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(54) Title: SHIELDING ASSEMBLY FOR CABLE

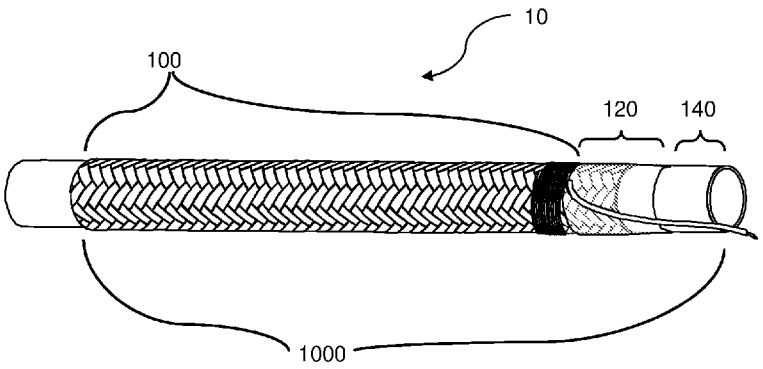


Fig. 1

(57) Abstract: A shielding assembly adapted for enclosing or wrapping around a cable for analog and/or digital signal transmission, including: one or more shielding layers enclosing at least partly the cable and preferably having a clearance portion arranged at its one end, and a shielding portion arranged adjacent to the clearance portion for effecting its shielding operation; wherein the shielding portion of the one or more shielding layers are in electric / conductive connection with each other and preferably in series connection with a filter element and ground terminal of the cable; wherein the shielding portion preferably includes an isolation tube on which a braid shield is mounted; and a spirally wound shield wound at least partly on the braid shield and extended between a first and a second ends of the braid shield.

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SHIELDING ASSEMBLY FOR CABLE

Technical Field

[001] The present disclosure relates to a shielding assembly, and more particularly, to a shielding assembly adapted for enclosing, winding on, or wrapping around a cable for analog and/or digital signal transmission and/or AC and/or DC power transmission for providing optimized shielding effect and transmission quality.

Background Art

[002] Electrical noise, either radiated or conducted as electromagnetic interference (EMI), can seriously disrupt proper operations of electronic equipment such that shielding is needed to minimize the effects of EMI. A cable might be a main source of transfer for EMI, both as a source and receiver. As a source, the cable might either conduct noise to other equipment or act as an antenna radiating noise. As a receiver, the cable can pick up EMI radiated from other sources.

[003] The primary way to combat EMI in cables is through the use of shielding. The shield surrounds the inner signal-carrying or power-carrying conductors. The shield can act on EMI in two ways. First, it can reflect the energy. Second, it can pick up the noise and conduct it to ground. In either case, the EMI does not reach the conductors. In either case, some energy still passes through the shield and might cause interference thereto if the energy somehow is not so highly attenuated.

[004] Cables come with various degrees of shielding and offer varying degrees of shielding effectiveness. The amount of shielding required depends on several factors, including the electrical environment in which the cable is used, the cost of the cable (more shielding generally means more expensive) and issues like cable diameter, weight, and flexibility. In this regard, a relatively low cost shielding mechanism with a relatively high or optimized shielding effectiveness is highly desirable.

Brief Summary of Invention

[005] There is disclosed a shielding assembly adapted for enclosing or wrapping around a cable for analog and/or digital signal transmission, comprising:

one or more shielding layers enclosing at least partly the cable and preferably having an optional clearance portion arranged at its one end for forming a clearance with a respective end of the cable or another shielding layer, an optional mounting portion arranged adjacent to the clearance portion for fixation of the shielding layer and a

shielding portion arranged adjacent to the mounting portion or the clearance portion for effecting its shielding operation;

wherein the shielding portion of the one or more shielding layers are in electric / conductive connection with each other and in a direct ground or floating ground connection and preferably in series connection with a filter element and ground terminal of the cable; and

wherein the shielding portion preferably comprises an isolation tube on which a braid shield is mounted; and a spirally wound shield provided with a direct ground or floating ground connection and wound at least partly on the braid shield and extended between a first and a second ends of the braid shield.

