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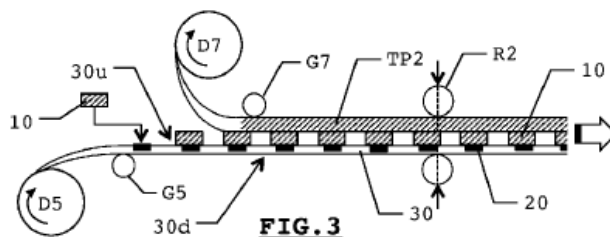
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(54) Titre : PRODUIT, PROCÉDE ET OUTIL INDUSTRIEL PERMETTANT LA FABRICATION DE TAGS RFID DANS LE DOMAINE DE LA TRACABILITE DE PRODUITS TEXTILES COMME PAR EXEMPLE DANS LES BLANCHISSERIES INDUSTRIELLES



(57) Abstract: The invention relates to a method (100) for assembling an electronic radio-frequency identification tag (1) comprising a dielectric carrier (30) arranged so as to receive a radio-frequency identification module (10) and a conductive antenna (20). Such a method particularly comprises a step (150) of depositing, on the upper face (30u) of the support (30), following the deposition of said radio-frequency identification module (10), a layer of a thermoplastic material (TP2), said layer at least partially covering the first conductive antenna (20) and the radio-frequency identification module (10).

(57) Abrégé: L'invention concerne un procédé d'assemblage (100) d'une étiquette électronique de radio-identification (1) comprenant un support (30) diélectrique agencé pour accueillir un module de radio-identification (10) et une antenne conductrice (20). Un tel procédé comportant notamment une étape (150) pour déposer sur la face supérieure (30u) du support (30), après le dépôt dudit module de radio-identification (10), une couche d'un matériau thermoplastique (TP2), ladite couche recouvrant au moins partiellement la première antenne conductrice (20) et le module de radio-identification (10).

**PRODUCT, METHOD AND INDUSTRIAL TOOL ALLOWING THE
PRODUCTION OF RFID TAGS IN THE FIELD OF TRACEABILITY OF
TEXTILE PRODUCTS SUCH AS, FOR EXAMPLE, IN INDUSTRIAL
LAUNDRIES**

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The invention relates to a method of assembling an electronic radio-frequency identification tag. It also relates to an electronic radio-frequency identification tag obtained by implementing such a method.

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Electronic Radio-Frequency Identification tags, or "RFID tags", are small objects used to memorize and restore data, through a radio frequency communication, generally linked to a host object. An electronic radio-frequency identification tag is therefore generally affixed, i.e., glued or sewn for example, or even embedded, on or in an object. An electronic radio-frequency identification tag generally consists of a support or substrate on which an associated conductive antenna is deposited, i.e., electromagnetically connected or coupled, to an electronic component. The antenna gives the electronic component a contactless or wireless communication interface to enable it to receive requests sent from a transmitter or reader by radio means. In return, the electronic component develops a response also transmitted via said antenna by radio means. These communications are generally operated on a frequency band of approximately 900 megahertz (or UHF, acronym for Ultra High Frequencies) or 13.56

megahertz (or HF, acronym for High Frequencies) in the context of short distance communication.

The majority of electronic tags are called "passive". Indeed, the electrical energy, necessary for the operation of the electronic component of such a tag, is drawn from the electromagnetic field generated by the transmitter of a request, when the latter is within communication range of the tag, i.e., a few tens of centimeters, or even a few meters for the most efficient. Other electronic tags are called "active" because they integrate an energy source capable of increasing the power and, therefore, the emission range of the tag tenfold.

Electronic tags notably provide an alternative to graphic tags, such as barcodes, for example, because they do not require direct reading.

The support constituting the majority of the body of an electronic tag is generally composed of one or more materials adapted to the conditions of use or operation of the tag or of the object on or in which said tag is affixed or embedded.

Such a support may be rigid or flexible. By way of non-limiting examples, such a support may comprise plastic, cellulosic or textile materials.

The choice of materials and constituents used to make an electronic radio-frequency identification tag, as well as the assembly method of said tag greatly influence its cost, relevance with regard to a targeted application, robustness and the durability of such an electronic tag.

In the remainder of the document, we will describe an example of embodiment or assembly of an electronic radio-frequency identification tag through a preferred and non-limiting example of application, linked to the monitoring of an industrial dry-cleaning or laundry service workflow. According to this application, an electronic tag is affixed, generally sewn, to a linen, for example a bedsheet, to trace the washing flow and frequency of said linen, in a hospital or hotel environment. Such an electronic tag must necessarily be made to be easily affixed to said linen and to resist, i.e., remain operational, the particularly harsh environments and/or conditions encountered in textile cleaning. Thus, the tag must be compact and not come off or fall apart when cleaning or ironing linens. It must, in particular, resist attacks from various chemical products present in cleaning products, such as acids, bases or even detergents, and thermal stresses from drying and mechanical stresses from pressing and/or spinning.

Many electronic tags, such as those described in document WO2012/1206063, comprise a support or main body containing a textile material selected to be welded by ultrasound, in order to enclose a conductive antenna coupled to a radio-frequency identification module of the RFID type. Said module comprises an electronic component connected to a second conductive antenna arranged to be coupled to said first antenna and thus improve the communication range. The latter is responsible for

receiving and transmitting messages over a wider range. Such a tag results from an assembly method requiring a large quantity of expensive textile or fabric because such a textile or fabric must melt under the effect of ultrasound. The textile support consists of a strip folded in two lengthwise to enclose the first antenna, said first antenna being
5 previously woven onto said textile support, or even deposited, like the radio-frequency identification module, on a layer of an adhesive material ensuring bonding of the elements to the support at room temperature. The two half-strips of fabric are welded together using an ultrasonic welding process, which is particularly complex to industrialize and, therefore, ultimately expensive. In order to apply such a tag to a host
10 object, such as, for example, linens, whose path needs to be monitored during a laundry process, said tag is generally sewn onto said object at the risk of damaging the antenna and/or the module while sewing the tag.

In order to reduce, in particular, the amount of fabric required to make up the
15 support for a tag as described above, a method, such as that described in document EP2405054, consists in using a textile support comprising a pocket in which the radio-frequency identification module of the future tag is inserted. A conductive antenna, arranged to ensure far-field communication, is affixed to the textile support by sewing, laser printing, or even with glue applied to said pocket. Such a method reduces the

amount of fabric necessary to produce the support of the tag and avoids requiring the use of ultrasonic welding. However, closing the pocket so that said pocket surrounds the radio-frequency identification module after insertion of the latter is complex. The economic gain resulting from a reduction in the amount of fabric to make up the body of the tag, or even from the selection of materials to arrange the body of the tag, is negatively affected or canceled out by the implementation of the delicate sewing process to create the pocket housing the module then closing said pocket.

Another technique disclosed by document FR3012682 to make up the body of the tag, consists in using a textile material in the form of a strip comprising a conductive antenna, previously embroidered on said textile or printed on it. According to this teaching, a thermosetting adhesive is deposited on said support, at least on an area partially covering the antenna in order to ensure future communication by coupling, said area being intended to accommodate a radio-frequency identification module. Such a method consists in covering the module with a strip of textile, by folding the initial strip or by depositing a second strip. The textile support is thus "folded over" the module and the antenna. In order to enclose the elements, the two textile strips are glued together by hot pressure, irreversibly causing the polymerization of the thermosetting adhesive placed inside said support. Such a method makes it possible to prevent the use of the ultrasonic welding previously

mentioned and eliminates the need to make a pocket to be closed by sewing. However, such a method also involves the inherent drawbacks already mentioned, in particular the use of a large amount of textile materials to make up a support envelope in order to enclose the antenna and radio-frequency identification module. Such a method also involves the use of a stiffening element made of flexible and resilient material, to give a certain strength to the electronic tag so that it naturally recovers its initial shape, i.e., substantially flat, after folding the tag. Indeed, a tag made according to the teaching drawn from document FR3012682, not comprising a stiffening element, would remain folded on itself under the action of an ironing or wringing operation of a textile on which the tag would be applied. The wireless communication provided by the antenna of a tag folded on itself would clearly be impaired, at least penalized. Such a stiffening element, in the form of a tubular element or a silicone plane for example, integrated within the tag before the hot pressing operation to close the envelope thereof, provides a force elastic enough for the tag to recover its resting configuration. The assembly of such a tag ultimately still proves to be unsatisfactory and inefficient.

Furthermore, in order to make such an electronic tag capable of being applied as a thermopatch or positioned as such on a host object, in particular so as not to alter the integrity thereof, it is necessary to add another adhesive to said tag, which increases its manufacturing cost.

The invention makes it possible to address the drawbacks raised by known solutions by proposing an innovative method of assembling an electronic radio-frequency identification tag.

Modular and particularly innovative in design, such a method provides numerous advantages, among which can be mentioned:

- the manufacture of a robust electronic radio-frequency identification tag that can be used in a wide variety of applications;
- the assembly of a resilient electronic tag offering, by its design, excellent protection of the radio-frequency identification module and the antenna;
- the production of an electronic tag including security elements attesting to any malicious attempt to disassemble said tag;
- the development of an electronic tag naturally equipped with shape memory allowing to preserve its communication capacity without requiring stiffening elements;
- the configuration of a tag easy to be affixed to any support, thus preventing any risk of alteration of the integrity of the radio-frequency identification module and/or the antenna of said electronic tag.

