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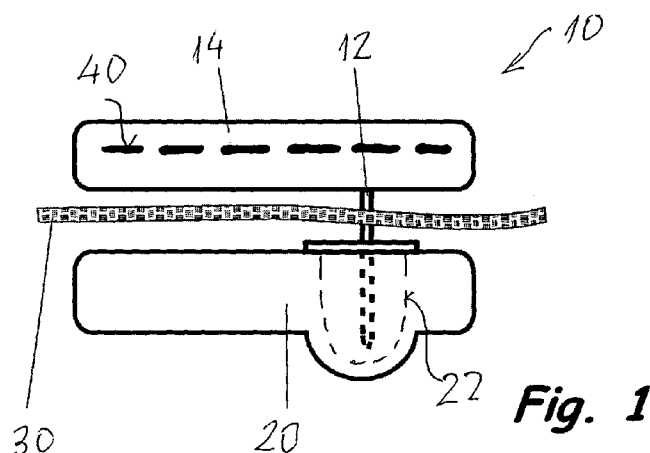
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(54) Title: EAS PIN COMBINED WITH A PLASTIC ENCAPSULATED RFID TAG TO BE CONNECTED TO AN EAS LABEL, PARTICULARLY FOR TRACKING ARTICLES OF CLOTHING



(57) Abstract: An EAS pin combined with a plastic encapsulated RFID tag to be releasable locked to an EAS label, particularly for tracking articles of clothing comprises a pin having a stem adapted to be engaged into a locking mechanism of said EAS label and a pinhead as well as a plastic body fixedly receiving said pinhead, wherein said body encapsulates said RFID inlay. Said plastic body can be injection moulded onto said RFID inlay. The operating frequency band of the RFID inlay is adjusted by the material of the plastic body and the thickness of the material encapsulating said RFID inlay. The material of the plastic body preferably comprises a filling material having a relative dielectric constant exceeding that of the base material. The RFID inlay can be inserted into a cavity of said plastic body composed of two parts defining said cavity.



an EAS label, particularly for tracking articles of clothing

[01] The object of the invention is an EAS pin or pin assembly engagable to an
5 EAS label, particularly for tracking articles of clothing, including a pin releasably
lockable to an EAS label, which pin has a head and a stem formed so that it may
be engaged with the locking mechanism of the EAS label.

[02] It has been recognised that plastic encapsulated electronic article protecting
labels (using the abbreviation for the generally known Electronic Article
10 Surveillance, hereinafter referred to as EAS label) can be favourably combined
with the RFID technology. The significance of the use of such combination has
also been recognised but in every case the aim has been the integration of the
two technologies. US patents US 7,183,917, US 7,109,867 B2, and US
5,939,984, and the publications US 2009/0189768 A1 and US 2008/0048863 A1
15 are good examples for this. The pin or pin assembly that can be releasably
engaged to the locking mechanism of the EAS label was left unchanged; such
pin or pin assembly customarily contains a pin comprising a pinhead and a
stem, as well as a cap, metal or plastic body, that enhances visibility,
manageability and palpability.

20 [03] The solutions produced according to the referred publications always result
in that the size of the product increases or in case of their introduction, require
the complete replacement of the EAS label stocks in use. In order to achieve a
high quality, the products may need to be tested for both functions in the course
of their production, which deteriorates both the cycle time and the output of
25 production.

[04] It is a further disadvantage that such integrated products have to be
produced specifically for the various designs of EAS labels (radio-frequency,
acousto-magnetic, magnetic, microwave systems, etc.)

[05] The locking mechanism of EAS labels are described in US 7,190,272 B2
30 and US 5,528,914, in the following, these are referred to as a locking
mechanism.

[06] When developing the invention, the objective was to provide an EAS pin
assembly that can be attached to any system of EAS labels and is combined
with a plastic encapsulated RFID tag which eliminates the above disadvantages

significance of the fact was realised in that these two functions (EAS and RFID) can be realised not only within a single product but as two products that can be engaged with one another.

5 [07] The objective of the invention is, by eliminating the known deficiencies, to develop an EAS pin assembly combined with a plastic encapsulated RFID tag attaching to the locking mechanism of the EAS labels formed in accordance with the above patents, which EAS pin assembly – after its attachment – provides the advantages of the RFID tag and the EAS systems, or which in itself, when
10 attached to a generally known EAS locking mechanism (not including the electronic article surveillance function) offers the advantages of RFID tags as identifiers and thereby it is capable of fulfilling an independent function similar to EAS systems.

