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(54) Title: DROPWIRE

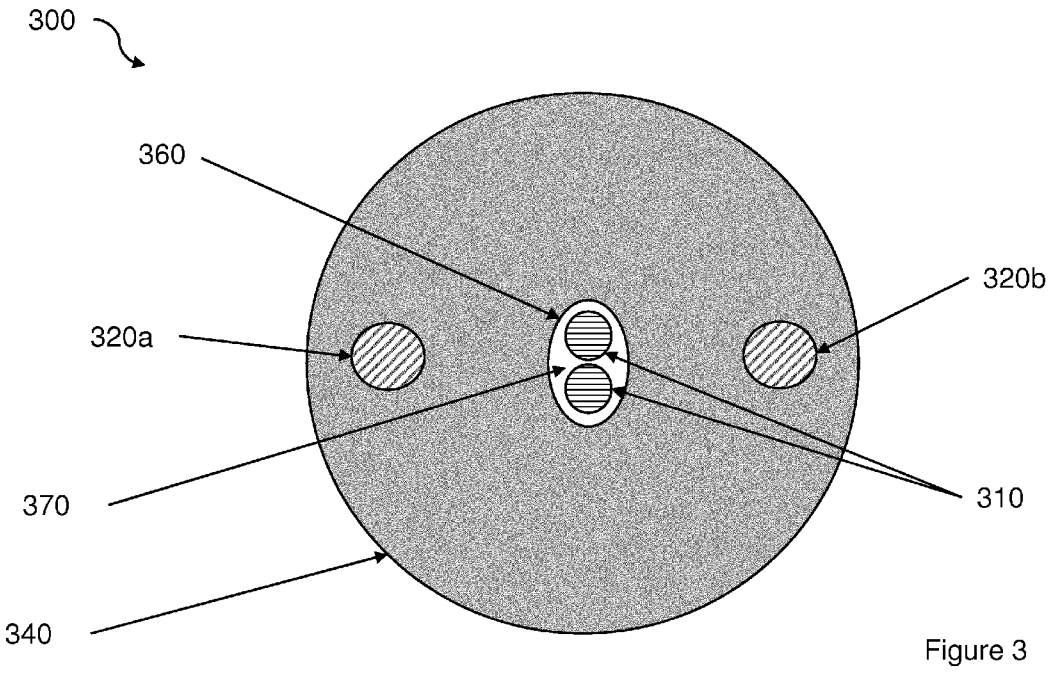


Figure 3

(57) Abstract: A dropwire for use in an access network, such as a hybrid fibre-copper access network, in which the dropwire comprises a central bore, defined by the dropwire body, in which a pair of conductors are received. The strength members are received within the body of the dropwire and are remote from the conductors. Such a cable design reduces the electromagnetic interference which can be generated when using conventional dropwires.

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[Continued on next page]

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DROPWIRE

Field of the Invention

The present invention relates to a dropwire for use in an access network, and in particular to a dropwire for use in a hybrid fibre-copper access network.

Background to the Invention

Since the advent of the World Wide Web, there has been a need to provide internet access to customers at ever increasing data rates. Asymmetric Digital Subscriber Line (ADSL) technology over existing copper wires can provide data rates of up to 24 Mbit/s, but many customers will experience significantly lower data rates due to the length of the network connection. One solution is to install Fibre to the Premises (FTTP) networks, such as PONs (Passive Optical Networks), but this approach requires very significant investment.