To this end, the invention relates to a method of assembling an electronic radio-frequency identification tag comprising a radio-frequency identification module, a first conductive antenna, a first dielectric support arranged to accommodate

said radio-frequency identification module and said conductive antenna, said method comprising a step of depositing the radio-frequency identification module on the upper face of the first support, the latter comprising the first conductive antenna, said radio-frequency identification module being positioned in the immediate vicinity of the first conductive antenna.

To manufacture a robust electronic radio-frequency identification tag that can be used in a wide variety of applications, such a method comprises:

- a preliminary step of depositing a layer of a first thermoplastic material on the upper and lower faces of the radio-frequency identification module;
- a step for pressing the assembly at a temperature sufficient to activate the first thermoplastic material;
- a step of depositing a layer of a second thermoplastic material on the upper face of the first support and for pressing the assembly at a temperature sufficient to activate the second thermoplastic material, said layer of second thermoplastic material covering at least partially the first conductive antenna and the radio-frequency identification module.

Preferably but not limitatively, the step of depositing on the upper face of a first support included in a method for assembling an electronic radio-frequency identification tag may consist in depositing a layer of a second heat-reactivable thermoplastic material.

In order to ensure the correct positioning of the radio-frequency identification

module before implementing the step of depositing, on the upper face of the first support, a layer of a second thermoplastic material, a method according to the invention may advantageously comprise, prior to the step of depositing the radio-frequency identification module on the upper face of the first support, a step of
5 depositing at least on an area of the upper face of the first support, a layer of an adhesive material whose tack at room temperature is sufficient to maintain the position of the radio-frequency identification module on the first support, said area of the upper face of the first support being intended to accommodate the radio-frequency identification module.

10 Alternatively, or in addition, such a method may comprise, prior to the step of depositing the radio-frequency identification module on the upper face of the first support, a step of depositing on the face of the radio-frequency identification module intended to cooperate with the upper face of the first support, a layer of an adhesive material whose tack at room temperature is sufficient to maintain the position of the
15 radio-frequency identification module on the first support.

As a further variant, a method according to the invention may comprise, prior to the step of depositing the radio-frequency identification module on the upper face of the first support, a step of heating the first material deposited on the face of radio-frequency identification module intended to cooperate with the upper face of the first
20 support, beyond the melting temperature of said first material.

Prior to assembling an electronic tag as such, a method according to the invention may comprise a step for assembling the radio-frequency identification module. Such a preliminary step may consist in:

- depositing or engraving on a second dielectric support a second
5 conductive antenna arranged to ensure near-field electromagnetic communication and an electronic component;
- ensuring electrical cooperation between said second conductive antenna and said electronic component, and
- depositing a layer of a protective resin on the remaining exposed faces of
10 said electronic component and said second conductive antenna.

In order to protect the radio-frequency identification module from possible shocks or mechanical constraints and also offer a security function attesting to any attempt at fraudulent disassembly of an electronic tag assembled according to a method in accordance with the invention, the latter may include a step of depositing,
15 at least on the face remaining exposed to the radio-frequency identification module, a fibrous mesh arranged so as to be irrecoverably unraveled during an attempt to disassemble the electronic tag aimed at tearing off said radio-frequency identification module from the first support, said step being implemented prior to the step of depositing a layer of a second thermoplastic material on the upper face of the first
20 support.

Alternatively, or in addition, such a method may comprise a step of inscribing,

at least on the exposed face of the radio-frequency identification module and on part of the upper face of the first support remaining exposed, a message whose content would be irreparably altered during an attempt to disassemble the electronic tag aimed at tearing off said radio-frequency identification module from the first support, said
5 step being implemented prior to the step of depositing on the upper face of the first support a layer of a second thermoplastic material.

In order to reduce the number of scraps at the end of the assembly method, a method according to the invention may comprise a step for electrically testing the radio-frequency identification module, the step of depositing said radio-frequency
10 identification module on the upper face of the first support being only carried out if said radio-frequency identification module is operational.

The first support constituting the main body of an electronic tag according to the invention may initially comprise the first conductive antenna. Alternatively, said first support may lack such antenna. In this case, the invention provides that an
15 assembly method may include a preliminary step of depositing the first conductive antenna on the first support or of embroidering, printing, laminating or weaving said first antenna on said first support.

Depending on the desired communication range, in order to reduce the bulk of the tag, the invention provides that the first conductive antenna carried by the first
20 support may advantageously comprise one or more loops of a conductive track and/or wire.

In order to enable a radio-frequency identification module to be deposited on the upper face of the first support, said radio-frequency identification module comprising an internal conductive antenna, without said internal conductive antenna advantageously covering, even if only partially, the first antenna, the latter may be arranged to form one or more loops of a diameter greater than the dimensions of the conductive antenna internal to the radio-frequency identification module.

According to a preferred embodiment, the first and second thermoplastic materials may be selected from thermoplastic polyurethanes, polyphenylene oxides, polyamides, polyacetates, polyethylenes, polypropylenes, polyolefins or ethylene-vinyl acetates.

Depending on the field of application in which the electronic tag must be used, the first and second thermoplastic materials may be selected to have respective melting temperatures greater than a determined temperature threshold. Such a threshold should be higher than the temperatures to which said tag will be exposed. The same may be true for the choice of the material(s) constituting the first support. The latter may include a material selected from cotton, nylon, viscose, polyester, or a synthetic material.

When choosing to condition the tags in the form of a strip comprising a plurality of electronic tags, the assembly method according to the invention may comprise a step for facilitating their separation by transversely pre-cutting the first support provided in the shape of a strip, each section thus materialized with pre-cuts

being arranged to include the first conductive antenna and accommodate the radio-frequency identification module.

To increase the protection of the internal elements of an electronic tag assembled according to the invention, or even to facilitate the fixing of said tag on a host object, an assembly method may include a step of depositing on the face of the first support opposite to the face intended to accommodate the radio-frequency identification module, a layer of a third thermoplastic material.

The invention advantageously provides that the first and second, or even third, thermoplastic materials may be substantially identical.

According to a second subject matter, the invention relates to a radio-frequency identification module comprising a dielectric support, a conductive antenna arranged to ensure near-field electromagnetic communication and an electronic component, said electronic component being electrically connected to said conductive antenna, any exposed face of said electronic component and of the conductive antenna being covered by a protective resin, said radio-frequency identification module mainly having an upper face and a lower face. Said upper and lower faces of such a module comprise a layer of a heat-reactivable thermoplastic material.

The invention also relates to an electronic radio-frequency identification tag obtained by implementing an assembly method such as that described previously. This comprises a support, a tag conductive antenna, a radio-frequency identification

module as mentioned above, said radio-frequency identification module being positioned on said support so that the internal antenna of said radio-frequency identification module does not cover said tag conductive antenna. To resolve the disadvantages of known tags, the upper face of the support, i.e., that on which the module is placed, comprises a layer of a thermoplastic material, said layer at least partially covering the conductive antenna and said radio-frequency identification module.

In order to preserve the radio-frequency identification module of such a tag when it is affixed, for example by sewing onto a host object, said tag conductive antenna and said radio-frequency identification module may be mutually arranged on the support so that said module occupies an eccentric position on said support, the latter comprising a range of a determined minimum height, said range partially encompassing said tag antenna but not said radio-frequency identification module.

Other characteristics and advantages will appear more clearly on reading the following description and examining the accompanying figures, which include:

- Fig. 1 shows the main steps of a method for manufacturing and/or adapting a radio-frequency identification module on a production line and/or on an assembly machine according to the invention;

- Fig. 1A illustrates a preferred embodiment for adapting or producing radio-frequency identification modules arranged in transverse columns on a dielectric support in the form of a strip;
- Fig. 1B describes the respective configurations of a radio-frequency identification module, before and after adaptation of said module;
- Fig. 2 schematically shows a production line for manufacturing and/or assembling an electronic radio-frequency identification tag comprising a far-field communication antenna;
- Figs. 2A, 2B and 2C respectively illustrate three successive situations during assembly of an electronic radio-frequency identification tag according to the invention;
- Fig. 3 schematically shows a production line for manufacturing and/or assembling an electronic radio-frequency identification tag comprising a near-field communication antenna on a production line according to the invention, said electronic tag being adapted to cooperate with a second far-field communication antenna arranged on the host object of the electronic tag;
- Figs. 3A and 3B respectively illustrate two successive situations during assembly of an electronic radio-frequency identification tag according to the invention;

- Fig. 3C describes an electronic tag according to the invention, connected and sewn onto a host object;
- Fig. 3D describes an example of a tag assembled according to the invention whose arrangement is particularly advantageous;
- 5 - Fig. 4 illustrates all the steps of a preferred example of an assembly method according to the invention, said steps being implemented by a production line according to the invention.

Fig. 1 illustrates a preferred example of implementing a production line or a machine for assembling and/or adapting a radio-frequency identification module 10 according to the invention. Said Fig. 1 will be described in relation to Fig. 4 which
10 illustrates, in turn, an overall sequence of an assembly method 100 of an electronic radio-frequency identification tag integrating such a module 10.

The assembly as such of an electronic tag 1 will be described, in turn, in conjunction with Figs. 2 and 3, according to the configuration of the electronic tag
15 that is intended to be produced.

In connection with Figs. 1, 1A, 1B and 4, a first step of an assembly method 100 according to the invention consists in assembling or adapting a radio-frequency identification module 10 intended to cooperate by coupling with a conductive antenna,
20 said antenna being arranged to ensure far-field communication, i.e., at a distance of a

few meters.

