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(54) Title: RFID DEVICE

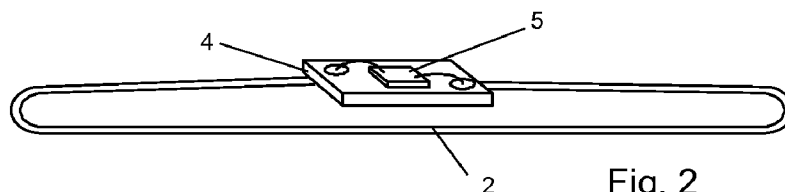


Fig. 2

(57) Abstract: The present invention relates to an RFID device comprising an IC module and at least one flexible antenna electrically connected to the IC module. The flexible antenna has at least two degrees of freedom in the Cartesian space in respect to the IC module.



RFID DEVICE

Field of the invention

The invention relates to RFID device. More
5 specifically the invention applies or embeds miniature RFID
devices to or into components or item to track all
operations that have been performed on each item and also
to provide useful data about this item.

The invention also pertains to a method to
10 manufacture such a device and the use of this device.

Description of prior art

RFID systems are useful in a wide variety of
applications. RFID systems are radio communication systems
15 that include small electronic devices that store
information including identification ("ID") information,
for example. These devices are referred to as RFID tags.

Data stored in the RFID tags (also called
transponders) is wirelessly transmitted to readers (also
20 called interrogators). RFID tag generally includes a
substrate, an embedded microchip where information about
the object is stored and an antenna supported by the
substrate and to which the microchip is electrically
connected. RFID tags are typically powered, via the
25 antenna, by a radio frequency signal sent by the RFID
reader. In response to receiving the radio frequency
signal, the RFID tag responds by transmitting the
identification data stored on the RFID.

The radio frequency signals received by the RFID tags
30 may be sent over a range of distances and are useful
devices for making inventory by tracking the items.

The RFID tags are usually attached onto a surface of
the item (e.g. packages) to track and their presence on
said item does not cause any nuisance for the user.

However, when implemented with some other items, the presence of the prior art RFID tag could felt as not convenient. For instance, prio art RFID tags are not user-friendly when it is attached to an item which is intended
5 to be in direct contact with the user's body or skin (such as a cloth, or linen) insofar as the RFID tag is too rigid with respect to the item material. Taking the case of a napkin, the RFID tag may appear a little nuisance for the user when he wants to use it for drying a part of his body
10 since the tags may scratch his skin due to the rigidity of the RFID tag components.

An additional challenge to meet for the RFID tag in a so-called "laundry" application is that the tag is capable to withstand harsh conditions of use, especially laundry
15 processes. In particular, the RFID tag should display water-tightness performance and high level of mechanical resistance, in particular crushing resistance. Indeed, taking the example of hotels or resorts, when fabric articles are wasted, they are washed in large size laundry
20 machines in the presence of chemical detergents (surfactants, bleach, etc) and submitted to a first mechanical drying process in order to remove impregnated water. Thus, in the case where a water extractor press is implemented, the laundry can be submitted to a pressing
25 pressure as high as 35 bars for 15 minutes.

An additional constraint arises in that the laundry or linen article is subjected to a drying step in drying machines (for instance a laundry article in a drying tunnel finisher is exposed at a temperature as high as 180°C for
30 15 minutes) and then a final ironing step which occurs at a temperature as high as 180°C.

Summary of the invention

It is a primary object of the present invention to provide an improved RFID device which is adapted to be attached to a flexible or supple item in order to track it
5 and which does not cause nuisance for the end user.

To this end, it is provided an RFID device according to claim 1.

Another objective of the invention is to further provide a RFID device which is capable to operate
10 effectively after having undergone several times of harsh conditions.