[006] In some embodiments, the spirally wound shield comprises at least one turn of a bare conductive wire provided with a direct ground or floating ground connection and preferably in series connection with a filter element and ground terminal of the cable; and/or the spirally wound shield is in conductive connection with the braid shield.

[007] In some embodiments, the filter element is a capacitor with a capacitance of preferably 0.1μF or below and/or a ferrite bead preferably adapted for implementing a floating ground for the cable.

[008] In some other embodiments, the spirally wound shield is a bare conductive wire of which number of turns and/or length are preferably determined and based on diameter of the cable or an inner signal-carrying or power-carrying conductor in the cable.

[009] In some embodiments, the spirally wound shield of at least some of the one or more shielding layers are in electric connection with each other and preferably in series connection with a filter element and ground terminal of the cable; and/or the spirally wound shield of at least some of the one or more shielding layers are isolated from each other; and/or at least some of the one or more shielding layers with the spirally wound shield are isolated from each other.

[0010] In some embodiments, the isolation tube and/or the braid shield of the shielding portion are firmly fixed or mounted at least partly with the mounting portion by an adhesive, a clamping member, and/or a plastic tape wound thereon and/or extended between both ends of the mounting portion.

[0011] In some embodiments, further comprising a heat shrinkable tube mounted on and enclosed at least the shielding assembly of the cable and preferably served as an external sheath for protection and fixation of respective members, portions, shields, and/or layers of the cable.

[0012] In some embodiments, the spirally wound shield is a bare conductive wire preferably having a number of turns and/or an axial length being in inverse proportion to diameter of the cable and/or a conductor enclosed by the cable.

[0013] In some embodiments, the number of turns ranges from 1 to 50 and preferably from 1 to 40; and/or the diameter of the cable ranges from 2mm to 60mm and preferably from 4mm to 30mm.

[0014] In some embodiments, the isolation tube and/or the braid shield of the shielding portion are configured to cover and extend from the clearance portion to the shielding portion of respective shielding layer and/or arranged to be isolated from respective cable connectors located at ends of the cable.

Brief Description of Drawings

[0015] The disclosure will be described by way of example with reference to the accompanying drawings, in which:

[0016] Figure 1 is a schematic view of an example shielding assembly of the present disclosure having a single shielding layer;

[0017] Figure 2 is a schematic view of another example shielding assembly of the present disclosure having three shielding layers;

[0018] Figure 3 is a schematic view of an example shielding assembly of the present disclosure having a filter member.

Detailed Description of Invention

[0019] Some preferred embodiments of the present disclosure are set forth below in conjunction with the accompanying drawings, so as to illustrate in details the technical solutions thereof.

[0020] There are two types of shielding typically used for cables, foil and braid, and the shielding assembly of the present disclosure is adapted for use with both.

[0021] Foil shielding used a thin layer of aluminium, typically attached to a carrier such as polyester to add strength and ruggedness. It provides 100% coverage of the conductors it surrounds, but it is thin, which makes it harder to work with, especially when applying a connector.

[0022] The braid provides a low-resistance path to ground and is much easier to termination by crimping or soldering when attaching a connector. But braided shields do not provide 100% coverage. They allow small gaps in coverage. Depending on the tightness of the weave, braids typically provide between 70% and 95% coverage. When the cable is stationary, 70% is usually sufficient. Because copper has higher conductivity than aluminium and the braid has more bulk for conducting noise, the braid is more effective as a shield even though it adds size and cost to the cable.

[0023] In the present disclosure, the foil and/or the braid layer might be used as the first and/or second stage of shielding while a spirally wound shield comprising at least one turn of bare conductive wire might be used as the extra or further stage of shielding for providing optimized shielding effectiveness to preserve a relatively high signal and power transmission quality. The shielding effectiveness is enhanced through reduced shield resistance and an optional filter element to facilitate quick and reliable termination and/or the formation of a floating ground which might help eliminate ground loops, so as to reduce the noise coupled thereto.

[0024] Referring to Fig. 1, a schematic view of an example shielding assembly of the present disclosure is shown. The example shielding assembly 10 adapted for enclosing or wrapping around a cable for analog and/or digital signal or power transmission of Fig. 1 comprises at least one shielding layer 1000 enclosing at least partly the cable and preferably having an optional clearance portion 140 arranged at its one end for forming a clearance with a respective end of the cable or another shielding layer, an optional mounting portion 120 arranged adjacent to the clearance portion for fixation of the shielding layer and a shielding portion 100 arranged adjacent to the mounting portion or the clearance portion for effecting its shielding operation.