Another approach is to install limited amounts of optical fibre and to utilise it in conjunction with the legacy copper cabling. Figure 1 shows a schematic depiction of a hybrid fibre-copper access network 100 in which a telephone exchange 110 is connected to a plurality of customer premises 500 (the customer premises may be domestic, commercial or industrial premises). One network architecture is Fibre to the Cabinet (FTTC [or FTTCab]), in which the telephone exchange 110 is connected to cabinets 120 by optical fibre cable 115. VDSL (Very-high-bit-rate Digital Subscriber Line) data signals can be transmitted over the fibre cable to equipment in the cabinet which converts the optical signal to an electrical signal which can then be transmitted over a copper cable 125 to the customer premises 500. The customer premises are connected to the cabinet via a distribution point 130, which is typically located near to the customer premises, for example at a telephone pole. The distribution point is typically connected to the customer premises 500 using a dropwire 135, via a telephone pole (not shown). A further network architecture is Fibre to the Node (FTTN) in which optical fibre is installed to the distribution point and the opto-electronic conversion of signals takes place in a node which is located at the distribution point. Electrical data signals are then transmitted from the node to the user, via the dropwire.

The dropwire needs to be mechanically robust enough to withstand the additional loads caused by ice formation on the dropwire and/or high winds. However, it is important that

the dropwire is not too strong. In the event that a dropwire is struck by a tall vehicle it is desirable that dropwire effectively acts as a mechanical fuse, such that it breaks before the mechanical load becomes sufficient to damage the telephone pole and/or the building to which the dropwire is connected.

Figure 2 shows a schematic depiction of the cross-section of a conventional dropwire 200 which comprises a pair of copper conductors 210, a plurality of steel strength members 220 and a ripcord 230, all of which are received within a sheath 240. The pair of copper conductors are preferably received within a plastic film 250 such that they are separated from the other dropwire components. The copper conductors 210 will have a slight twist imposed on them during the cable manufacturing process. Each of the plurality of steel strength members will be formed from a plurality of strands.

New data transmission technologies such as G.fast enable downstream data rates of up to 1 Gbit/s to be transmitted over the copper portion of a hybrid fibre-copper access network, such as FTTC or FTTN network, dependent on the length of the copper link length. Previous deployments of VDSL over FTTC networks have provided downstream data rates of up to 80 Mbit/s. G.fast provides greater data throughput, in part, through the use of higher frequencies than those used in VDSL. It has been observed that at high data rates the losses in conventional dropwires increase such that the very high bit-rates associated with G.fast cannot be delivered reliably and consistently.

It was assumed that the losses were due to electro-magnetic interference which was caused by the presence of the steel strength members in the dropwire. A new dropwire design was tested with the steel strength members being replaced by glass-fibre plastics (GRP) strength members. Whilst the observed transmission losses decreased, due to decreased levels of electromagnetic interference, the new dropwire design did not have sufficient mechanical strength for it to be deployed in a network.

Summary of the Invention

According to a first aspect of the invention, there is provided a dropwire for use in an access network, the dropwire comprising:

a body, a plurality of metallic strength members and a pair of metallic conductors adapted for carrying data signals characterised in that the pair of metallic conductors are located substantially near to the longitudinal axis of the dropwire and the plurality of

metallic strength members are located within the body away from the longitudinal axis of the dropwire..

The dropwire may comprise two strength members. The body of the dropwire may comprise a void formed substantially near to the central axis of the dropwire and the pair of metallic conductors are received within the void. The two strength members may be located such that one strength member is located on each side of the void. Each of the plurality of strength members may comprise multiple stranded elements. The dropwire body may comprise medium density polyethylene.

Brief Description of the Figures

In order that the present invention may be better understood, embodiments thereof will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a shows a schematic depiction of a hybrid fibre-copper access network;

Figure 2 shows a schematic depiction of the cross-section of a conventional dropwire;

Figure 3 shows a schematic depiction of the cross-section of a dropwire according to the present invention; and

Figure 4 shows a graphical depiction of the transmission loss for a dropwire.

Detailed Description of Embodiments

Figure 3 shows a schematic depiction of the cross-section of a dropwire 300 according to the present invention. The dropwire 300 comprises a body 340 which is formed around a pair of twisted copper conductors 310. The pair of twisted copper conductors 310 are received at, or near to, the central axis of the dropwire. The copper conductors are each preferably 0.5mm copper wires, covered with an appropriate insulating material. The dropwire comprises a pair of strength members 320a 320b, which are received within the dropwire body such that they are away from the central axis of the dropwire. The pair of strength members 320a 320b preferably comprise three steel wires, each of diameter 0.32mm, wound around each other. As shown in Figure 3, preferably the strength members are located on opposite sides of the copper conductors.

