustive of all embodiments according to the disclosure. It is to be understood that other embodiments may be utilized, and structural or logical changes may be made without departing from the scope of the disclosure. The following detailed description,

therefore, is not to be taken in a limiting sense, and the scope of the invention is defined by the appended claims.

In the following Detailed Description, reference is made to the accompanying drawings, which form a part hereof, and in which is shown by way of illustration specific embodiments in which the invention may be practiced. In this regard, directional terminology, such as "left", "right", "top," "bottom," "front," "back," "leading," "forward," "trailing," etc., is used with reference to the orientation of the Figure(s) being described. Because components of embodiments of the present invention can be positioned in a number of different orientations, the directional terminology is used for purposes of illustration and is in no way limiting. It is to be understood that other embodiments may be utilized and structural or logical changes may be made without departing from the scope of the present invention. The following detailed description, therefore, is not to be taken in a limiting sense, and the scope of the present invention is defined by the appended claims.

Hereinafter, for purpose of clarity, aspects of the disclosure are described and illustrated herein as used with coaxial cables. However, such illustration is exemplary only, and it is understood and intended that other types of cables can be used, including but not limited to twinaxial cables, power cables and other cable configurations with signal and ground elements.

Furthermore, for illustrative purpose only, aspects of the grounding module of the disclosure are described for using with a support bracket which is connected to earth. In one exemplary aspect, the support bracket may be a portion of a wireless communication tower. In an alternative aspect, a fastening bracket or small mounting bracket capable of connecting one or more grounding modules may be attached to the support bracket which is connected to earth. It shall be appreciated that the frame of aspects of the disclosure may be any other object that is connected to earth.

FIG. 1 illustrates an exemplary embodiment of a grounding module for a cable, the schematic view of which is shown in FIG. 16. FIGS. 2a and 2b illustrate exemplary embodiments of a base portion of the grounding module in FIG. 1.

Referring to FIG. 16, the cable 80 is a coaxial cable which includes an inner conductor 81, an insulation dielectric 82 surrounding the inner conductor 81, an outer conductor 83 (hereinafter referred to as grounding layer) disposed over the insulation dielectric 82, and a sheath 84 disposed over the outer conductor 83. To achieve the grounding of the cable 80, the sheath 84 of the cable 80 is removed to expose the grounding layer 83, and then the grounding layer 83 of the cable 80 is connected to the earth.

Referring to FIGS. 1, 2a and 2b, the grounding module 10 comprises a base portion 12 which may be formed from a polymeric or metal material by methods such as injection molding, extrusion, casting, machining, and the like. Advantageously, the base portion 12 may be a molded plastic piece.

The base portion 12 includes a channel 122 for receiving a cable 80. The channel 122 may be of any shape which is suitable to accommodate the cable 80, but a cylindrical channel 122, as shown in

FIG. 2a, is more desired when the cable 80 is of cylindrical shape. To well accommodate the cable 80, advantageously, the radius of the cylindrical channel 122 may be sized substantially equal to that of the cable 80.

The base portion 12 further includes a sharp protrusion 124 disposed within the channel 122. The sharp protrusion 124 is configured to puncture the sheath 84 of the cable 80 when the cable 80 is installed and secured in the channel 122 of the base portion 12. When the sheath 84 of the cable 80 is punctured by the sharp protrusion 124, the sharp protrusion 124 makes electrical contact with the grounding layer 83 of the cable 80. To attain both puncturing and conductive functions, the sharp protrusion 124 may generally be made from a metal material of relatively high hardness, such as stainless steel, copper, or iron, for example.

The sharp protrusion 124 may be a pair of spaced apart blades as shown in FIG. 3a, for example. Advantageously, the pair of spaced apart blades 124 may be substantially symmetrically disposed in the channel 122 with respect to the longitudinal axis of the channel 122.

To save material and decrease pressure on the grounding layer 83, each of the pair of spaced apart blades 124 may be of forked shape, as show in FIG. 3a.

To ensure the pair of spaced apart blades 124 punctures the sheath 84 of cable 80 while not damaging the grounding layer 83, the distance, d, between the pair of spaced apart blades 124 may be set to be larger than the radius of the cable 80 and smaller than the diameter of the cable 80, as shown FIG. 3b. Furthermore, each of the pair of spaced apart blades 124 may be slightly inclined outwards with respect to a reference plane by an inclination angle α, wherein the reference plane contains the longitudinal axis of the channel 122 and is perpendicular to the bottom of the channel 122. The inclination angle α may be within the range of 0° to 5°. Advantageously, the inclination angle α is about 0.5°.

When the cable 80 is installed in the channel 122 and then gradually pushed towards the pair of spaced apart blades 124 in the channel 122 by a force, the pair of spaced apart blades 124 begins to puncture into the sheath 84 of the cable 80. As each of the pair of spaced apart blades 124 has an inclination angle towards the sidewall of the channel 122, the spaced apart blades 124 are elastically deformed towards the sidewall of the channel 122 after the pair of spaced apart blades 124 puncture sheath 84. The deflection of the blades ensures that the grounding layer 83 of the cable 80 is not punctured, and also helps to get stable electrical connection between the pair of spaced apart blades 124 and the grounding layer 83 of the cable 80.

To ensure well grounding of the cable 80, the pair of spaced apart blades 124 may be dimensioned such that the pair of spaced apart blades 124 and the grounding layer 83 of the cable 80 are well electrically contacted when the cable 80 is installed and secured in the channel 122 of the base portion 12.

It shall be appreciated that the pair of spaced apart blades is an illustrative example of the sharp protrusion 124. Any suitable configuration of sharp protrusion is possible, such as pins or annular teeth, which will be described in detail in the following embodiments.

The base portion 12 further includes an attaching member 126 for enabling the grounding module 10 to be attached to the support bracket (not shown). The attaching member 126 may take on any configuration, but generally include an orifice 128 through the base portion 12, as shown in FIG. 2b, for permitting a mounting screw 130 to pass through. The orifice 128 may be defined at any lateral position of the base portion 12 away from the channel 122, but an orifice 128 defined substantially perpendicular to the channel 122 is more desirable.

The base portion 12 further comprises a conductive member 18 (not shown in FIGS. 1, 2a and 2b). The conductive member 18 is configured to connect the sharp protrusion 124 to the attaching member 126 such that the sharp protrusion 124 is electrically coupled to the support bracket.

The conductive member 18 may be of any suitable shape. For example, the conductive member 18 may be of ⊔-shape, which comprises two sidewalls substantially parallel to each other, and a base connecting the two sidewalls, as shown in FIG. 4.

The pair of spaced apart blades 124 and the conductive member 18 may be configured as a one-piece member 19, as shown in FIG. 4. The one-piece member 19 may be integrally formed with the base portion 12 by using conventional injection molding techniques, with the conductive member 18 buried in the base portion 12 and the pair of spaced apart blades 124 extending from the channel 122 of the base portion 12, as shown in FIG. 2a. Alternatively, the base portion 12 may comprise two slots respectively through the attaching member 126 and the bottom of the channel 122 for the one-piece member 19 to be inserted. In this manner, the one-piece member 19 can be assembled into the base portion 12 by inserting the pair of spaced apart blades 124 into respective slots.

When the mounting screw 130 is inserted into the orifice 128 or the base portion 12 is installed over the mounting screw 130, the conductive member 18 makes electrical contact with the mounting screw 130 such that the pair of spaced apart blades 124 is electrically coupled to the mounting screw 130. To be specific, for instance, the two sidewalls of the ⊔-shape conductive member 18 may be formed with two through-holes 139A and 139B which are aligned with each other, as shown in FIG. 4. The conductive member 18 is formed in the base portion 12 such that the two through-holes 139A and 139B are aligned with the orifice 128 in the attachment member 126, as shown in FIG. 2b, for permitting the mounting screw 130 to pass through. A recess 136 is formed in the attachment member 126 around the orifice 128 to expose part of the conductive member 18 to receive a mating fastener, such as a nut, a threaded spacer or a washer for example. When the base portion 12 is installed onto the mounting screw 130, the mating fastener is screwed towards the recess 136 to fix the base portion 12 on the mounting screw 130. Furthermore, as the mating fastener makes electrical contact with the

conductive member 18, the pair of spaced apart blades 124 is electrically coupled to the mounting screw 130 by the mating fastener.

The mounting screw 130 is intended to attach the base portion 12, i.e. the grounding module 10 to the support bracket by passing through the orifice 128, such that the pair of spaced apart blades 124 is electrically coupled to the support bracket and thereby the grounding layer 83 of the cable 80 is electrically coupled to the support bracket. In one exemplary aspect, the support bracket may be a portion of a wireless communication tower. In this case, one end of the mounting screw 130 may for example comprise a U-shape fastening bracket 132 fixed thereon with a nut 134 or other threaded fastener, as shown in FIG. 1. The U-shape fastening bracket 132 is configured to be fixed onto the support bracket.

