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(12) # PATENT APPLICATION

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This publication also includes changes to the description, claims and drawings filed under Art. 35 (20) of GD 547/2008.

(54) DOUBLE-LOOP RFID TAG WITH INDUCTIVE COUPLING INTENDED FOR HARSH ENVIRONMENTS

(57) Summary:
The invention concerns a radio frequency identification tag, RFID, for the UHF-SHF frequency range, intended for use in harsh industrial environments. The RFID tag, according to the invention, consists of a UHF-SHF antenna (2) made of an electroconductive, electrically insulated textile thread, embroidered onto a fabric support, an encapsulated RFID transponder (3), inductively coupled to the antenna (2), and a fabric substrate (4) on which the RFID transponder (3) and the UHF-SHF antenna (2) are placed, in which the UHF-SHF antenna occupies a central area formed by a double loop (5), that is inductively coupled to the encapsulated RFID transponder (3).

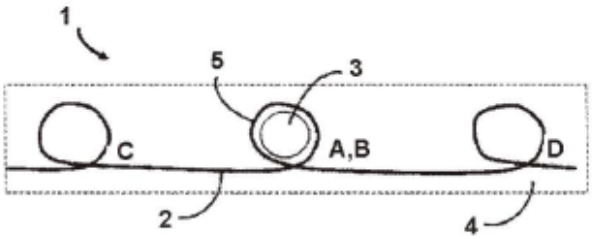


Figure 1

Initial claims: 5
Amended claims: 5
Figures: 3

Starting on the publication date of the patent application, the application provides to the applicant, provisionally, the protection granted under Art. 32 of Law 64/1991, except in cases where the patent application was rejected, withdrawn or deemed withdrawn, the extent of the protection granted by the patent application is determined by the claims contained in the application published under Art. 23 (1) - (3).

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Double loop RFID tag with inductive coupling intended for harsh environments

DESCRIPTION

[0001] A minimal radio frequency identification (RFID) system consists of a reader/interrogator connected to a PC and a tag population attached to the products it uniquely identifies. An application software manages the RFID information to track and take inventory of these products. The system uses passive RFID tags operating in the UHF (860-960MHz) or SHF (2.45GHz) frequency ranges.
[0002] With regard to RFID tagged textile items that are cleaned in industrial laundries and dry cleaners, the demands to which the items, and, by default, the attached tags are subjected are as follows:
- being immersed, repeatedly, in an aquatic environment,
- being exposed to high washing temperatures, up to 90°C, over a period exceeding 20 minutes,
- being exposed to significant temperature variations, cold/hot (8 °C / 90 °C),
- being exposed to chemicals used during the washing process,
- mechanical spin-dry pressures of 40-60 bar,
- finishing/ironing temperatures of 220°C, for 20 seconds.
- repeated mechanical stresses (bending, pressing, etc.),
- over 200 wash cycles.

[0003] Historically, passive RFID tags operating in the HF range (13.65Mhz) were first used for RFID applications. From a constructional viewpoint, they consisted of an integrated circuit that was galvanically connected to a flat coil, in the shape of a spiral, with many turns. The reading range was under 1m, and the reading speed was of approximately one tag per second. After introducing passive RFID tags in the UHF range and the development of communication protocols, performance increased dramatically, with high reading speeds (10 RFID tags/s) and reading distances of up to 7m.

[0004] A design of an RFID tag consisting of an encapsulated transponder, which was therefore protected from the harsh environment of industrial laundries, combined with a metallic wire UHF antenna, has been widely used for textile tracking applications. The encapsulated transponder contains an integrated circuit and a near field antenna through which it is inductively coupled to a segment of the UHF antenna.

[0005] This category includes the UHF RFID tags subject to patents EP 2405054 A1, DE 102007026720 A1, US 20090079574 A1.

