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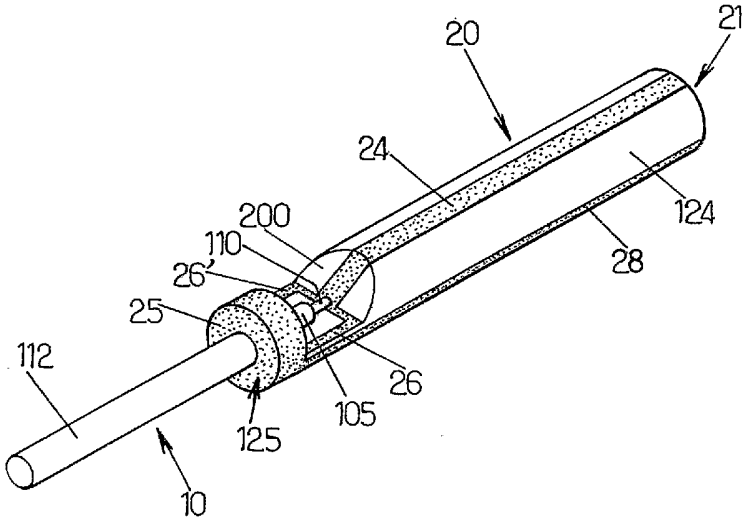
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(54) **Title:** ANTENNA ASSEMBLY



(57) **Abstract:** The invention relates to an antenna assembly for a radio communication equipment. The antenna comprises an elongated body (20) made of non conductive material, presenting an upper (124) and a lower (128) side, and a first (125) and a second (225) end, an upper (24) and a lower (28) conductive layer covering respectively said upper and lower sides, said layers being separated from each other along said elongated body, and connected to each other through a lateral conductive layer (25) covering said first end. A coax cable is connected to said antenna. More particularly, the cable sheath is connected to the lower layer and the cable core is welded to the upper layer in a recess provided in the upper side, the cable core passing through an opening provided at the first end of body.

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ANTENNA ASSEMBLY

The present invention generally relates to the field of wireless communications, and more specifically to antennas for radio communication equipments.

Since laptop and desktop computers started offering wireless connection possibilities, different options have been offered to provide the necessary antenna for the wireless communication. Among wireless communications, one can list for example WLAN (wireless local-area network) applications, such as WiFi (wireless fidelity) or Bluetooth applications. Today's trend is toward antenna integration inside the desktop or laptop as a standard for computer features. To reach that objective, antennas are now embedded in the computer body, for instance in flat panel displays.

Known antennas currently available use a coax cable connection to connect the antenna to the RF (radio frequency) front end of the computer. Examples of known connection techniques are shown on FIG. 1a and 1b. FIG. 1a shows an antenna assembly using a pair of mating connectors 12 and 14. The coax cable 10, with its outer insulation 115, the outer metal sheath 112, the inner insulation 105 and its core 110 is connected to a first coax connector 12, either male or female. The antenna 16 is connected to a second coax connector 14 adapted to mate the first coax connector 12. Another known assembly is shown on FIG. 1b, the antenna 16 is attached to a PCB 15, to which is also attached a coax connector 14 of the type shown in FIG. 1a. In both instances, coax connectors are needed for the assembly of the coax cable to the antenna.

Studies have shown that antenna placement is of the utmost importance for either external or embedded antennas. Depending and the placement, the quality of the radio link of the WLAN can be optimized. An IBM publication ("Developing integrated antenna subsystems for laptop computers" published in May 2003), shows that the best location for embedded antennas was as high as possible on the laptop display.

In order to optimize the antenna communication properties, as well as insertion into a laptop or a desktop computer, there is a need for a compact

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antenna that can be placed anywhere in the computer. Known technologies, as the ones shown in FIG. 1a and 1b, would not meet the compactness requirements, and require too many elements.

The purpose of the present invention is to offer a simplified and compact antenna assembly, as well as an antenna, usable in desktop or laptop computers.

Accordingly, the present invention provides an antenna assembly for radio communication equipments according to claim 1. Thanks to these features, the antenna assembly is compact.

The present invention further provides an antenna according to claim 9, and a method for manufacturing such an antenna according to claim 14.

In various embodiments of the connector according to the invention, one may use one and/or other of features of claims 2 to 8, for the antenna assembly, and 10 to 13 for the antenna.