In an alternative aspect, a fastening bracket or small mounting bracket capable of connecting the grounding module 10 may be attached to the support bracket. The fastening bracket or small mounting bracket may for example comprise a hole to receive the mounting screw 130. When the mounting screw 130 is inserted into the hole on the fastening bracket or small mounting bracket and then fixed by a nut or other threaded fastener, the grounding module 10 is installed on the support bracket.

It shall be appreciated that the orifice 128 is only an illustrative example of the attaching member 126, and any suitable form of attaching member is possible, such as a clip.

Still referring to FIG. 1, the grounding module 10 further comprises a securing member 14 for securing the cable 80 within the channel 122 of the base portion 12. The securing member 14 may be a pair of strip members, such as a pair of hose clamps for example, or a cover which will be described in detail in the following embodiments, or any other suitable mechanism.

As shown in FIG. 1, the securing member 14 is a pair of hose clamps 142A and 142B. When the cable 80 is installed into the channel 122 of the base portion 12, the pair of hose clamps 142A and 142B are respectively positioned around each end of the base portion 12 and the cable 80 to secure the cable 80 within the channel 122 of the base portion 12. Accordingly, the base portion 12 may further comprise a pair of notches 121A and 121B around the outer surface of the base portion 12 on either side of the sharp protrusions 124, as shown in FIGS. 2a and 2b, to accommodate the pair of hose clamps 142A and 142B and provide a stable connection of the pair of hose clamps 142A and 142B and the cable 80 to the grounding module 10.

When the pair of hose clamps 142A and 142B are respectively positioned around each end of the base portion 12 and the cable 80, a force applied as the pair of hose clamps 142A and 142B are tightened is exerted on the cable 80 to push it towards the pair of spaced apart blades 124 in the channel 122. In this manner, the sheath 84 of the cable 80 is punctured by the pair of spaced apart blades 124 disposed within the channel 122 and thereby the pair of spaced apart blades 124 make electrical contact with the grounding layer 83 of the cable 80.

It is to be noted that the number of the hose clamps is not limited to two, and one hose clamp, or more than two hose clamps is also applicable.

It is further to be noted that the number of the notches formed in the base portion 12 is intended to correspond to the number of hose clamps that should be used to secure the cable 80 in the base portion 12.

Still referring to FIG. 2a, the base portion 12 may further comprise a recess 123 formed around the pair of spaced apart blades 124. The recess 123 is filled with a sealing material to provide a seal around openings through the sheath 84 punctured by the pair of spaced apart blades 124 when the cable 80 is installed and secured within the channel 122. Such a seal around the openings may effectively reduce environmental influence, such as rain or humidity for example, to the grounding of the cable 80. The sealing material may be a grease, an encapsulant, a hydrophobic elastomeric gel, a mastic, or a low durometer gasket, for example.

It is to be noted that the sealing material may be filled into the recess 123 when the grounding module 10 is manufactured, or be filled into the recess 123 when the cable 80 is installed in field.

When the cable 80 is installed and secured within the channel 122, the sealing material in the recess 123 is squeezed and then may be overflowed from the recess 123. In this case, the base portion 12 may further comprise a vessel 129 at the bottom of the channel 122 to receive the excess sealing material.

Alternatively, the bottom of the recess 123 may be formed with at least one opening through the base portion 12 such that the excess sealing material may be dislocated via the at least one opening when the cable 80 is installed and secured within the channel 122.

Alternatively, the at least one opening may be used to inject the sealing material into the recess 123 around the pair of spaced apart blades 124 after the cable 80 is installed and secured within the channel 122.

Still referring to FIG. 1, the grounding module 10 may further comprise two positioning members 16A and 16B detachably mounted on each end of the base portion 12 to center the cable 80 in the channel 122 of the base portion 12. The positioning member 16A or 16B may for example comprise a V-shape slot 162 and a mounting member 164, as shown in FIG. 5. The V-shape slot 162 is configured to, when the cable 80 is received by the channel 122, keep the cable 80 at the correct position, i.e. the center of the channel 122 and be well secured by the pair of hose clamps 142A and 142B, such that the pair of spaced apart blades 124 may puncture into the sheath 84 of the cable 80 symmetrically.

The mounting member 164 is configured to mount the positioning member 16A or 16B onto the base portion 12, which may comprise a pair of dove-tailed grooves 166A and 166B for example. Accordingly, each end of the base portion 12 may comprise a pair of dove-tailed guides 125A and 125B which are respectively mated with the pair of dove-tailed grooves 166A and 166B when the

positioning member 16A or 16B is attached to the base portion 12 of the grounding module 10. Before the installation of the cable 80, the pair of dove-tailed grooves 166A and 166B are slid into the pair of dove-tailed guides 125A and 125B, and after the installation of the cable 80, the pair of dove-tailed grooves 166A and 166B are slid out of the pair of dove-tailed guides 125A and 125B for reusing.

Alternatively, as shown in FIG. 6, the mounting member 164 may comprise a hinge 167, and the positioning member 16A' or 16B' is mounted onto the base portion 12 by means of the hinge 167.

The base portion 12 may further comprise a height-indicating member 127, such as a jut on the ridge of the dove-tailed guides 125A or 125B, as shown in FIG. 5, to indicate the correct mounting height of the positioning member 16A or 16B. For example, the positioning member 16A or 16B may be considered to be mounted at the correct height when the top of the dove-tailed grooves 166A and 166B are level with the jut.

It shall be appreciated that the number of the positioning members is not limited to two, and one positioning member is also applicable.

The configuration and function of each portion of the grounding module 10 is described above in great detail, and hereinafter the method of installing the cable 80 onto the support bracket by the grounding module 10 will be further described.

First, the mounting screw 130 is fixed to the support bracket by attaching the U-shape fastening bracket 132 on the mounting screw 130 onto the support bracket.

Next, the base portion 12 is fitted over the mounting screw 130 by inserting the mounting screw 130 through the orifice 128 in the attachment member 126. The base portion 12 of the grounding module 10 is secured to the mounting screw 130 by the mating fastener received in the recess 136.

Then, the two positioning members 16A and 16B are mounted onto each end of the base portion 12 by engaging the dove-tail grooves 166A and 166B on the positioning member 16A and 16B with the dove-tail guides 125A and 125B on the base portion 12 to align the V-shaped slot 162 with the channel 122 in the base portion 12 of the grounding module 10 as shown in Fig. 5. The cable 80 can then be centered in the channel 122 in the base portion 12 via the two positioning members 16A and 16B.

Then, the cable 80 is secured within the channel 122 of the base portion 12 by tightening the pair of hose clamps 142A and 142B at either end of the base portion 12. As the pair of hose clamps 142A and 142B are tightened, the cable 80 is driven down towards the pair of spaced apart blades 124 of the channel 122 allowing the pair of spaced apart blades 124 to puncture the sheath 84 of the cable 80 and contact the grounding layer 83 within the cable 80 to permit electrical contact between the grounding layer 83 and the pair of spaced apart blades 124 of the grounding module 10.

Finally, the two positioning members 16A and 16B can be removed from the base portion 12.

With above steps, the cable 80 is installed onto the support bracket by the grounding module 10. Furthermore, after the cable 80 is installed and secured within the channel 122 of the base portion 12, the sheath 84 of the cable 80 is punctured by the sharp protrusion 124 and thereby the grounding layer 83 of the cable 80 is electrically coupled to the support bracket. As the support bracket is connected to the earth, the grounding of the cable 80 is achieved.

It is to be noted that as the two positioning members 16A and 16B are optional members, the steps of mounting and removing the two positioning members 16A and 16B may be omitted.

It is further to be noted that the first step of fixing the mounting screw 130 onto the support bracket may also be implemented when all the other steps are finished.

FIG. 7 illustrates another exemplary embodiment of a grounding module for a cable. FIG. 8 illustrates an exemplary embodiment of a base portion of the grounding module in FIG. 7. FIG. 9 illustrates an exemplary embodiment of the securing member of a grounding module in FIG. 7.

Referring to FIGS. 7-9, in this exemplary embodiment, the grounding module 20 comprises a base portion 22 and a securing member 24. The base portion 22 includes a first channel 222, a sharp protrusion 224, a conductive member (not shown), an attaching member 226, and a recess 223.

The configurations and functions of the first channel 222, the sharp protrusion 224, the conductive member 28, the attaching member 226 and the recess 223 are the same as those of the channel 122, the sharp protrusion 124, the conductive member 18, the attaching member 126 and the recess 123 in the embodiments of FIGS. 1-6, as will not be described herein for the purpose of simplicity.

The grounding module 20 differs from the grounding module 10 mainly in the securing member 24. In this exemplary embodiment, the securing member 24 may comprise a cover 242, as shown in FIG. 9. The cover 242 includes a second channel 244 for receiving the cable 80 and then be mounted onto the base portion 22 together with the cable 80, which may be formed from a polymeric or metal material by methods such as injection molding, extrusion, casting, machining, and the like. Advantageously, the cover 242 may be a molded plastic piece.

The cover 242 may further include two male members 246A and 246B, as show in FIG. 9. Accordingly, the base portion 22 may further include two female members 248A and 248B, as shown in FIG. 8, which are engaged with the male members 246A and 246B on the cover 242 when the cover 242 is mounted onto the base portion 22, such that the cable 80 is secured within the first channel 222.