[0006] But even this design has its limitations. Encapsulation ensures that the contacts between the pins of the integrated circuit (IC) and the terminals of the near field antenna are protected, but at the level of the UHF antenna there are major discrepancies in terms of the mechanical and thermal characteristics of the textile substrate, compared to the wire used for the UHF antenna.
Here is a short list of the issues encountered while using these tags in industrial laundries:
- the seams get loose and the fabric on which the RFID tag is affixed gets torn,
- the metallic wire of the UHF antenna gets oxidized when it comes in contact with water and the oxidizing chemicals used during the washing process, which stains the fabric and affects its

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appearance. Also, following the oxidation, the electrical parameters of the material of the antenna and, therefore, its electromagnetic performance are affected.
- the material of the wire used for the antenna stores much more thermal energy than the fabric, and due to this difference, the fabric is pierced and perforated by the metallic wire of the antenna that protrudes from it.
These lead to the encapsulated RFID transponder 3 becoming loose and falling off, which leads to the loss of identity of the tracked items, to appearance-related issues of the item, but especially to issues for the customers, namely they get injured when they use the items (towels, pillowcases, sheets) that were pierced by the wire.
At the same time, current UHF tags are quite large, in which case their use to identify smaller items (such as napkins) is inadequate and unappealing.

[0007] The ideal passive RFID tag for the identification of textile items that are laundered or dry cleaned:
- has high electromagnetic performance (extensive reading range)
- is small-sized,
- is flexible and resistant to bending,
- is resistant to chemical stress,
- is resistant to a higher number of exposures than the product it identifies; over 200 wash cycles.
Therefore, it is an RFID tag with high electromagnetic performance, which is durable and unobtrusive.
[0008] The approaches to this ideal prototype are as follows:
- using encapsulation materials that effectively protect the integrated circuit and its contacts with the near field antenna, at the transponder level,
- designing a geometry of the UHF antenna which gives it superior electromagnetic properties and at the same time has the smallest possible size,
- electroconductive materials, having mechanical parameters similar to those of the textile item should be used when constructing the UHF antenna,
- the components of the tag which interact directly should have similar coefficients of thermal expansion.

[0009] The UHF antennas of the RFID tags currently existing on the market are made of electrically insulated metallic wire, which is either sewn or embroidered onto the fabric. They are meandering in shape (EP 2405054 A1) or take the shape of overlapping loops (WO 2013128299 A1). They all have the shortcomings and limitations described in paragraph [0006].
[0010] This patent proposes, for the UHF antenna, electroconductive textile threads made of stainless steel metallic wires, which are resistant to the action of oxidizing agents. By using an electroconductive textile thread to make the UHF antenna, given its flexibility, the electroconductive textile thread allows for geometries that are impossible to achieve with an electrically insulated metallic wire. Achieving very short radius curves without creating mechanical stresses that affect the structure of the tag becomes possible. Also, the UHF antenna made of electroconductive conductive textile thread is very inconspicuous, it is not intrusive, and integrates naturally into the fabric of the product it identifies.

[0011] The UHF antenna 2 has a specific, innovative geometry, characterized by the fact that it has in the central area a double loop 5 through which it provides an effective inductive coupling with the encapsulated RFID transponder 3, which results in an RFID tag with high electromagnetic performance.

[0012] Also, the double loop 5 allows for the execution of a small-sized RFID tag, the material of the antenna and, therefore, its electromagnetic performance are affected.

- the material of the wire used for the antenna stores much more thermal en *[illegible signatures]* d due to this difference, the fabric is pierced and perforated by the metallic wire of the antenna that protrudes from it.

These lead to the encapsulated RFID transponder 3 becoming loose and falling off, which leads to the loss of identity of the tracked items, to appearance-related issues of the item, but especially to issues for the customers, namely they get injured when they use the items (towels, pillowcases, sheets) that were pierced by the wire.

At the same time, current UHF tags are quite large, in which case their use to identify smaller items (such as napkins) is inadequate and unappealing.

[0007] The ideal passive RFID tag for the identification of textile items that are laundered or dry cleaned:

- has high electromagnetic performance (extensive reading range)
- is small-sized,
- is flexible and resistant to bending,
- is resistant to chemical stress,
- is resistant to a higher number of exposures than the product it identifies; over 200 wash cycles.

Therefore, an RFID tag with high electromagnetic performance, durable and unobtrusive.

[0008] The approaches to this ideal prototype are as follows:

- using encapsulation materials that effectively protect the integrated circuit and its contacts with the near field antenna, at the transponder level,
- designing a geometry of the UHF antenna which gives it superior electromagnetic properties and at the same time has the smallest possible size,
- electroconductive materials, having mechanical parameters similar to those of the textile item should be used when constructing the UHF antenna,
- the components of the tag which interact directly should have similar coefficients of thermal expansion.

