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(54) **Title**: BODY PART OF RFID DEVICE MOUNTABLE BY NAILING OR RFID NAIL

(57) **Abstract**: A body of an RFID identifier, or an identifier comprising it, mounted by means of nailing or a nailer inside an object to be marked or tracked, which comprises, inside an at least partly non-conductive body, a space for a thin RFID circuit board comprising a strip antenna.

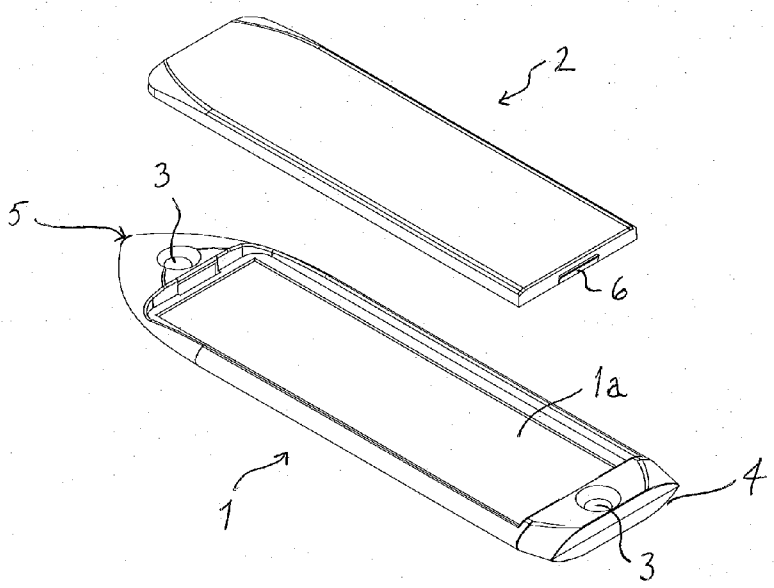

Fig. 1

WO 2010/052375 A1

BODY PART OF RFID DEVICE MOUNTABLE BY NAILING, OR RFID NAIL

The invention relates to improving wireless marking means, and especially to improving the RFID marking means mounted inside the object to be marked by nailing or shooting, and the mounting method.

Prior art

RFID devices, that is, marking means operating with radio frequency, are widely used for product identification. They may also include sensors for wireless reading of measurement results. Most commonly, RFID devices are adhered to the object being tracked by means of a self-adhesive label and they may, for example, be implanted with a needle into people or animals.

RFID devices are advantageously used, for example, for tracking and identifying pallets. According to the prior art, a hole is drilled for RFID identifiers mounted in a pallet, in which hole the identifier is mounted, or the identifier is fixed otherwise in the pallet, for example, by gluing, stapling or leaving the RFID transponder between the parts of the pallet at the manufacturing stage. An identifier remaining on the surface of the pallet is susceptible to damage and mounting inside the wooden structure of the pallet is slow because a hole has to be drilled for the identifier.

Nail-like RFID devices are also known, for example, the TAGnology company's Nail Tag. It is a 4 mm thick, fibreglass reinforced nail made of polyamide, inside which is cast an RFID chip and a ferrite-rod antenna. The ferrite-rod antenna is expensive to manufacture and requires fill-casting in order for the RFID circuit and antenna to withstand the accelerations required in nailing. Manufacturing a nail of the above type is relatively expensive, because a winding wire and ferrite have to be cast inside the body of the nail.

Prior art is also disclosed in the publication US 2006/0244612 A1, which describes an RFID device incorporated in the bullet of a firearm for the purpose of tracking shot game.