The cover 242 may further include two positioning members 243A and 243B disposed on each side of the cover 242, which may include V-Shape slots for example. The two positioning members 243A and 243B are configured to center the cable 80 in the second channel 244 when the cable 80 is received by the second channel 244.

It shall be appreciated that the positioning members 243A and 243B may also be disposed on each side of the base portion 22. In this manner, the cable 80 is first installed into the first channel 222

of the base portion 22, and then the cover 242 is mounted onto the base portion 22 to secure the cable 80 within the first channel 222 of the base portion 22.

Still referring to FIG. 7, the securing member 24 may further include a fastening member 241 configured to fasten the cover 242 and the base portion 22 when the cover 242 is mounted on the base portion 22, which may be two hose clamps for example. The tightening of the cover 242 to the base portion 22 drives the cable 80 into the first channel 222 over the sharp protrusion 224. The sharp protrusion 224 punctures the sheath 84 of cable 80 and makes electrical contact with grounding layer 83 in the cable 80.

The configuration and function of each portion of the grounding module 20 is described above in great detail, and hereinafter the method of installing the cable 80 onto the support bracket by the grounding module 20 will be further described.

First, the mounting screw 230 is fixed to the support bracket by attaching the U-shape fastening bracket 232 on the mounting screw 230 onto the support bracket.

Next, the base portion 22 is fitted over the mounting screw 230 by inserting the mounting screw 230 through the orifice in the attachment member 226. The base portion 22 of the grounding module 20 is secured to the mounting screw 230 by a mating fastener.

Then, the cable 80 is installed and centered in the second channel 244 of the cover 242 via the positioning members 243A and 243B respectively disposed on each side of the cover 242.

Then, the cover 242 together with the cable 80 are mounted on the base portion 22 by engaging the two male members 246A and 246B on the cover 242 with the two female members 248A and 248B on the base portion 22.

Finally, the cable 80 is secured within the first channel 222 of the base portion 22 by the fastening member 241. With the fastening of the fastening member 241, the cable 80 is driven down into the first channel 222 over the sharp protrusion 224, allowing the sharp protrusion 224 to puncture the sheath 84 of the cable 80 and make contact with the grounding layer 83 within the cable 80 to permit electrical contact between the grounding layer 83 and the sharp protrusion 224 of the grounding module 20.

With above steps, the cable 80 is installed onto the support bracket by the grounding module 20. Furthermore, after the cable 80 is installed and secured within the first channel 222 of the base portion 22, the sheath 84 of the cable 80 is punctured by the sharp protrusion 224 and thereby the grounding layer 83 of the cable 80 is electrically coupled to the support bracket. As the support bracket is connected to the earth, the grounding of the cable 80 is achieved.

It is to be noted that the first step of fixing the mounting screw 230 onto the support bracket may also be implemented when all the other steps are finished.

FIG. 10 illustrates still another exemplary embodiment of a grounding module for a cable. FIG. 11 illustrates an exemplary embodiment of a base portion of the grounding module in FIG. 10.

FIG. 12 illustrates an exemplary embodiment of a securing member of the grounding module in FIG. 10.

Referring to FIGS. 10-12, the grounding module 30 comprises a base portion 32 which may be formed from a polymeric or metal material by methods such as injection molding, extrusion, casting, machining, and the like. Advantageously, the base portion 32 may be a molded plastic piece.

The base portion 32 includes a first channel 322 for receiving a cable 80. In this exemplary embodiment, the first channel 322 may be a cylindrical channel, as shown in FIG. 11.

The base portion 32 further includes a sharp protrusion 324 disposed within the first channel 322. In this exemplary embodiment, the sharp protrusion 324 may be annular teeth, as shown in FIG. 11. The annular teeth 324 are configured to puncture the sheath 84 of the cable 80 when the cable 80 is installed and secured in the first channel 322 of the base portion 32. When the sheath 84 of the cable 80 is punctured by the annular teeth 324, the annular teeth 324 make electrical contact with the grounding layer 83 of the cable 80. To attain both puncturing and conductive functions, the annular teeth 324 may generally be made from a metal material of relatively high hardness, such as stainless steel, copper, or iron, for example.

The base portion 32 further includes an attaching member 326 for enabling the grounding module 30 to be attached to the support bracket (not shown). In this exemplary embodiment, the attaching member 326 may include an orifice 328 through the base portion 32 for permitting a mounting screw 330 to pass through.

The base portion 32 further includes a conductive member 38 for connecting the annular teeth 324 to the attaching member 326 so that the annular teeth 324 are electrically coupled to the support bracket. In this exemplary embodiment, the conductive member 38 is of strip-shape, with one end connected with the annular teeth 324 and the other end connected with the attaching member 326, as shown by dashed lines in FIG. 11.

When the mounting screw 330 is inserted into the orifice 328 in the attaching member 326 or the base portion 32 is installed over the mounting screw 330, the annular teeth 324 are electrically coupled to the mounting screw 330 by the conductive strap 38. To be specific, the conductive member 38 may for example comprise a hole 371, as shown in FIG. 13. The conductive member 38 is formed within the base portion 32 such that the hole 371 is aligned with the orifice 328, as shown in FIG. 11, for permitting the mounting screw 330 to pass through. When the base portion 32 is installed over the mounting screw 330 and then fixed on the mounting screw 330 by a nut or other threaded fastener, the annular teeth 324 are electrically coupled to the mounting screw 330.

The annual teeth 324 and the conductive member 38 may be configured as a one-piece member 39, as shown in FIG. 13. The one-piece member 39 may be integrally formed within the base portion 32 by using conventional insert molding techniques, with the conductive member 38 buried in the base portion 32 and the annular teeth 324 extending from the first channel 322. Alternatively, the

one-piece member 39 may be assembled into the base portion 32 of the grounding module 30 after the base portion 32 has been separately molded.

The mounting screw 330 is intended to attach the base portion 32, i.e. the grounding module 30 to the support bracket by passing through the orifice 328, such that the annular teeth 324 are electrically coupled to the support bracket and thereby the grounding layer 83 of the cable 80 is electrically coupled to the support bracket. Still referring to FIG. 10, for example, one end of the mounting screw 330 may comprise a U-shape fastening bracket 332 fixed thereon with a nut 334 or other threaded fastener. The U-shape fastening bracket 332 is configured to be fixed onto the support bracket.

Still referring to FIG. 10, the grounding module 30 further comprises a securing member 34 for securing the cable 80 within the first channel 322 of the base portion 32. In this exemplary embodiment, the securing member 34 may comprise a cover 342, as shown in FIG. 12, which may be formed from the same material as the base portion 32. The cover 342 may include an orifice 344 therethrough for permitting the mounting screw 330 to be inserted through the cover 342, and a second channel 346 for accommodating the cable 80. After cable 80 is installed into the first channel 322 of the base portion 32, the cover 342 is installed over the base portion 32 by passing the mounting screw 330 through the orifice 344 within the cover 342 such that the second channel 346 of the cover 342 is facing the first channel 322 of the base portion 32, and then fixed on the mounting screw 330 by a nut or other threaded fastener so that the cable 80 is secured within the first channel 342 and the second channel 346.

The securing member 34 may further comprise a pushing member 341 configured to drive the cable 80 towards the annular teeth 324 of the first channel 322 when the cover 342 is mounted on the base portion 32, as shown in FIG. 12. The pushing member 341 may include a pusher washer 358 and a pusher bolt 359 with external thread thereon. Accordingly, the cover 342 may further comprise a through-hole 354 through the bottom of the second channel 346, and the through-hole 354 has internal thread. After the pusher bolt 359 is installed through the through-hole 354, the pusher washer 358 is fixed onto the tail of the pusher bolt 359.

When the cover 342 is mounted on the base portion 32, by screwing the head of the pusher bolt 359 downwards, the pusher washer 358 on the tail of the pusher bolt 359 moves towards the cable 80, which exerts a pressure on the cable 80 so as to drive the cable 80 into the first channel 322 of the base portion 32.

Alternatively, the securing member 34 may further comprise a fastening member 343, as shown in FIG. 14. The fastening member 343 may include a screw 349 with external thread thereon. Accordingly, the base portion 32 may comprise a protrusion, extending from the external sidewall of the first channel 322, with a hole 329 therethrough, and likewise the cover 342 may comprise a protrusion, extending from the external sidewall of the second channel 346, with a hole 352

therethrough. Both the hole 329 and hole 352 have internal threads to engage with the external threads on screw 349. After the cover 342 is installed through the mounting screw 330 and mounted onto the base portion 32, the screw 349 is screwed into the hole 329 and hole 352 with the external thread mating with the internal threads of the hole 329 and hole 352, such that the cover 342 and the base portion 32 are fastened tightly. The tightening of the cover 342 to the base portion 32 drives the cable 80 into the first channel 322 over the annular teeth 324. The annular teeth 324 puncture the sheath 84 of cable 80 and make electrical contact with grounding layer 83 in the cable 80.