[0009] The UHF antennas of the RFID tags currently existing on the market are made of electrically insulated metallic wire, which is either sewn or embroidered onto the fabric. They are meandering in shape (EP 2405054 A1) or take the shape of overlapping loops (WO 2013128299 A1). They all have the shortcomings and limitations described in paragraph [0006].

[0010] This patent proposes, for the UHF antenna, electroconductive textile threads made of stainless steel metallic wires, which are resistant to the action of oxidizing agents. By using an electroconductive textile thread to make the UHF antenna, given its flexibility, the electroconductive textile thread allows for geometries that are impossible to achieve with an electrically insulated metallic wire. Achieving very short radius curves without creating mechanical stresses that affect the structure of the tag becomes possible. Also, the UHF antenna made of electroconductive conductive textile thread is very inconspicuous, it is not intrusive, and integrates naturally into the fabric of the product it identifies.

[0011] The UHF antenna 2 has a specific, innovative geometry, characterized by the fact that it has in the central area a double loop 5 through which provides an effective inductive coupling with the encapsulated RFID transponder 3, which results in an RFID tag with high electromagnetic performance.

[0012] Also, the double loop 5 allows for the execution of a small-sized RFID tag, which is non-intrusive and easy to integrate even in small items.

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[0013] The UHF antenna of the RFID passive tag can be made in two embodiments shown in Figure 2 and Figure 3. In the first embodiment, Figure 2, the electroconductive textile thread is electrically insulated and allows the thread to overlap at certain points (A, B, C, D) without electrical contact. For the second embodiment, Figure 3, the geometry of the UHF antenna also allows for the use of an uninsulated electroconductive textile thread. Both embodiments are achieved through embroidery.

[0014] In the first constructive embodiment, Figure 2, the double loop 5 of the UHF antenna 2 through which the inductive coupling with the encapsulated RFID transponder 3 is made, is a spiral with two turns (the first turn is 7mm in diameter, and the second is 9mm in diameter), a geometry that led to the creation of an effective UHF antenna in terms of power transfer and ensuring information integrity, with a substantially reduced construction size. There is no electrical contact at points A, B, C, and D.

[0014] In the second constructive embodiment of the UHF antenna, Figure 3, the embroidery is designed in such a way so as to allow the electroconductive textile thread to be continuously embroidered, without crossing over.
After the embroidery phase, by bending on the dotted line and overlapping the two P and Q loops, a double loop is formed. The P loop is 7mm in diameter, and the Q loop is 9mm in diameter. We can see that, after bending and overlapping, the currents in the two loops have the same direction, contributing together to achieving an efficient inductive coupling. Before bending the two P and Q loops, the encapsulated transponder 3 will be attached with adhesive onto the P loop. After bending and overlapping, the encapsulated transponder 3 will be attached between the two P and Q loops.

[0015] This patent complements the patent no. **a 2016 00791**, which proposed an RFID transponder designed to operate in harsh environments. The RFID transponder was described as designed to be used both independently, in the case of RFID applications for which the reading distance spans centimeters, and with a UHF-SHF antenna, in the case of RFID applications for which the reading distance spans meters.

[0016] The design of this RFID tag, by incorporating in its structure the encapsulated transponder 3, subject to patent **a 2016 00791**, overcomes the issues created by the difference in size between the very small integrated circuits and the antennas to which they are galvanically connected, which require the use of expensive connection technologies (wire bonding) or of technologies that are unsuitable for the harsh environment of industrial laundries (gluing with conductive adhesives).

[0017] The design of the tag seeks to achieve a balance between the size of the objects that it identifies and the size of the tag itself. It does not fall into the trap of excessive miniaturization when it is not required.

[0018] A maximal design is proposed – the maximum achievable using currently available components.
- a transponder with a minimum number of galvanic contacts, two, equal to the number of active pins of the IC, robust galvanic contacts, using an IC placed in the SOT323 housing, which is welded, using cost-effective and mature SMT technology, to the terminals of the near field antenna, encapsulated and protected against the harsh environment of industrial laundries,
- an inductive coupling between the encapsulated transponder 3 and the UHF antenna,
- homogeneity of the components of the UHF antenna – fabric substrate assembly, both made of fabric;
- a substantially reduced tag length, by using the double loop of the UHF antenna.
- a tag that is ideally suited to the textile field, both due to the materials used (textile thread on fabric support) and the execution methods (embroidery of electroconductive textile thread onto the fabric

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support).