The aim of the invention is to provide a nail-like RFID transponder which is more economical to produce, distance-readable, and more flexibly modifiable than before. The aims of the invention are achieved by means of a transponder, which comprises a flexible circuit board mountable inside a flat nail body. The flat body may be openable or have two parts and thus the flexible circuit board can be mounted inside it only after the body has been manufactured. The flat shape gives the nail a small cross-sectional area and thus the nailing force is reasonable. At the same time, the flat shape makes possible the use of a strip antenna and allows a reading distance of several metres. Furthermore, a strip antenna, a flexible circuit board and an RFID circuit are considerably cheaper to produce than an RFID device based on a coil antenna. Since the flexible circuit board is extremely light and strong, it withstands high accelerations even unsupported, in addition to which the flexible circuit board can be laminated to be liquid- and gas-tight, in which case the nail body itself does not have to be tight. The flexible circuit board is preferably of the same laminated material as is currently used in the manufacture of distance-readable smart cards. In this way is achieved a strong, dimensionally accurate and gas-tight casing for the RFID circuit. The circuit board does not necessarily have to be very flexible; it suffices that it withstands the forces generated by the impact without breaking. For example, a fibreglass reinforced board may also be sufficiently flexible. It is, however, disadvantageously thick and its jointing techniques withstand high accelerations poorly.

The characterising features of the invention are described in the characterising part of the independent claims and the dependent claims describe embodiments of the invention.

The invention is described in the following with reference to the drawings.

Figure 1 shows the body part of the RFID device according to the invention with the body part opened.

Figure 2 shows the device of Figure 1 as seen from the other side.

Figure 1 shows a perspective view of the body of the RFID device according to the invention. The body 1 has a recess 1a for the circuit board and antenna of the RFID

transponder. The circuit board is placed in the recess and the lid 2 is closed. The circuit board remains supported by the lid and the lid is locked into place by the locking means 6. At this stage, the circuit board may also be glued to the lid 2, the bottom of the recess 1a of the body part or to both.

Figure 2 shows the lid 2 and the body part from a different direction. The lid 2 has a recess 2a for the electronic part of the RFID circuit. The recess may be provided with an adhesive or a casting filler either before or after closing by injecting, spraying or pouring. This will both support the components of the circuit and prevent the disassembling of the device without breaking it.

The body 1 described in Figures 1 and 2 comprises holes 3 which can be used for alternative fixing or suspension. Furthermore, the holes 3 can be utilised in the operation of the device nailing the marking means for aligning the device before ramming the device, for example, into wood by striking it on the rear part 4. The holes 3 may also act as fastening means in the assembly, by means of which the body can be kept exactly in place.

The holes 7 provided in connection with the locking means make it possible to open the locking means 6 and thus, for example, to change the circuit board. According to the picture, the locking means are spring bolts 6, which may be released through the holes 7 by using an appropriate tool. Spring bolts are only one option for locking the lid.

The lid 2 fits the recess 1a tightly lengthwise. The lid, therefore, takes on some of the impact generated during nailing and prevents for its part the distortion of the body.

According to the invention, the lid may also be on a different side than the largest side shown in the picture. The lid may be on the small side, in which case the lid is preferably designed so that it wedges the circuit board containing the antenna into place. The lid may also be on the tip or on the base. The material of a lid mounted on the tip or the base may also be metal, in which case it is possible to make the tip or the base, which are subjected to the greatest stress, of a harder material without encumbering the manufacture to any great extent. The leading tip or base may also

be arranged as a part of the antenna circuit by making a suitable contact area for the tip in the circuit board. A lid located on the largest side in accordance with Figures 1 and 2 facilitates the mounting of various sensors and measuring devices inside the device, because a suitable recess can be made for the measuring devices and they can be more easily supported between the lid and the body. The sensors may thus also be more easily arranged in the recesses made in the body. Examples of suitable sensors are temperature sensors, a humidity sensor, sensors measuring force and vibrations which may act, for example, as anti-theft devices which detect the moving of an object or they may function as a vibration transducer for monitoring the construction. The sensor may also be a chemical one, in which case it may detect, for example, the metabolism of a living tree or the decay of a foodstuff. The hardness of a body containing a sensor which is nailed into a live tree or in harvested timber can be made such that it will not cause inconvenience to wood harvesting or pulp manufacture.

According to a second embodiment of the invention, the lid and the recess 1a in the body are designed to be wavy or curved, so that the RFID circuit board is wavy or curved when viewed from the back or front. The directional pattern of the antenna can thus be modified to be more omnidirectional, because a curved antenna also extends out of the plane, which makes it possible to even out the directional pattern of a completely planar antenna in such a way that no equally steep dead directions are formed in the radiation pattern. The waviness also rigidifies the structure to some extent. The body and the lid may also be wavy or curved on the outer surface, or only the part supporting the flexible circuit board is designed to be wavy or curved.