Still referring to FIG. 11, the base portion 32 may further comprise a recess 323 formed around the annular teeth 324. The recess 323 is filled with a sealing material to provide a seal around openings through the sheath 84 punctured by the annular teeth 324 when the cable 80 is installed and secured within the first channel 322. Such a seal around the openings may effectively reduce environmental influence, such as rain or humidity for example, to the grounding of the cable 80.

It shall be appreciated that the grounding module 30 may further comprise positioning member(s) configured to center the cable 80 in the first channel 322 of the base portion 32, which will not be described here in detail for the purpose of simplicity.

The configuration and function of each portion of the grounding module 30 is described above in great detail, and hereinafter the method of installing the cable 80 onto the support bracket by the grounding module 30 will be further described.

First, the mounting screw 330 is fixed to the support bracket by attaching the U-shape fastening bracket 332 on the mounting screw 330 onto the support bracket.

Next, the base portion 32 is fitted over the mounting screw 330 by inserting the mounting screw 330 through the orifice 328 in the attachment member 326. The base portion 32 of the grounding module 30 is secured to the mounting screw 330 by the nut or other threaded fastener.

Then, the cable 80 is installed in the first channel 322 in the base portion 32.

Then, the cover 342 is installed over the base portion 32 by inserting the mounting screw 330 through the orifice 344 within the cover 342. The cover 342 is secured to the mounting screw 330 by the nut or other threaded fastener.

Finally, the cable 80 is secured within the first channel 322 of the base portion 32 by screwing the head of the pusher bolt 359 of the pushing member 341 downwards. As the head of the pusher bolt 359 is screwed downwards, the pusher washer 358 on the tail of the pusher bolt 359 moves towards the cable 80, which exerts a pressure on the cable 80 so as to drive the cable 80 towards the annular teeth 324 in the first channel 322 of the base portion 32, as shown in FIG. 12. Alternatively, the cable 80 is secured within the first channel 322 of the base portion 32 by screwing the screw 349 into the hole 329 and hole 352 with the external thread mating with the internal threads of the hole 329 and hole 352. As the screw 349 is screwed into the hole 329 and hole 352, the cover 342 and the base

portion 32 are fastened tightly such that the cable 80 is driven into the first channel 322 of the base portion 32 over the annular teeth 324, as shown in FIG. 14.

With above steps, the cable 80 is installed onto the support bracket by the grounding module 30. Furthermore, after the cable 80 is secured within the first channel 322 of the base portion 32 by the cover 342 and the fastening member 341, the sheath 84 of the cable 80 is punctured by the sharp protrusion 324 and thereby the grounding layer 83 of the cable 80 is electrically coupled to the support bracket. As the support bracket is connected to the earth, the grounding of the cable 80 is achieved.

It is further to be noted that the first step of fixing the mounting screw 330 onto the support bracket may also be implemented when all the other steps are finished.

With the grounding module 10, 20 and 30, the cable 80 can be installed on the support bracket and be connected to the earth at the same time.

According to another aspect of the disclosure, there provides a grounding system for cables. FIG. 15 illustrates an isometric view of an exemplary embodiment of a grounding system for cables.

Referring to FIG. 15, the grounding system 40 comprises a plurality of stackable grounding modules 42 and a mounting bolt 44 for attaching the plurality of stackable grounding modules 42 to a support bracket.

Each grounding module 42 comprises a base portion, as shown in FIG. 2a, FIG. 8 or FIG. 11, which may be formed from a polymeric or metal material by methods such as injection molding, extrusion, casting, machining, and the like.

The base portion of each grounding module 42 includes a channel for receiving a cable, as shown in FIG. 2a, FIG. 8 or FIG. 11. The channel may be of any shape which is suitable to accommodate the cable, but a cylindrical channel is more desired when the cable is of cylindrical shape.

The base portion of each grounding module 42 further includes a sharp protrusion disposed within the channel, as shown in FIG. 2a, FIG. 8 or FIG. 11. The sharp protrusion is configured to puncture the sheath of the cable when the cable is installed and secured in the channel of the base portion. When the sheath of the cable is punctured by the sharp protrusion, the sharp protrusion makes electrical contact to the grounding layer of the cable. The sharp protrusion may be a pair of spaced apart blades as shown in FIG. 3a. Alternatively, the sharp protrusion may be annual teeth as shown in FIG. 11.

The base portion of each grounding module 42 further includes an orifice therethrough for the mounting screw 44 to pass through, as shown in FIG. 2b or FIG. 11. The orifice is substantially perpendicular to the channel.

The base portion of each grounding module 42 further comprises a conductive member for connecting the sharp protrusion to the mounting screw 44 when the mounting screw 44 is inserted into

the orifice. The conductive member may be of ⊔ -shape as shown in FIG. 4. Alternatively, the conductive member may be of strip-shape as shown in FIG. 13.

The sharp protrusion and the conductive member may be configured as a one-piece member as shown in FIG. 4 or FIG. 13.

Each grounding module 42 further comprises a securing member for securing the cable within the channel of the base portion. The securing member may be a pair of hose clamps as shown in FIG. 1. When the pair of hose clamps are respectively positioned around each end of the base portion and the cable, a force applied as the pair of hose clamps are tightened is exerted on the cable to push it towards the sharp protrusion in the channel.

Alternatively, the securing member may comprise a cover as shown in FIG. 7. After the cable is installed into the channel of the cover, the cover together with the cable are mounted onto the base portion by engaging the two male members on the cover with the two female members on the base portion, such that the cable is secured within the channel of the base portion. Furthermore, the securing member may further comprise a fastening member for fastening the cover and the base portion, as shown in FIG. 7.

Alternatively, the securing member may comprise a cover as shown in FIG. 10. The cover may include an orifice therethrough for permitting the mounting screw 44 to be inserted through the cover, and a channel for accommodating the cable. After the cable is installed into the channel of the base portion, the cover is installed over the base portion by passing the mounting screw 44 through the orifice within the cover, and then fixed on the mounting screw 44 by a nut or other threaded fastener. Furthermore, the securing member may further comprise a fastening member for fastening the cover and the base portion, as shown in FIG. 14. Alternatively, the securing member may further comprise a pushing member for driving the cable towards the sharp protrusion in the channel of the base portion, as shown in FIG. 12.

The base portion of each grounding module 42 may further comprise a recess formed around the sharp protrusion, as shown in FIG. 2a, FIG. 8 or FIG. 11. The recess is filled with a sealing material to provide a seal around openings through the sheath punctured by the sharp protrusion when the cable is installed and secured within the channel of the base portion.

Each grounding module 42 may further comprise a pair of positioning members detachably mounted on each end of the base portion for centering the cable in the channel when the cable is received by the channel of the base portion, such that the sharp protrusion may puncture into the sheath of the cable symmetrically, as shown in FIG. 5 or FIG. 6. Alternatively, the pair of positioning members may be disposed on each side of the cover, as shown in FIG. 9.

Still referring to FIG. 15, the mounting screw 44 is configured to respectively pass through the orifice on the base portion of each grounding module 42 such that the plurality of the stackable grounding modules 42 are disposed adjacent to one another. The mounting screw 44 is then fixed on

the support bracket such that the sharp protrusion of each grounding module 42 is electrically coupled to the support bracket and thereby the grounding layer of the cable received by each grounding module 42 is electrically coupled to the support bracket.

With the grounding system 40, the plurality of cables can be installed on the support bracket and be connected to the earth at the same time.

In the circumstance that the support bracket to which the grounding system 40 is attached is not connected to earth, the grounding system 40 may further comprise a grounding wire with one end connected to the mounting screw 44. The other end of the grounding wire is intended to be connected to the earth. In this manner, the grounding of a plurality of cables received by the plurality of grounding modules 42 can be achieved by merely one grounding wire.

Since the grounding system 40 requires merely one grounding wire to achieve the grounding of a plurality of cables received by the plurality of grounding modules 42, the cost for the grounding wire is saved.

It should be noted that the above described embodiments are given for describing rather than limiting the invention, and it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention as those skilled in the art readily understand. Such modifications and variations are considered to be within the scope of the invention and the appended claims. The protection scope of the invention is defined by the accompanying claims. In addition, any of the reference numerals in the claims should not be interpreted as a limitation to the claims. Use of the verb “comprise” and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. The indefinite article “a” or “an” preceding an element or step does not exclude the presence of a plurality of such elements or steps.

What is claimed:

1. A grounding module for a cable, the module comprising:

a base portion including a channel for receiving a cable; a sharp protrusion disposed within the channel for puncturing a sheath of the cable disposed in the channel; an attaching member for enabling the grounding module to be attached to a frame; a conductive member for connecting the sharp protrusion to the attaching member such that the sharp protrusion is electrically coupled to the frame; and

a securing member for securing the cable within the channel of the base portion.

2. The module of claim 1, wherein the attaching member comprises an orifice through the base portion for permitting a mounting screw passing through such that the sharp protrusion is electrically coupled to the mounting screw, the mounting screw intended for attaching the grounding module to the frame by passing through the orifice.

3. The module of claim 2, further comprising the mounting screw for attaching the grounding module to the frame by passing through the orifice.

