



(51) International Patent Classification:

B60R 16/02 (2006.01) **H02G 3/04** (2006.01)
H01B 7/282 (2006.01) **H05K 9/00** (2006.01)

(21) International Application Number:

PCT/EP2016/000390

(22) International Filing Date:

4 March 2016 (04.03.2016)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

10 2015 003 061.2 10 March 2015 (10.03.2015) DE

(71) Applicant: **SUMITOMO WIRING SYSTEMS, LTD**
[JP/JP]; 1-14, Nishisuehiro-cho, Yokkaichi, Mie, 510-8503
(JP).

(72) Inventors: **KODAMA, Hiroyuki**; Peter Sander Strasse 32,
55252 Mainz-Kastel (DE). **MINOROV, Ventsislav**; Peter
Sander Strasse 32, 55252 Mainz-Kastel (DE).

(74) Agents: **SCHIUMA, Daniele** et al.; Müller-Boré & Part-
ner, Patentanwälte PartG mbB, Friedenheimer Brücke 21,
80639 München (DE).

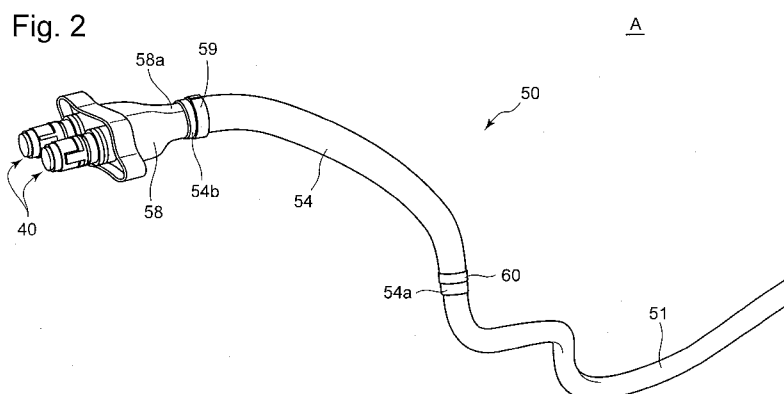
(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: SHIELDED WIRE HARNESS, SHIELDING MEMBER AND METHOD OF PRODUCING A SHIELDED WIRE HARNESS



(57) Abstract: There is disclosed a shielded wire harness A comprising: one or more of wires (30); a shielded connector (58) comprising one or more terminals (40) respectively connected to the wire(s) (30), and configured to be connected to a mating connector (12); and a shielding member (50) substantially formed in a tube shape and configured to collectively enclose the wire(s) (30) and to be connected to the shielded connector (58), wherein the shielding member (50) comprises a main shield portion (51) made of a conductive pipe (51), and a sub-shield portion (54) connected to the conductive pipe (51) and the shielded connector (58), and wherein the sub-shield portion (54) comprises a braided member (52) being at least partly covered by a coating (53) which provides fluid-tightness when the sub-shield portion (54) is connected to the conductive pipe (51) and the shielded connector (58). Furthermore, there is disclosed a corresponding shielding member and manufacturing method.

Description

The present invention relates to a shielded wire harness, to a shielding member and to a method of producing a shielded wire harness.

It is known in the art to shield wire harnesses used in vehicles, particularly used in electric vehicles (EV), in order to avoid unwanted influences in the electric system thereof. Such shielding can be achieved by individually shielding each wire or cable or by collectively shielding plural wires or cables by a shield layer such as by a braided shielding. Furthermore, it has been known e.g. from US 2014/0326479 A1 to use an electric-wire protection pipe which is a metal pipe that surrounds plural electric wires.

According to the present invention it is an object to improve shielding properties and sealability for a wire harness for a vehicle.

This object is solved according to the invention by the features of the
5 independent claims. Particular embodiments of the invention are subject of the dependent claims.

According to one aspect of the invention, there is provided a shielded wire harness comprising: one or more of wires; a shielded connector comprising one or more terminals respectively connected to the wire(s), and configured to be
10 connected to a mating connector; and a shielding member substantially formed in a

tube shape and configured to collectively enclose the wire(s) and to be connected to the shielded connector, wherein the shielding member comprises a main shield portion made of a conductive pipe, and a sub-shield portion connected to the conductive pipe and the shielded connector, and wherein the sub-shield portion
5 comprises a braided member being at least partly covered by or formed with a coating which provides fluid-tightness or sealability when the sub-shield portion is connected to the conductive pipe and the shielded connector.

Accordingly, by providing the shielding member comprising a main shield portion made of a conductive pipe and a sub-shield including a braided member
10 being at least partly covered by a coating high electromagnetic shielding properties and providing a high sealability (particularly fluid- or water-tightness) for the wire(s) arranged in the main shield portion. Moreover, the main shield portion made of the conductive pipe particularly allows for easily arranging the wire harness in a vehicle particularly taking into account its chassis design by bending the conductive pipe
15 accordingly. Furthermore, particularly due to a stiffness of the conductive pipe, it can be easily fixed to the vehicle at a reduced number of fixing points and/or it can efficiently protect the wire(s) against outside interactions (such as hitting of exterior objects e.g. stones). Accordingly, the shielded wire harness can be advantageously arranged in an underfloor layout of the vehicle. Moreover, the pipe-shape main shield
20 portion allows to protect the wire(s) from heat so that routing of the wire harness in the vehicle is facilitated, since the shielded wire harness may also be arranged close to the exhaust system, the engine or any other vehicle part which in operation may be strongly heated. Moreover, the shielded wire harness collectively enclosing plural wires has a lower overall weight as compared to a bundle of individually shielded
25 cables.

According to a particular embodiment, the braided member at least partly is embedded in the coating.

According to a further particular embodiment, the conductive pipe is a metal
5 pipe, preferably made of a metal selected from iron, aluminum, copper and stainless steel.

According to such a configuration, the conductive pipe can be easily manufactured and brought into the shape necessary for mounting it to the vehicle.

Particularly, the sub-shield portion is configured to be deformable.

10 According to such a configuration, the shielded wire harness can be more easily mounted to the vehicle, as the sub-shield portion can accommodate for size tolerances. Furthermore, the deformable sub-shield portion can adsorb vibrations and thus suppress vibration propagation between components of the vehicle.

Further particularly, the braided member is substantially formed in a tube shape
15 by braided metal wires.

According to such a configuration, the braided member provides excellent electromagnetic shielding properties while allowing a sufficient flexibility or deformability of the sub-shield portion.

Further particularly, the coating is made of an elastomer, wherein the elastomer
20 preferably is chosen from the group of a silicone elastomer, a polyamide elastomer and a polyolefin elastomer, wherein the polyolefin elastomer more preferably is chosen from the group of polyethylene (PE) and polyethylene vinyl chloride (PEVC).

According to such a configuration, the sub-shield portion can be easily manufactured, have good isolation properties and/or have a good flexibility.

25 Further particularly, the sub-shield portion is connected to the conductive pipe and/or the shielded connector by means of at least one fixing member.