[08] The objective determined in accordance with the invention has been
15 accomplished by the development of the EAS pin assembly according to Claim 1. The preferable embodiments of the pin assembly according to the invention are specified in the dependent claims.

[09] Thus, the solution according to the invention is an EAS pin assembly combined with a plastic encapsulated RFID tag lockable to an EAS label,
20 particularly for tracking articles of clothing, which pin assembly is engaged to the locking mechanism of the plastic encapsulated electronic article surveillance (EAS) label through the EAS pin assembly. The essence of the invention is that the electronic article surveillance system and the RFID system is not realised in a single product but it is attached to an article as a separate means. The device
25 so engaged performs the identifying function of the RFID tag, the article protection of EAS and the function of attaching to the object to be identified. The combined EAS pin assembly according to the invention can be produced in two steps: by plastic injection moulding, ultrasonic welding, adhesive bonding or by any other technology used in the plastic industry. The RFID tag contained
30 therein is a generally used technology that comprises an antenna and an identifying chip.

[10] The solution according to the invention can be attached to an EAS label using any widespread technology therefore the security gates used for their detection need not be replaced regardless of whether they use acousto-

can be used in itself in many cases. In addition to the advantages provided by the RFID tag technology, it is in itself capable of fulfilling the intelligent article surveillance function within the limitations defined by the RFID tag technology.

- 5 Thereby a smaller product in terms of size can be produced, which is an advantage in the trade of clothing articles and also has smaller costs.

[11] The solution according to the invention appears to be more costly than the former solutions at a first sight. However, taking into account that the integration of customary EAS labels with RFID tags gives rise to numerous technical
10 problems, and a few, otherwise unnecessary measures have to be taken in order to make the integration possible, the actual costs arising with the invention do not increase but rather decrease. Additionally, considering the fact that EAS labels and RFID tags can perform different functions independently of one another, and that an RFID tag is capable of adjunctively fulfilling other type of
15 functions, it can be seen that the concept according to the invention represents a cost-effective solution. It is also more cost-effective when some kind of an EAS system is already in use because only the pin according to the invention has to be purchased and the already existing EAS labels and gates can be kept on being used, only RFID tag reading devices have to be installed at the desired
20 locations.

[12] The EAS pin assembly combined according to the invention with a plastic encapsulated RFID tag and attachable to an EAS label, its further features and advantages are described with reference to a few embodiments and the attached drawings, wherein:

- 25 Figure 1 is the schematic side view of the combined EAS pin assembly according to the invention pierced through a piece of fabric and engaged to an EAS label.

Figure 2 is the schematic side view of the combined EAS pin assembly according to the invention pierced through a piece of fabric and connected to the
30 locking mechanism applied in the EAS label.

Figure 3 is a perspective view of the pin applied for the solution according to the invention in itself.

Figure 4 is the exploded perspective view of the combined EAS pin assembly provided with a plastic body made by injection moulding.

provided with two plastic body made of two pieces attached to one another.

[13] Figure 1 shows the EAS pin assembly 10 according to the invention combined with a plastic encapsulated RFID tag pierced through a piece of fabric 30 and in a state connected to the locking mechanism 22 of a EAS label 20. The EAS pin assembly 10 has a pin 12, which is pierced through the piece of fabric 30 representing the article to be identified and protected (e.g. articles of clothing, leather goods, other accessories, etc.). Furthermore, the EAS pin assembly 10 has a plastic body 14.

10 [14] Figure 2 is different from Figure 1 in that the pin 12 of the EAS pin assembly 10 is engaged in a locking mechanism 22 provided with a casing 24 without an EAS label.

[15] Figure 3 shows the pin 12 of the EAS pin assembly 10 according to the invention, which pin 12 has a head 18 and a stem 16 formed to be releasably locked to the locking mechanism 22. From the combined EAS pin assembly 10, only the stem 16 of the pin is 12 protruding, its head 18 is accommodated in the plastic body 14, and thereby it is firmly fixed to the plastic body 14. The plastic body 14 accommodates an RFID inlay 40 symbolically illustrated by a dashed line on Figures 1 and 2. The pin 12 is generally known and used for attaching the EAS labels to the articles to be protected.