As mentioned previously, such a module 10 mainly comprises a dielectric support 13, such as an epoxy, a polyimide or a polyethylene terephthalate, commonly known as "PET" for PolyEthylene Terephthalate. Such a support may advantageously be conditioned in the form of a strip actuated in translation by means of an unwinder D1 associated with a guide G1, such as a motorized roller. An assembly method 100 in accordance with the invention may comprise a first step 120 for assembling a radio-frequency identification module 10. Such a preliminary step 120 advantageously consists of depositing, engraving or printing 121 a conductive antenna 12 on a face 13u, called upper face, of the support 13. Said step 120 further consists in depositing an electronic component or microcontroller 11 on said upper face 13u of the support 13. So that said electronic component 11 is able to communicate by coupling with a third dipole, said component 11 is electrically connected 122 to the antenna 12. Such an operation 122 may result from a connection of contact pads of the component 11 to one or more tracks or turns of the antenna 12 by means of one or more conductive wires 16, as indicated in Fig. 1. Alternatively, certain electronic components 11 have an active face. Said component is deposited, active face against the antenna 12, this operation thus directly ensuring an electrical connection. This process is known as "flip chip". In order to protect the component 11, any wires 16 and the antenna 12, step 120 may consist in covering said exposed elements 11, 12, 16 with a non-conductive protective resin 14. "Exposed element" or "exposed face of an element"

shall be understood to mean any element or part thereof which is not in direct contact with a third element.

The component 11, the antenna 12 and, optionally, the wires 16 are thus covered by said protective resin. Said resin is hardened, for example, by ultraviolet polymerization, by thermal crosslinking or by any other technique. Step 120, as described in relation to Fig. 4, corresponds to a method of assembling a conventional and known radio-frequency identification module. Conversely, the invention provides an additional step 130 for depositing on the upper 10u and lower 10d faces of the radio-frequency identification module 10, a layer of a first thermoplastic material TP1.

Thus, at the end of this step 130, a radio-frequency identification module 10 according to the invention has an upper face 10u' and a lower face 10d' comprising such a layer of the first thermoplastic material TP1.

As a non-limiting example, the material TP1 may consist of a thermoplastic, also known as TPU. Alternatively, such a polyurethane material under the thermoplastic acronym TP1 may be selected from thermoplastic polyurethanes, polyphenylene oxides, polyamides, polyacetates, polyethylenes, polypropylenes, polyolefins or ethylene-vinyl acetates, advantageously conditioned in the form of films.

More generally, for the purposes of the invention, the term "thermoplastic material" shall be understood to mean any material or polymer capable of being activated repeatedly under the effect of an increase in temperature, said temperature

exceeding a determined melting temperature. The activation of such a material translates a change of state from the solid state (at room temperature) to a viscous liquid state. Thus, when a melting temperature of the material is reached or exceeded, the latter softens and can easily be shaped. It hardens by cooling. Thus, within the meaning of the invention and throughout the document, said thermoplastic material can advantageously be reactivated under heat. Such a material is distinguished from a thermosetting material which can only be used once by polymerization. In addition, such a thermoplastic material may include adhesion functions, which, when it is reactivated, i.e., heated beyond the melting temperature of said material, allows the radio-frequency identification module, or, more generally, the electronic radio-frequency identification tag, to be repositioned on a support or any host object.

The invention further provides that the thickness of the layer of the first thermoplastic material TP1 deposited on the faces 10u and 10d be fifty to five hundred micrometers, typically two hundred micrometers. Indeed, such a thickness makes it possible to obtain a radio-frequency identification module having interesting resilience properties, while retaining an optional flexibility. The active elements, i.e., the component 11 and the antenna 12, are thus protected against the occurrence of shocks, the latter being absorbed by the thermoplastic material TP1, or physicochemical attacks from the environment of the tag. To produce such a module 10, Fig. 1 describes an exemplary embodiment of a production line or a machine according to which, a second unwinder D2, associated with the guide means G1,

drives in translation a reel of the first thermoplastic material TP1 to deposit a layer thereof on the upper face 10u of the radio-frequency identification module 10. Likewise, a third unwinder D3, associated with a guide G3, may be used to drive in translation a coil of a first thermoplastic material TP1 to deposit a layer thereof on the lower face 10d of said radio-frequency identification module 10. A step 130a of rolling or hot pressing, i.e., at a temperature higher than the melting temperature of the first thermoplastic material TP1, ensures a lasting bond of the upper and lower layers of first material TP1 on the upper 10u and lower 10d faces of the module. Such a pressing operation 130a may be carried out by means of a pair R1 of rollers, mirroring each other, ensuring a pressing function of the assembly when the latter is pulled between said rollers, so that the adhesion of the two layers of the TP1 material is durable. Alternatively, parallel pressers, whose temperature, pressing time and pressure can be adjusted as necessary, may be used instead of said rollers R1.

Fig. 1 also illustrates an exemplary embodiment of a layer of thermoplastic material TP1 on the respective upper and lower faces of several modules simultaneously. As shown in Fig. 1A, radio-frequency identification modules 10 may advantageously be positioned on a support in the form of a thirty-five millimeter wide strip. Such a configuration makes it possible to position said modules 10 in columns of three modules transverse to the longitudinal axis of the strip. After an application 130 of the thermoplastic material TP1, the radio-frequency identification modules are

cut 132 and isolated from each other.

A method 100 in accordance with the invention provides, prior to the assembly of an electronic tag as such, a step 133 for electrically testing the proper functioning of the radio-frequency identification modules covered by the thermoplastic material TP1. Such an operation 133 may be implemented before or after the separation 132 of said modules 10. The defective modules are rejected, as illustrated by link 133-n in Fig. 4. Otherwise, as illustrated by link 133-y in Fig. 4, the module is operational and can be used as part of the subsequent assembly of an electronic tag. This test step 133 can also make it possible to initialize or update the content of certain memories of the electronic component included in a radio-frequency identification module deemed operational.

Furthermore, an assembly method 100 in accordance with the invention may comprise, after the deposition 130 of the layer of thermoplastic material TP1, an optional step 131 aimed at depositing on a lower or upper face of the module 10, i.e., one of the faces of the radio-frequency identification module 10 intended to cooperate with the upper face 30u of a support 30 constituting an electronic tag (this assembly step will be addressed later in relation to Figs. 2 and 3), a layer of an adhesive material A whose tack at room temperature is sufficient to maintain the future position of the radio-frequency identification module 10 on said support 30. In the example described in relation to Fig. 1B, such an adhesive A is deposited on the lower face 10d' of the

radio-frequency identification module 10. Said adhesive A could just as easily be deposited, as a variant or in addition, on the upper face 10u'. Such a material can advantageously be selected from sensitive or pressure-activated adhesives (or known by the acronym "PSA" for "Pressure-Sensitive Adhesive").

5 In the same manner as the layers of thermoplastic material TP1, the adhesive A may be deposited on one of the faces 10d' or 10u' of a radio-frequency identification module 10 by means of an unwinder D4, associated with a guide G4, operating a strip of adhesive material A applied by a pressure roller or press R1. Prior to operation 131 to deposit adhesive A, a method 100 according to the invention may include an
10 advantageous step 130b for accelerating a return to room temperature of module 10, said step 130b not being shown in Fig. 4.

As shown in Fig. 1B, following the implementation of the steps previously described, one or more radio-frequency identification modules are produced, each being adapted in accordance with the invention. More precisely, such a module 10
15 comprises a dielectric support 13, a conductive antenna 12 arranged to ensure near-field electromagnetic communication and an electronic component 11. Said electronic component 11 is electrically connected to said conductive antenna 12. Any exposed face of said electronic component 11 and the conductive antenna 12 is covered by a dielectric resin 14. Said upper 10u' and lower 10d' faces of such a module 10 comprise
20 a layer of a thermoplastic material TP1, or even for at least one of them, an outer layer

of an adhesive A. It should be noted that steps 121, 122 and 123 may be optional, if radio-frequency identification modules 10 are already assembled. Therefore, the invention consists of adapting said modules 10 so that their upper faces 10u' and lower faces 10d' each comprise a layer of a thermoplastic material TP1, or even so that one of the lower faces 10d' or upper faces 10u' comprises in addition an outer layer of an adhesive A which can be activated by pressure at room temperature.

Let us now describe in conjunction with Figs. 2, 2A, 2B, 2C and 4, the steps of a first example of a method of assembling an electronic tag as such, in accordance with the invention. According to said Figs. 2, 2A, 2B and 2C, the electronic tag that needs to be produced includes a far-field antenna 20 to ensure contactless communication with a third-party device, several tens of centimeters to several meters away. To reduce its bulk, the substantially planar conductive dipole, constituted by said antenna, advantageously comprises a plurality of loops 20L. Fig. 2A illustrates a preferred example of a support 30 in the form of a strip to constitute the body of an electronic tag according to the invention. As shown in Fig. 2, such a strip 30 can be actuated in traction by an unwinder D5 associated with a guide G5. The support 30 may comprise a material which may be selected from cotton, nylon, viscose, a polyester or a synthetic material, such as, by way of non-limiting example, Tyvek

(registered trademark), depending on the field of application where the future tag 1 will be used. Fig. 2A further illustrates a particular arrangement of a conductive antenna 20. Unlike known techniques according to which such an antenna generally traces a meander or a sinusoid, a conductive antenna 20, according to the embodiment illustrated by Fig. 2A, traces a plurality of loops 20L whose respective diameter(s) may be chosen to be greater than the dimensions (widths, lengths, even diameter) of a radio-frequency identification module. Such a loop diameter 20L will be more precisely, and advantageously, determined to be greater than the dimensions of the conductive antenna internal to said radio-frequency identification module, i.e., the antenna 12 of the module 10 described in relation to Fig. 1B. Thus, as will be seen later, such an antenna configuration 20 makes it possible to position a radio-frequency identification module in the immediate vicinity of said antenna, thus ensuring excellent coupling while preventing any coverage of the antenna 20, in particular by the internal antenna of said radio-frequency identification module capable of causing a partial breakage of the antenna 20, or even of the module 10, during a subsequent step of hot pressing of the assembly. Any other configuration of the antenna 20 whose arrangement would allow such positioning of a radio-frequency identification module 10, i.e., having a minimum distance d on the order of half a millimeter between the internal antenna 12 to said module 10 and the antenna 20, could be used, as described

by way of example in Fig. 3D in relation to a second example of assembly of a mini tag 1 according to the invention.