4. The module of claim 1, further comprising a recess formed around the sharp protrusion for filling a sealing material, the sealing material intended to provide a seal around openings through the sheath punctured by the sharp protrusion.

5. The module of claim 4, wherein the sealing material is one of a grease, an encapsulant, a hydrophobic elastomeric gel, a mastic and a gasket.

6. The module of claim 1, further comprising a pair of positioning members detachably mounted on each end of the base portion for centering the cable in the channel.

7. The module of claim 1, wherein the securing member comprises a first strip member intended to be positioned around the base portion and the cable disposed in the channel to secure the cable within the channel of the base portion.

8. The module of claim 7, wherein the base portion further comprises a notch around the outer surface thereof for accommodating the first strip member.

9. The module of claim 1, wherein the securing member comprises a cover intended to be mounted on the base portion.

10. The module of claim 9, wherein the securing member further comprises a fastening member for fastening the cover and the base portion.

11. The module of claim 9, wherein the securing member further comprises a pushing member for driving the cable towards the sharp protrusion of the channel.

12. The module of claim 1, wherein the shape protrusion comprises a pair of spaced apart blades substantially symmetrically disposed in the channel with respect to the axis of the channel.

13. The module of claim 12, wherein each blade is slightly inclined outwards with respect to a reference plane, the reference plane containing the axis of the channel and being perpendicular to the bottom of the channel.

14. A grounding system for cables, the system comprising a plurality of stackable grounding modules and a mounting screw,

each grounding module including:

a base portion having a channel for receiving a cable; a sharp protrusion disposed within the channel for puncturing a sheath of the cable disposed in the channel; an orifice through the base portion, substantially perpendicular to the channel for the mounting screw to pass through; a conductive member for electrically connecting the sharp protrusion to the mounting screw;

a securing member for securing the cable within the channel of the base portion; and

the mounting screw for attaching the plurality of stackable grounding modules to a frame by passing through orifices in the plurality of stackable grounding modules such that they are disposed adjacent to one another.

15. The system of claim 14, wherein each grounding module further comprises a recess formed around the sharp protrusion for filling a sealing material, the sealing material intended to provide a seal around openings through the sheath punctured by the sharp protrusion.

16. The system of claim 14, wherein each grounding module further comprising a pair of positioning members detachably mounted on each end of the base portion for centering the cable in the channel.

17. The system of claim 14, wherein the securing member comprises a pair of strip members intended to be positioned around each end of the base portion and the cable disposed in the channel to secure the cable within the channel of the base portion.

18. The system of claim 14, wherein the securing member comprises a cover intended to be mounted on the base portion.

19. The system of claim 18, wherein the securing member further comprises a fastening member for fastening the cover and the base portion.

20. The system of claim 18, wherein the securing member further comprises a pushing member for driving the cable towards the sharp protrusion of the channel.

21. The system of claim 14, wherein the shape protrusion comprises a pair of spaced apart blades symmetrically disposed within the channel with respect to the axis of the channel.