Other features and advantages of this invention will further appear in the hereafter description when considered in connection to the accompanying drawings, wherein:

- FIG. 1a is a schematic illustration of a known antenna to coax cable connection,
- FIG. 1b is a schematic illustration of a known antenna with a connector for connection to a coax cable,
- FIG. 2a is a schematic illustration of a first embodiment of the antenna according to the invention,
- FIG. 2b is a schematic illustration of the lower side of the first embodiment of the antenna according to the invention,
- FIG. 2c is a schematic illustration of the first embodiment of the antenna assembly according to the invention,
- FIG. 2d is a schematic illustration of the connection end of the first embodiment of the antenna assembly according to the invention,
- FIG. 3 is a cross section of the antenna assembly according to the first embodiment of the invention, and;
- FIG. 4 is a schematic illustration of a second embodiment of the antenna assembly according to the invention.

The antenna 20 as shown in FIG. 2a and 2b comprises an elongated body 21 made of non conductive material, and presenting an upper side 124 and a lower side 128. The body 21 further comprises a first end 125 and a second end 225 opposite the first end 125. The second end is bare of conductive material.

An upper conductive layer 24 and a lower conductive layer 28 cover partially respectively the upper and lower sides 124 and 128.

In the example of FIG. 2a and 2b, the elongated body presents a sensibly rectangular section, the dimensions of the section being sensibly smaller that the total length of the body, to give the antenna an elongated form. Furthermore, the lower layer 28 sensibly covers the lower side 128 as seen on FIG. 2b. The upper layer 24 presents a strip like form that covers only partially the upper side 124. Hence, the two conductive layers are electrically separated from each other along the body 21 between the two layers.

The lower conductive layer is connected to a lateral conductive layer 25 covering the first end 125. The upper conductive layer 24 is connected to the lateral conductive layer 25 through a conductive loop formed with two arms 26 and 26' located on the upper side.

An opening 27 is provided on the first end 125 to receive connections means 10 of the antenna 20 to a radio communication equipment (see FIG. 2c).

As FIG. 3 shows it, this connection means generally comprises a first electrically conductive path 112 and second electrically conductive path 110, electrically separated from each other. In this embodiment, the first electrically conductive path 112 is a coax cable sheath (a copper mesh) and the second electrically conductive path is a coax cable core. The coax cable as seen on FIG. 1a and on FIG. 3, further comprises an inner insulation 105 and an outer insulation 115.

The opening 27 is adapted so that when inserting the connection means, the electrically conductive path extends further into the opening 27 than the first electrically conductive path 112. The lateral conductive layer 25 extends partially into the opening 27 to electrically connect the first electrically conductive path 112 so that the latter is electrically connected to the lower

conductive layer 28. The second electrically conductive path extends in such a way that it is electrically connected to the upper conductive layer 24. In a preferred embodiment, the opening opens up on the upper side 124, as seen later on.

In the assembly of FIG. 2c and the detailed view of FIG. 2d, a recess 200 is provided on the upper side 124 of the antenna body 21 in the vicinity of the first end 125. The upper conductive layer 24 extends on the walls of the recess up to the lateral conductive layer 25. In a preferred embodiment, the upper conductive layer 24 is continued to the bottom of the recess, all the way to arms 26 and 26' that extend from the bottom of the recess to the first end 125 and its lateral conductive layer 25.

In order to connect the core 110 of the coax cable to the upper conductive layer 24, the opening 27 extends inside the antenna body 27 till it opens up on the upper side 124, and more precisely in the recess 200, at the vicinity of the recess bottom. The recess is preferably deep enough to allow the opening 27 to open between the two arms 26 and 26', i.e. above the recess bottom, as seen on FIG. 2d. In this area of the recess between the two arms 26 and 26', no conductive layer is provided on the recess wall.

The insulation layers of the coax cable are cleared so that the core 110 extends further than the metal sheath 112, as seen in FIG. 1a and FIG. 3. Thus when inserting the coax cable 10 into the opening 27, the metal sheath comes into contact with the extension of the lateral conductive layer inside the opening 27, and the tip of the coax cable, i.e. the core 110 comes into contact with the upper conductive layer 24. The two contact zones are separated with the inner insulation 105 partially lying against the recess wall between the two arms 26 and 26'.