The body of the dropwire may be formed directly over the pair of twisted copper conductors, or the body may comprise a void 370 within which the pair of twisted copper conductors can be received. In the latter case, the inner surface 360 of the dropwire body which defines the void may be coated in a layer of a material which comprises anti-static carbon black particles.

It will be understood that variants of the dropwire described above with reference to Figure 3 will fall within the scope of the present invention. For example, the dropwire may comprise three, or more, strength members received within the dropwire body. The body preferably comprises medium density polyethylene (MDPE) although it will be understood that other suitable materials could be used. The Applicant's earlier application EP – A 0 432 171 provides teaching on materials which can be used in similar transmission lines. LDPE (low density polyethylene) may be used although there is a risk that higher tensile loads may lead to the cable stretching (or breaking). HDPE (high density polyethylene) may be used but the increased hardness will make it more difficult for technicians to cut and manipulate the cable during installation and maintenance processes.

Figure 4 shows a graphical depiction of the transmission loss for a dropwire according to the present invention and a conventional dropwire (that is, one described above with reference to Figure 2) for an installed length of 50m of dropwire. The upper trace (shown by the solid line) shows the loss in the dropwire according to the present invention and the lower trace (shown by the dashed line) shows the loss in a conventional dropwire.

In summary, there is provided a dropwire for use in an access network, such as a hybrid fibre-copper access network, in which the dropwire comprises a central bore, defined by the dropwire body, in which a pair of conductors are received. The strength members are received within the body of the dropwire and are remote from the conductors. Such a cable design reduces the electromagnetic interference which can be generated when using conventional dropwires.

CLAIMS

1. A dropwire (300) for use in an access network, the dropwire comprising:

a body (340), a plurality of metallic strength members (320) and a pair of metallic conductors (310) adapted for carrying data signals wherein the pair of metallic conductors are located substantially near to the longitudinal axis of the dropwire and characterised in that the plurality of metallic strength members are located within the body, away from the longitudinal axis of the dropwire..

2. A dropwire according to Claim 1, wherein the dropwire comprises 2 strength members (320a, 320b).

3. A dropwire according to any preceding Claim wherein the body comprises a void (370) formed substantially near to the central axis of the dropwire and the pair of metallic conductors are received within the void.

4. A dropwire according to Claim 3 when dependent on Claim 2 wherein the strength members are located on either side of the void.

5. A dropwire according to any preceding Claim wherein each of the plurality of strength members comprises multiple stranded elements.