To this end it is proposed an RFID device of according to one of the dependent claims 8 to 10

15 Short description of the drawings

These and further aspects of the invention will be explained in greater detail by way of example and with reference to the accompanying drawings in which:

20 Fig.1 shows a first embodiment of an RFID device according to the invention;

Fig.2 shows is perspective view of a second embodiment of an RFID device;

Fig.3 shows an enlarged bottom view of an IC module;

25 Fig.4 shows a cross-sectional view of the IC module of Fig.3 along line IV-IV;

Fig.5 shows a top view of a second embodiment of an IC module;

30 Fig.6 shows a napkin or a towel comprising an RFID device according to the invention.

Fig. 7 and 8 display a second example of IC module packaging, especially adapted to the RFID tag of the invention.

Fig. 9A to 9C illustrate the steps of an exemplary method for making a IC module packaging according to Fig. 7.

5 The figures are not drawn to scale. Generally, identical components are denoted by the same reference numerals in the figures.

Detailed description of preferred embodiments

10

Fig. 1 is an overall view a first embodiment of an UHF RFID device. The RFID device 1 comprises a first and a second individual antenna 2 electrically connected to an IC module 3 comprising a microchip. The connection area is covered by a protective insulative encapsulating material (also called glob-top), whose purpose is to isolate the active part of the RFID device from external environment such as dirt, moisture. Further, the glob-top material helps rigidify the active part locally and to further secure the antenna to the IC chip and provide water-tightness of the IC packaging.

In the first embodiment, the first antenna is a single loop antenna whose overall circumference is greater than that of the second single loop antenna. The antennas are made of a flexible conductive material, such as a copper wire whose diameter is smaller enough to ensure flexibility to the wire. In contrast to conventional RFID tag where the antenna is formed onto a relatively rigid substrate (such as a Printed Circuit Board), the antenna of the present invention is flexible enough to experience at least two degrees of freedom in the Cartesian coordinate system, in respect to the IC module. According to an advantageous embodiment, the antenna 2 is made from an electrical cable

comprising an insulating flexible core and a plurality of copper strands wound around this flexible core. According to a preferred embodiment, the cable is known as "hook-up" wire. Typically the copper strands, having about 40
5 micrometer diameter, are braided around the core made of nylon cord of about 200 to 300 micrometer diameter.

It should be understood that other material for the strand and the cord can be used. For instance the strand material could be made of any metal material, such as
10 aluminium, gold or silver.

The cables behave like a dipole whose ends are electrically connected to the IC module. Thus, due to the fact that the ends of the cables are not free ends with sharp features, risks of injury are highly reduced when the
15 RFID device is manipulated or used.

Fig. 2 schematically represents a second embodiment of the RFID device comprising a single loop antenna 2 providing a single dipole.

Fig. 3 shows an IC module electrically connected to
20 the antenna. The IC module comprises a printed circuit board (PCB) which supports a microchip. The PCB comprises an insulating substrate 4 (flexible or rigid). On a first surface of the substrate 4 is mounted the microchip 5. On the opposite second surface are formed two electrical
25 conductive tracks 6 (or pads) to which are connected the antenna ends 7. The electrical pads 6 can be formed for instance by lamination of metal foils or by etching an electrically conductive layer deposited onto the substrate surface. However other methods can be used such as printing
30 methods. The substrate 4 further comprises two through-holes which provide access to the conductive pads from the first surface. Thus the microchip 5 is electrically connected to pads 6 through the holes by e.g. wire bonding

as shown in Fig. 4. However it should be understood that other processes can be implemented for interconnecting the microchip to the pads; a list of non-exhaustive examples of process includes flip-chip or direct welding or solder.

5 Fig. 5 shows another embodiment of an IC module packaging. This embodiment differs from Fig. 2 and 3 in that the pads 6 and the chip 5 are located on the same side of the substrate 4 of the IC module. Therefore no through-hole is needed to connect the microchip to pads. The cable
10 strand(s) 8 is (are) directly soldered to the pads 6 and the IC chip is connected to the pads by the flip-chip technology using for instance solder balls or an anisotropic conductive adhesive.