A support 30 may already include one or more conductive antennas 20. Alternatively, as indicated in Fig. 4, an assembly method 100 according to the invention may include a step 110 for producing said support 30. Thus, a first step 111 may consist in depositing a conductive antenna 20 on the support 30. Such an antenna may consist of several conductive wires. In this case, said threads may be embroidered or woven on said support 30. Alternatively, such an antenna 20 may be printed by any known technique or deposited by lamination and thus consist of a conductive track.

As indicated by the preferred example described in relation to Fig. 2A and Fig. 4, a method 100 according to the invention may include a step 112 for transversely pre-cutting the support 30. Each section 30s thus materialized between two pre-cuts 30c is arranged to include the conductive antenna 20 and accommodate a radio-frequency identification module 10. The support 30 has a face which we will call upper face 30u and a face opposite to the previous one which we will call lower face 30d.

As shown in Fig. 2B, an assembly method 100 according to the invention comprises a step 140 for depositing, on the upper face 30u of the support 30, a radio-frequency identification module 10, previously adapted according to the technique

described above in relation to Figs. 1A, 1B and 1. Such a module 10 thus comprises a layer of a first thermoplastic material TP1 on its lower faces 10d' and upper 10u'. The invention provides that the positioning of said radio-frequency identification module 10 can be precisely determined, for example by means of a vision system, symbolized in Fig. 2B by a video sensor C, so that the antenna, internal to said radio-frequency identification module 10, advantageously does not cover, even if only partially, the conductive antenna 20, like the advantageous embodiment of a tag 1 of a reduced format described in relation to Fig. 3D. Thus, said vision system makes it possible to control the coordinates of the radio-frequency identification module 10 in the plane of the support 30. Any other technique, making it possible to, correctly and precisely, position a radio-frequency identification module 10 on the support 30, could be used in variant. According to the exemplary embodiment described in Fig. 2B, such a module 10 occupies, once deposited on said support 30, a substantially central position within a pre-cut section 30s. Alternatively, said module could be positioned within another loop 20L of said antenna 20 and thus occupy a more eccentric position within the tag. Furthermore, Fig. 2B illustrates an advantageous example of a production and/or assembly line for which a plurality of radio-frequency identification modules, in this case, three by three, are positioned simultaneously and respectively in three consecutive sections 30s of support 30.

In order to maintain the position of a radio-frequency identification module 10 during the travel of the support 30, the invention provides for the advantageous use of an adhesive A whose tack at room temperature is sufficient to maintain the position of said radio-frequency identification module 10. The previously described
5 embodiment of a process 100 according to which an optional step 131 consists of depositing on the face 10u' or 10d', intended to be in contact with the support 30, a layer of such an adhesive A. In this case, when placing 140 such a radio-frequency identification module on the support 30, said module is held in position under the action of said adhesive A.

10 The invention provides a first variant or a first complement according to which such an adhesive A, for example selected from pressure-sensitive or pressure-activatable adhesives (or known by the acronym "PSA" for "Pressure-Sensitive Adhesive ") may be deposited, at least on an area of the upper face 30u of the support 30 before a radio-frequency identification module 10 is positioned. According to this
15 embodiment, described in relation to Fig. 2B (not shown in Fig. 2), a layer of an adhesive material A is deposited from an unwinder, on the central loops 20L of the respective antennas 20 of the sections 30s of the support 30. Alternatively, such an adhesive A could be deposited on the entire upper face 30u of the support 30 or on other portions of said face 30u corresponding to antenna sections 20, different from
20 those describing the central loops 20L, as illustrated by way of example in Fig. 2B, if the radio-frequency identification module(s) 10 is(are) not intended to occupy a

substantially central position.

According to a third embodiment, the invention provides that it may not be necessary to use such an adhesive A. Indeed, the thermoplastic material TP1, deposited in a layer beforehand on the radio-frequency identification module, can be heated beyond the melting temperature of said material TP1, just before coming into contact with the upper face of the support 30. Said module 10 is then placed, then hot pressed on the support 30. In the absence of adhesive A, the thermoplastic material TP1 provides an adhesion or adhesion function, once said thermoplastic material TP1 is heated beyond the melting temperature of said thermoplastic material TP1, and thus makes it possible not to resort to an additional adhesive.

An assembly method 100 according to the invention, such as that described by way of example in relation to Figs. 2C, 2 and 4, may comprise, after a radio-frequency identification module has been positioned on the support 30, a step 142 for depositing at least on the face remaining exposed 10u' of said radio-frequency identification module 10, a fibrous mesh 50. The latter is advantageously arranged to be irrecoverably unraveled during a malicious attempt to disassemble the electronic tag 1, aimed at tearing off said radio-frequency identification module 10 from the first support 30. As shown in Fig. 2, such a mesh may be unrolled from an unwinder D6 and guided by a roller G6. To optimize the quantity of mesh required, the latter can be packaged in the form of a strip with a width significantly greater than that of the radio-frequency identification module. Beyond a security function aimed at revealing

an attempt to disassemble a tag, the presence of said mesh can contribute to the protection of the electronic component housed by the radio-frequency identification module against possible shocks or mechanical constraints.

Alternatively or in addition, in order to provide an additional security element
5 aimed at attesting to an attempted fraud, the invention provides that a method 100 may include a step 143 for writing, at least on the exposed face of the radio-frequency identification module 10 and on a part of the upper face 30u of the first support 30 remaining exposed, a message 60 whose content would be irreparably altered during
10 an attempt to disassemble the electronic tag, aimed at tearing off said radio-frequency identification module 10 from the first support 30. Such a message could be textual, for example "Void if removed", or figurative (such as a logo), or even both.

Whether a mesh 50 and/or a message 60 is respectively deposited and/or printed, a method 100 comprises an essential step aimed at depositing a layer on the upper face 30u of the first support 30 of a second thermoplastic material TP2, said
15 layer at least partially covering the first conductive antenna 20 and the radio-frequency identification module 10. Such a layer may be deposited, as shown in Fig. 2 by way of example, by means of a D7 unwinder of a strip of thermoplastic material. Step 150 further consists in heat-pressing the assembly, i.e., at a temperature higher than the melting temperature of the thermoplastic material TP2, in order to ensure a lasting
20 bond of the layer of thermoplastic material TP2 on the upper face 30u of the support

30. Such a pressing operation may be carried out by means of a pair R2 of rollers opposite one another, ensuring a pressing function of the assembly or the unit when the latter is pulled between said rollers, so that the adhesion of the two layers of the TP2 material is durable. Alternatively, parallel pressers, whose temperature, pressing
5 time and pressure can be adjusted as necessary, may be used instead of said rollers R2.

In the same manner as the first material TP1 used to adapt a radio-frequency identification module, the thermoplastic material TP2 may be selected from thermoplastic polyurethanes, polyphenylene oxides, polyamides, polyacetates,
10 polyethylenes, polypropylenes, polyolefins or ethylene vinyl acetates, advantageously conditioned in the form of films. Depending on the targeted field of application, the choice of the TP2 material will depend on the melting temperature beyond which said material can be activated one or more times. For the field of electronic tags used in industrial laundry, a thermoplastic polyurethane whose melting temperature is greater
15 than 180 °C will advantageously be preferred.

Thanks to the use of such a TP2 thermoplastic material, an electronic tag produced according to the invention has interesting resilience properties, while retaining an optional flexibility. It has a shape memory, to some extent naturally, in that it does require the use of additional stiffening elements. The TP2 material, as well

as the TP1 material, gives the body of the tag a very good hold so that said tag naturally recovers its initial shape, i.e., substantially flat, after being folded, therefore preserving the quality of the wireless communication provided by the antenna 20.

5 An assembly method 100 can now be completed. According to Fig. 2, a plurality of electronic tags is thus conditioned in the form of a strip. Said method 100 may, however, include additional steps. A first step, not shown in Fig. 4, may consist of electrically testing the operation of each tag produced. A non-operational tag can be marked, for example by inkjet, in order to be identified and discarded. Such a test
10 step can also make it possible to update certain memories of the electronic component of the radio-frequency identification module of each tag produced. Thus, this step of segregating operational tags makes it possible to manage and control the sequence of serial numbers or other unique references associated with the tags and to ensure consistency with an optional graphic printing step of said process 100, step also not
15 shown in Fig. 4, so as to allow each tag to be personalized, or even to visually record said serial number or unique reference.

The strip advantageously comprising a plurality of tags, resulting from an assembly method 100 described in relation to Fig. 2, may also include a step 160 for

cutting said strip, in order to separate the tags from each other, or even to package them each in a blister pack. As a variant, in particular if the support 30 is not pre-cut, such a step 160 may consist of pre-cutting said strip comprising the tags produced in order to make it easy to separate said tags from each other, while maintaining a packaging mode in the form of strips, each comprising a plurality of tags.