PATENT REFERENCES

Quoted patent	Date of registration	Date of publication	Applicant	Title
EP 2405054 A1	07/07/2010	01/11/2012	Datamars SA (CH)	Textile item Identification tag
DE 102007026720A1	06/06/2007	12/11/2008	Bielomatik	Chip module for an RFID system
US 20090079574 A1	09/19/2008	03/26/2009	Noriyuki	Rfid tag
WO 2013128299 A1	03/02/2012	09/06/2013	Usta	Enhanced antenna structure for RFID tags

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CLAIMS

1. An RFID tag 1, consisting of:
   - a UHF antenna 2 that has a specific geometry, characterized by the fact that it has in the central area a double loop 5 through which it provides an effective inductive coupling with the encapsulated RFID transponder 3. The UHF antenna 2 is made of electroconductive textile thread, embroidered on a fabric support,
   - an encapsulated RFID transponder 3 intended for use in harsh environments,
   - a fabric substrate 3 on which the RFID transponder for harsh environments and the UHF antenna 2 are placed. The entire assembly is sealed by hot gluing a second fabric substrate

2. The frequency range in which the RFID tag 1 can operate is UHF (860-960MHz) or SHF (2.5Ghz RFID).

3. The UHF antenna 2 is made of an electroconductive textile thread or insulated metallic wire, in two construction embodiments.

4. In the first constructive embodiment, the double loop 5 of the UHF antenna 2 through which the inductive coupling with the encapsulated RFID transponder 3 is made, is a spiral with two turns (the first turn is 7mm in diameter, and the second is 10mm in diameter, a geometry that achieves an effective electromagnetic energy transfer, which results in a substantially reduced construction size. There is no electrical contact at points A and B (Figure 2). Likewise, the loops located at the ends of the UHF antenna 2 have no electrical contact in points C and D (Figure 1).

5. In the second constructive embodiment of the UHF antenna, the embroidery is designed in such a way so as to allow the electroconductive textile thread to be sewn continuously, without crossing over. After the embroidery phase, by bending on the dotted line and overlapping the two P and Q loops, a double loop is formed. The P loop is 7mm in diameter, and the Q loop is 9mm in diameter. We can see that, after bending and overlapping, the currents in the two loops have the same direction, contributing together to achieving an effective inductive coupling. Before bending the two P and B loops, the encapsulated transponder 3 will be attached with adhesive onto the P loop. After bending and overlapping, the encapsulated transponder 3 will be attached between the two P and Q loops.

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FIGURES

Figure 1. Double loop 5 RFID tag 1

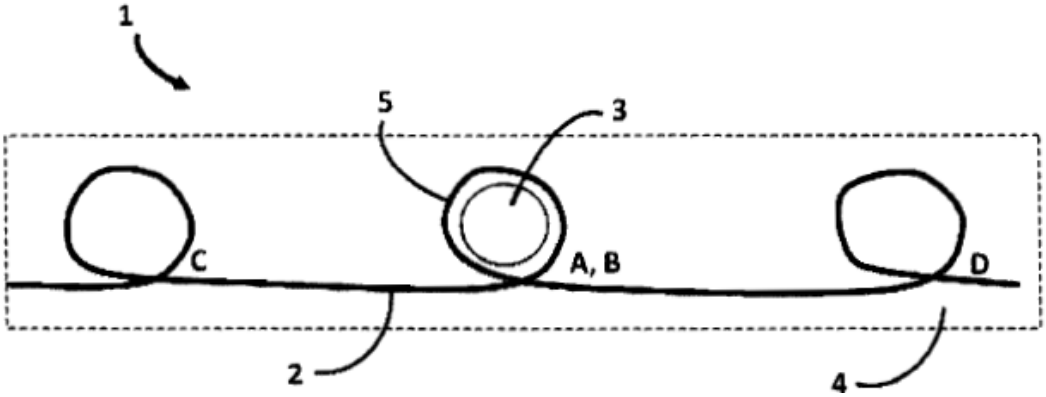


Figure 2. Detail, double loop 5 achieving the inductive coupling with the encapsulated RFID transponder 3