According to such a configuration, the shielding member can be easily assembled.

Further preferably, a connection area of the sub-shield portion to the conductive pipe and/or the shielded connector is covered by at least one sealing member.

- 5 According to such a configuration, it is possible to ensure sealability (particularly water-tightness) of the shielding member, as not only the sub-shield portion (by means of its coating) and the conductive pipe are properly sealed, but also their connection area is properly sealed by the sealing member.

- 10 According to a further aspect of the invention, there is provided a shielding member for a shielded wire harness comprising one or more of wires and a shielded connector, wherein: the shielding member is formed in a tube shape and configured to enclose the wire(s) collectively and to be connected to the shielded connector, the shielding member comprises a main shield portion made of a conductive pipe, and a sub-shield portion connected to the conductive pipe and the shielded connector, and
15 the sub-shield portion comprises a braided member being at least partly covered by or formed with a coating.

- 20 Accordingly, by providing the shielding member comprising a main shield portion made of a conductive pipe and a sub-shield including a braided member being at least partly covered by or formed with a coating high electromagnetic shielding properties and providing a high sealability (particularly water-tightness) for the wire(s) arranged in the main shield portion. Moreover, the above mentioned advantages can be further achieved.

- 25 According to a particular embodiment, the braided member is substantially formed in a tube shape by braided metal wires, and/or the coating is made of an elastomer, wherein the elastomer preferably is chosen from the group of a silicone elastomer, a polyamide elastomer and a polyolefin elastomer, wherein the polyolefin

elastomer more preferably is chosen from the group of polyethylene (PE) and polyethylene vinyl chloride (PEVC).

According to such a configuration, the sub-shield portion can be easily manufactured, have good isolation properties and/or have a good flexibility.

5 According to a further aspect of the invention, there is provided a method of producing a shielded wire harness, in particular according to the above aspect of the invention or a particular embodiment thereof, comprising the following steps: providing one or more of wires; collectively enclosing the wire(s) by means of a shielding member formed in a tube shape; respectively connecting one or more
10 terminals of a shielded connector to the wire(s); and connecting the shielding member to the shielded connector; wherein the shielding member comprises a main shield portion made of a conductive pipe, and a sub-shield portion connected to the conductive pipe and the shielded connector, and wherein the sub-shield portion comprises a braided member being at least partly covered by or formed with a
15 coating which provides fluid-tightness or sealability when the sub-shield portion is connected to the conductive pipe and the shielded connector..

Accordingly, it is possible to produce a shielded wire harness having good sealability (particularly water-tightness) of the shielding member.

20 According to a particular embodiment, the coating is made of an elastomer, wherein the elastomer preferably is chosen from the group of a silicone elastomer, a polyamide elastomer and a polyolefin elastomer, wherein the polyolefin elastomer more preferably is chosen from the group of polyethylene (PE) and polyethylene vinyl chloride (PEVC).

Particularly, the braided member at least partly is embedded in the coating.

25 Further particularly, the sub-shield portion is connected to the conductive pipe and/or the shielded connector by means of at least one fixing member.

Further particularly, the method further comprises covering at least one of a connection area of the sub-shield portion to the conductive pipe and the shielded connector (58) by at least one sealing member.

These and other objects, features and advantages of the present invention will become more apparent upon reading of the following detailed description of preferred embodiments and accompanying drawings. It should be understood that even though embodiments are separately described, single features thereof may be combined to additional embodiments.

FIG. 1a is a schematic side view, showing a state in which a shielded wire harness according to an embodiment of the invention is interposed between two pieces of equipment;

FIG. 1b is a perspective view of the motor-side end portion of the shielded wire harness;

FIG. 2 is a perspective view of a part of a shielded wire harness according to an embodiment of the invention;

FIG. 3 is a longitudinal sectional view of a part of the shielded wire harness;

FIG. 4 is a sectional view of along A-A of **Fig. 3**;

FIG. 5 is a longitudinal sectional view of a part of a shielded wire harness according to a further embodiment of the invention; and

FIG. 6 is a sectional view of along A-A of **Fig. 5**.

Referring now to the accompanying drawings, a description will be given in detail of preferred embodiments of the invention.

A shielded wire harness A according to a first particular embodiment of the present invention, described with reference to **FIGS. 1 through 4**, is used for connecting a first equipment 10 (such as an inverter unit) of a vehicle (particularly an

electric vehicle (EV), a hybrid electric vehicle (EHV), plug-in hybrid electric vehicle (PEHV), range extended electric vehicle (REEV) and the like) to a second equipment 20 (such as a motor) respectively disposed in the vehicle.

The first equipment 10 is e.g. disposed in an engine room and is structured such that an equipment connector 12 (as a particular mating connector) having one or more equipment-side terminals extended from the first equipment 10 are at least partly accommodated in a connector housing having shielding properties.

The motor 20 particularly is disposed on a wheel of the electric vehicle and is structured such that a coil (not shown) and equipment-side terminals (not shown) connected to the coil are stored in a conductive shield case 21. Each of the equipment-side terminals may particularly be formed as a thick plate shape referred to as a bus bar and includes a bolt hole which penetrates through the terminal in the thickness direction thereof. In the side wall of the shield case 21, there are formed one or more mounting holes shaped in oblong so as to correspond to the three equipment-side terminals, and also there are formed a pair of female screw holes 26 which are situated on the two right and left sides of the mounting holes 25.

Next, description will be given below of the shielded wire harness A according to the first embodiment.

The wire harness A includes one or more wires 30, at least one shielded connector 58 provided on at least one side of the wire(s) 30 and comprising a shielded housing at least partly accommodating one or more terminals 40, which are to be electrically connected to the wire(s) 30 and a tube-shaped shielding member 50 (bracket shield) collectively enclosing the one or more wires 30. In other words, the wire(s) 30 are arranged inside the conductive tube-shaped shielding member 50 thus shielding the wire(s) 30 from electromagnetic radiation and/or protecting them from outside interactions (water, hitting objects, etc.). It should be understood that a

second shielded connector may be provided also at the second end of the wire(s) 30. Alternatively or additionally, wire-side terminals may be fixedly secured to the other end portion of each of the one or more wires 30 to be directly connected to an equipment e.g. by bolting, i.e. without interposition of a connector and mating
5 connector. In such case, each of the wire-side terminals may be made of a thick metal plane member; and, a front portion (particularly a substantially front-half section) of each of the wire-side terminals provides an equipment connecting portion which is formed in a substantially-flat-plate shape and includes a bolt hole penetrating in a thickness direction of the wire-side terminal through the equipment
10 connecting portion, while a rear portion (particularly a substantially-rear-half section) provides an open-barrel-shaped wire pressure connect portion. Specifically, a conductor 31 of the wire 30 may be crimped or pressure connected to the wire pressure connect portion 43 in a conductible manner.

The one or more (e.g. two) wires 30 each include a conductor 31 and an
15 insulation sheath 32 enclosing the outer periphery of the conductor 31 and, differently from a shielded wire, no shield layer is arranged in or on the wire 30.