[16] In case of the embodiment according to Figure 4, the combined EAS pin assembly 100 according to the invention is made by injection moulding in two steps. Its lower part 110 produced in a first step accommodates the head 18 of the pin 12, and the stem 16 of the pin 12 protrudes downwards from the lower part 110 as shown at the Figure. The pin 12 can also be inserted into the injection moulding device before the injection moulding, and in this case the lower part 110 tightly accommodates the pin 12. According to another solution, an opening (not shown in the Figure) remains on the lower part 110 after the injection moulding wherein the stem 16 of the pin 12 can be inserted, and its head 18 hits against the lower part 110. In the lower part 110, an indentation 112 is formed, wherein the RFID inlay 40 fits into. The indentation 112 defines the position of the RFID inlay 40. The RFID inlay 40 is fixed against displacement by adhesive bonding, for which the adhesive may be applied either on the bottom of the indentation 112 or on the lower surface of the RFID

applied to the lower surface of the RFID inlay 40 during manufacturing. The lower part 110, together with the pin 12 therein and with the RFID inlay 40 can be placed into another injection moulding die, and the upper part 120 of the EAS pin assembly 100 is formed in such a position by way of a second injection moulding.

[17] In case of the embodiment according to Figure 4, the plastic body constituted by the lower part 110 and the upper part 120 is in direct contact with the RFID inlay 40, therefore it significantly influences the operating frequency range of the RFID inlay 40. Such influence is mainly defined by the dielectric constant and wall thickness of the material of the lower part 110 and the upper part 120.

[18] In case of the embodiment according to Figure 5, the plastic body is constituted by a lower part 130 and an upper part 140, which are manufactured separately. The lower part 130 accommodates the pin 12, which in this case can be inserted in the injection moulding device before the injection moulding, but is may also be inserted into a (not shown) opening formed in the lower part 130 for this purpose. In this case, indentations 138 are formed both on the lower part 130 and the upper part 140, which indentations 138 define a closed cavity as a capsule after the lower part 130 and the upper part 140 have been appropriately fixed together. In case of the upper part 140 the indentation is not shown, but it may be formed in corresponding the indentation 138 of the lower part 130. The wall thickness of the capsule is defined by the distance between the bottom of the indentation 138 and the respective lower and upper surfaces of the lower part 130 and upper part 140.

[19] In the indentation 138, there are distance pieces, namely 132, 136 ribs and 134 supports, which are locally touching the RFID inlay 40, and which are located at proper spacings for maintaining the position of the RFID inlay 40 placed on a flexible plastic sheet, for maintaining its distance from the lower part 130 and the upper part 140. Where there is no such touching, there is an air-gap between the RFID inlay 40 and the lower part 130 and upper part 140 constituting the plastic body. The position of the RFID inlay 40 can be stabilised by auxiliary adhesive bonding, which facilitates the assembly and bonding of the lower part 130 with the upper part 140. They may be assembled manually, by

method used in the plastic industry; and the exact layout of the lower part 130 and the upper part 140 is defined by the selected manufacturing technology. The RFID inlay 40 can be obtained in the form of a label or can be formed in the
5 course of the manufacture of the product. In both cases, it comprises an antenna and a chip.

[20] The EAS pin assembly according to the invention combined with a plastic encapsulated RFID tag and attachable to an EAS label provides the following advantages as compared to the generally widespread disposable label
10 integrated (e.g. sewn) into the label in the article of clothing:

[21] By its multiple use, significant cost reduction can be achieved.

[22] It can be applied in retail trade units in a first step, then in central warehouses, therefore its testing and implementation in practice is easier, and results in saving costs sooner. This is contrary to disposable items, which are
15 typically placed on the articles by the manufacturers, and manufacturers can be very far from the place of trading; or the owner of a brand can have articles manufactured by several independent manufacturers, and therefore the introduction or modification of the application of disposable labels is quite difficult, and what is more, the suppliers interests are not necessarily the same
20 as those of the client or the dealer, not to mention that problems that may arise due to the difference in the communication technologies.

[23] The RFID tag according to the invention do not have to be deactivated after sale as other RFID tags (e.g. ones sewn into the clothing or adhered to the clothing label) do have to, as they are not to be taken out of the store but will be
25 reused several times.

[24] In relation to the above, the advantages of the use of the RFID tag according to the invention in the trade of clothing and accessories can be summarised as follows:

- Faster, more accurate and cost-effective stock management and sales.
- 30 • Faster, more accurate and cost-effective inventory taking.
- Stock accounting is more accurate, the occurrence of stock shortages is less likely, therefore less sales can be lost.

possible (sensors for the RFID tags can be placed in the changing rooms, the process of association with articles and their removal can be linked to persons, prompt and accurate information is available on articles tried to be stolen).