22. The system of claim 14, further comprising a grounding wire with one end connected to the mounting screw.

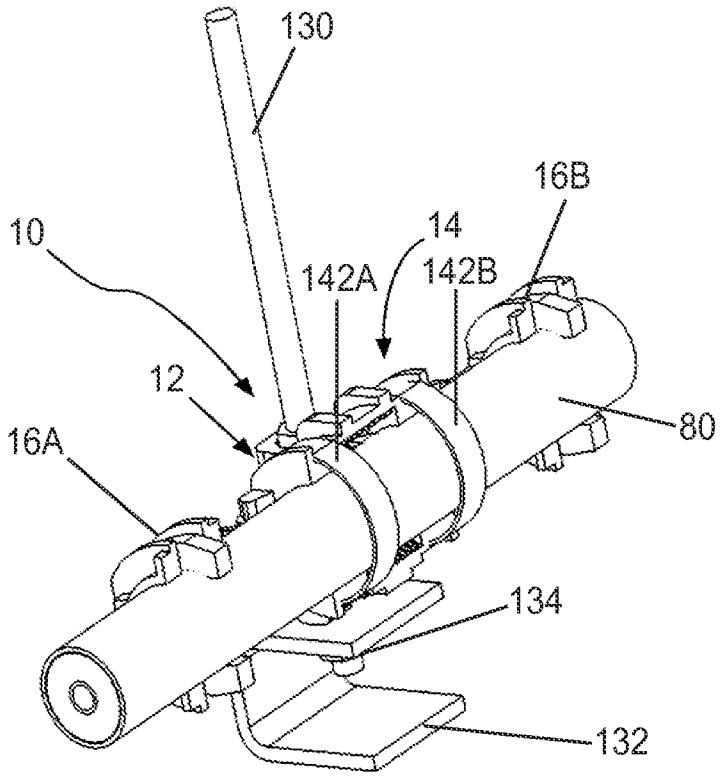


FIG. 1

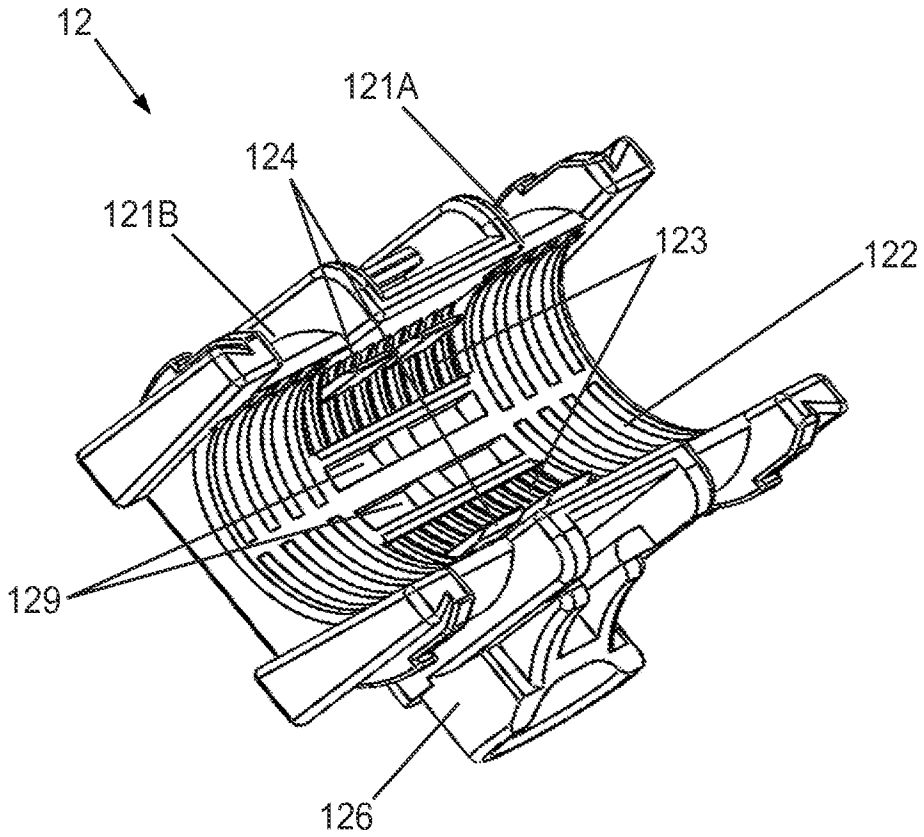


FIG. 2a

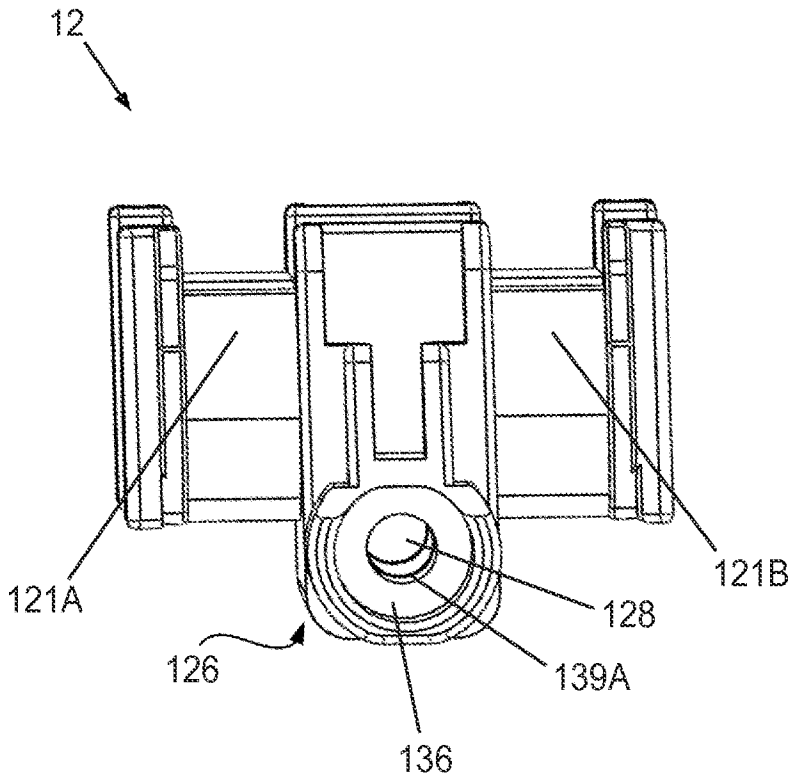


FIG. 2b

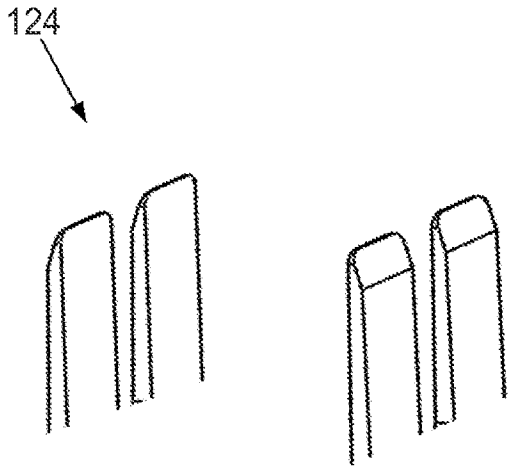


FIG. 3a

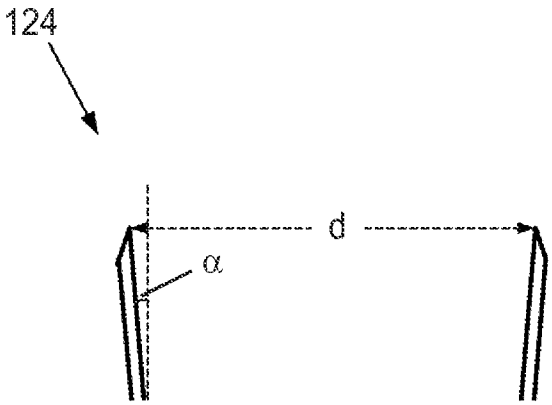


FIG. 3b

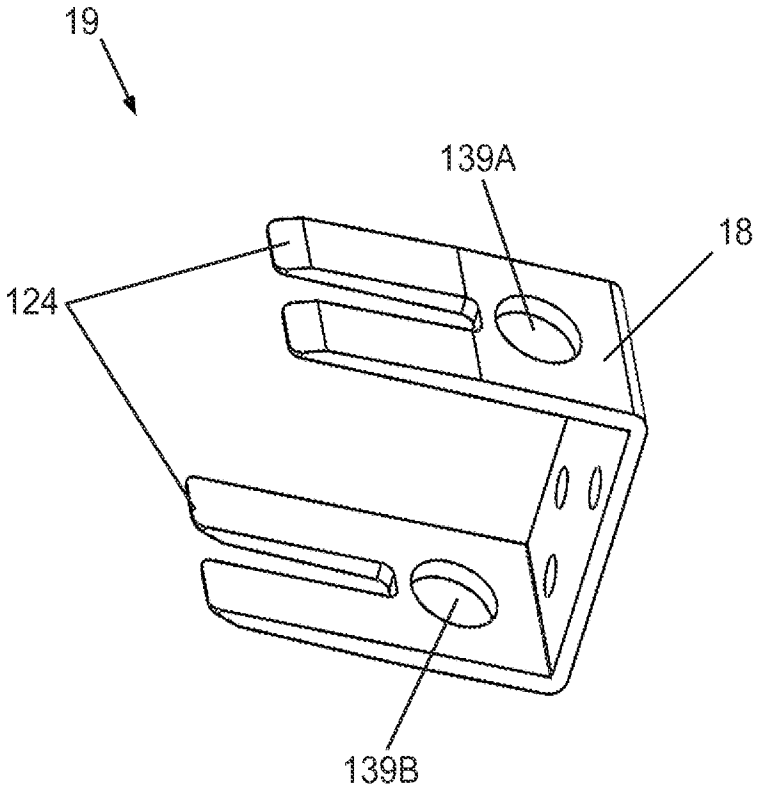
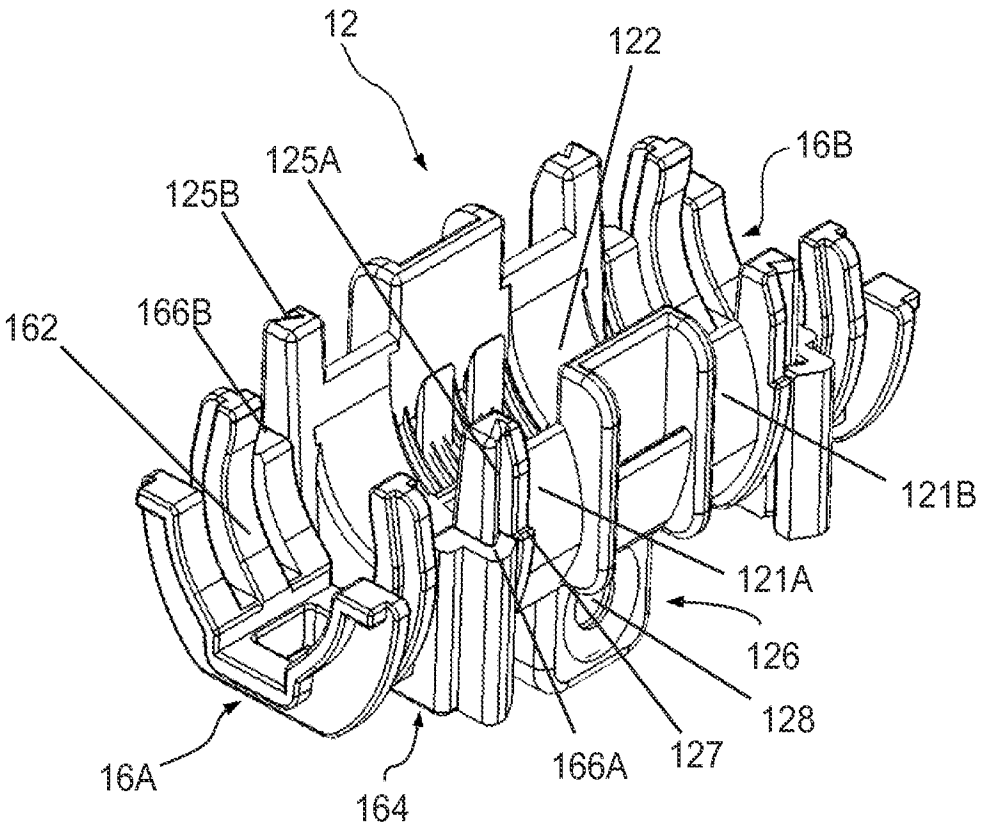

19
139A
18
124
139B

FIG. 4


12
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16B
125B
166B
162
121B
121A
126
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16A
164
166A
127