The shielding member 50 includes: a main shield portion 51 which is long in dimension, conductive, and particularly extends for more than about two thirds (particularly almost the entire length) of the shielding member 50; and a sub-shield
20 portion 54 as a particular connector end portion of the shielding member 50, and is shorter than the main shield portion 51.

The main shield portion 51 includes a (particularly substantially cylindrical or elliptical shaped) pipe or tubular member made of conductive material such as metal (e.g. iron, aluminum, copper, or stainless steel), and has an inside diameter that
25 allows the one or more (e.g. two) wires 30 to be inserted through the main shield portion 51. The main shield portion 51 substantially is bent along the wiring route of

the wire harness A. That is, the portion of the main shield portion 51 situated adjacent to the motor 20 provides a long horizontal portion 51a e.g. extending substantially in the horizontal direction, while part of the long horizontal portion 51a is formed low in position. The low portion is a lowest portion 51b that is lowest in the wiring route of the wire harness A and, in the lowest portion 51b, there particularly may be formed at least one drain hole 52' which is open on the lower surface side thereof. A rising portion 51c is formed so as to substantially extend upwardly from the end portion of the long horizontal portion 51a of the main shield portion 51 on the opposite side to the motor 20 and, from the upper or distal end portion of the rising portion 51c, there is formed a short horizontal portion 51d in such a manner that it extends substantially horizontally toward the first equipment 10. Also, a motor-side end portion of the long horizontal portion 51a provides a substantially elliptic portion 51e which substantially spreads in a tapered shape in the lateral direction. In or at the open edge portion of the substantially elliptic portion 51e, there are formed one or more, particularly a pair of mounting portions 51f which project in the lateral directions and, in (particularly each of) the mounting portion(s) 51f, there is formed a bolt hole 51g. On the other hand, the connector end portion of the short horizontal portion 51d particularly may be formed in a substantially circular shape.

The sub-shield portion 54 includes a (particularly substantially tube-shaped) braided member 52 which is at least partly covered by or formed with or embedded in a coating 53.

The (tube-shaped) braided member 52 particularly is formed by braiding together conductive thin lines particularly made of metal (e.g. copper or aluminum) in a mesh-like manner. Particularly, the braided member 52 at least partly is embedded in the coating 53 so that the thin lines at least partly are surrounded by the (particularly elastomeric) material of the coating 53. Thus, an increased sealability or

fluid-tightness is achieved. In view of allowing a simple electric connection to the main shield portion 51 and/or the shielded connector 58, the braided member 52 is not completely embedded in the coating 53, but one or more portions thereof are left not embedded or non-coated so that at least part of the thin lines can be electrically
5 connected to the main shield portion 51 and/or the shielded connector 58, respectively. In specific applications, additional plastic wires or yarn may be meshed into the braided member 52 to improve the mechanical properties of the sub-shield portion 54. One end portion (main-shield-portion-side) of the tube-shaped braided member 54 is formed as a pipe-side portion 54a having a diameter dimension
10 necessary for insertion of the one or more wires 30 and to be connectable to the respective part of the conductive pipe 51, while the other (connector-side) end portion thereof is formed as a connector-side portion 54b which is able to store the one or more wires 30 (and potentially also the one or more wire-side terminals in such a manner that they are arranged spaced apart from each other in the lateral
15 direction thereof). Moreover, in case the braided member 52 is connected to the shielded connector 58, the connector-side portion 54b is dimensioned such that it can be connected to a braided-member side connector portion 58a.

The braided member 52 is at least partly covered by or formed with or embedded in a flexible coating 53, so that the sub-shield portion 54 is overall
20 configured to be deformable. The coating 53 particularly is made of an elastomer, particularly chosen from the group of a silicone elastomer, a polyamide elastomer and a polyolefin elastomer, such as polyethylene (PE) or polyethylene vinyl chloride (PEVC). The sub-shield portion 54 particularly is configured such that the coating 53 is substantially provided only on the outside surface of the braided member 52.
25 Accordingly, the braided member 52 is at least partly exposed to the inner side of the substantially tubular sub-shield portion 54. In some instances, the braided member

52 may be (particularly slightly) immersed or embedded in the coating 53, but inner parts of the braided member 52 may still be exposed in order to contact the main shield portion 51 (as described hereinafter). By providing the coating 53, fluid-tightness (particularly water-tightness) is achieved for the sub-shield portion 54.

5 The connector portion 58a of the connector particularly may be made of metal (e.g. iron, aluminum, copper or stainless steel) and/or particularly may be formed in a cylindrical shape having a dimension substantially equal to the short horizontal portion 51d of the main shield portion 51. The connector portion 58a particularly has a length necessary and sufficient to connect together the tube-shaped braided
10 member 54 and the main shield portion 51, while the length dimension thereof is much shorter than that of the main shield portion 51.

 The pipe-side portion 54a of the tube-shaped braided member 54 is fitted with the outer surface of the first equipment-side end portion of the main shield portion 51 (particularly on the short horizontal portion 51d), at least one caulking ring or clamp
15 60 is fitted with the outer surface of the pipe-side portion 54a from outside, and, by caulking or deforming the caulking ring 60, the pipe-side portion 54a of the tube-shaped braided member 54 is conductively fixed to the distal end portion (particularly on the short horizontal portion 51d) of the main shield portion 51. In this respect it is noted that the braided member 54 is at least partly exposed to the inner side of the
20 sub-shield portion 54 so that it can be easily electrically connected to the main shield portion 51. Accordingly, the electromagnetic shielding properties are improved. Also, a tin plating treatment (not shown) particularly is enforced or may be provided on the outer peripheral surface of the main shield portion 51, that is, particularly on the surface thereof to be contacted with the tube-shaped braided member 54.
25 Specifically, the tin plating treatment can reduce the contact resistance between the main shield portion 51 and (particularly tube-shaped) braided member 54.

Incidentally, in the embodiment, on the surface of the main shield portion 51 with which the tube-shaped braided member 54 is not directly contacted, particularly there is not enforced or provided a plating treatment for reduction of the contact resistance between them. However, an anti-corrosion plate may be enforced or provided (for example, in case where the main shield portion 51 is made of iron, a zinc plating treatment may be enforced on the surface thereof).

Furthermore, a sealing member 62 may be provided in correspondence of the connecting area of the braided member 54 and the main shield portion 51. The sealing member 62 may be provided by arranging a heat-shrinkable tube over the connecting area and subsequently shrinking it to seal the connection of the braided member 54 and the main shield portion 51. Alternatively or additionally, the sealing member 62 may comprise taping wound over the connecting area.

The connector-side portion 54b of the tube-shaped braided member 54 is placed on the braided-member side connector portion 58a of the shielded connector 58, a caulking ring 59 is fitted with the connector-side portion 54b from the outside thereof and, by caulking or deforming the caulking ring 59, the connector-side portion 54b of the tube-shaped braided member 54 is conductively fixed to the connector portion 58a of the shielded connector 58.