[0025] In some embodiments, the length of the clearance portion of the first shielding layer ranges from 0mm – 10mm and preferably from 1mm – 9mm, and the length of the mounting portion ranges from 0mm – 20mm and preferably from 5mm – 15mm.

[0026] The shielding portion of the at least one / one or more shielding layers are in electric / conductive connection with each other and preferably in a direct ground or floating ground connection, such as in series connection with a filter element and ground terminal of the cable (not shown).

[0027] In some embodiments, the spirally wound shield of at least some of the one or more shielding layers are in electric connection with each other and preferably in series connection with a filter element and ground terminal of the cable; and/or the spirally wound shield of at least some of the one or more shielding layers are isolated

from each other; and/or at least some of the one or more shielding layers with the spirally wound shield are isolated from each other. In this regard, the spirally wound shield of multiple shielding layers and/or shielding layers with the spirally wound shield might be made in an isolated, non-isolated, or mixed manner depending on specific applications.

[0028] The shielding portion preferably comprises an isolation tube on which a braid shield is mounted; and a spirally wound shield provided with a direct ground or preferably a floating ground connection and wound at least partly on the braid shield and extended substantially between two ends of the braid shield. There are a lot of possible grounding methods for yielding similar results, and different grounding methods just vary the effectiveness or sounding characters of the output.

[0029] The grounding to the bare conductive wire is desirable or preferably needed no matter what grounding methods are used. In addition, the bare conductive wire could be grounded at any particular position because grounding at any point of the bare conductive wire being mounted on the braids should also work.

[0030] In some embodiments, the spirally wound shield comprises at least one turn of a bare conductive wire provided with a direct ground or floating ground connection and preferably connected in series with the ground terminal of the cable and/or any other grounding positions on electrical components of the cable and/or the earth ground; and/or the spirally wound shield is in conductive connection with the braid shield; and/or the spirally wound shield might be arranged at preset positions along the length of the cable for specific applications and is preferably arranged near the output end of the cable for optimized output quality thereof.

[0031] Referring to Fig. 2, a schematic view of another example shielding assembly of the present disclosure is shown. The example shielding assembly 20 adapted for enclosing or wrapping around a cable for analog and/or digital signal or power transmission of Fig. 2 is similar to the same depicted in Fig. 1, but it comprises multiple shielding layers 1000, 2000, 3000, each of which is configured for respectively enclosing at least partly the cable and preferably having an optional clearance portion arranged at its one end for forming a clearance with a respective end of the cable or respective spirally wound shield of another underneath shielding layer, an optional mounting portion 120, 220, 320 arranged adjacent to the clearance portion for facilitating the fixation of the respective shielding layers with another underneath shielding layer and a shielding portion 100, 200, 300 preferably provided with a direct ground or floating ground

connection and arranged adjacent to the mounting portion or the clearance portion for effecting its shielding operation.

[0032] In some embodiments, each of the isolation tubes 150, 250, 350 and/or the braid shields 130, 230, 330 of the shielding portion are firmly fixed or mounted on the mounting portion, the shielding portion, and/or the cable underneath by an adhesive (not shown), a clamping mechanism such as a clamping collar (not shown), and/or a plastic tape 135, 235, 335 wound thereon and/or extended between both ends of the mounting portion and/or the shielding portion.

[0033] In some embodiments, the length of the clearance portion of each of the first, the second and onward shielding layers ranges from 0mm – 10mm, and the length of the mounting portion of each of the second and onward shielding layers ranges from 0mm – 20mm and preferably from 5mm – 15mm. In this regard, the first, the second and onward shielding layers might be dispensed with the clearance portion and/or the mounting portion for some specific applications. The arrangement, lengths, and positions of all clearance portion and mounting portion might vary and the foregoing are provided only as some of the possible embodiments for various installation and production purposes, no matter how each metal braid layer is installed adjacent to the former or latter layer, or even wholly cover or being covered by the former or latter metal braid layer. In addition, the grounded spirally wound shield comprising the bare conductive wire could be arranged at any specific positions at each shielding layer for effecting its shielding operations.