- Improved shopping experience (by sensors located in the appropriate places, supplementary offers can be made for the article of clothing recognised based on the RFID tag, e.g. on appropriate displays.)
- It makes the collection of various types of data possible (e.g. clothes tried on but not purchased, frequency of trying on), and thereby the different processes, the sales can be traced better, the planning of operation and the management of sales can be controlled.

[25] The RFID inlay used for the solution according to the invention can be e.g. an adhesive UPM Raflatac (Pirkkala, Finland) make, code 3001400 device, which can operate in the frequency range between 902-928 MHz. This is a standard used in the USA and defined by FCC. By injection moulding, this RFID tag device can be tuned to the 865.6-867.6 MHz frequency used in Europe and defined by ETSI, particularly, with a plastic having a lower dielectric constant and/or with a smaller wall thickness, a reliably operating product can be produced that operates properly in the original 902- 928 MHz frequency range, especially in its lower range, which can be handled by RFID tag reading devices.

[26] The steps of designing the product:

- determining the desired frequency range of the product to be manufactured according to the invention
- selecting or manufacturing an RFID inlay having a frequency higher than desired frequency
- selecting the materials which have the appropriate dielectric constant and mechanical strength and which can be injection moulded well
- determining the wall thicknesses that provide the appropriate mechanical strength.

[27] Selection of the most appropriate variation of the above three (e.g. iteration, test planning. The order of the above three steps is not fixed, they may be

the test article is manufactured).

[28] An example for a product realised in accordance with the above.

- Target range: as per ETSI
- 5 • RFID inlay applied: UPM Raflatac 3001723. Its reading distance at an EAS frequency differing from the target frequency range did not reach 1 meter before its tuning with the plastic. Depending on the actual needs and possibilities, RFID inlays of other manufacturers may also be used. Such other manufacturers are: Alien Technology (Morgan Hill CA 95037
- 10 US), Avery Dennison (Flowery Branch, GA 30542, US)
- Plastic: 70% Polypropylene, mixed with 30% glass fibre by the manufacturer
- Wall thicknesses: Lower part 2.5 mm , upper part 1.5 mm

[29] It is worth noting that in case of a higher performance RFID tag, a version

15 tuned to the entire UHF range can be used (e.g. UPM Raflatac Short Dipole); in this case the effect of the plastic is not so significant that it would prevent its use both on ETSI and FCC frequencies.

[30] The process of manufacturing:

- Moulding the first component
- 20 • Insertion of the pin
- Producing an interim-phase product by adhesive bonding of the RFID inlay
- Placing the interim-phase product back to the injection moulding device
- Moulding on the second component

25 [31] Another version of the manufacturing process:

- Insertion of the pin into the injection moulding device
- Moulding the first component
- Adhesive bonding of the RFID inlay
- Putting the whole back to the injection moulding device
- 30 • Moulding on the second component,

[32] Process of the embodiment using air-gap:

- determining the desired frequency range of the product to be manufactured according to the invention

the desired frequency range (this can be and preferably is the entire UHF (860-960 MHz) range)

- selecting the materials which have the appropriate dielectric constant and mechanical strength and which can be injection moulded well
- determining the wall thicknesses that provide the appropriate strength.
- determining the appropriate air-gap
- determining the most appropriate variation of the above three (e.g. iteration, test planning)

[33] An example:

- Target range: entire UHF range
- RFID inlay: UPM Raflatac 3001636 or 3001723
- Plastic: ABS
- Characteristic wall thickness: 0.9 mm
- Air-gap (both below and above the inlay) 2.3 mm 2.3 mm

[34] The manufacturing process:

- Injection moulding of the lower and upper components either together with the pin or with a pin inserted afterwards
- fixing the RFID inlay to one of the components (e.g. adhesive bonding at the edges, bearing)
- Ultrasonic welding or adhesive bonding of the lower and upper components to one another

[35] In case the RFID inlay is not placed in the RFID tag between the two steps of the injection moulding but it is placed in a chamber, where it is separated from the encapsulating case by an air-gap, another type of RFID tag device can also be used, such as the 3001723 or 3001636 code UPM Raflatac devices, which can operate in the frequency range between 860-960 MHz. The referred RFID inlays are obviously provided as examples, any other RFID inlay meeting the actual needs and requirements can be used instead. In this respect, it has to be noted that the permitted frequency range may vary by country. In case of the use of a plastic having the appropriate dielectric constant, the use of a filling material for increasing the dielectric constant may be omitted.