To connect the wire harness A above configured to the first equipment 10, firstly, the shielded connector 58 housing the one or more terminals 40 electrically connected to the wire(s) 30 and electrically connected to the shielding member 50 is connected to a mating connector 12 provided at the first equipment 10 such as an electric device (particularly an inverter).

Although not shown, the connection of the wire harness A and the second equipment (e.g. the motor) 20 is also executed similarly to the connection of the wire harness A and first equipment (e.g. the inverter unit) 10. Alternatively, one or more

wire-side terminals (not shown) projected from the substantially-elliptic-shaped portion 51e forming the end portion of the long horizontal portion 51a are inserted into their associated mounting holes 25 of the shield case 21 to thereby place the equipment-side connecting portion onto equipment-side terminals (not shown), and
5 the (particularly two kinds of) terminals are then conductively connected to each other using bolts and nuts. Incidentally, the main shield portion 51 is fixed to a vehicle body (not shown) at one or more positions in the intermediate portion of the wiring route of the wire harness A.

As described above, the wire harness A according to the embodiment is
10 structured such that the shielding member 50 enclosing the one or more wires 30 collectively comprises the main shield portion 51 composed of a metal-made pipe and the sub-shield portion 54 formed to be deformable particularly because it is shorter than the main shield portion 51 and/or it uses the tube-shaped braided member 52 (at least partly) covered by or formed with or embedded in a flexible
15 coating 53. As a result, the wire harness A can provide the following advantages.

Since the main shield portion 51 particularly is made of a metal-made pipe, it not only can fulfill a shield function but also can positively protect the one or more wires 30 from objects such as bouncing stones. In this manner, because the main shield portion 51 (particularly constituting or forming a major part of the shielding
20 member 50) serves also as means for protecting the wire(s) 30, the number of parts can be reduced when compared with a structure in which protect means is disposed separately from the shielding member 50.

Since the main shield portion 51 particularly is made of a metal pipe, if the two ends of the main shield portion 51 are fixed generated stresses in the fixed portions
25 due to the vibrations thereof. However, in the embodiment, because the sub-shield portion 54 particularly is formed flexible, it can absorb the vibrations, thereby being

able to avoid the generation of the stresses in the fixed portion thereof to the first equipment.

Also, the sub-shield portion 54 includes the substantially tube-shaped braided member 52 and, because the tube-shaped braided member 52 is composed of or
5 comprises metal thin lines braided together, it can be deformed flexibly. Therefore, the sub-shield portion 54 is able to cope with even a case in which the one or more wires 30 are bent and/or wired with large curvature in the neighbouring portion of the equipment.

Since the (tube-shaped) braided member 52 is made of metal thin lines, the
10 contact area thereof with the main shield portion 51 (particularly with the short horizontal portion 51d thereof) is small and thus the two parts 52 and 51 can be lowered in reliability. However, according to the embodiment, because a plating treatment for reducing the contact resistance of the main shield portion 51 with respect to the (tube-shaped) braided member 52 particularly is enforced e.g. in
15 correspondence of the short horizontal portion 51d, the contact reliability of the two parts 52 and 51 is high.

Moreover, the plate treatment may be enforced substantially only on the part of the main shield portion 51 which is to be contacted with the tube-shaped braided member 52, and no plating is necessary on the long main shield portion 51.
20 Therefore, it is possible to reduce the cost of the wire harness A down to a low level.

In addition, in the main shield portion 51 of the shielding member 50, specifically, in the lowest portion of the wiring route of the wire harness, there particularly is formed the drain hole 52' which is open in the substantially downward direction, thereby being able to discharge the water that collects in the interior of the
25 shielding member 50. Due to the above configuration, it can positively prevent occurrence of an unfavourable phenomenon such as corrosion due to the existence

of the water.

A shielded wire harness according to a further particular embodiment of the invention is described with reference to **Figs. 5 and 6**. It should be understood that elements of the further embodiment similar to or substantially same as the first embodiment are denoted by the same reference numerals and a description is omitted herein.

Unlike the first embodiment, in this embodiment the sub-shield portion 54 is such that the coating 53 is provided along the longitudinal extension of the (particularly tube-shaped) braided member 52 except on one or more distal ends of the sub-shield portion 54 so as to create one or more exposed portions 52a of the (particularly tube-shaped) braided member 52 (see **Fig. 5**). The exposed end portions 52a may be created by stripping-off a respective part of the coating 53 or by not providing the coating 53 on these portions 52a from the outset. The exposed end portion(s) 52a may then be fixed to and electrically connected with the main shield portion 51 (particularly to/with the short horizontal portion 51d thereof) and/or the shielded connector 58 (particularly with/to the braided-member side connector portion 58a thereof) by means of at least one caulking ring or clamp 60/59.

Accordingly, since the main shield portion particularly is composed of a metal-made pipe, it not only can fulfill a shielding function but also can positively protect the wires from object such as bounced stones. Further, because the main shield portion, which constitutes a major part of the shielding member, serves also as member to protect the wires, the number of parts can be reduced when compared with a wire harness which uses protecting members in addition to the shielding member. Since the main shield portion is made of a metal pipe, if the two ends of the main shield portion are fixed directly to the shield case, there can be generated stresses in the

fixed portions due to vibrations or the like. However, because the sub-shield portion is deformable and thus can absorb the vibrations, actually, there can be prevented occurrence of the stresses in the fixed portions of the main shield portion to the shield case.

5 The present invention is not limited to the embodiments respectively discussed through the foregoing description and drawings but, for example, the following embodiments also fall within the technical scope of the invention. Also, other various changes and modifications than the following embodiments are also possible without departing from the scope of the claims.

10 (1) It should be understood that the braided member 52, particularly its exposed end portion(s) 52a may be connected to the main shield portion 51 and/or the shielded connector 58 by means other than a caulk ring 60/59 such as by welding or soldering or mechanical crimping, a hose clamp or the like.

15 (2) In the embodiments described above, the sub-shield portion is connected to the first equipment such as inverter unit. However, according to the invention, the sub-shield portion can also be alternatively or additionally connected to the motor.

20 (3) In the embodiments described above, the major area of the main shield portion is formed so as to have a substantially circular section except for the end portion thereof. However, according to the invention, the major area of the main shield portion may also be formed so as to have another section shape such as an elliptic section or a square shape.

25 (4) In the embodiments described above, the connecting pipe is formed so as to have a circular section. However, according to the invention, the connecting pipe may also be formed so as to have another section shape such as an elliptic section shape or a square section shape.

(5) In the embodiments described above, the tube-shaped braided member is directly connected to the main shield portion. However, according to the invention, tube-shaped braided member may be connected to the main shield portion through a connecting pipe fixedly connected to the main shield portion.

5 (6) In the embodiments described above, description has been given of a case in which the wire harness is used for connecting together the inverter unit and motor of an electric vehicle. However, the invention can also be applied to a wire harness which is arranged between other pieces of equipment.