[0034] In some embodiments, the mounting portion can be enlarged to 10cm in length or above, wherein the spirally wound shield might be helical rather than circular. However, the length of bare conductive wire mounting to the mounting portion should be same or similar within the ranges provided in the table below no matter the spirally wound shield extended along the metal braids is circular or helical or even straight. In this regard, the most important point is the actual conducting ranges of length between the bare conductive wire and metal braids being mounted no matter how the bare conductive wire is configured to make contact with the metal braids, i.e. extended in a spirally circular or a helical or even a straight manner along with the metal braids. In essence, the spirally wound shield is devised and configured in such a manner that it is simply for the ease of production purposes and further applying the design with multiple metal braids on a cable body.

[0035] In some embodiments, the isolation tube and/or the braid shield of the shielding portion are configured to cover and extend from the clearance portion to the

shielding portion of respective shielding layer and/or arranged to be isolated from respective cable connectors located at either ends of the cable.

[0036] In some embodiments, the shielding assembly might further comprise a heat shrinkable tube (not shown) mounted on and enclosed at least the shielding assembly of the cable and preferably served as an external or outer sheath for protection and fixation of respective members, portions, shields, and/or layers of the cable. Accordingly, each of the shielding layers might be dispensed with the mounting portion and all the layers will be adequately fixed in place by the shrunk outer sheath. In some embodiments, the shielding assembly might be arranged on an inner sheath 5, preferably made of isolation material such as plastic, in which the cable 3 containing one or more signal-carrying conductors and/or one or more power-carrying conductors is received. In some embodiments, the cable 3 might comprise a signal cable, a power cable, and/or a coaxial cable of one or more conductors.

[0037] Referring to Fig. 3, which illustrates another example shielding assembly 30 of the present disclosure. The configuration of the example shielding assembly 30 is similar to the same of Fig. 2 except that one end 318 of the bare conductive wire is in series connection with a filter element 380 and ground terminal of the cable.

[0038] In some embodiments, the respective spirally wound shields 110, 210, 310 of the respective shielding layers are all in electric connection with each other and in a direct ground or floating ground connection and preferably further in series connection with the filter element 380 and ground terminal of the cable.

[0039] In some embodiments, the filter element is a capacitor with a capacitance of preferably 0.1μF or below and/or a ferrite bead preferably adapted for implementing a floating ground for the cable.

[0040] In some embodiments, the spirally wound shield is a bare conductive wire preferably having a number of turns and/or an axial length AL (as shown in Fig. 2) being in inverse proportion to diameter of the cable.

[0041] In some embodiments, the number of turns ranges from 1 to 50 and preferably from 1 to 40; and/or the diameter of the cable ranges from 2mm to 60mm and preferably from 4mm to 30mm.

[0042] In some embodiments, the number of turns and/or length of the spirally wound shield or the bare conductive wire are preferably determined and based on diameter of the cable or an inner signal-carrying or power-carrying conductor in the cable, as shown in the following table.

Table: The relationship of number of turns or length of the bare conductive wire and the diameter of the cable

Diameter of the cable (mm)	Min. no. of turns	Max. no. of turns	Difference in turns	Length (min. length, mm)	Length (max. length, mm)	Length difference (mm)
4	1	50	49	12.56	628	615.44
5	1	45	44	15.7	706.5	690.8
6	1	42	41	18.84	791.28	772.44
7	1	40	39	21.98	879.2	857.22
8	1	37	36	25.12	929.44	904.32
9	1	35	34	28.26	989.1	960.84
10	1	32	31	31.4	1004.8	973.4
11	1	30	29	34.54	1036.2	1001.66
12	1	28	27	37.68	1055.04	1017.36
13	1	26	25	40.82	1061.32	1020.5
14	1	24	23	43.96	1055.04	1011.08
15	1	22	21	47.1	1036.2	989.1
16	1	20	19	50.24	1004.8	954.56
17	1	18	17	53.38	960.84	907.46
18	1	17	16	56.52	960.84	904.32
19	1	17	16	59.66	1014.22	954.56
20	1	14	13	62.8	879.2	816.4
21	1	14	13	65.94	923.16	857.22
22	1	13	12	69.08	898.04	828.96
23	1	12	11	72.22	866.64	794.42
24	1	12	11	75.36	904.32	828.96
25	1	10	9	78.5	785	706.5
26	1	10	9	81.64	816.4	734.76
27	1	9	8	84.78	763.02	678.24
28	1	9	8	87.92	791.28	703.36