As shown on FIG. 3, the core 110 is welded to the conductive layer 24 at the bottom of the recess through soldering 141. The inner insulation 105 is freed from its outer insulation and outer sheath so that it lies at the bottom of the recess, on a section 135 with no conductive layer. The outer sheath is freed of its outer insulation so that a section 112 can be inserted inside the opening 27 to be in contact with the conductive layer covering the walls of the opening 27. A soldering 142 allows to weld the sheath 112 against the conductive layer.

As seen on FIGS. 2c and 2d, as well as on FIGS. 3 and 4, the transverse dimensions of the antenna are relatively small compared to the length of the antenna body. The section of the antenna is sensibly of the same size that the section of the coax cable, therefore it does not require much more room than the cable itself.

Conductive layers can be incorporated on the antenna body 21 using techniques like MID (molded interconnect device). All known MID techniques may be used to manufacture the antenna, such as the Single Shot Molding with Photo Imaging, the Two Shot Molding, or the different Film Techniques.

A two shot molding MID can be advantageously used to position the conductive layers on the elongated body 21 of the antenna. This technique uses two separate molding cycles and usually different polymers to form the body. It requires the construction of different mold cavities for each shot.

A first shot, which usually contains platable catalyzed resin, is injection molded in one cavity in a mould. This produces a first-stage molding having identifiable areas for placement or incorporation of further molding material for additional processing. The first-stage molding is then inserted into a second cavity where a second shot, generally of non catalyzed resin, is introduced into the mould. This typically produces a molding with exposed, platable, catalyzed resin on its surface, the patterns of which define the required circuit tracks of the conductive layers. The areas not to be plated are covered with the second molding. As part of the plating process, the molding may undergo a chemical treatment to enhance the ability of catalyzed resin to accept plating. The molding is finally metal plated, for example copper plated, to a specified thickness. Metallic or organic finishes may then be applied. A variation of this technique is to use resins which do not contain a plating catalyst. In this case the first shot is molded and chemically treated with a catalyst to render the polymer metal sensitive before molding the second shot. Copper plating is then undertaken and only the resin that has been chemically treated plates to form circuits. In both instances, only the polymer which is sensitive to the metallization will keep the metal after the plating.

As seen in FIG. 3, the antenna body 21 is made of two different moldings 130 and 135. The molding 130, carrying the conductive layers, is

made of the polymer sensitive to plating, while the molding 135 is not. All the conductive layers, as presented in FIGS. 2a to 2d, and 3, i.e. the upper layer 24, the lower layer 28, the lateral 25, the arms 26 and 26', as well as the layer extending within the opening 27, actually define the outline of the molding 130 of metal sensitive polymer. The regions of the antenna body 21 which are not covered by the conductive layers or plating belong to the second shot of molding. The second molding covers the first molding to define the free areas on the first molding to be covered during the subsequent plating operation with the conductive layers. Thus, the second molding, which remains metal free after the plating operation, allows to define the outline of the conductive layers defining the antenna as it prevents some areas of the first molding to be plated during the plating process.

The antenna defined here before displays a generally rectangular section. Another embodiment, presenting a generally round section, is show in FIG. 4. The same numbers refer to the same parts. The antenna of FIG. 4 displays the exact same characteristics of the first embodiment, except for the round section. The body 21 presents a cylindrical form, which comprises an upper half cylinder 124 and a lower half cylinder 128. The upper half cylinder carries the upper conductive layer 24, and the lower half cylinder carries the lower conductive layer 28. An opening 27 is also provided on the first end 125 covered with the lateral conductive layer 25. The coax cable 21 is cleared of its external layers so that its core 100 can extend to the bottom of the recess when the cable 10 is inserted inside the opening 27, and be welded to the layer 24. The outer conductive sheath (not shown) of the coax cable 10 is inserted into the opening 27 so that it can be welded to the layer covering the walls of the opening.

In both embodiments, the conductive layer 24 is connected to the lateral conductive layer 25 through the arms 26 and 26', which form a loop through which the opening 27 opens on to. Other connection means could be used such as only one arm, or a different pattern of conductive layer, as long as the core 110 of the coax cable 10 can be welded to the conductive layer 24.