 Fig. 6 discloses an example of application of the RFID
15 device. The RFID device can be used for inventory of linen of a resort. The "linen" term includes for instance: blankets, napkins, wash cloths, bed sheet, towels ... etc

 The RFID device is embedded within a border seam 9 of the napkin 10 made of wounded material (such as cotton
20 yarn). By virtue to the fact that the antenna is made from flexible material and not supported by any rigid or semi-rigid material, except for the IC module, the user is not able to feel the presence of the RFID device when he utilizes it and therefore is not disturbed by the RFID
25 device according to the invention.

 Fig. 7 is a perspective view of a second embodiment of the IC module packaging 11 which is connected to an RFID antenna assembly. In the present case, the antenna assembly is yet made of a first and a second loops implementing
30 respectively a first and a second electrical cable 12,12', as shown in Fig. 1. The IC module 11 is encased by a protecting body, made of electrically insulating material, which surrounds the IC chip and its electrical connections.

The electrical cable comprises a conductive strand (copper strand) covered by an insulating jacket made of, for instance in silicone or FEP (fluorinated ethylene-propylene plastic) material

5 Fig. 8 displays the IC module 11 wherein one half portion of the protecting body 13 has been removed to expose the IC module packaging. The IC module comprises two leadframe pads 14,14' which are made by stamping of a sheet of metal. For instance, the metal may be selected from
10 copper or aluminium.

 The IC chip 5 is supported by one of the leadframe pads 14,14' and is electrically connected to both leadframes pads 14,14' by wire bonding. In order to electrically connecting the IC chip 5 to the two UHF
15 antennas, each electrical cable is connected to one of the leadframe pads 14, 14'. As shown in Fig. 8, a first end 15 of the cable 12 is soldered onto a first major side of the first leadframe pad 14 while a second end 15' of the wire 12 is soldered onto a second opposite major side of the
20 first leadframe pad 14. The connection of the second cable 12' is made the same way; a first end 16 of the cable 12' is soldered onto a first major side of the second leadframe pad 14' while a second end 16' of the wire 12' is soldered onto a second opposite major side of the second leadframe
25 pad 14'.

 Referring now to Fig. 9A to 9C is explained a method to manufacture the IC module packaging of Fig. 7.

 In a first step, a sheet of metal is stamped to provide a leadframe. The blank comprises two leadframe pads
30 facing each other and wherein the pads are held together on carrier strip 17,17'. The stamping process may result in two exact mirror image pads or in two different pads. In

the shown example, the pads are not symmetrical and have different shapes.

In the next step shown in Fig. 9A, an IC chip 5 is electrically connected to the two leadframe pads 14,14' by, e.g. wire bonding, with the IC chip 5 supported by one the leadframe pads.

In a third step (Fig. 9B and Fig 9C), the leadframe pads with its connected IC chip is overmolded with an insulating material to provide a half protecting body. The half protecting body 18 includes four channels 19,20,21,22 with two channels 19,21 and 20,22 facing each other on either side of the leadframe pads 14,14'. The channels 19,20,21,22 are configured to receive the free ends of the two antenna cables.

In a four step (not shown), the wires are put in place with their respective free ends received in the respective channels and are soldered to the pads.

In a fifth step, a second overmolding operation is performed to provide a second half protecting body so as to form a kind of glob-top for isolating the IC chip and its connection assembly from external environment (moisture, dirt, dust, grease) and which also ensures mechanical strength in particular against bending and crushing stress.

Finally, the leadframe pads are then severed from their carrier strip to provide individualized RFID tag.

According to an alternative method, after connection of the IC chip to the leadframe pads, the cables are then soldered to the leadframe pads and finally the IC assembly is overmoulded in one shot with an insulating material to provide the IC module.

According to a third method, after connection of the IC chip to the leadframe pads, the leadframe assembly is fitted into a half shell of insulating material. The half

shell has substantially the same shape as the overmoulded body of Fig. 9C, i.e. it comprises four channels with two channels facing each other on either side of the leadframe pads. Once mounted into the half shell, the cables are
5 electrically connected to the pads and then a complementary second half shell is mounted to the first half shell to form the encased IC module.