A method 100 may further comprise a step 151 for depositing a layer of a third thermoplastic material TP3 on the lower face 30d of the support 30, i.e., the face opposite to the face 30u accommodating a radio-frequency identification module 10. At the end of this step, the front, but also the back, of a substantially flat electronic tag may be covered with thermoplastic material. For the reasons mentioned above, said TP3 material may be advantageously selected to be substantially similar to the first and/or second thermoplastic materials TP2 and/or TP1.

Whether this last step 151 is carried out or not, it should be noted that the use of the layer of material TP2, particularly if it is carried out on the entire upper face of the support 30, reduces, or substantially eliminates, any relief on the tag, thus facilitating the subsequent application of said tag 1 on a host object. Said application may be carried out by heat-pressing. The activation of the TP2 thermoplastic material, followed by cooling, ensures a lasting positioning of the tag.

Figs. 3A, 3B and 3 illustrate a second example of an assembly method of an electronic tag according to the invention. According to this variant, the format of a tag obtained is smaller than that of an electronic tag assembled according to the method described previously in relation to Figs. 2 and 2A.

5 Indeed, as shown in the example in Fig. 3A, the support 30 consists of a strip of smaller width, optionally pre-cut. The support 30 includes an antenna 20 comprising, for example, only one loop 20L. The dipole thus constituted by the antenna 20 is, therefore, shorter than that of a tag as assembled with an antenna 20 comprising a plurality of loops 20L, as shown in Fig. 2A.

10 The communication range provided by the antenna 20 according to the example of Fig. 3A, or Fig. 3D, is therefore lower but sufficient to serve as a relay between the identification module 10, coupled with said antenna 20 and a third antenna 2, sewn, for example, on a host object 3 such as a cloth and passing through the antenna 20, as shown in Fig. 3C. An assembly method 100, such as that described
15 in relation to Figs. 3A, 3B and 3, is close or similar to that described previously. It can be seen that it includes a step 140 for depositing, on the upper face 30u of the support 30, a radio-frequency identification module 10 previously adapted according to the technique described above in relation to Figs. 1A, 1B and 1. Thus, such a module comprises a layer of a first thermoplastic material TP1 on its lower face 10d' and upper

face 10u'. The invention provides that the positioning of said radio-frequency identification module 10 be precisely determined, for example by means of a vision system, symbolized in Fig. 3B by a video sensor C, so that the internal antenna of said radio-frequency identification module 10 advantageously does not cover, even if only
5 partially, the conductive antenna 20. Said vision system thus makes it possible to control the coordinates of the radio-frequency identification module 10 in the plane of the support 30. Any other technique making it possible to position correctly and precisely a radio-frequency identification module 10 on the support 30 could alternatively be used. Unlike the substantially central position of a module deposited
10 according to the example of Fig. 2B, a radio-frequency identification module 10 is deposited, according to this second embodiment, substantially eccentric within an optionally pre-cut section 30s. As shown by way of example in Fig. 3D, an eccentric positioning of the radio-frequency identification module 10 within an electronic tag 1 conforming to the invention makes it possible to have, at the end of the assembly
15 method, a main body of electronic tag 1 comprising an increased range P, for example with a height h of four to five millimeters or more, partially comprising the antenna 20 but not including the radio-frequency identification module 10. Such assembly method 100 makes it possible to reduce the size of an electronic tag 1 while remaining very easy to sew, for example as shown in Fig. 3C, an antenna 2 passing through the
20 antenna 20 of said "mini tag", without the risk of altering the radio-frequency

identification module thereof. Thus, said antenna 2 ensures the respective functions of improving electromagnetic performance and fixing the mini tag on the host object 3. Such an arrangement of electronic tag 1, described in relation to Fig. 3D, which illustrates an example of tag assembled in accordance with the invention, makes it possible to provide a configuration of an antenna 20, different from that illustrated in Fig. 3A, but which is arranged so as to remain close in part, i.e., at a distance d of about half a millimeter from the antenna 12 internal to the radio-frequency identification module of the tag, without said antenna 20 being at any time covered by said internal antenna 12. Such an arrangement ensures excellent coupling and minimizes the risk of breakage during the pressing phases. Thus, independently of the materials used to constitute such an electronic tag 1, such an arrangement according to which the tag includes a range P preserving the radio-frequency identification module is particularly innovative and prevents any destruction of the radio-frequency identification module during attachment, in particular when sewing the tag onto the host object 3.

In addition, Fig. 3B illustrates an advantageous example of a production and/or assembly line for which a plurality of radio-frequency identification modules, in this case, three by three, are positioned simultaneously in three consecutive sections 30s of support 30, respectively.

In the same manner as the assembly method described previously in relation

to Fig. 2, a method according to Fig. 3 provides for the advantageous use of an adhesive A whose tack at room temperature is sufficient to maintain the position of a radio-frequency identification module 10 on the support 30. Alternatively, the layer of thermoplastic material TP1, previously deposited on the radio-frequency identification module, may be heated beyond the melting temperature of said material TP1, just before placing said radio-frequency identification module on the upper face of the support 30. Said module 10 is then placed, then heat-pressed on the support 30.

An assembly method 100 in accordance with the invention and such as that described by way of example in relation to Figs. 3 and 4, may comprise, after a radio-frequency identification module has been positioned on the support 30, a step 142 for depositing at least on the upper face remaining exposed of said radio-frequency identification module 10, a fibrous mesh 50 advantageously arranged to be irrecoverably unraveled during an attempt to disassemble the electronic tag 1, aimed at tearing off said radio-frequency identification module from the first support 30.

Such a method 100 could further include a step 143 for writing, at least on the exposed face of the radio-frequency identification module 10 and on part of the upper face 30u of the first support 30 remaining exposed, a message 60 whose content would be irreparably altered during an attempt to disassemble the electronic tag aimed at removing said radio-frequency identification module 10 from the first support 30.

Such a message could be textual, for example "Void if removed", or figurative, such as a logo, or even both.

However, these steps are optional. For the sake of simplification, and to illustrate an alternative embodiment according to which the use of means attesting to an attempt to alter the integrity of an electronic tag is not required, Fig. 3 illustrates an assembly method which does not comprise steps 142 and/or 143.

5 Conversely, a method 100 according to Fig. 3 comprises an essential step 150 for depositing on the upper face 30u of the first support 30 a layer of a second thermoplastic material TP2, said layer covering at least the first conductive antenna 20 and the module of radio-frequency identification 10. Given the small surface area of the electronic antenna produced, said layer of thermoplastic material TP2
10 advantageously covers the entire surface of the support 30. Such a layer may be deposited, as shown in Fig. 3 as an example, under the action of a D7 unwinder of a strip of thermoplastic material. Step 150 further consists of heat-pressing the assembly, i.e., at a temperature higher than the melting temperature of the thermoplastic material TP2, to ensure a lasting bond of the layer of thermoplastic
15 material TP2 on the upper face 30u of the support 30. Such a pressing operation may be carried out by means of a pair R2 of rollers, opposite one another, ensuring a pressing function of the assembly when the latter is pulled between said rollers, so that the adhesion of the two layers of the TP2 material is durable.

The second thermoplastic material TP2 may be selected from thermoplastic

polyurethanes, polyphenylene oxides, polyamides, polyacetates, polyethylenes, polypropylenes, polyolefins or ethylene-vinyl acetates, advantageously conditioned in the form of films.

The example of the assembly method 100 described in relation to Fig. 3 can now be completed. A plurality of electronic tags can thus be conditioned in the form of a strip. Said method 100 may, however, include additional steps. A first step may consist of electrically testing the operation of each tag produced. An electronic tag deemed non-operational may be marked, for example by inkjet printing, in order to be discarded. Such a test step may also make it possible to update certain memories of the electronic component of the radio-frequency identification module of each tag produced. Thus, this step of segregating operational tags makes it possible to manage and control the sequence of serial numbers or other unique references associated respectively with the tags and to ensure consistency with an optional step of said graphic printing process 100, step also not shown in Fig. 4, to allow each tag to be personalized, or even to visually record said serial number or unique reference. Such a step can also make it possible to materialize graphically, for example by printing a mark, the possible sewing range P within which the radio-frequency identification module is preserved.

A strip of tags resulting from an assembly method 100 described in relation to Fig. 3 may also include a step 160 for cutting said strip, in order to separate the tags from each other, or even to package them each in a blister pack. Alternatively, in particular if the support 30 is not pre-cut, such a step 160 may consist of pre-cutting said strip comprising the tags produced in order to make it easy to separate the latter from each other, while maintaining a packaging mode in the form of strips, each comprising a plurality of tags.

According to this example described in relation to Fig. 3, a method 100 does not include a step of depositing on the face 30d of the support 30, i.e., the face opposite to that 30u accommodating a radio-frequency identification module 10, a layer of a third thermoplastic material TP3. However, such a step could also be carried out.

Figs. 2 and 3 thus illustrate examples of a particularly innovative and adaptable radio-frequency identification tag assembly method according to the requirements of the field of application. The tags produced can be of different dimensions, as shown in Figs. 2A and 3A, and include antennas allowing them to communicate directly with a remote reader, coupled or even connected to a third-party antenna positioned on a host object. The use of thermoplastic materials gives the tags conforming to the invention, whatever their arrangement, great ease of positioning, or even

repositioning, as well as unrivaled reliability. They are particularly suited to the field of industrial laundries, demanding and harsh in terms of operation given the high temperatures and chemical products to which said tags are exposed.