The RFID circuit board may be manufactured by a technique used in manufacturing distance- or proximity-readable smart cards, in which case thin and flexible RFID circuit laminate, laminated inside the card, is used as such or as a circuit board cut into a suitable shape. In smart card manufacture, a thin circuit board laminate is laminated inside the card itself. The technique used makes possible a dimensionally very accurate laminate thickness and size. The body according to the invention may preferably be directly dimensioned so that a suitable circuit board can be cut from the laminate blank used in smart card manufacture. Suitable circuit board laminates can be made, for example, of polyimide, polyamide, polyethene or polycarbonate.

The body may preferably be made of strong non-conducting material. Polyamide, aramid, polyimide, polycarbonate and nylon are suitable plastic types. Reinforcing or filling materials, such as fibre glass, graphite, carbon fibre, silica or glass balls are preferably also used. The tip and the sides may also be of metal.

According to a third embodiment, there is hot-setting adhesive or heat- or pressure-activated adhesive on the surface of the lid and/or body. In this case, the pressure and frictional heat caused by nailing activate the adhesive after nailing. The hot-setting adhesive also acts as a lubricant during nailing, as long as the properties of the adhesive are suitable and the adhesive melts due to frictional heat or becomes essentially liquid under high pressure. To enhance the effect of the adhesive, the surface of the body and of the lid may be grooved or roughened to improve contact. Suitable adhesives include at least polyolefins or two-component adhesives activated by nano- or microparticles. Two adhesive components which react with one another may also be patterned on the surface of the body as stripes perpendicular to the nailing direction, whereupon when the nail penetrates the object, the adhesive components are mixed together. The adhesive may also be provided on the tip of the nail or, for example, in a vial inside the body, the said vial releasing the adhesive as it breaks in connection with the nailing. Liquid adhesives can thus also be used.

The adhesive surface prevents for its part the tearing of the wood after nailing, because the adhesive also has tensile strength. It is, therefore, not easy, for example, to wedge wood from beside the marking means to detach the flat marking means from the object. Due to its tensile strength, the adhesive maintains the wood intact at the marking means so that splitting will not occur easily at the marking means once the adhesive has dried, or should the basic material of the object to be marked be split, for example, by wedging with force at the marking means, the marking means adhered with an effective adhesive will not detach easily from its hole, at least not without breaking. It is worthwhile to secure the joint between the body and lid of the marking means, for example, by fill-casting it after closing, in which case an attempt at splitting will not detach lid and the body from one another in such a way that the circuit board could be detached from inside the body intact.

For nailing the RFID marking means inside the object to be marked can be used a nailer which drives the device with a single stroke inside the object to be marked, or a nailer which drives the nail in with several low-energy strokes. A hammer or a manual device provided with a guide can also be used. The devices driving with a single stroke usually function with compressed air or with an impulse produced by the combustion gases of a gas or solid. A palm nailer driving with several strokes is smaller and lighter, but operates more slowly, and is usually not provided with automatic feed. These palm nailers usually operate with compressed air. The power driven devices available include electropneumatic devices similar to a drilling hammer. It would seem that the nailing method driving with several strokes is better suited for nailing a relatively large marking means, because the friction of the body is relatively high when nailing and a device driving with one stroke becomes large in size and bulky.

Claims

1. A body of an RFID identifier mounted by means of nailing or a nailer inside an object to be marked or tracked, **characterised** in that inside the at least partly non-conductive body adapted for nailing inside an object to be marked is a space for an RFID circuit board comprising a strip antenna.

2. A body of an RFID identifier as claimed in the above claim, which is flat, however, possibly wavy or curved, essentially in one direction.

3. A body of an RFID identifier as claimed in either of the above claims, **characterised** in that the body can be opened and closed to replace the circuit board.

4. A body of an RFID identifier as claimed in any of the above claims, **characterised** in that the body contains an adhesive which is activated in connection with nailing and hardens after nailing.