FIG. 5

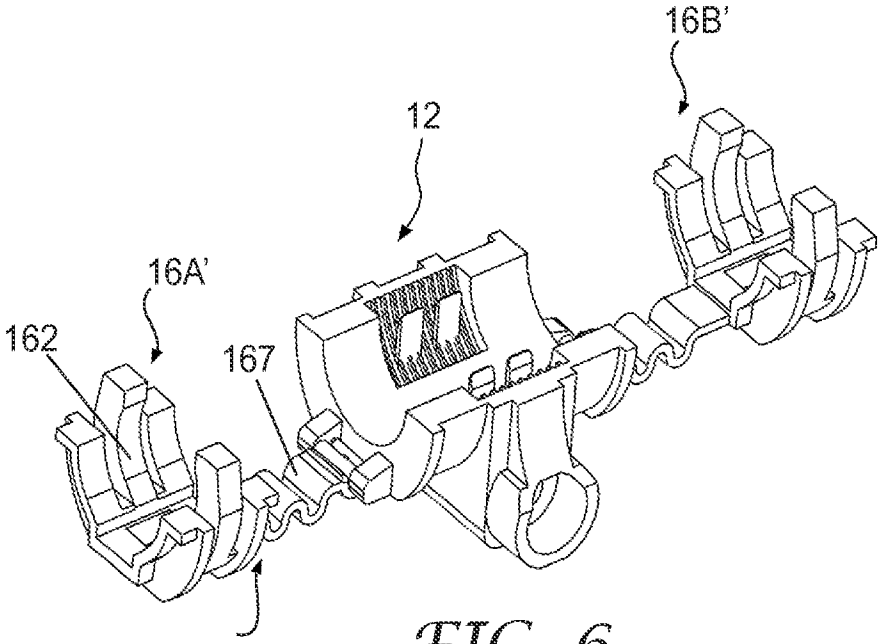

FIG. 6

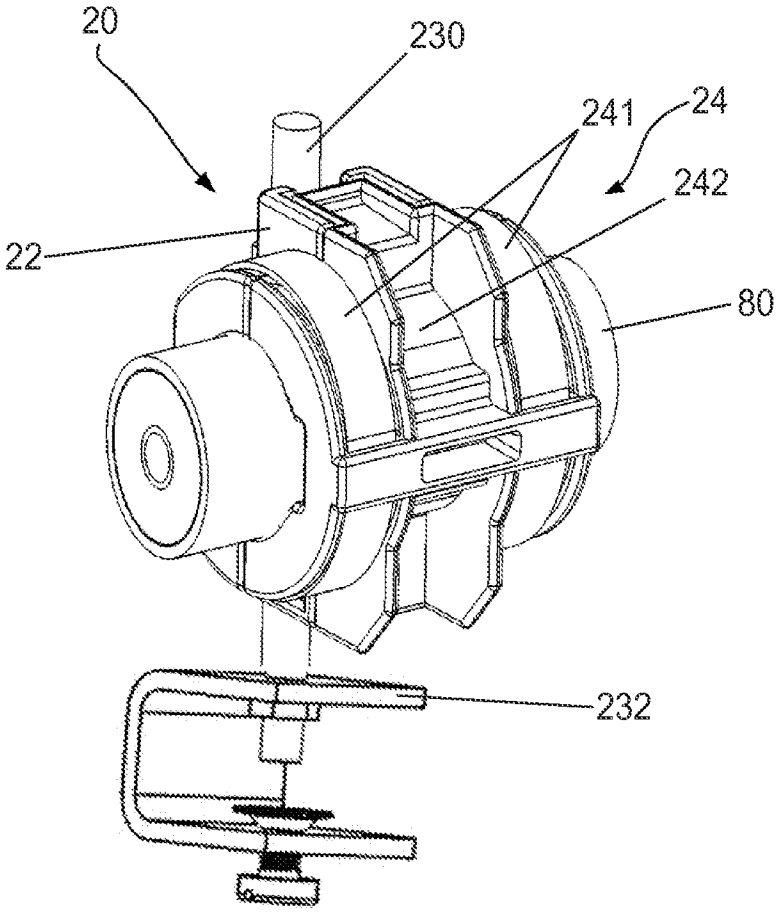

FIG. 7

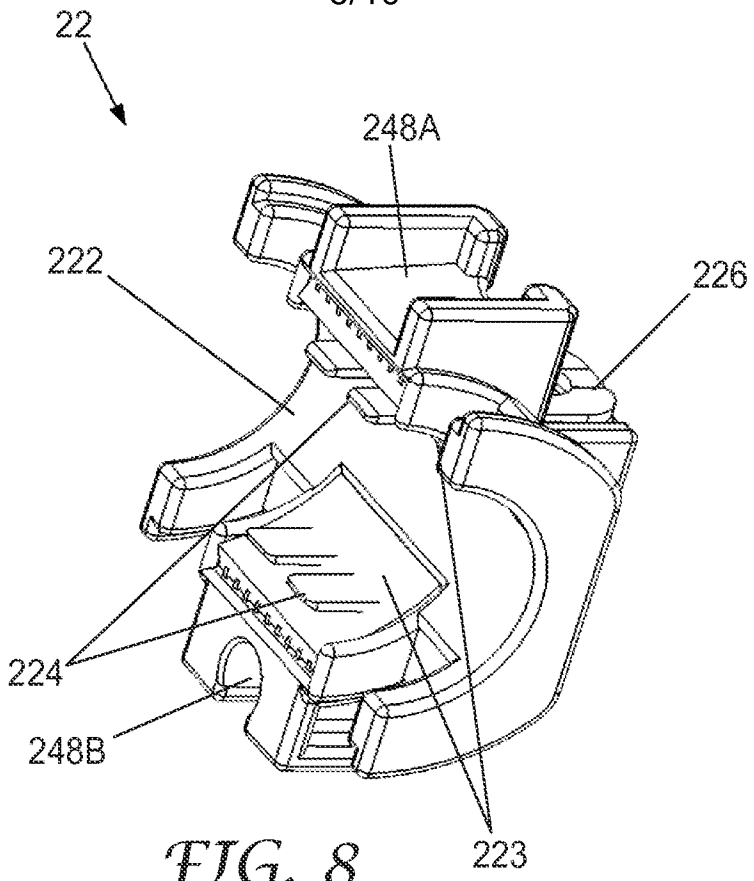

FIG. 8

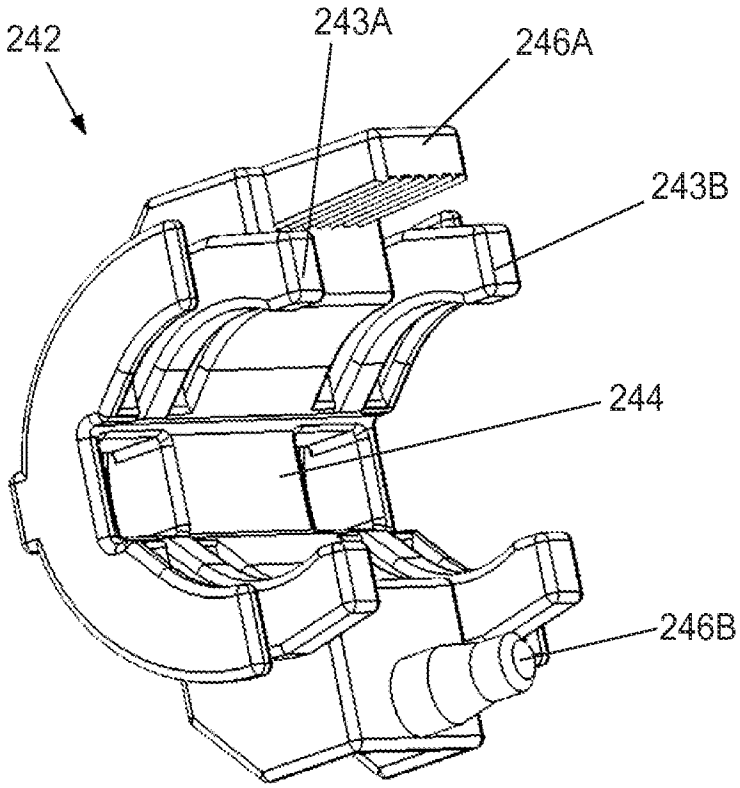

FIG. 9

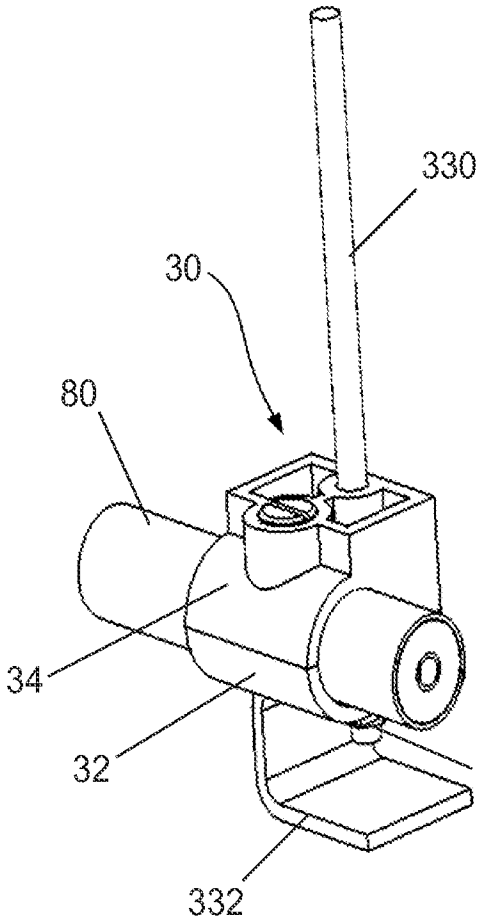

FIG. 10

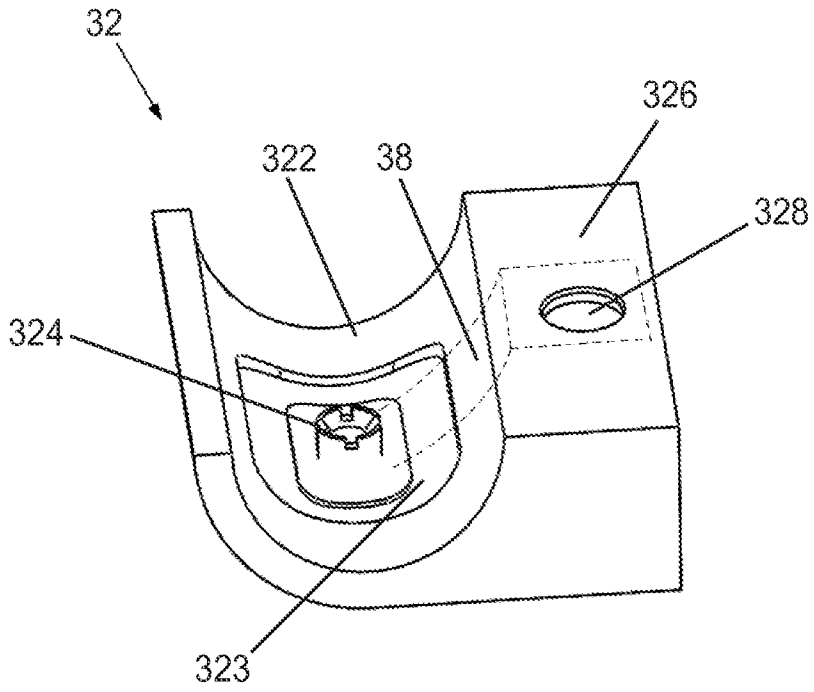

FIG. 11

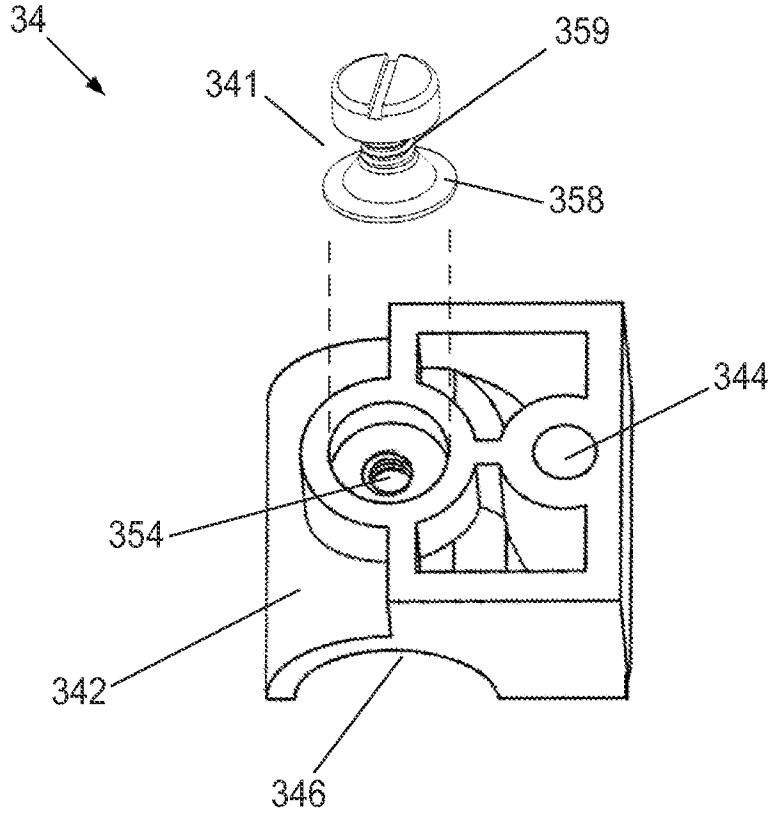

FIG. 12

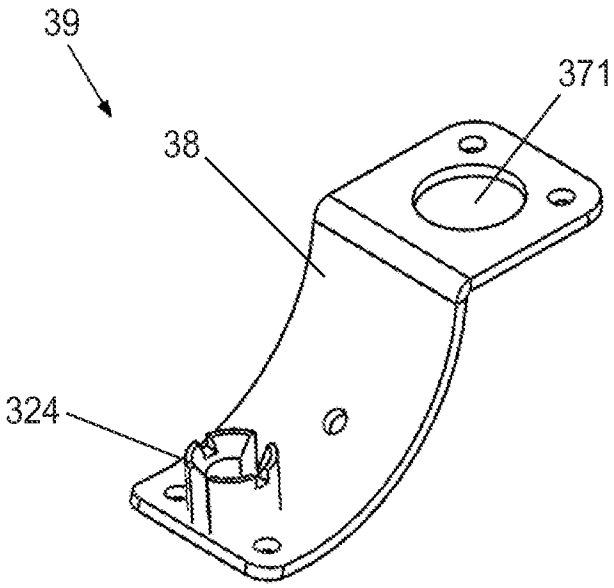

FIG. 13

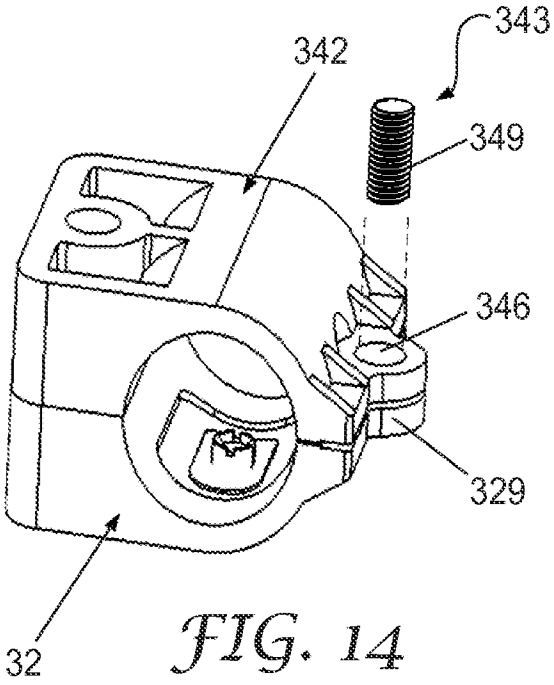

FIG. 14

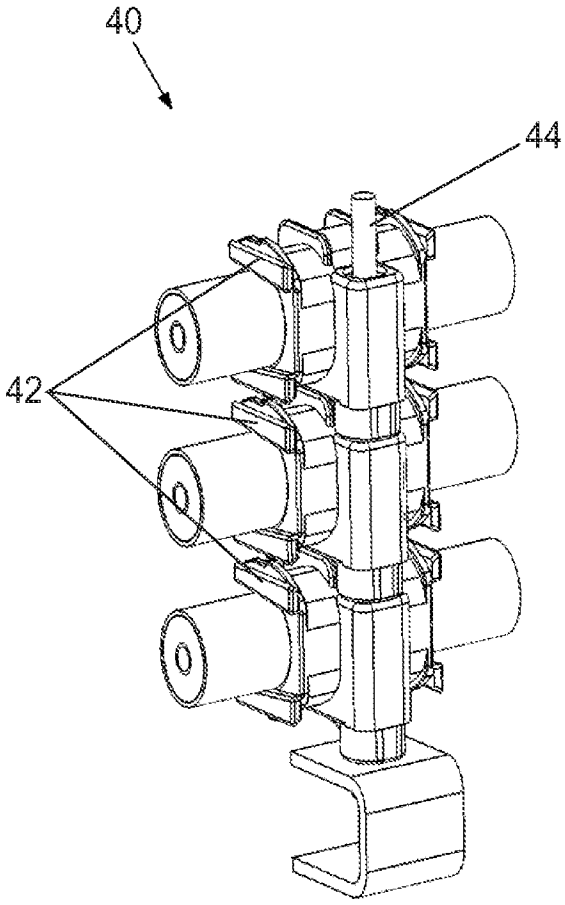

FIG. 15

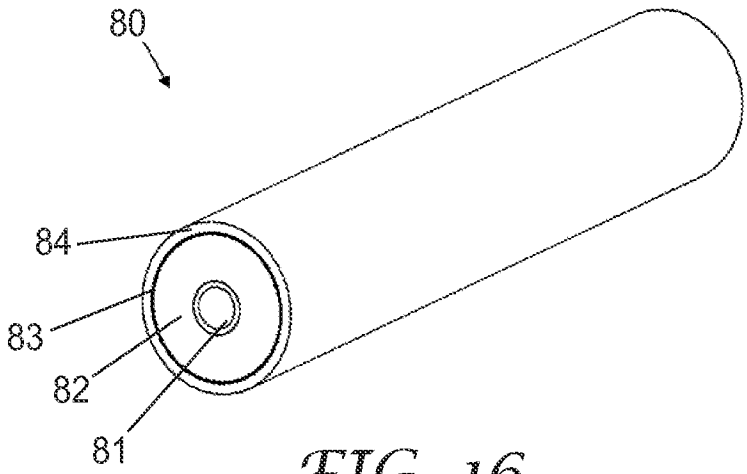

FIG. 16

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/027054

A. CLASSIFICATION OF SUBJECT MATTER

H01R 13/648(2006.01)i, H01R 9/05(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01R 13/648; H01R 9/03; H02G 15/08; H01R 4/66

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords:grounding module,coaxial cable,feeder cable,clamp,channel,sheath,protrusion,frame,orifice,screw,base portion

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2005-0233642 A1 (WALTER GERLICH et al.) 20 October 2005 See abstract; paragraphs [0032]-[0036]; claim 16 and figures 1-5.	1-22
A	US 05722841 A (JOHN O. WRIGHT) 03 March 1998 See abstract; column 2,lines 40-42; column 3,lines 55-57; column 4,lines 1-15; claim 1 and figures 1-2.	1-22
A	US 2007-0137877 A1 (MICHAEL STANSBIE et al.) 21 June 2007 See abstract; paragraphs [0025]-[0027]; claim 1 and figures 1-3.	1-22
A	US 05122068 A (MICHAEL R. KOSS) 16 June 1992 See abstract; column 4,lines 20-22; column 7,lines 20-24; claim 1 and figures 1-4.	1-22

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 SEPTEMBER 2012 (25.09.2012)	**25 SEPTEMBER 2012 (25.09.2012)**

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

Park Jung MIn

Telephone No. 82-42-481-5562

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2012/027054

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