5 However, such a method cannot be limited to the production of electronic tags for this field alone. The materials used can be advantageously chosen to meet the conditions and constraints imposed by any other application.

CLAIMS

1. The method for assembling (100) an electronic radio-frequency identification tag (1) comprising a radio-frequency identification module (10), a first conductive antenna (20), a first dielectric support (30) arranged to accommodate said radio-frequency identification module (10) and said conductive antenna (20), said method comprising a step (140) for depositing the radio-frequency identification module (10) on the upper face (30u) of the first support (30), the latter comprising the first conductive antenna (20), said radio-frequency identification module (10) being positioned in the immediate vicinity of the first conductive antenna (20), said method (100) being characterized in that it comprises:
- a preliminary step (130) for depositing on the upper (10u) and lower (10d) faces of the radio-frequency identification module (10) a layer of a first thermoplastic material (TP1);
 - a step (130a) for pressing the assembly at a temperature sufficient to activate the first thermoplastic material (TP1);
 - a step (150) for depositing on the upper face (30u) of the first support (30) a layer of a second thermoplastic material (TP2) and for pressing the assembly at a temperature sufficient to activate the second thermoplastic material (TP2), said layer of second thermoplastic material (TP2) at least partially covering the first conductive antenna (20) and the radio-frequency identification module (10).
2. The method (100) according to the preceding claim, wherein the step (150) for

depositing on the upper face (30u) of the first support (30) consists of depositing a layer of a second heat-reactivable thermoplastic material (TP2).

3. The method (100) according to any of the preceding claims, comprising, prior to
5 step (140) for depositing the radio-frequency identification module (10) on the upper face (30u) of the first support (30), a step (134) for depositing, at least on an area of the upper face (30u) of the first support (30), a layer of an adhesive material (A) whose tack at room temperature is sufficient to maintain the position of the radio-frequency identification module (10) on the first support (30), said
10 area of the upper face (30u) of the first support (30) being intended to accommodate the radio-frequency identification module (10).

4. The method (100) according to any of claims 1 or 2, comprising, prior to step (140) for depositing the radio-frequency identification module (10) on the upper
15 face (30u) of the first support (30), a step (131) for depositing on the face (10d') of the radio-frequency identification module (10) intended to cooperate with the upper face (30u) of the first support (30), a layer of an adhesive material (A) whose tack at room temperature is sufficient to maintain the position of the radio-frequency identification module (10) on the first support (30).

5. The method (100) according to any of claims 1 or 2, comprising, prior to step (140) for depositing the radio-frequency identification module (10) on the upper
20 face (30u) of the first support (30), a step (135) for heating the first material (TP1) deposited on the face (10d') of the radio-frequency identification module (10) intended to cooperate with the upper face (30u) of the first support (30), beyond
25

the melting temperature of said first material (TP1).

6. The method according to any of the preceding claims, comprising a preliminary step (120) for assembling the radio-frequency identification module (10), said step (120) consisting of:

- depositing or engraving (121) on a second dielectric support (13) a second conductive antenna (12) arranged to ensure near-field electromagnetic communication and an electronic component (11);
- ensuring (122) electrical cooperation between said second conductive antenna (12) and said electronic component (11); and,
- depositing (123) a layer of a resin (14) on the faces remaining exposed of said electronic component (11) and said second conductive antenna (12).

7. The method (100) according to any of the preceding claims, comprising a step (142) for depositing, at least on the face remaining exposed (10u') of the radio-frequency identification module (10), a fibrous mesh (50) arranged to be irrecoverably unraveled during an attempt to disassemble the electronic tag (1) aimed at tearing off said radio-frequency identification module (10) from the first support (30), said step (142) being implemented prior to the step (150) for depositing on the upper face (30u) of the first support (30) a layer of a second thermoplastic material (TP2).

8. The method (100) according to any of the preceding claims, comprising a step (143) for writing, at least on the exposed face (10u') of the radio-frequency identification module (10) and on part of the upper face (30u) of the first support (30) remaining exposed, a message (60) whose content would be irreparably

altered during an attempt to disassemble the electronic tag aimed at tearing off said radio-frequency identification module (10) from the first support (30), said step (143) being implemented prior to step (150) for depositing on the upper face (30u) of the first support (30) a layer of a second thermoplastic material (TP2).

5

9. The method (100) according to any of the preceding claims, comprising a step (133) for electrically testing the radio-frequency identification module (10) and for which the step (140) for depositing said radio-frequency identification module (10) on the upper face (30u) of the first support (30) is only carried out if said radio-frequency identification module is operational (133-y).

10

10. The method (100) according to any of the preceding claims, comprising a preliminary step (111) for depositing the first conductive antenna (20) on the first support (30) or for embroidering, printing, laminating or weaving said antenna (20) on said first support (30).

15

11. The method (100) according to any of the preceding claims, wherein the first conductive antenna (20) carried by the first support (30) comprises one or more loops (20b) of a conductive track and/or wire.

20

12. The method (100) according to the preceding claim, wherein the radio-frequency identification module comprises an internal conductive antenna (12), the first conductive antenna (20) being arranged to form one or more loops (20L) of a diameter greater than the dimensions of said conductive antenna (12) internal to the radio-frequency identification module (10).

25

13. The method (100) according to any of the preceding claims, wherein the first (TP1) and second (TP2) thermoplastic materials are selected from thermoplastic polyurethanes, polyphenylene oxides, polyamides, polyacetates, polyethylenes, polypropylenes, polyolefins or ethylene-vinyl acetates.

5

14. The method (100) according to any of the preceding claims, wherein the first (TP1) and second (TP2) thermoplastic materials are selected to have respective melting temperatures greater than a determined temperature threshold.

10 15. The method (100) according to any of the preceding claims, wherein the first support (30) comprises a material selected from cotton, nylon, viscose, a polyester, or a synthetic material.

15 16. The method (100) according to any of the preceding claims, comprising a step (112) for transversely pre-cutting the first support (30) when it is in the form of a strip, each section (30s) thus materialized between two pre-cuts (30c) being arranged to include the first conductive antenna (20) and accommodate the radio-frequency identification module (10).

20 17. The method (100) according to any of the preceding claims, wherein the first (TP1) and second (TP2) thermoplastic materials are substantially identical.

25 18. The method (100) according to any of the preceding claims, comprising a step (151) for depositing a layer of a third thermoplastic material (TP3) on the face (30d) of the first support (30), opposite face (30u) intended to accommodate the radio module identification (10).

19. The method according to the preceding claim, wherein the third thermoplastic material (TP3) is identical to the second thermoplastic material (TP2).

20. The method (100) according to any of the preceding claims, wherein any
5 thermoplastic material (TP1, TP2, TP3) deposited on the first support (30) and/or on the radio-frequency identification module (10) has a melting temperature above 150 °C.