6. A dropwire according to any preceding Claim wherein the body comprises medium density polyethylene.

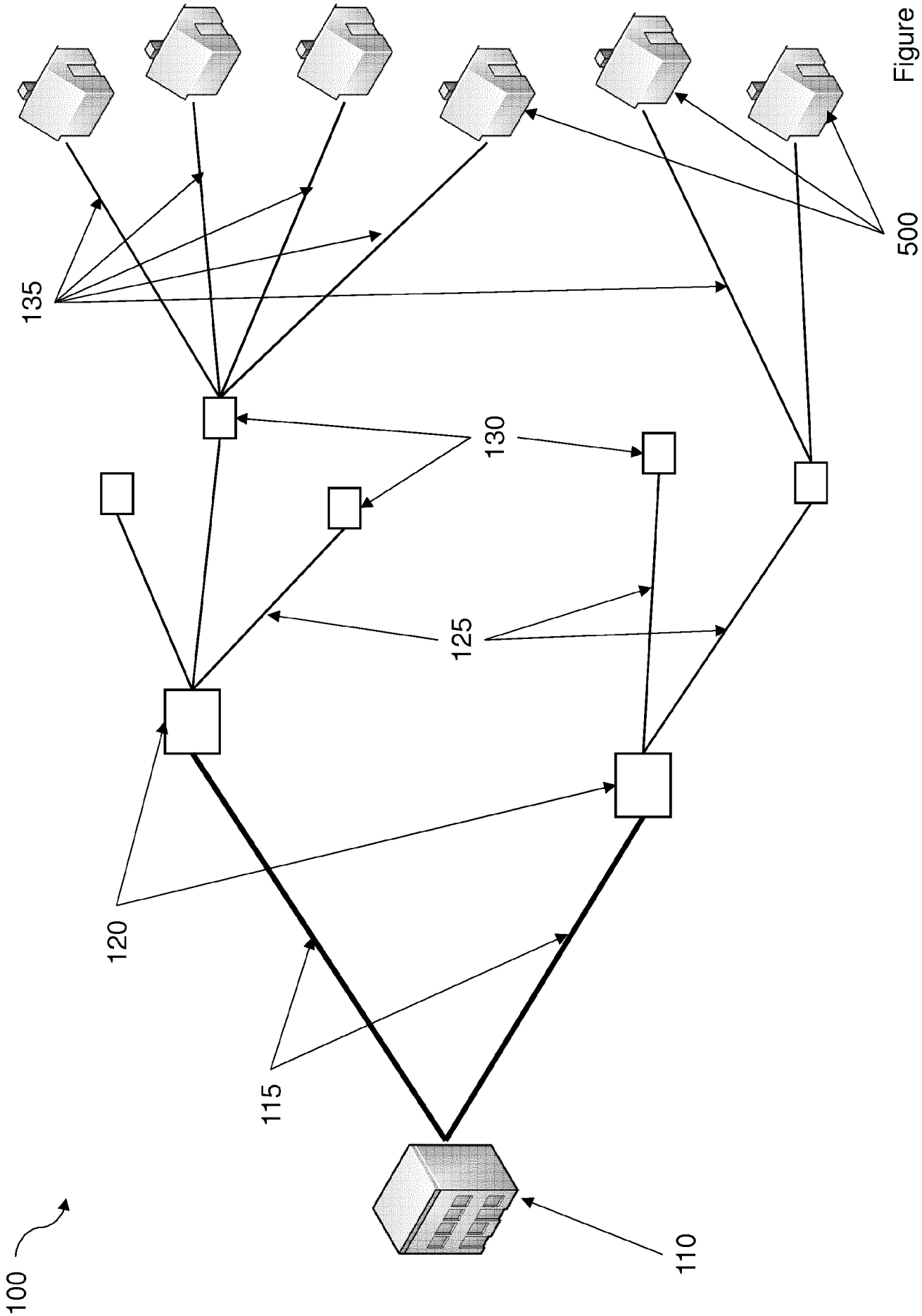
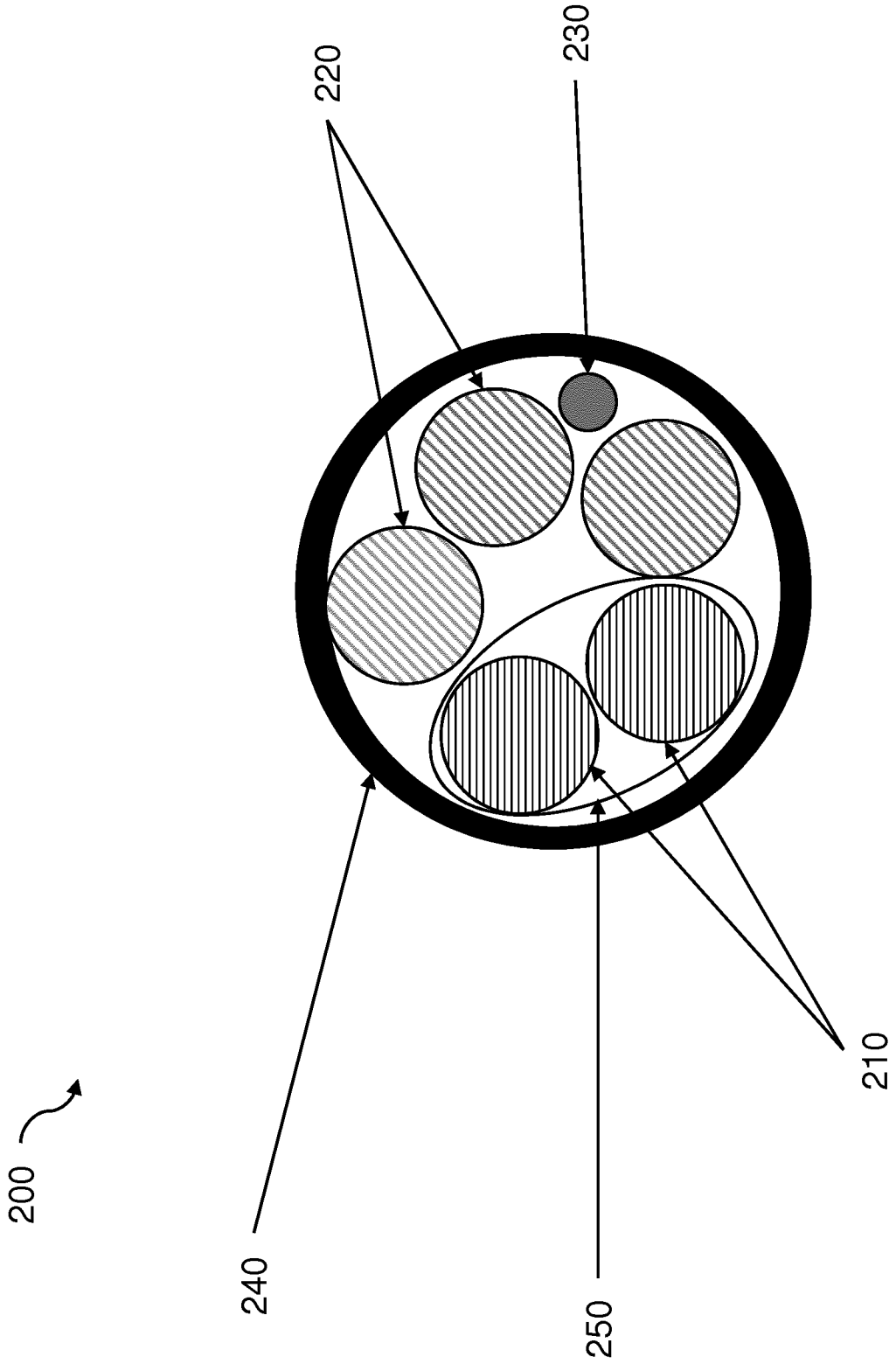