The antenna assembly according to the invention offers a small transversal section, of dimensions sensibly equivalent to the section of the coax

cable. Thus the antenna does not need more room than the cable itself. Thus the integration of the antenna is facilitated, specifically for computer flat panel displays.

CLAIMS

1. An antenna assembly for a radio communication equipment, comprising an antenna comprising a body (20) made of non conductive material and a conductive layer (24, 28) supported by the body (20), and connection means (10) for connection of said antenna to said radio communication equipment, comprising at least one electrically conductive path directly electrically contacting the conductive layer.

2. An antenna assembly according to claim 1, wherein the body (20) presents an upper side (124) and a lower side (128), an upper (24) and a lower (28) conductive layers cover respectively said upper and lower sides, said layers being connected to each other through a lateral conductive layer (25), and the connection means (10) comprises a first (112) and second (105) electrically conductive paths, electrically separated from each other, said first electrically conductive path being electrically connected to said lower conductive layer, and said second electrically conductive path being electrically connected to said upper conductive layer.

3. An antenna assembly according to claim 2, comprising a recess (200), the upper conductive layer extending in said recess.

4. An antenna assembly according to claim 3, wherein the upper conductive layer extends to the bottom of the recess, and is further connected at said bottom of said recess to two arms (26, 26') forming a loop, said two arms being connected to the lateral conductive layer.

5. An antenna assembly according to any one of claim 2 to 4, wherein the body (20) comprises an opening (27) provided on a lateral side, through which an electrically conductive path extends.

6. An antenna assembly according to claim 5, wherein the opening opens up on the upper side.

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7. An antenna assembly according to any one of the claims 2 to 6, wherein the connections means is a coax cable (10), a first electrically conductive path being the coax cable sheath (112), and the second electrically conductive path being the coax cable core (110).

8. An antenna assembly according to claim 7, wherein the core of the coax cable extends up to the recess, said core being welded to the upper conductive layer at the bottom of the recess, and the sheath being welded to the conductive layer covering the walls of the opening and.

9. An antenna for a radio communication equipment, comprising

a body (20) made of non conductive material, presenting an upper (124) and a lower (128) side,

an upper (24) and a lower (28) conductive layer covering respectively said upper and lower sides, said layers being connected to each other through a lateral conductive layer (25),

an opening (27) provided on said first end, adapted to receive connection means (10) for connection of said antenna to said radio communication equipment.

10. An antenna according to claim 9, wherein the opening opens up on the upper side.

11. An antenna according to claim 9 or 10, wherein the upper side comprises a recess (200), the upper conductive layer extending through said recess up to the lateral conductive layer.

12. An antenna according to claim 11, wherein the upper conductive layer extends to the bottom of the recess, and is further connected at said bottom of said recess to two arms (26, 26') forming a loop, said two arms being connected to the lateral conductive layer.

13. An antenna according to claim 12, wherein the opening opens up inside the recess at the vicinity of the bottom of said recess, the walls of said opening further being covered with a conductive layer.

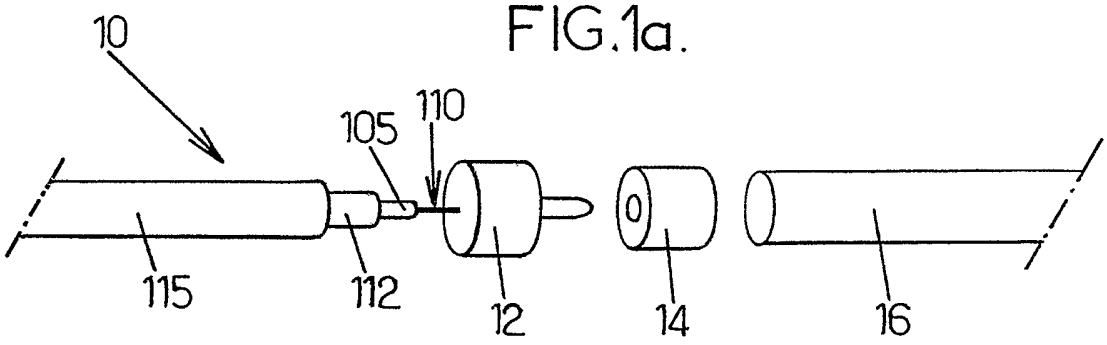
14. A method for manufacturing the antenna of claims 9 to 13, comprising

a first shot molding with a metal sensitive polymer, or a metal rendered sensitive to metal, for forming the body,

a second shot molding being made of a non metal sensitive polymer, said second shot molding covering said first shot to define metal sensitive free areas on said first shot,

a metal plating operation so that said free areas can form the conductive layers when plated, while leaving said second shot molding free of metal.