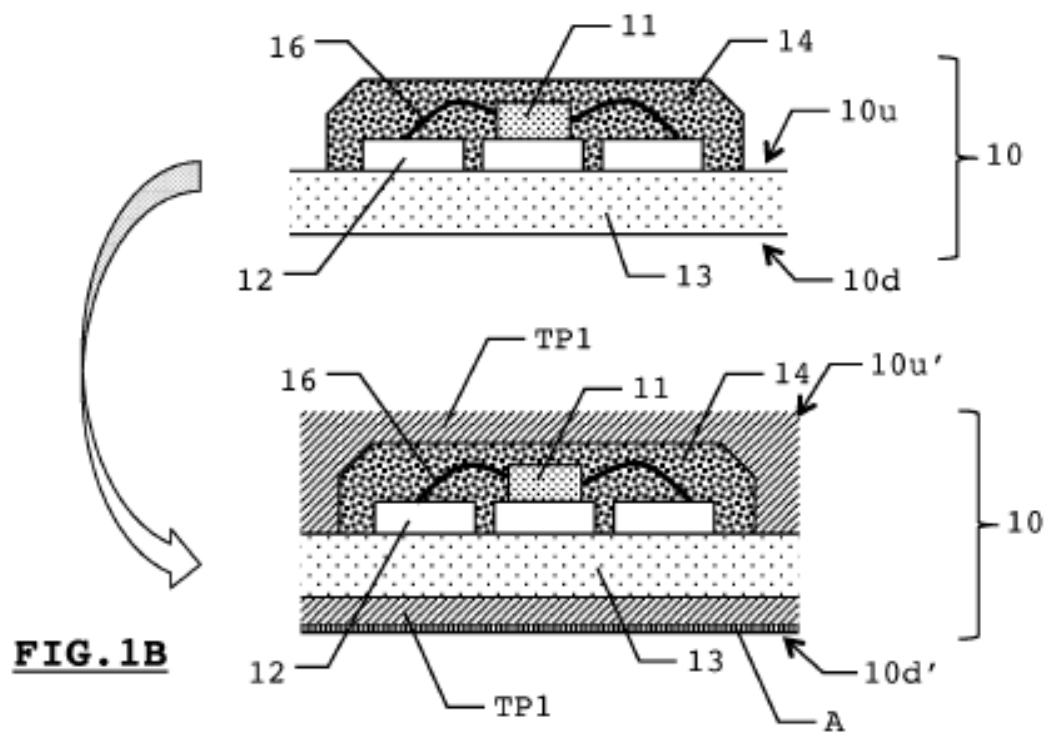
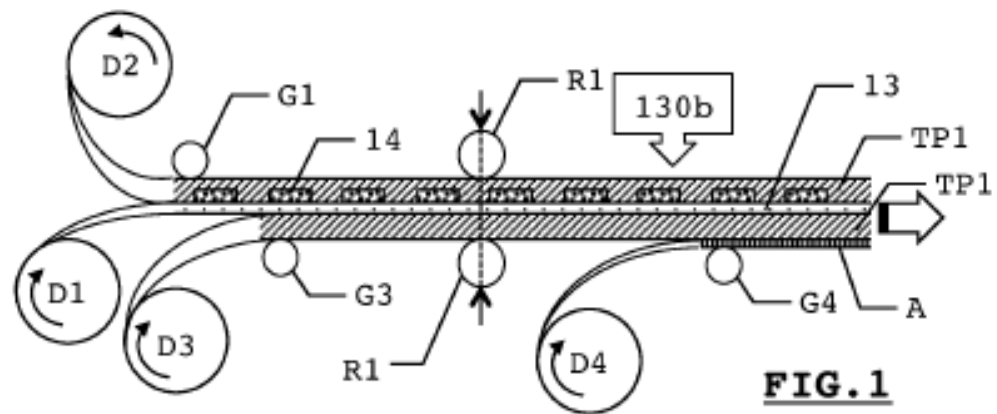
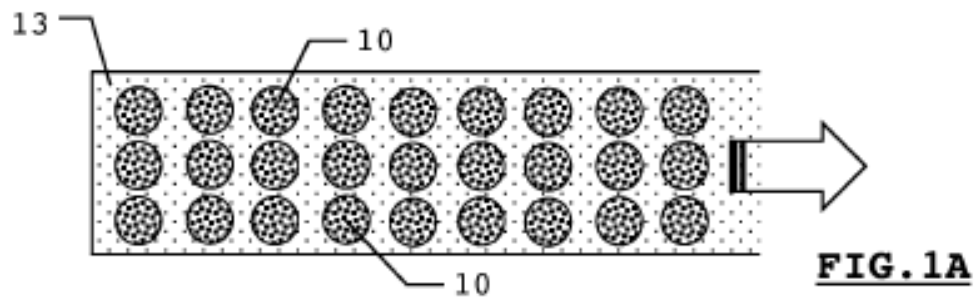
21. A radio-frequency identification module (10) comprising a dielectric support
10 (13), a conductive antenna (12) arranged to ensure near-field electromagnetic communication and an electronic component (11), said electronic component (11) being electrically connected to said conductive antenna (12), any exposed face of said electronic component (11) and of the conductive antenna (12) being covered by a protective resin (14), said radio-frequency identification module (10) mainly
15 having an upper face (10u') and a lower face (10d'), characterized in that said upper (10u') and lower (10d') faces comprise a layer of a heat-reactivable thermoplastic material (TP1).

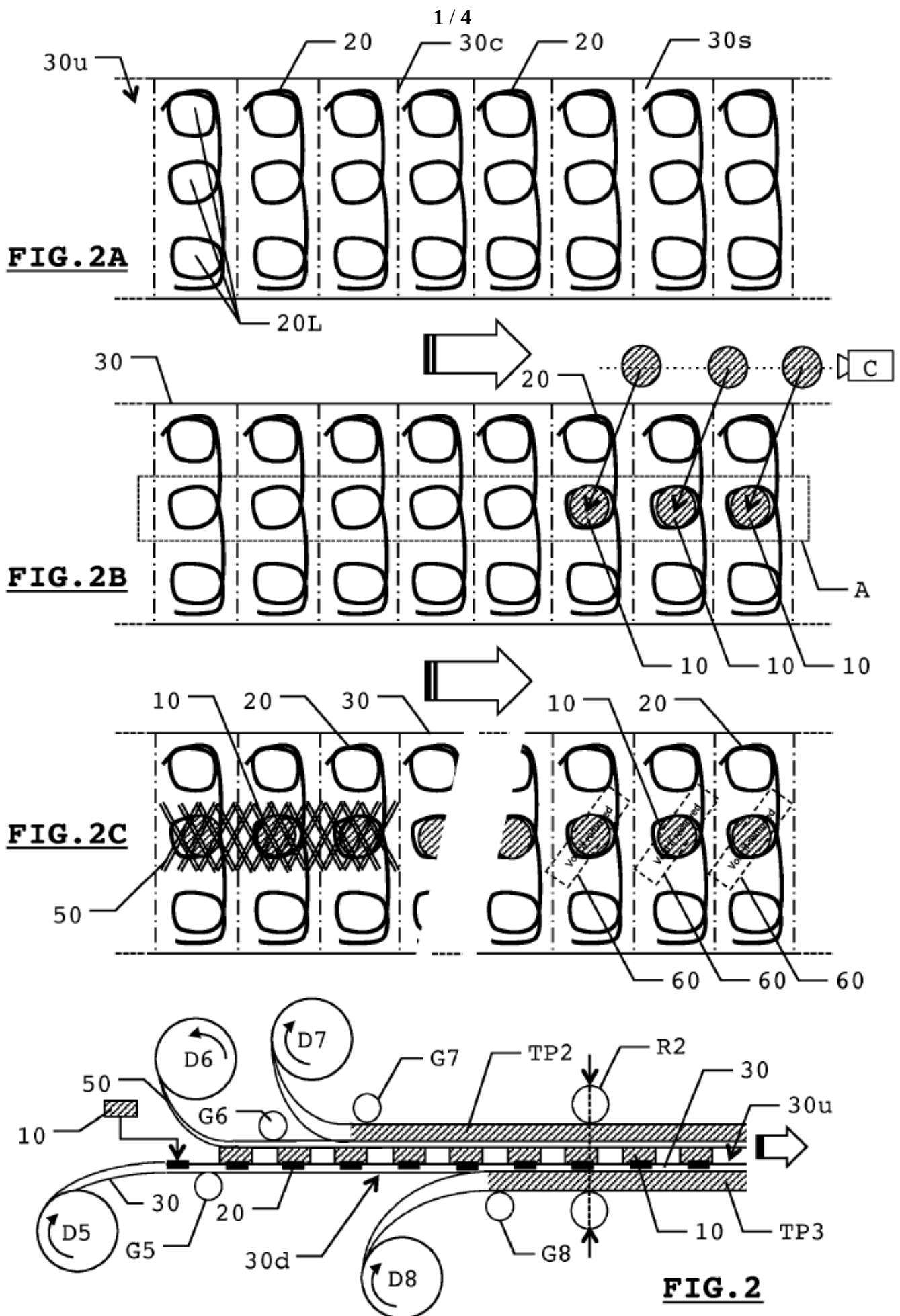
22. An electronic radio-frequency identification tag (1) comprising a support (30),
20 a tag conductive antenna (20), a radio-frequency identification module (10) according to the preceding claim, characterized in that said radio-frequency identification module (10) is positioned on a so-called upper face (30u) of said support (30) so that the internal conductive antenna (12) of said radio-frequency identification module (10) does not cover said tag conductive antenna (20), and in
25 that said upper face (30u) of the support (30) comprises a layer of a thermoplastic