It will be appreciated by persons skilled in the art
10 that the present invention is not limited by what has been particularly shown and described hereinabove. The invention resides in each and every novel characteristic feature and each and every combination of characteristic features. Reference numerals in the claims do not limit their
15 protective scope. Use of the verb "to comprise" and its conjugations does not exclude the presence of elements other than those stated. Use of the article "a" or "an" preceding an element does not exclude the presence of a plurality of such elements.

CLAIMS

1. RFID device comprising an IC module and at least
5 one flexible antenna electrically connected to the IC
module, wherein the flexible antenna has at least two
degrees of freedom in the Cartesian space in respect to the
IC module.

2. RFID device according to claim 1, wherein the
10 antenna is an UHF antenna.

3. RFID device according to claim 1 or 2, wherein
the antenna comprises an electrical cable.

4. RFID device according to claim 3, wherein the
electrical cable comprises an electrically conductive
15 strand surrounded by an insulating jacket.

5. RFID device according to claim 4, wherein the
electrically conductive strand comprises a plurality of
electrical wires.

6. RFID device according to claim 4, wherein the
20 electrically conductive strand comprises a plurality of
electrical wires wound around an insulating core.

7. RFID device according to any preceding claims,
wherein the IC module comprises a Printed Circuit Board
with at least two electrical tracks and wherein an IC chip
25 is electrically connected to the at least two electrical
tracks.

8. RFID device according to anyone of claims 1 to 6,
wherein the IC module comprises at least two leadframe pads
and an IC chip and wherein the IC chip is electrically
30 connected to the at least two leadframe pads.

9. RFID device of any preceding claims, further
comprising a second individual flexible UHF antenna.

10. RFID device of any preceding claims, wherein the IC module is overmoulded with an insulative material.

11. RFID device of anyone of claims 1 to 9, wherein the IC module is encased by a body made of two
5 complementary halves portions.

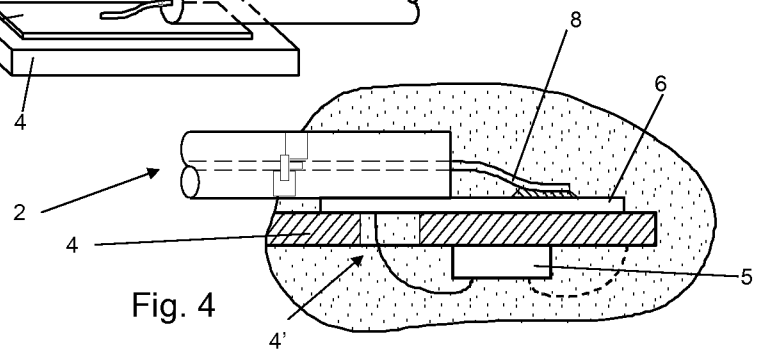
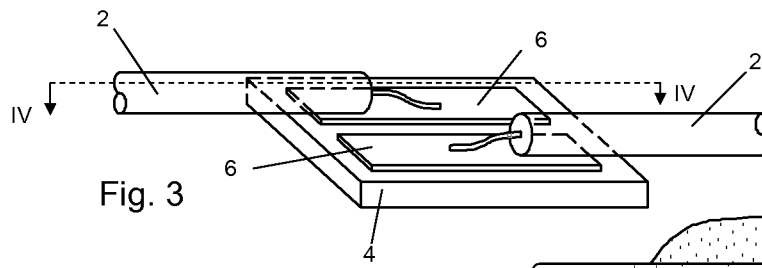
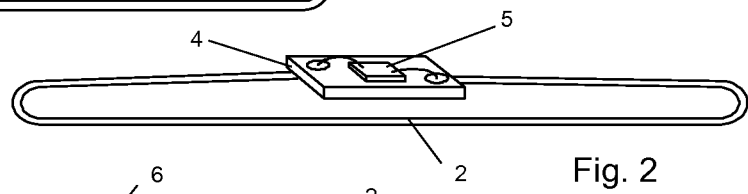
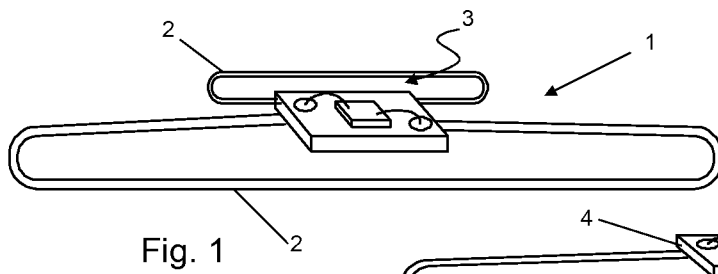
12. Method for manufacturing a RFID device of anyone of claims 1 to 10, comprising the steps:

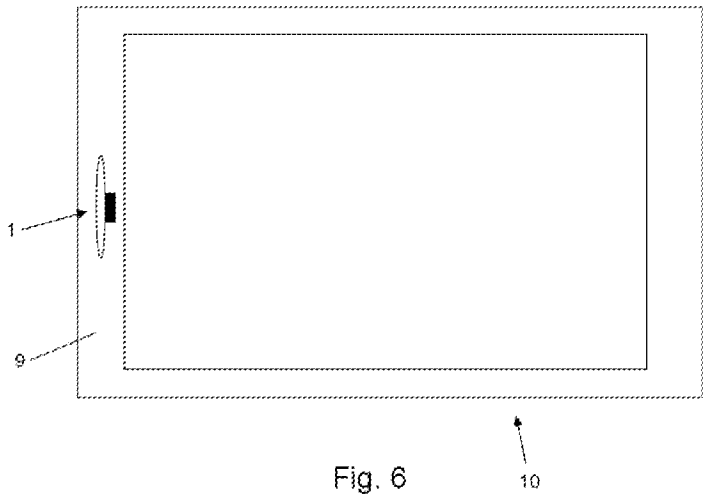
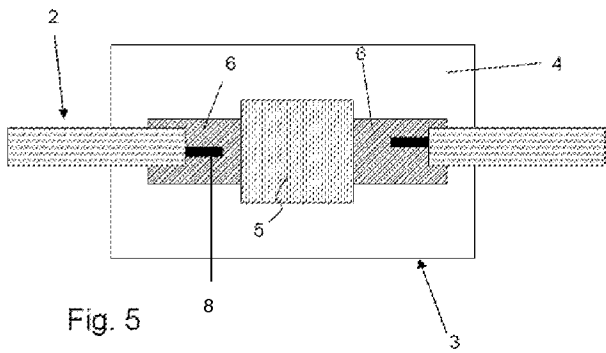
- providing an IC module having a microchip and at least two electrical tracks;
- 10 - connecting the ends of a flexible electrical cable to the at least two electrical tracks respectively.

13. Method according to claim 12, further comprising the step of overmoulding the IC module with an electrically insulating material.

15 14. Use of an RFID device according to anyone of claims 1 to 10 for tracking an item made of matrix of supple material.