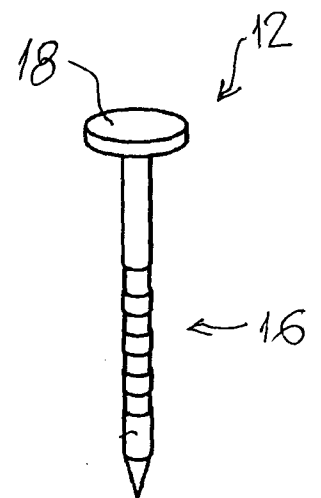
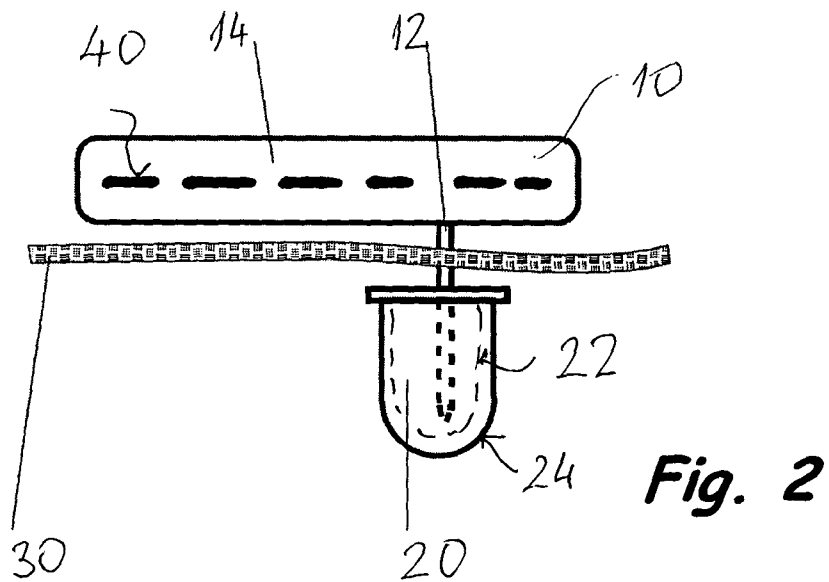
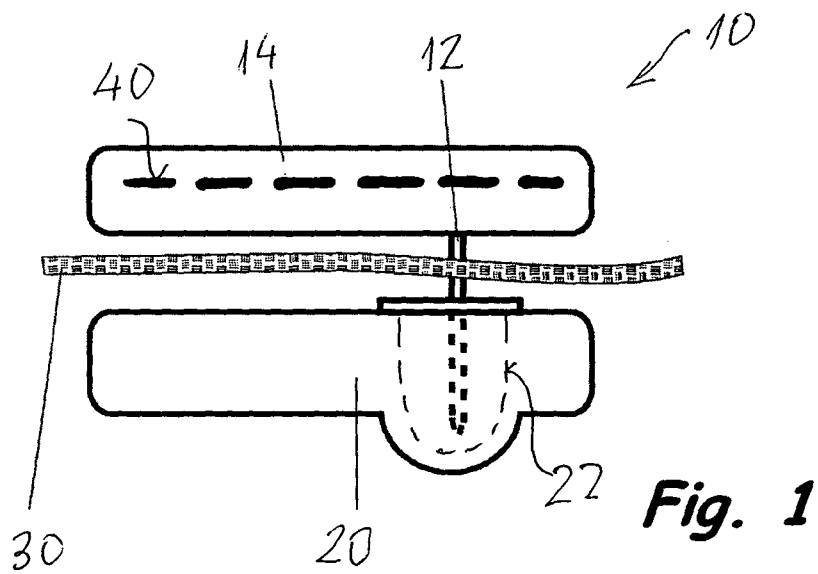
was approximately 4 meters at ETSI frequency (with the above 3001723, it was max 1 meter previously). In case injection moulding, several thermoplastic materials, such as polypropylene, polycarbonate, ABS, etc. may be used for the production of the plastic body. The plastic changes the operating frequency range depending on the dielectric constant of the material used and the wall thickness of the plastic surrounding the RFID inlay. The relative dielectric constant of polypropylene (PP) is between the range of 2.2. and 2.6., while the relative dielectric constant of polycarbonate varies in a wider range, between 2.9 and 4, and the relative dielectric constant of ABS is approximately 2.7 to 3.1. Considering that the operating frequency range realised is primarily influenced by the dielectric constant, it may be adjusted by adding glass fibre having a higher dielectric constant. The relative dielectric constant of such glass fibre is e.g. 3.8, and taking a mix of 70 weight% PP and 30 weight% glass fibre as a basis, we determine the frequency range to be realised after injection moulding. In case of a certain geometry, the desired frequency range can be adjusted by changing the mixing ratio as necessary. For example, for the frequency range defined by FCC, a mix of 80 weight% PP and 20 weight% glass fibre can be taken as a basis. Of course, the wall thickness can be modified as well, however, in such case the injection moulding device has to be modified, therefore it is more expedient to change the mixing ratio.