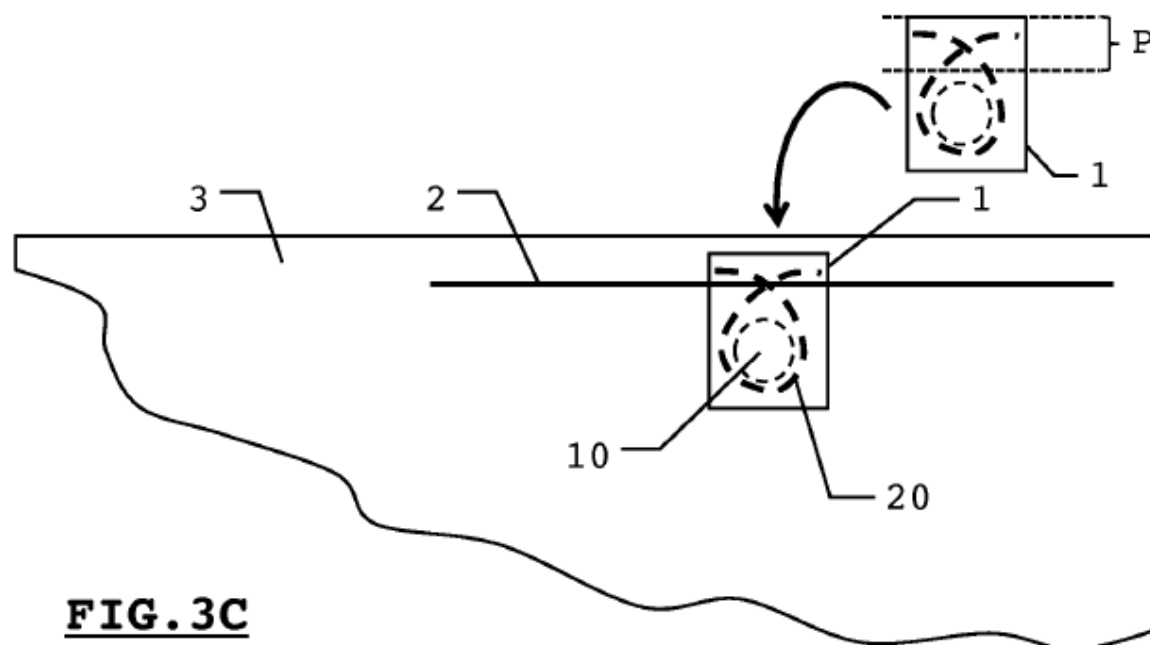
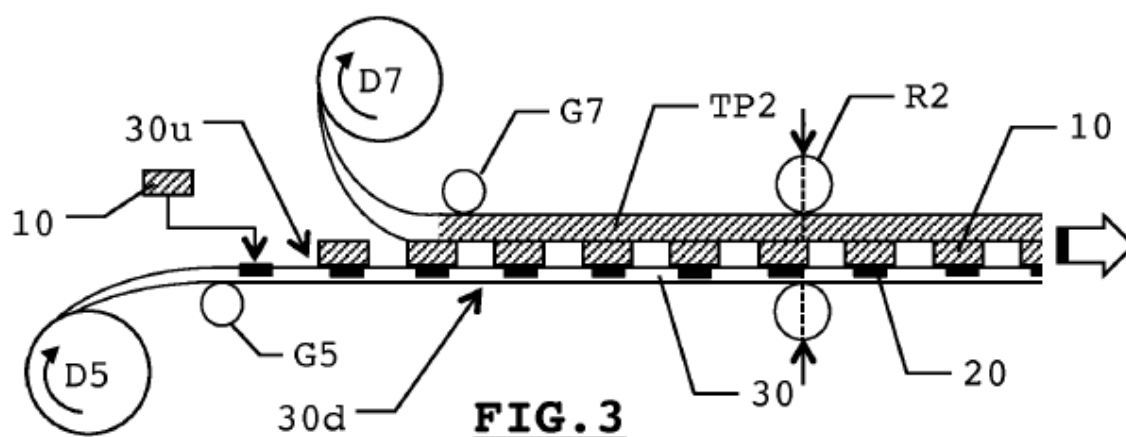
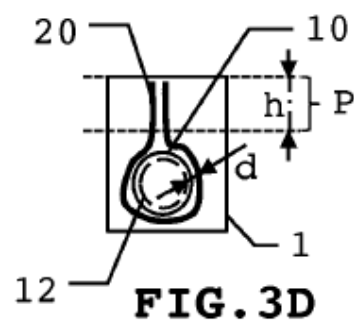
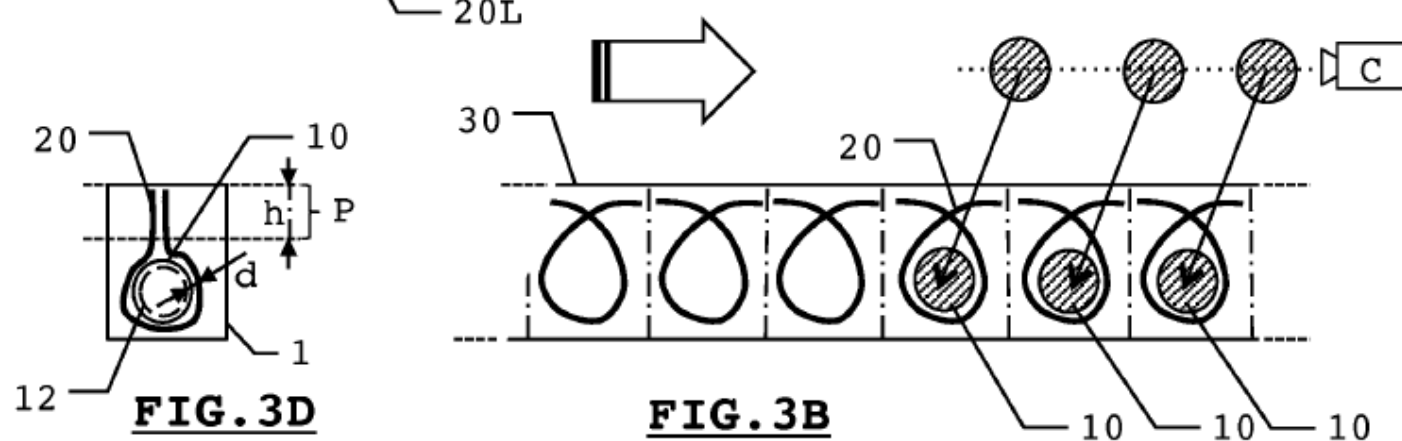
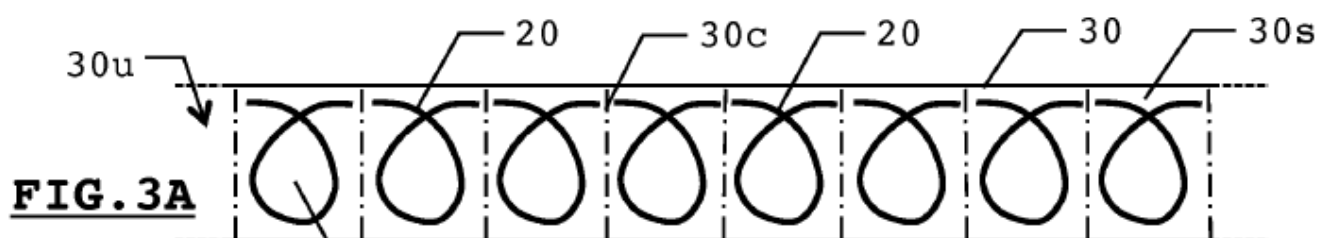
material (TP2), said layer at least partially covering the tag conductive antenna (20) and the radio-frequency identification module (10).

23. The tag according to the preceding claim, wherein the tag conductive antenna (20) and the radio-frequency identification module (10) are mutually arranged on the support (30) so that said module occupies an eccentric position on said support (30), the latter comprising a range (P) of a determined minimum height (h), said range (P) partially encompassing said tag antenna (20) but not said radio-frequency identification module (10).

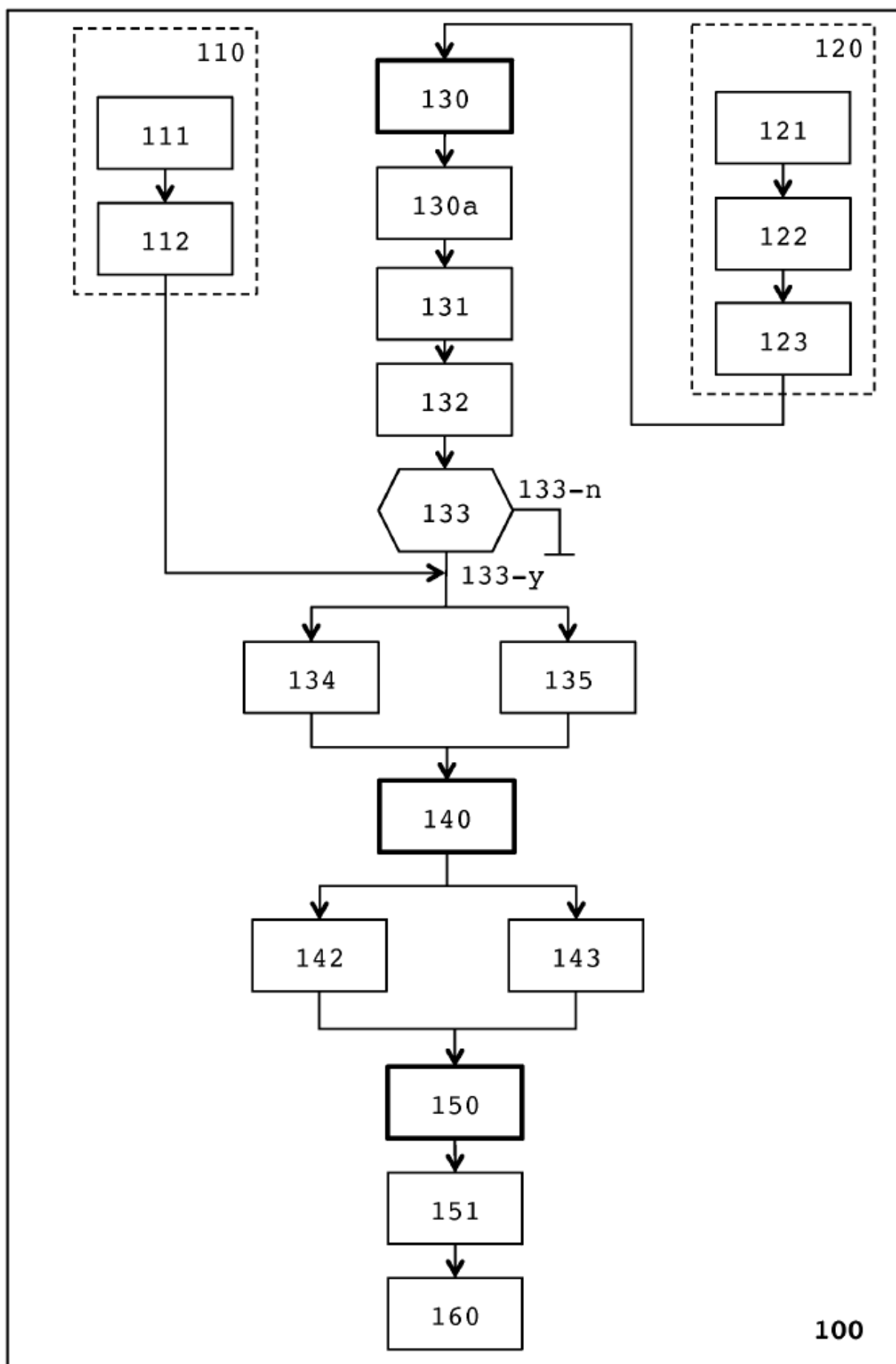
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**FIG. 4**