5. An RFID transponder comprising a body of an RFID identifier as claimed in any of the above claims.

6. An RFID transponder as claimed in claim 5, **characterised** in that the transponder comprises measuring electronics or sensors.

7. An RFID transponder as claimed in claim 5 or 6, **characterised** in that the circuit board of the transponder can be selected or replaced before nailing according to the intended use.

8. A body of an RFID identifier as claimed in any of the above claims, which is adapted to be used with an RFID circuit board cut from circuit board laminate used in smart card manufacture.

9. A nailed marking means comprising an RFID transponder, **characterised** in that the nail is essentially flat and comprises an antenna arranged in the circuit board.

10. A marking method, **characterised** in that in the method, an RFID circuit board comprising a strip antenna arranged inside a flat piece, which withstands nailing, is nailed inside the object to be marked.

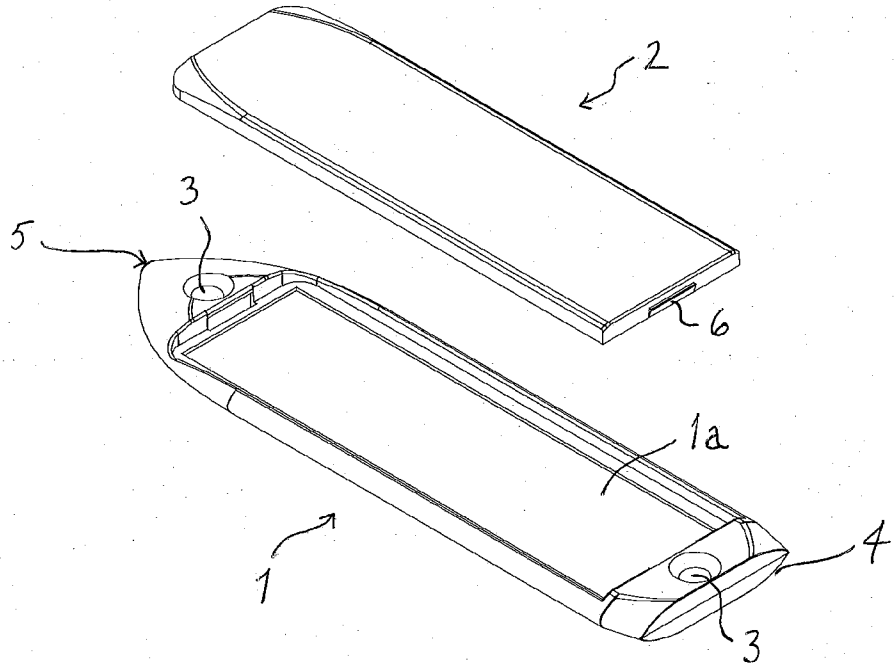

Fig. 1

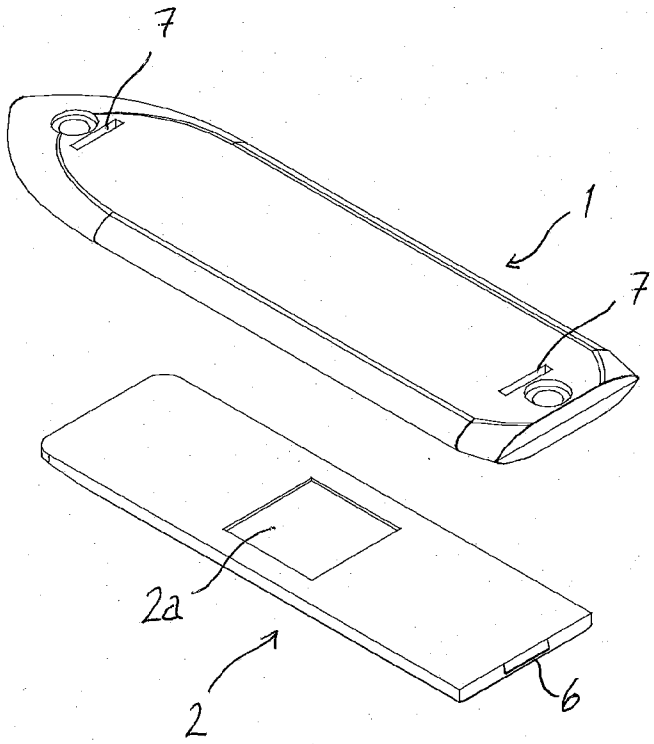

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

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)