10 Although the present invention has been shown and described with reference to a specific embodiment, various changes and modifications will be apparent to those skilled in the art from the teachings herein. Such changes and modifications as are obvious are deemed to come within the spirit, scope and contemplation of the invention as defined in the appended claims.

15

Reference List

	A	...	shielded wire harness
	10	...	first equipment (e.g. inverter)
	12	...	equipment connector (mating connector)
20	20	...	second equipment (e.g. motor)
	21	...	conductive shield case
	25	...	mounting hole
	26	...	hole
	30	...	wires
25	31	...	conductor

	32	...	insulation sheath
	40	...	terminal
	50	...	shielding member
	51	...	conductive pipe (main shield portion)
5	51a	...	horizontal portion
	51b	...	lowest portion
	51c	...	rising portion
	51d	...	short horizontal portion
	51e	...	substantially elliptic portion
10	51f	...	mounting portion
	51g	...	bolt hole
	52'	...	drain hole
	52	...	braided member
	52a	...	exposed end portion
15	53	...	coating
	54	...	sub-shield portion
	54a	...	pipe-side portion
	54b	...	connector-side portion
	58	...	shielded connector
20	58a	...	braided-member side connector portion
	59, 60	...	caulk ring (fixing member)
	61, 62	...	heat-shrinkable tube (sealing member)

Claims

1. A shielded wire harness (A) comprising:

one or more of wires (30);

a shielded connector (58) comprising one or more terminals (40) respectively connected to the wire(s) (30), and configured to be connected to a mating
5 connector (12); and

a shielding member (50) substantially formed in a tube shape and configured to collectively enclose the wire(s) (30) and to be connected to the shielded connector (58),

wherein the shielding member (50) comprises a main shield portion (51)
10 made of a conductive pipe (51), and a sub-shield portion (54) connected to the conductive pipe (51) and the shielded connector (58), and

wherein the sub-shield portion (54) comprises a braided member (52) being at least partly covered by a coating (53) which provides fluid-tightness when the sub-shield portion (54) is connected to the conductive pipe (51) and the shielded
15 connector (58).

2. A shielded wire harness according to claim 1, wherein the braided member (52) at least partly is embedded in the coating (53).

20 3. A shielded wire harness according to any one of the preceding claims, wherein the conductive pipe (51) is a metal pipe, preferably made of a

claims, wherein the conductive pipe (51) is a metal pipe, preferably made of a metal selected from iron, aluminum, copper and stainless steel.

4. A shielded wire harness according to any one of the preceding
5 claims, wherein the sub-shield portion (54) is configured to be deformable.

5. A shielded wire harness according to any one of the preceding
claims, wherein the braided member (52) is substantially formed in a tube shape
by braided metal wires.

10

6. A shielded wire harness according to any one of the preceding
claims, wherein the coating (53) is made of an elastomer, wherein the elastomer
preferably is chosen from the group of a silicone elastomer, a polyamide
elastomer and a polyolefin elastomer, wherein the polyolefin elastomer more
15 preferably is chosen from the group of polyethylene (PE) and polyethylene vinyl
chloride (PEVC).

7. A shielded wire harness according to any one of the preceding
claims, wherein the sub-shield portion (54) is connected to the conductive pipe
20 (51) and/or the shielded connector (58) by means of at least one fixing member
(60; 59).

8. A shielded wire harness according to any one of the preceding
claims, wherein a connection area of the sub-shield portion (54) to the conductive
25 pipe (51) and/or the shielded connector (58) is covered by at least one sealing
member (62; 61).

9. A shielding member (50) for a shielded wire harness (A) comprising

one or more of wires (30) and a shielded connector (58), wherein:

the shielding member (50) is formed in a tube shape and configured to enclose the wire(s) (30) collectively and to be connected to the shielded connector (58),

5 the shielding member (50) comprises a main shield portion (51) made of a conductive pipe (51), and a sub-shield portion (54) connected to the conductive pipe (51) and the shielded connector (58), and

the sub-shield portion (54) comprises a braided member (52) being at least partly covered by a coating (53).

10

10. A shielding member according to claim 9, wherein:

the braided member (52) is substantially formed in a tube shape by braided metal wires, and/or

wherein the coating (53) is made of an elastomer, wherein the elastomer
15 preferably is chosen from the group of a silicone elastomer, a polyamide elastomer and a polyolefin elastomer, wherein the polyolefin elastomer more preferably is chosen from the group of polyethylene (PE) and polyethylene vinyl chloride (PEVC).

20 11. A method of producing a shielded wire harness (A) comprising the following steps:

providing one or more of wires (30);

collectively enclosing the wire(s) (30) by means of a shielding member (50) formed in a tube shape;

25 respectively connecting one or more terminals (40) of a shielded connector (58) to the wire(s) (30); and

connecting the shielding member (50) to the shielded connector (58);

wherein the shielding member (50) comprises a main shield portion (51) made of a conductive pipe (51), and a sub-shield portion (54) connected to the conductive pipe (51) and the shielded connector (58), and

wherein the sub-shield portion (54) comprises a braided member (52) being
5 at least partly covered by a coating (53) which provides fluid-tightness when the sub-shield portion (54) is connected to the conductive pipe (51) and the shielded connector (58).

12. A method according to claim 11, wherein the coating (53) is made of
10 an elastomer, wherein the elastomer preferably is chosen from the group of a silicone elastomer, a polyamide elastomer and a polyolefin elastomer, wherein the polyolefin elastomer more preferably is chosen from the group of polyethylene (PE) and polyethylene vinyl chloride (PEVC).

15 13. A method according to claim 11 or 12, wherein the braided member (52) at least partly is embedded in the coating (53).

14. A method according to any one of the preceding claims 11 to 13,
wherein the sub-shield portion (54) is connected to the conductive pipe (51) and/or
20 the shielded connector (58) by means of at least one fixing member (60; 59).

15. A method according to any one of the preceding claims 11 to 14,
further comprising covering at least one of a connection area of the sub-shield
portion (54) to the conductive pipe (51) and the shielded connector (58) by at least
25 one sealing member (62; 61).