15. Use according to claim 13, wherein the item is linen.





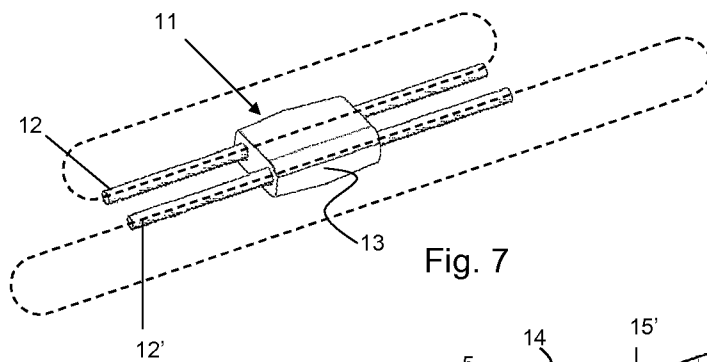


Fig. 7

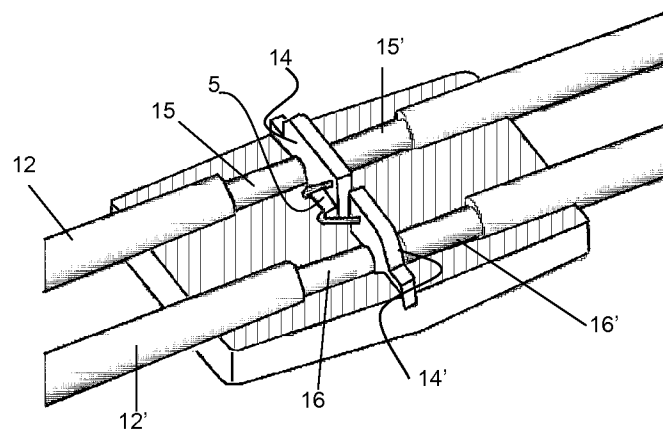


Fig. 8

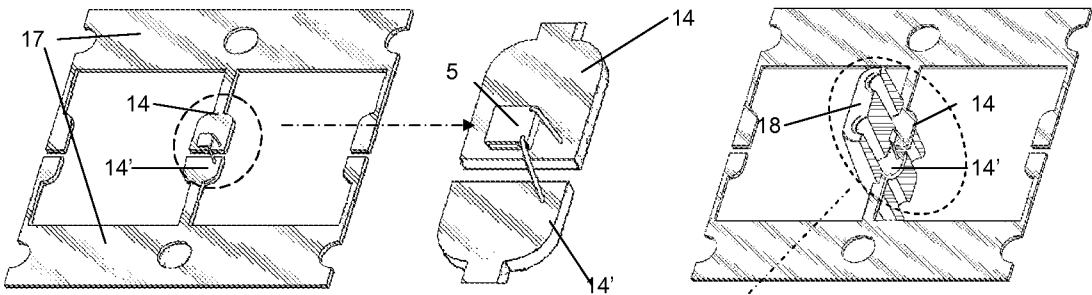


Fig. 9A

Fig. 9B

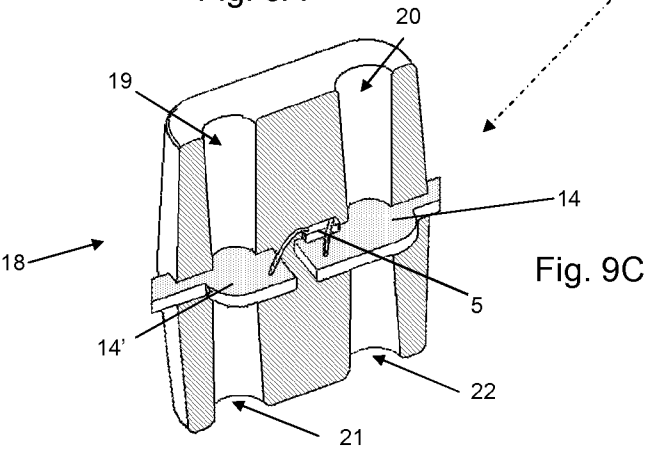


Fig. 9C

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2010/000621

A. CLASSIFICATION OF SUBJECT MATTER

INV. G06K19/04 G06K19/077

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)

G06K

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 03/071474 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]) 28 August 2003 (2003-08-28) page 3, line 3 - line 14 page 4, line 8 - page 5, line 28 claims 1,3,8 figures 1-3	1-15
A	WO 01/95250 A1 (ZOLLER HANSPETER [CH]) 13 December 2001 (2001-12-13) * abstract page 5, line 5 - page 8, line 19 figures 1,12,13	1,2,7,8, 10-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

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30/06/2010

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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