FIG.1a.



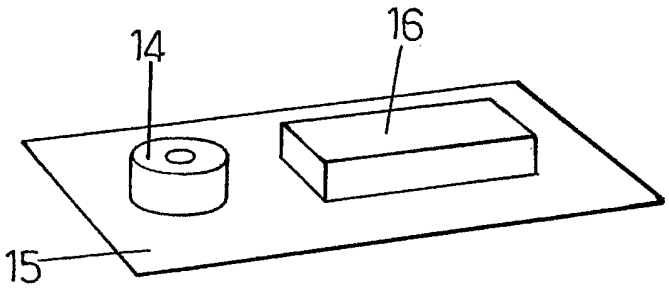


FIG.1b.

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FIG.2a.

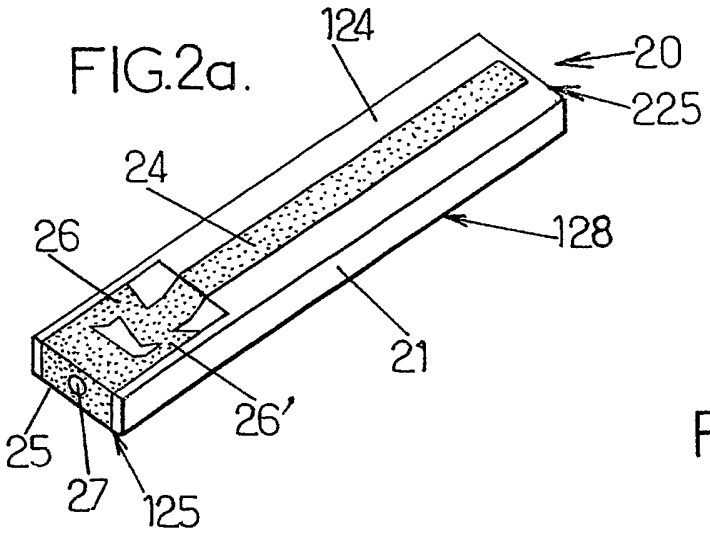


FIG.2b.

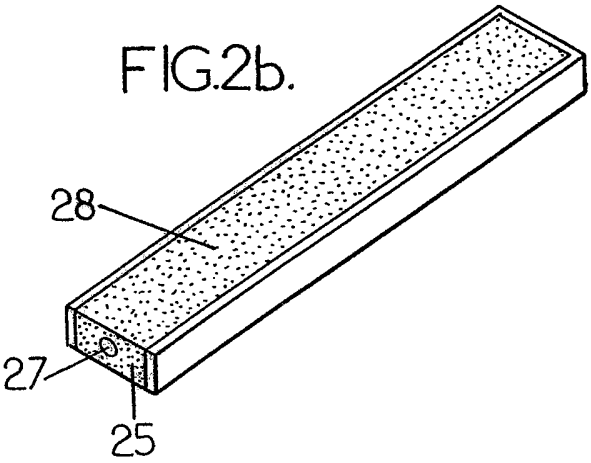


FIG.2d.

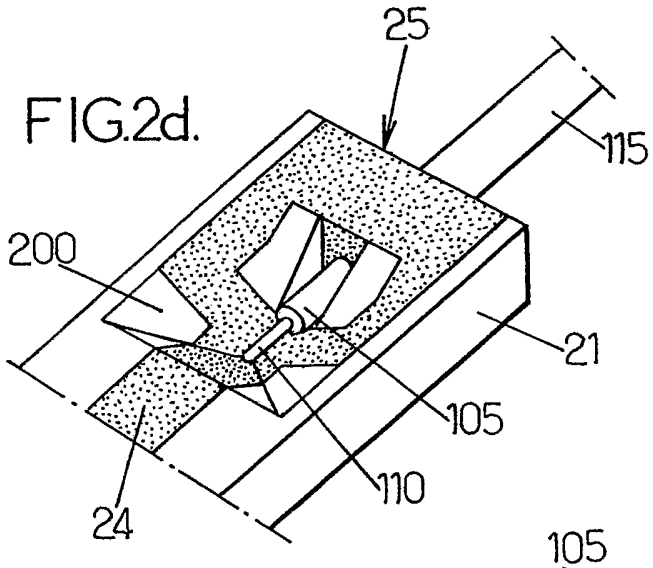


FIG.2c.