IPC: G06K, H01Q

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

FI, SE, NO, DK

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

EPO-internal, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO 2008087714 A1 (NITTA IND CO LTD et al.) 24 July 2008 (24.07.2008) & EPODOC and WPI-abstracts [online] & Thomson Scientific machine translation [online], whole text figures 1, 3, 11, 12	1, 5, 6, 8 4
Y	FR 2810436 A1 (LEUVREY BERNARD ABEL ANDRE) 21 December 2001 (21.12.2001) page 1 lines 1-12, page 3 line 37-53, page 9 line 36 - page 10 line 12, figures 16-18	1, 3-8

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

* Special categories of cited documents:
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"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/FI	Authorized officer
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International application No.
PCT/FI2009/050902

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	FR 2902222 A1 (LEUVREY BERNARD ABEL ANDRE) 14 December 2007 (14.12.2007) page 1 lines 1-2, page 2 lines 1-31 and lines 46-53, page 4 lines 7-16, figures 1, 5, 6	9 1, 2, 4-6, 8, 10
Y	FR 2913134 A1 (LEUVREY BERNARD ABEL ANDRE) 29 August 2008 (29.08.2008) page 2 lines 38-47, page 4 lines 22-29, figure 1	1, 4-6, 8
Y	GB 2294846 A (KERBY ROBERT ANTHONY) 08 May 1996 (08.05.1996) abstract	1, 4-6, 8
Y	EP 0535919 A2 (RYAN MICHAEL C) 07 April 1993 (07.04.1993) abstract, column 4 lines 19-45, column 5 lines 40-54, claim 1	1, 4-6, 8
Y	WO 2008127192 A1 (SP SVERIGES TEKNISKA FORSKNING et al.) 23 October 2008 (23.10.2008) abstract, page 4 line 31 - page 5 line 6, claim 4	1, 4-6, 8
X	JP 2007241781 A (DAINIPPON PRINTING CO LTD) 20 September 2007 (20.09.2007) & EPODOC and WPI-abstracts [online] & Thomson Scientific machine translation [online], paragraphs [0002], [0012], [0022], [0023], [0032] and [0033] figures 2A-C and 4A-C	1, 3-8
Y	US 7405664 B2 (SAKAMA ISAO et al.) 29 July 2008 (29.07.2008) column 4 lines 53-63, column 5 lines 30-37, column 9 line 12-15	1-8, 10
Y	US 5391029 A (FARDELL EMANUEL S) 21 February 1995 (21.02.1995) column 4 line 63 - column 5 line 8	4

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/FI2009/050902

Patent document cited in search report	Publication date	Patent family members(s)	Publication date
WO 2008087714 A1	24/07/2008	None	
FR 2810436 A1	21/12/2001	None	
FR 2902222 A1	14/12/2007	None	
FR 2913134 A1	29/08/2008	None	
GB 2294846 A	08/05/1996	None	
EP 0535919 A2	07/04/1993	CA 2079517 A1	02/04/1993
WO 2008127192 A1	23/10/2008	EP 2137556 A1	30/12/2009
JP 2007241781 A	20/09/2007	None	
US 7405664 B2	29/07/2008	JP 2009153146 A EP 1605397 A2 CN 1707855 A KR 20050118108 A TW 267030B B JP 2006025390 A	09/07/2009 14/12/2005 14/12/2005 15/12/2005 21/11/2006 26/01/2006
US 5391029 A	21/02/1995	EP 0576034 A1 DE 69305244T T2 NZ 247994 A MX 9303857 A1 JP 6213220 A CA 2099228 A1 AU 4151293 A	29/12/1993 06/03/1997 24/02/1997 31/01/1994 02/08/1994 27/12/1993 06/01/1994

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CLASSIFICATION OF SUBJECT MATTER

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