29	1	8	7	91.06	728.48	637.42
30	1	8	7	94.2	753.6	659.4

[0043] In some embodiments, the shielding assembly is adapted for use with or configured to enclose an audio cable and a noticeable improvement in the quality of output/sound is observed as the EMI and other noises are properly shielded by the multiple shielding stages of the shielding assembly of the present disclosure in an optimized and utmost manner.

[0044] Features set out in the claims hereto (jointly and severally where appropriate) are to form part of this disclosure and are incorporated herein by reference.

[0045] While various examples or embodiments have been described herein, it should be appreciated that they are for illustration and are not for scope restriction. It should be appreciated that portions or parts of the various example embodiments can be excerpted for combination and/or mix-and-match where appropriate to form other variants without loss of generality.

Claims

1. A shielding assembly adapted for enclosing or wrapping around a cable for analog and/or digital signal, and/or AC and/or DC power transmission, comprising:

one or more shielding layers enclosing at least partly the cable and preferably having an optional clearance portion arranged at its one end for forming a clearance with a respective end of the cable or another shielding layer, an optional mounting portion arranged adjacent to the clearance portion for fixation of the shielding layer and a shielding portion arranged adjacent to the mounting portion or the clearance portion for effecting its shielding operation;

wherein the shielding portion of the one or more shielding layers are in electric / conductive connection with each other and in a direct ground or floating ground connection and preferably in series connection with a filter element and ground terminal of the cable; and

wherein the shielding portion preferably comprises an isolation tube on which a braid shield is mounted; and a spirally wound shield provided with a direct ground or floating ground connection and wound at least partly on the braid shield and extended between a first and a second ends of the braid shield.

2. The shielding assembly of Claim 1, wherein the spirally wound shield comprises at least one turn of a bare conductive wire provided with a direct ground or floating ground connection and preferably connected in series with a filter element and ground terminal of the cable; and/or the spirally wound shield is in conductive connection with the braid shield.

3. The shielding assembly of Claim 1, wherein the filter element is a capacitor with a capacitance of preferably 0.1μF or below and/or a ferrite bead preferably adapted for implementing a floating ground for the cable.

4. The shielding assembly of Claim 1, wherein the spirally wound shield is a bare conductive wire of which number of turns and/or length are preferably determined and based on diameter of the cable or an inner signal-carrying or power-carrying conductor in the cable.

5. The shielding assembly of Claim 1, wherein the spirally wound shield of at least some of the one or more shielding layers are in electric connection with each other and preferably in series connection with a filter element and ground terminal of the cable; and/or the spirally wound shield of at least some of the one or more shielding layers

are isolated from each other; and/or at least some of the one or more shielding layers with the spirally wound shield are isolated from each other.

6. The shielding assembly of Claim 1, wherein the isolation tube and/or the braid shield of the shielding portion are firmly fixed or mounted at least partly with the mounting portion by an adhesive, a clamping member, and/or a plastic tape wound thereon and/or extended between both ends of the mounting portion.

7. The shielding assembly of Claim 1, further comprising a heat shrinkable tube mounted on and enclosed at least the shielding assembly of the cable and preferably served as an external sheath for protection and fixation of respective members, portions, shields, and/or layers of the cable.

8. The shielding assembly of Claim 1, wherein the spirally wound shield is a bare conductive wire preferably having a number of turns and/or an axial length being in inverse proportion to diameter of the cable and/or a conductor enclosed by the cable.

9. The shielding assembly of Claim 8, wherein the number of turns ranges from 1 to 50 and preferably from 1 to 40; and/or the diameter of the cable ranges from 2mm to 60mm and preferably from 4mm to 30mm.

10. The shielding assembly of Claim 1, wherein the isolation tube and/or the braid shield of the shielding portion are configured to cover and extend from the clearance portion to the shielding portion of respective shielding layer and/or arranged to be isolated from respective cable connectors located at ends of the cable.