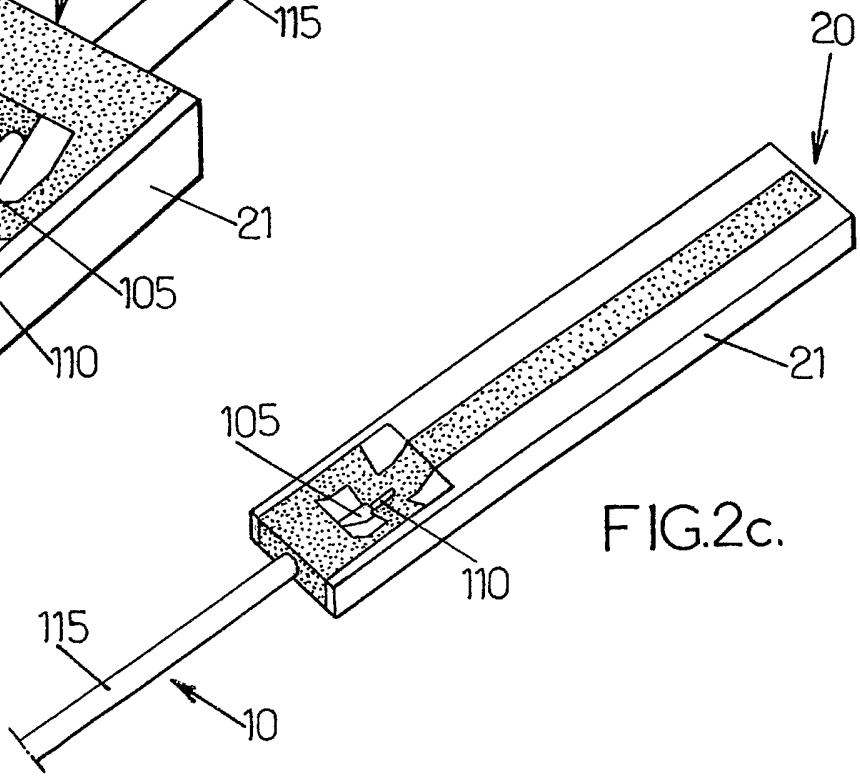
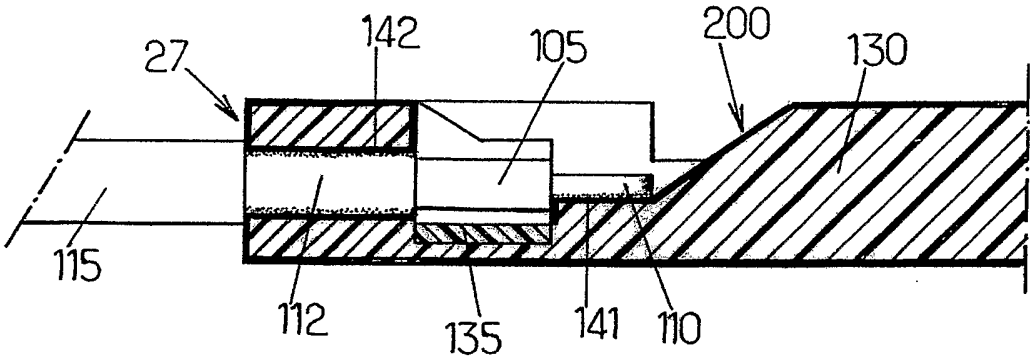


FIG.3.