Fig. 1a

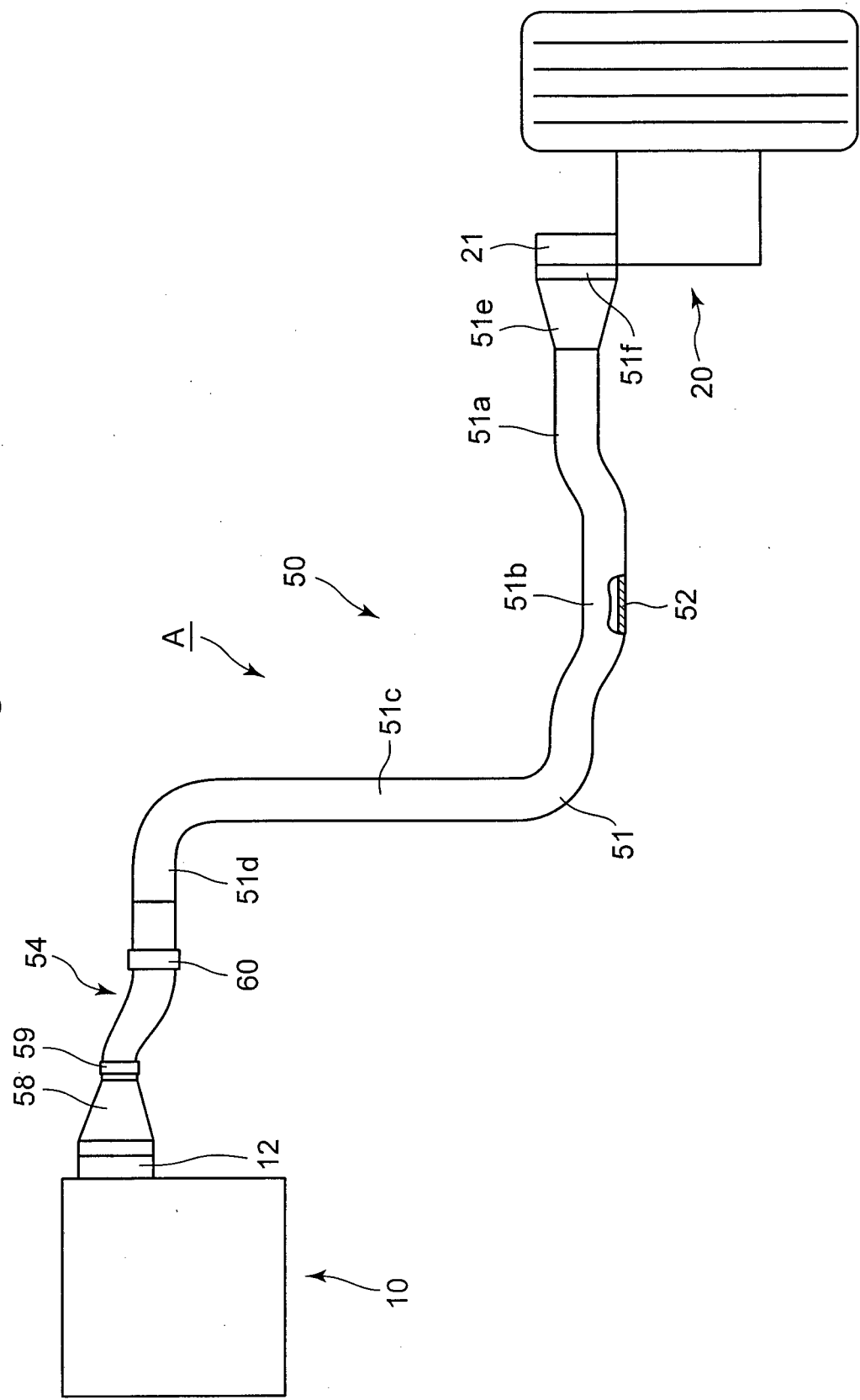


Fig. 1b

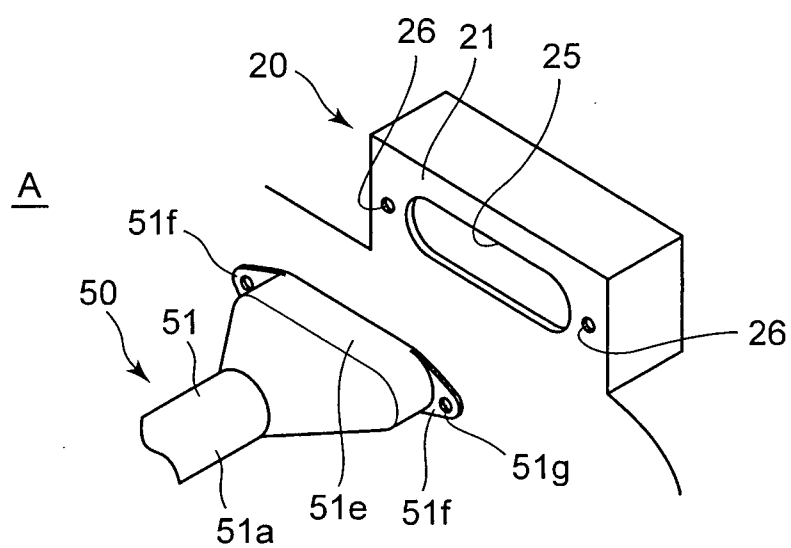