[37] In case the RFID inlay is placed into the cavity formed in the plastic body afterwards, the effect of the plastic imposed on the operating frequency is a lot smaller, especially if the stabilisation of the air-gap between the RFID tag and the wall of the cavity is ensured. In such case, the effect of the wall thickness of the plastic imposed on the frequency shift is much smaller.

[38] A person skilled in the art (e.g. on the basis of experience obtained in connection with the planning and measurement carried out respecting three RFID tags) can achieve the desired result in three to five steps after having defined the exterior geometry of the RFID tag, meaning that such person can tune the frequency range of the RFID inlay to the desired range.

Claims

1. EAS pin assembly (10) attachable to an EAS label, especially for tracking articles of clothing, including a pin (12) releasably locked to the EAS label
5 (20), which pin (12) has a head (18) and stem (16) formed to be engagable with the locking mechanism (22) of the EAS label (20) **characterised in that** it contains a plastic body (14), which steadily accommodates the pin-head (18), and that the plastic body (14) accommodates an RFID inlay (40).
- 10 2. EAS pin assembly (10) according to Claim 1, **characterised in that** the plastic body (14) is injection moulded onto the RFID inlay.
3. A EAS pin assembly (10) according to Claim 2, **characterised in that** operating frequency range of the RFID inlay (40) is determined by the material of the plastic body (14) and its thickness surrounding the RFID
15 inlay (40).
4. EAS pin assembly (10) according to Claim 3, **characterised in that** the material of the plastic body (14) contains a filling material, the dielectric constant of which is greater than that of the plastic body.
5. EAS pin assembly (10) according to Claim 4, **characterised in that**
20 the material of the plastic body (14) is selected from polypropylene, polycarbonate, ABS, or similar plastic materials or the mixture of these materials, and that the filling material is glass fibre.
6. EAS pin assembly (100) according to Claim 2, **characterised in that**
25 the plastic body is assembled from two parts (120, 130), and that such two parts (120, 130) define a closed cavity, and the RFID inlay (40) is accommodated by the cavity (138), and that in the cavity (138) there are distance pieces which are formed to define the position of the RFID inlay (40) and which locally touch the outer surface of the RFID inlay (40) at places, and there is an air-gap between the remaining parts of the surface
30 of the RFID inlay (40) and the inner surface of the cavity (138.)