27
142
105
200
130
115
112
135
141
110

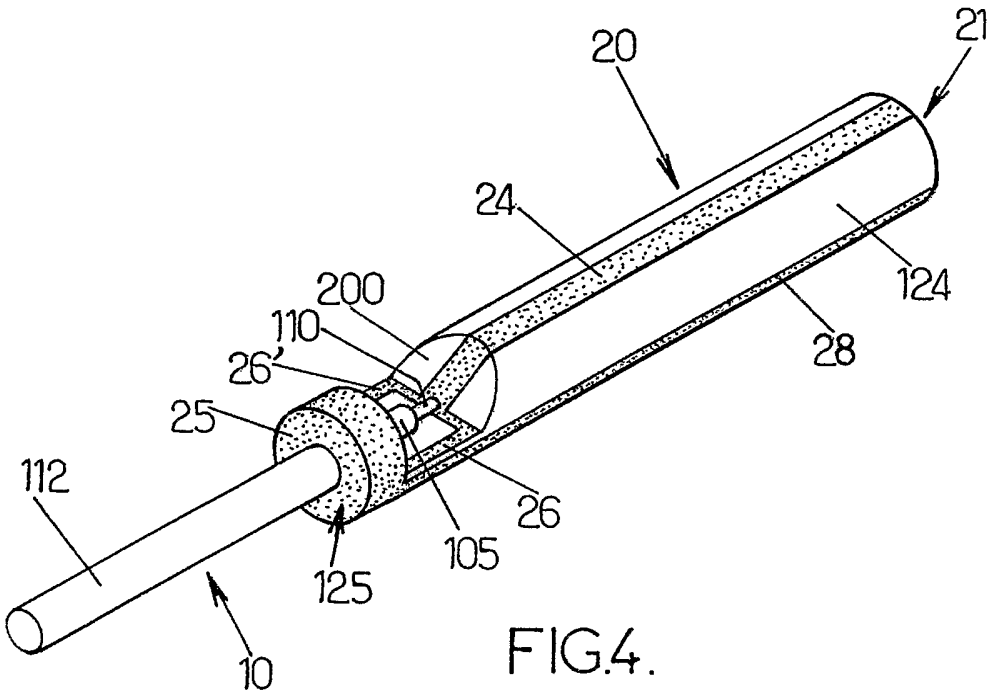

20
21
24
124
200
110
26'
28
25
112
26
105
125
10

FIG.4.

INTERNATIONAL SEARCH REPORT

International Application No
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A. CLASSIFICATION OF SUBJECT MATTER
H01Q9/04 H01Q1/38 H01Q1/24

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)
H01P H01Q

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 practical, search terms used)
EPO-Internal, PAJ, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 6 121 930 A (GRANGEAT ET AL) 19 September 2000 (2000-09-19) column 6, line 35 - column 7, line 41; figure 1	1,2,7 3,5,6,8, 10,11
X	GB 2 345 022 A (* NOKIA MOBILE PHONES LIMITED; * NOKIA CORPORATION) 28 June 2000 (2000-06-28) the whole document	1-3,9,14
Y	EP 0 537 548 A (BALL CORPORATION) 21 April 1993 (1993-04-21) the whole document	3,5,6,8, 10,11

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
18 November 2005	25/11/2005

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 017, no. 160 (E-1342), 29 March 1993 (1993-03-29) -& JP 04 323905 A (ASAHI GLASS CO LTD), 13 November 1992 (1992-11-13) the whole document	1,9
A	EP 1 130 678 A (ALPS ELECTRIC CO., LTD) 5 September 2001 (2001-09-05) the whole document	1-13

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP2005/005241

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6121930 A	19-09-2000	AT 276591 T	15-10-2004
		AU 9697598 A	01-07-1999
		CA 2254255 A1	11-06-1999
		CN 1224254 A	28-07-1999
		DE 69826223 D1	21-10-2004
		DE 69826223 T2	03-11-2005
		EP 0923157 A1	16-06-1999
		FR 2772519 A1	18-06-1999
		JP 11317614 A	16-11-1999
		SG 71880 A1	18-04-2000
		TW 393811 B	11-06-2000
GB 2345022 A	28-06-2000	NONE	
EP 0537548 A	21-04-1993	CA 2079398 A1	16-04-1993
		JP 5226925 A	03-09-1993
		US 5355142 A	11-10-1994
JP 04323905 A	13-11-1992	NONE	
EP 1130678 A	05-09-2001	DE 60103437 D1	01-07-2004
		DE 60103437 T2	16-09-2004
		JP 2001244723 A	07-09-2001
		US 6310586 B1	30-10-2001