Fig. 2

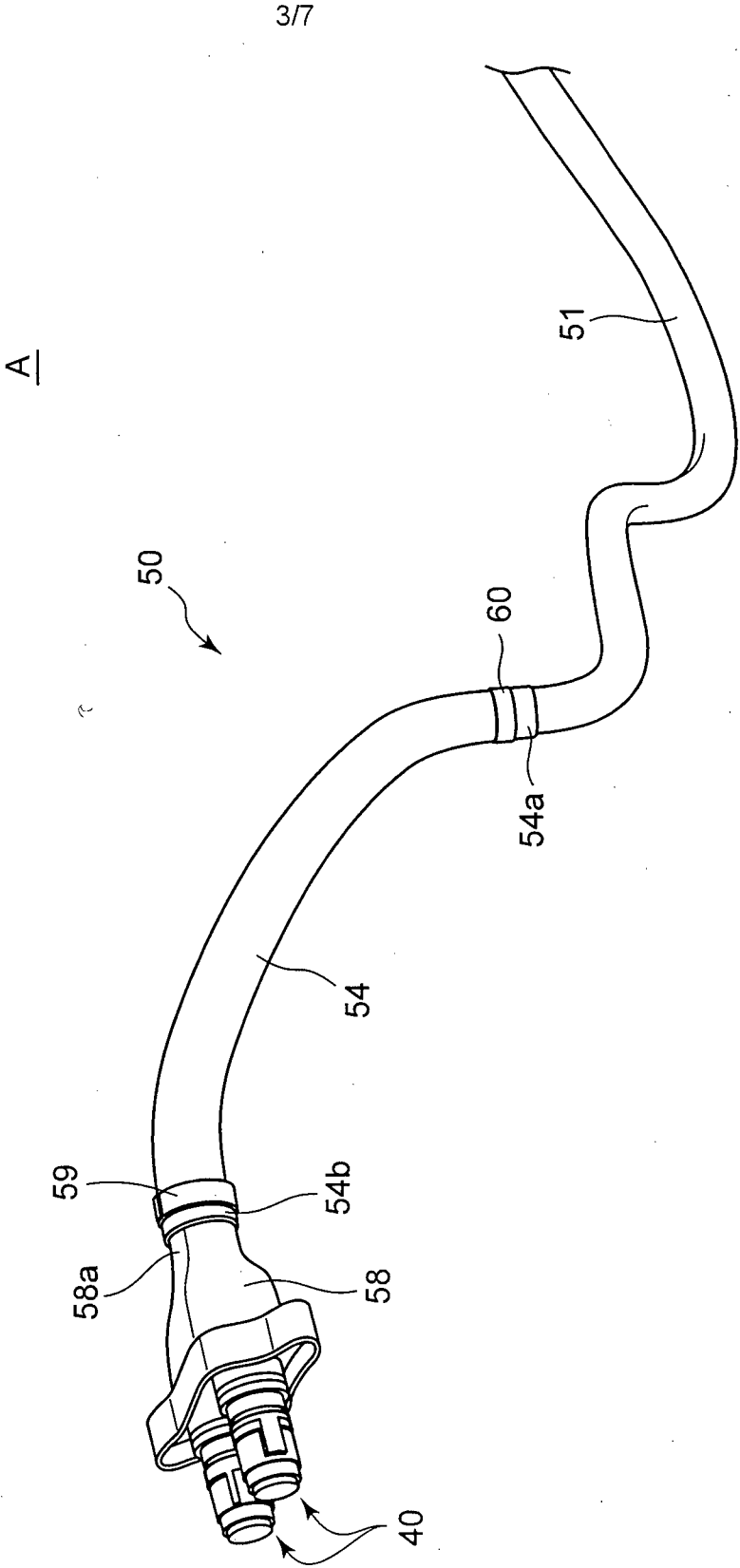
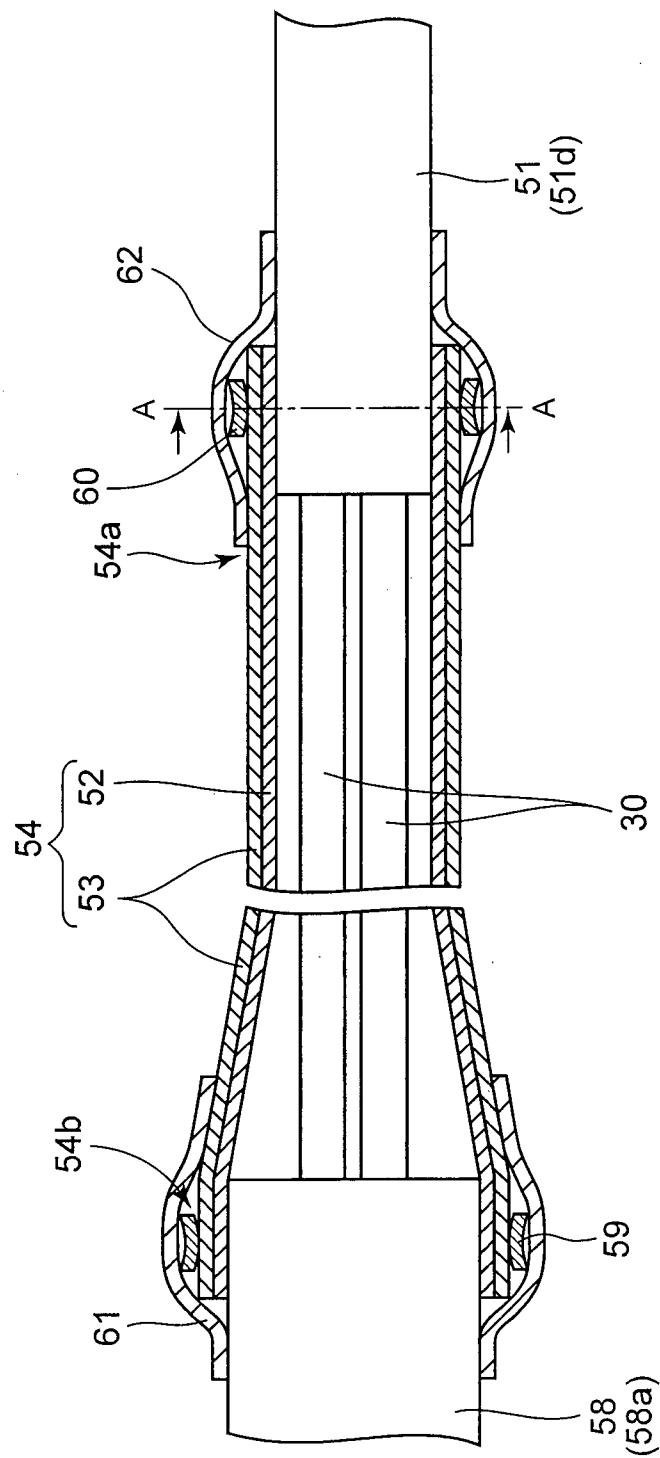