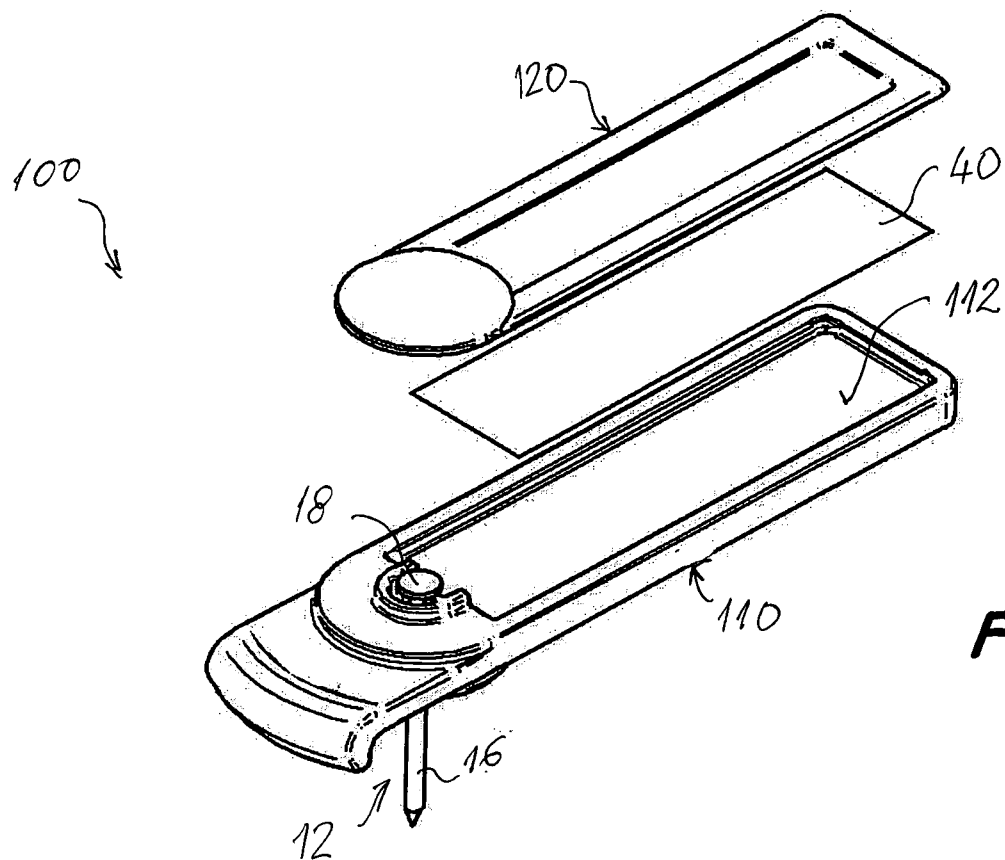


Fig. 4

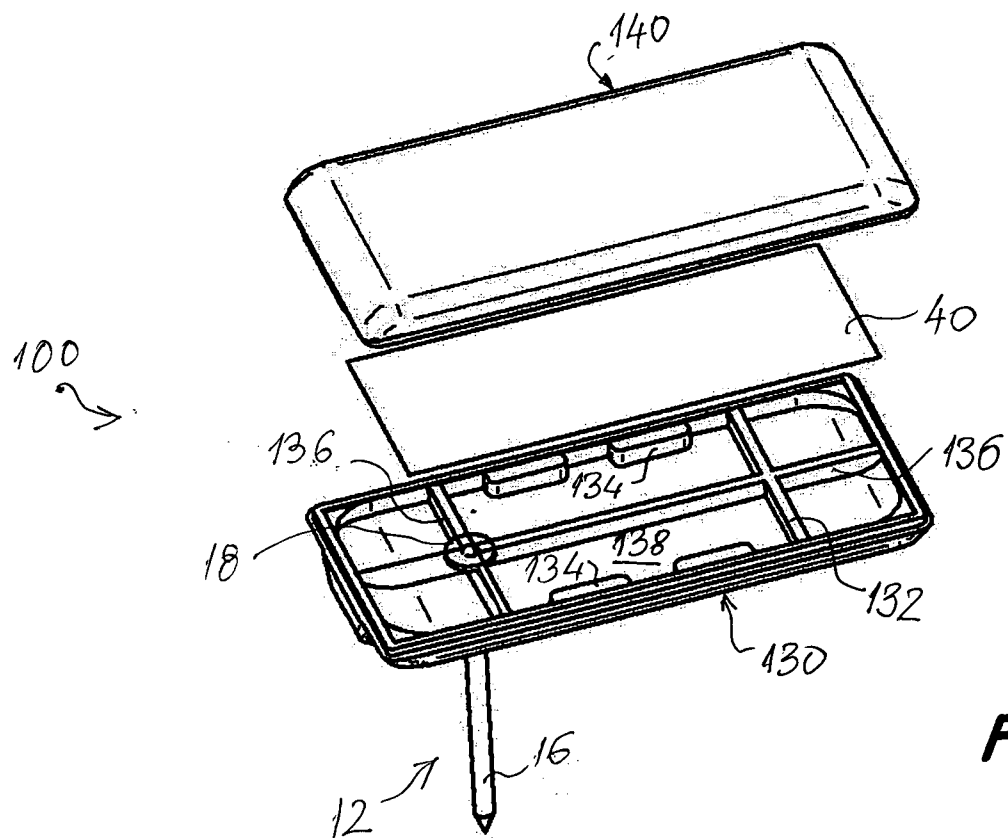


Fig. 5