Figure 1

Figure 2



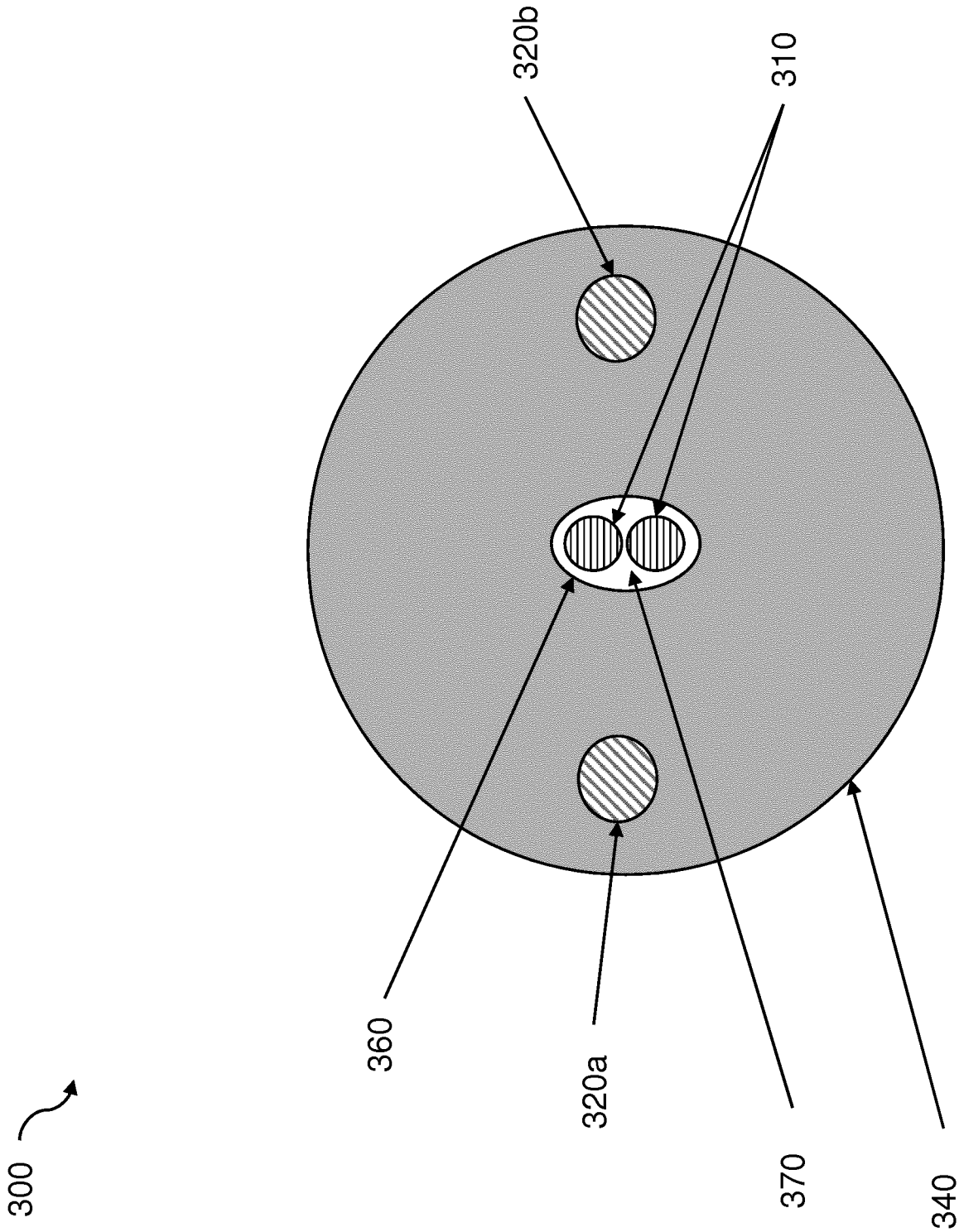


Figure 3

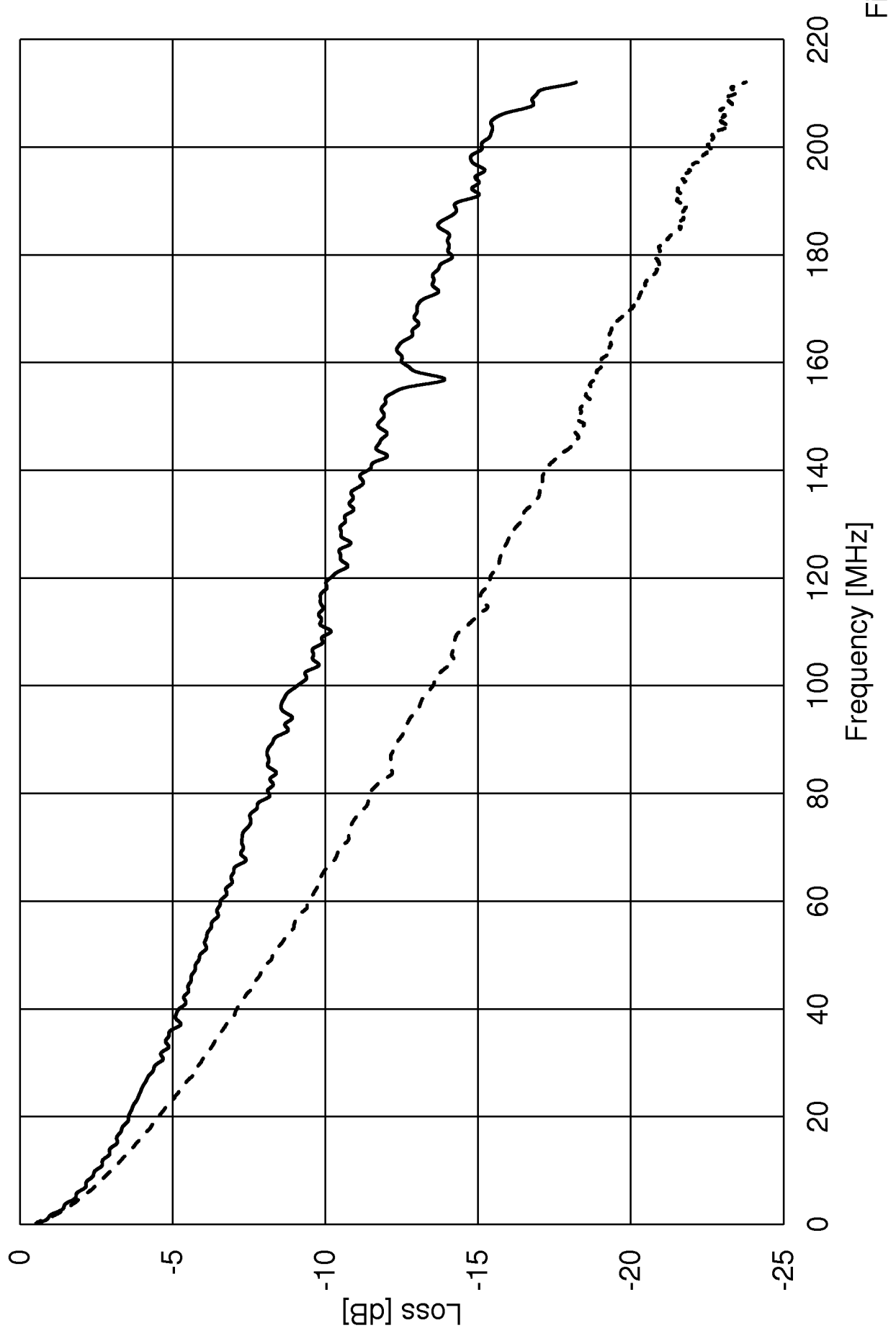

0
-5
-10
-15
-20
-25
Loss [dB]
0
20
40
60
80
100
120
140
160
180
200
220
Frequency [MHz]

Figure 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/058424

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01B7/22 H01B11/00 H01B11/06
ADD. H01B7/18

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)
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.
X	US 2014/241677 A1 (SUTEHALL RALPH [GB] ET AL) 28 August 2014 (2014-08-28) figure 2	1-6
X	US 9 116 322 B1 (LAWS JEFFREY SCOTT [US]) 25 August 2015 (2015-08-25) figure 1	1-6
X	US 2014/137974 A1 (LUNCEFORD BRENT [US] ET AL) 22 May 2014 (2014-05-22) figure 2A	1-4
X	US 2005/126817 A1 (ARZATE FERMIN M [MX] ET AL) 16 June 2005 (2005-06-16) figure 2	1-4
X	US 6 509 526 B2 (SERVICIES CONOUMEX S A DEC V [US]) 21 January 2003 (2003-01-21) figure 3	1-4

☐ 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

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"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	Date of mailing of the international search report
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Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2018/058424

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