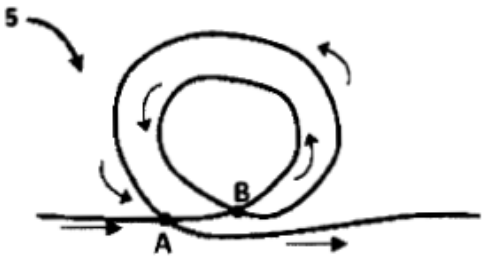
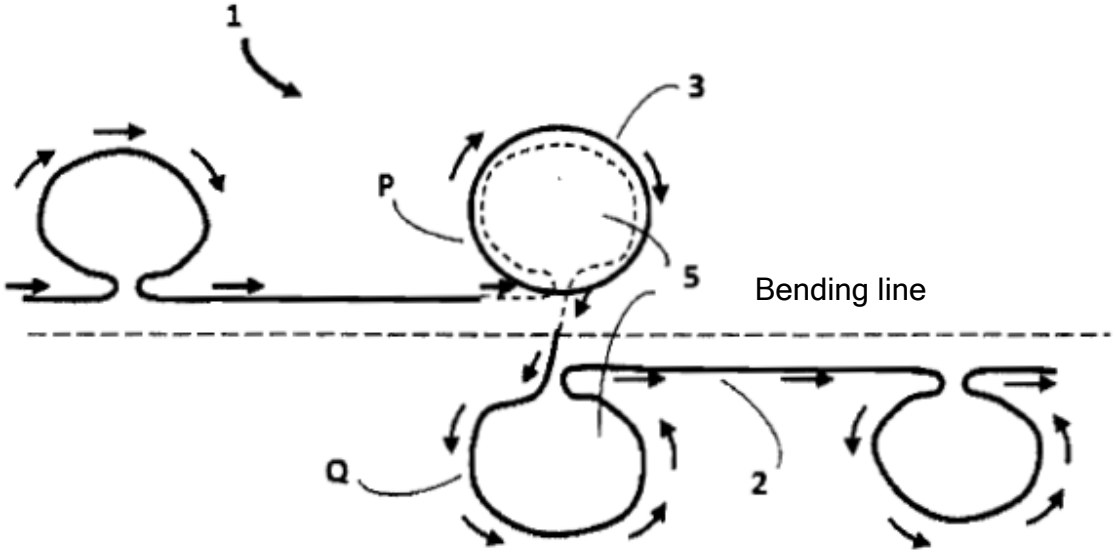


Figure 3. Double loop 5 RFID tag 1, achieved by bending



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Double loop RFID tag with inductive coupling intended for harsh environments

DESCRIPTION

[0001] A minimal radio frequency identification (RFID) system consists of a reader/interrogator connected to a PC and a tag population attached to the products it uniquely identifies. An application software manages the RFID information to track and take inventory of these products. The system uses passive RFID tags operating in the UHF (860-960MHz) or SHF (2.45GHz) frequency ranges.

[0002] The objects identified using RFID tags and intended for use in harsh environments must withstand the following demands:

- being immersed, repeatedly, in an aquatic environment,
- being exposed to high temperatures, up to 200 °C, over a period exceeding 20 minutes, - being exposed to significant temperature variations, repeatedly (8 °C / 90 °C);
- corrosive chemical agents,
- mechanical pressures of 40-60 bar,
- repeated mechanical stresses (bending, pressing, etc.),
- over 300 cycles of use.

[0003] Historically, passive RFID tags operating in the HF range (13.65Mhz) were first used for RFID applications. From a constructional viewpoint, they consisted of an integrated circuit that was galvanically connected to a flat coil, in the shape of a spiral, with many turns. The reading range was under 1m, and the reading speed was of approximately one tag per second. After introducing passive RFID tags in the UHF range and the development of communication protocols, performance increased dramatically, with high reading speeds (10 RFID tags/s) and reading distances of up to 7m.

[0004] A design of an RFID tag consisting of an encapsulated transponder, which was therefore protected from the harsh environment of industrial laundries, and a metallic wire UHF antenna, has been widely used for textile tracking applications. The encapsulated transponder contains an integrated circuit and a near field antenna through which it is inductively coupled to a segment of the UHF antenna.

[0005] This category includes the UHF RFID tags subject to patents EP 2405054 A1, DE 102007026720 A1, US 20090079574 A1.