Fig. 3



5/7

Fig. 4

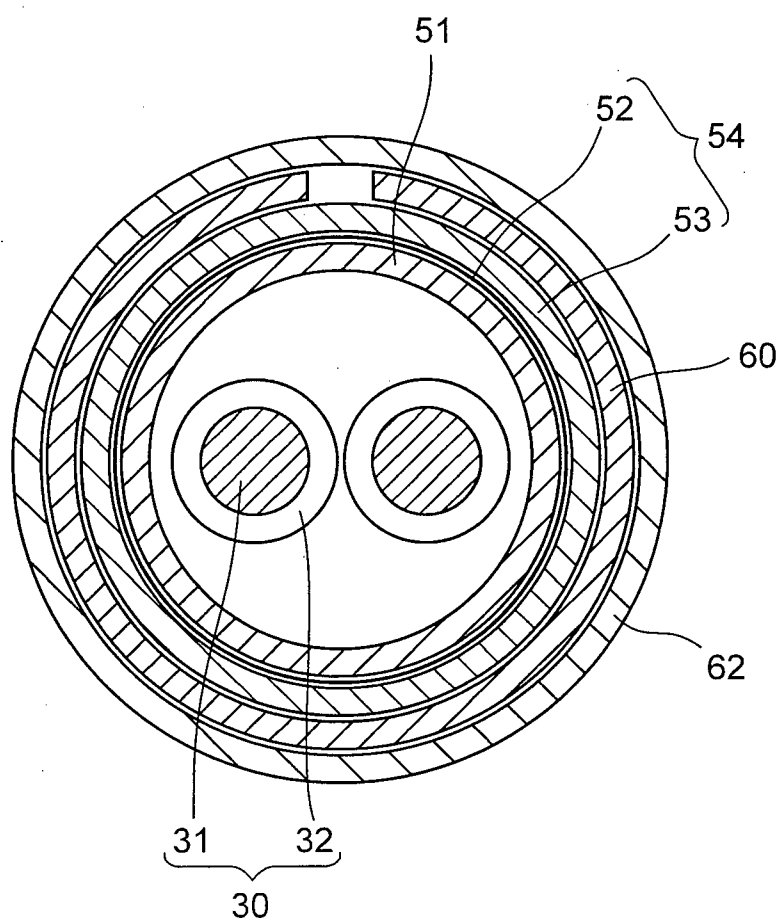
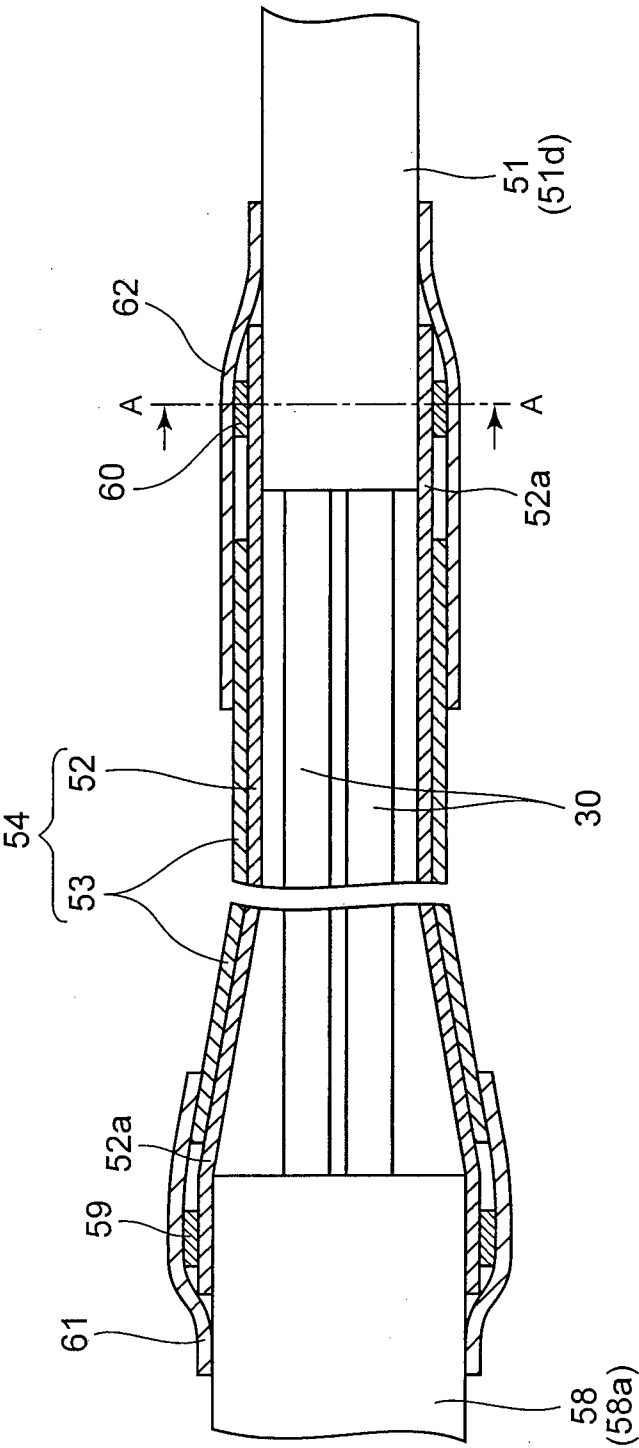
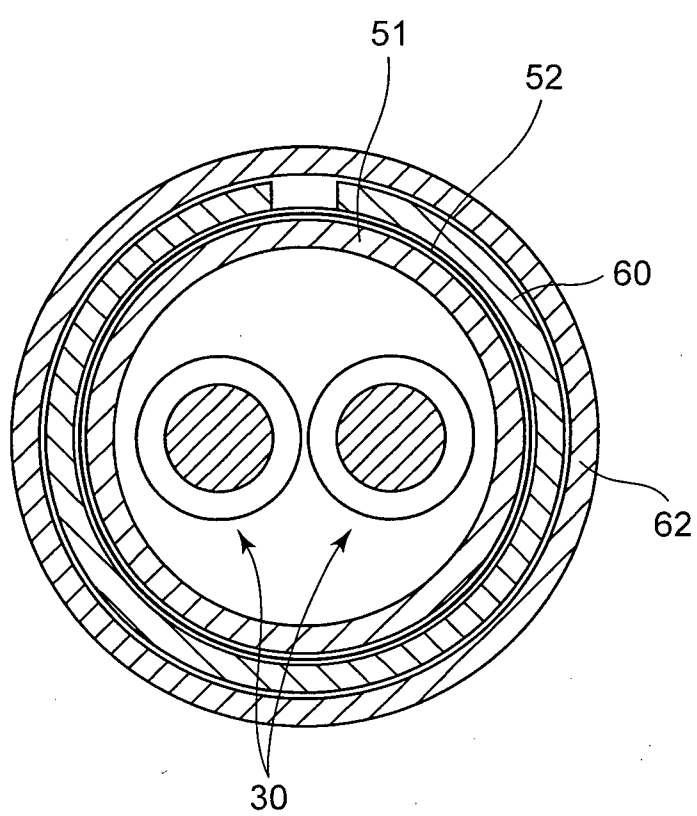


Fig. 5



7/7

Fig. 6



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/000390

A. CLASSIFICATION OF SUBJECT MATTER

INV. B60R16/02 H01B7/282 H02G3/04 H05K9/00
ADD.

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)

B60R H01B H02G H05K

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2004/099427 A1 (KIHIRA SOUJI [JP]) 27 May 2004 (2004-05-27) the whole document	1-7,9-14
Y	EP 2 802 048 A1 (FRÄNKISCHE INDUSTRIAL PIPES) 12 November 2014 (2014-11-12) paragraphs [0005], [0016], [0017]; figure 1	1-7,9-14
A	US 2005/162015 A1 (YAMAGUCHI HIROO [JP] ET AL) 28 July 2005 (2005-07-28) paragraphs [0052], [0055], [0056]; figures 4,7	1,3-5, 7-9
A	US 2004/144557 A1 (MIYAZAKI SHO [JP]) 29 July 2004 (2004-07-29) paragraph [0031]; figures	1,4,5,7
	-/--	



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 another 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

20 June 2016

Date of mailing of the international search report

24/06/2016

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Krieger, Philippe

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2016/000390

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1 744 409 A2 (SUMITOMO WIRING SYSTEMS [JP]) 17 January 2007 (2007-01-17) abstract; figure 2 -----	1,4,5,7

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2016/000390

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 2004099427	A1	27-05-2004	DE	10354284 A1	03-06-2004
			JP	3909763 B2	25-04-2007
			JP	2004171952 A	17-06-2004
			US	2004099427 A1	27-05-2004

EP 2802048	A1	12-11-2014	DE	102013208250 A1	06-11-2014
			EP	2802048 A1	12-11-2014

US 2005162015	A1	28-07-2005	CN	1667898 A	14-09-2005
			DE	102005003654 A1	25-08-2005
			JP	4015120 B2	28-11-2007
			JP	2005218189 A	11-08-2005
			US	2005162015 A1	28-07-2005

US 2004144557	A1	29-07-2004	DE	10354288 A1	03-06-2004
			JP	2004172476 A	17-06-2004
			US	2004144557 A1	29-07-2004

EP 1744409	A2	17-01-2007	EP	1744409 A2	17-01-2007
			JP	4527019 B2	18-08-2010
			JP	2007026759 A	01-02-2007
			US	2007021006 A1	25-01-2007