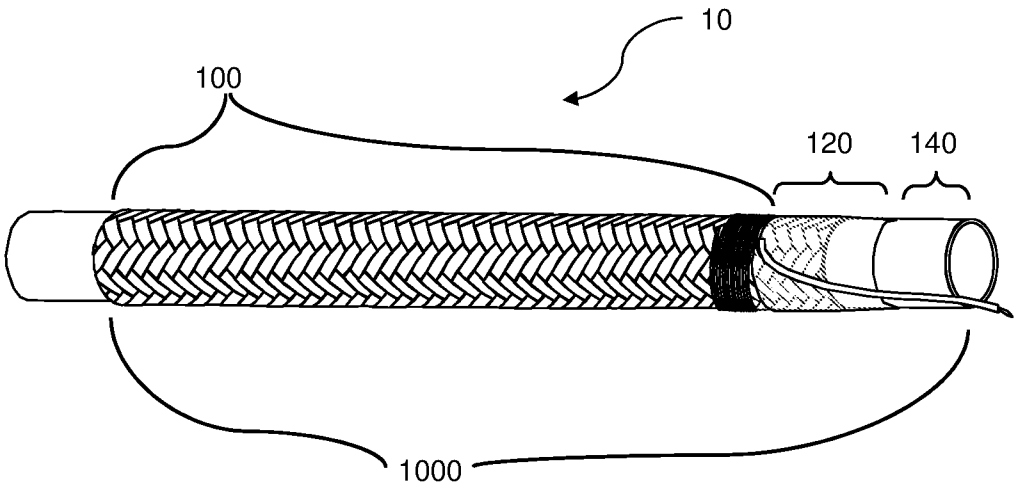

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Fig. 1

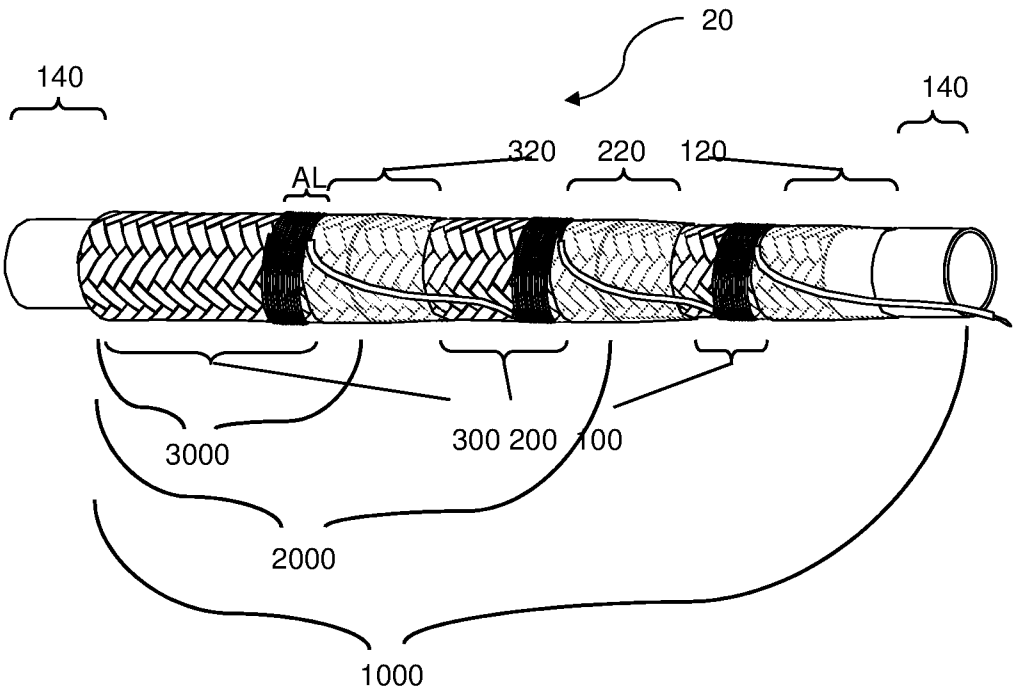

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Fig. 2

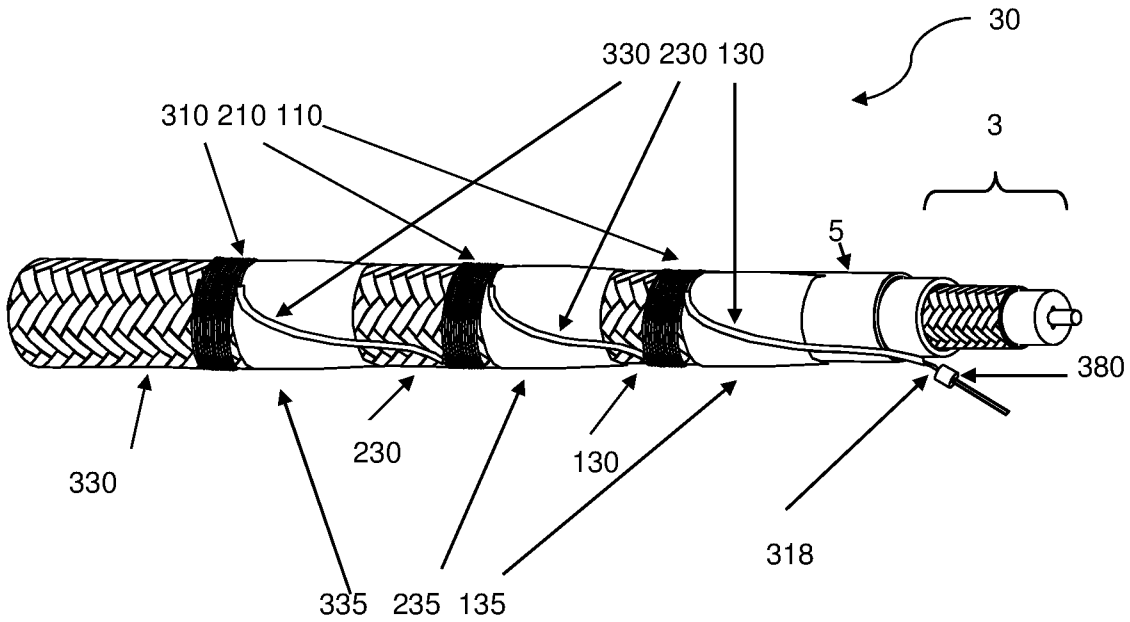


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2018/057795

A. CLASSIFICATION OF SUBJECT MATTER

H01B 7/17(2006.01)i; H01B 11/06(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)

H01B

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)

CNABS;CNTXT;CNKI;DWPI;SIPOABS:cable, shield+, separat+, isolat+, tube, ground, series, wind, wound, layer

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 207800184 U (CFM CABLES MUSIC LTD) 31 August 2018 (2018-08-31) Claims 1-12	1-10
A	US 2011315419 A1 (GRANT ET AL.) 29 December 2011 (2011-12-29) The whole document	1-10
A	CN 101447254 A (CHANGSHU HONGLIN WIRES&CABLES CO., LTD.) 03 June 2009 (2009-06-03) The whole document	1-10
A	US 2014209347 A1 (BUCK ET AL.) 31 July 2014 (2014-07-31) The whole document	1-10

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 January 2019	**13 February 2019**

Name and mailing address of the ISA/CN	Authorized officer
National Intellectual Property Administration, PRC **6, Xitucheng Rd., Jimen Bridge, Haidian District, Beijing 100088** **China**	**ZHENG,Jiaqing**
Facsimile No. **(86-10)62019451**	Telephone No. **86-(010)-62411684**

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2018/057795

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	207800184	U	31 August 2018	None			
US	2011315419	A1	29 December 2011	CN	102332337	A	25 January 2012
				US	8981216	B2	17 March 2015
CN	101447254	A	03 June 2009	None			
US	2014209347	A1	31 July 2014	KR	20150111942	A	06 October 2015
				WO	2014120826	A1	07 August 2014
				CN	104956450	A	30 September 2015
				CN	104956450	B	14 November 2017
				US	2015371738	A1	24 December 2015
				EP	2951840	A1	09 December 2015
				JP	2016509344	A	24 March 2016
				US	10037834	B2	31 July 2018
				EP	2951840	B1	02 November 2016