[0006] But even this design has its limitations. Encapsulation ensures that the contacts between the pins of the integrated circuit (IC) and the terminals of the near field antenna are protected, but at the level of the UHF antenna there are major discrepancies in terms of the mechanical and thermal characteristics of the textile substrate, compared to the wire used for the UHF antenna.

Here is a short list of the issues encountered while using these tags in industrial laundries:

- the seams get loose and the fabric on which the RFID tag is affixed gets torn,

- the metallic wire of the UHF antenna gets oxidized when it comes in contact with water and the oxidizing chemicals used during the washing process, which stains the fabric and affects its appearance. Also, following the oxidation, the electrical parameters of the material of the antenna and, therefore, its electromagnetic performance are affected.

- the material of the metallic wire used for the antenna stores much more thermal energy than the fabric, and due to this difference, the fabric is pierced and perforated by the metallic wire of the antenna that protrudes from it.

- due to the rigidity of the metallic wire, the whole tag is less flexible compared to the fabric of the item to be identified. Reduced flexibility leads to breaking lines on the outline of the RFID tag.

These lead to the encapsulated RFID transponder becoming loose and falling off, which leads to the loss of identity of the tracked items, to appearance-related issues of the item, but especially to issues for the customers, namely they get injured when they use the items (towels, pillowcases, sheets) that were pierced by the wire.

At the same time, current UHF tags are quite large, in which case their use to identify smaller items (such as napkins) is inadequate and unappealing.

[0007] The ideal passive RFID tag for the identification of textile items that are cleaned in industrial laundries and dry cleaners:

- has high electromagnetic performance, indicated by a high percentage of successful readings at a distance defined by the requirements of the application.
- is small-sized,
- is flexible and resistant to bending,
- is resistant to chemical stress,
- is resistant to a higher number of exposures than the product it identifies; over 200 wash cycles.

Therefore, it is an RFID tag with high electromagnetic performance, which is durable and unobtrusive.

[0008] The approaches to this ideal prototype are as follows:

- using encapsulation materials that effectively protect the integrated circuit and its contacts with the near field antenna, at the transponder level,

- designing a geometry of the UHF/SHF antenna which gives it superior electromagnetic properties and at the same time has the smallest possible size,

- electroconductive materials, having mechanical parameters similar to those of the textile item should be used when constructing the UHF/SHF antenna,

- the components of the tag which interact directly should have similar coefficients of thermal expansion.

[0009] The UHF antennas of the RFID tags currently existing on the market are made of electrically insulated metallic wire, which is either sewn or embroidered onto the fabric. They are meandering in shape (EP 2405054 A1) or take the shape of overlapping loops (WO 2013128299 A1). They all have the shortcomings and limitations described in paragraph [0006].

[0010] This invention eliminates the above-mentioned disadvantages associated with prior art solutions by providing a tag that has the characteristics mentioned in independent claim 1.

[0011] Other preferred characteristics of this invention are presented in the attached dependent claims.

[0012] This patent proposes, for the UHF/SHF antenna, electroconductive textile threads made of stainless steel metallic wires, which are resistant to the action of oxidizing agents. By using an electroconductive textile thread to make the UHF/SHF antenna, given its flexibility, the electroconductive textile thread allows for geometries that are impossible to achieve with an electrically insulated metallic wire. Achieving very short radius curves without creating mechanical stresses that affect the structure of the tag becomes possible. Also, the UHF-SHF antenna made of electroconductive conductive textile thread is very inconspicuous, it is not intrusive, and integrates naturally into the fabric of the product it identifies.

[0013] Other characteristics and advantages of this invention will become more apparent from the following detailed description, given in connection with the accompanying figures, where:

- Figure 1 shows a schematic view of the double loop RFID tag, according to a first embodiment of the invention;

- Figure 2 shows a detailed view of the double loop, according to the first embodiment of the invention;

- Figure 3 shows a schematic view of the double loop RFID tag, according to a second embodiment of the invention;

[0014] The UHF/SHF antenna 2 has a specific, innovative geometry, characterized by the fact that it has in the central area a double loop 5 through which it provides an effective inductive coupling with the encapsulated RFID transponder 3, which results in an RFID tag with high electromagnetic performance.

[0015] Also, the double loop 5 allows for the execution of a small-sized RFID tag, which is non-intrusive and easy to integrate even in small textile items.

[0016] The UHF/SHF antenna of the RFID passive tag can be executed in two embodiments shown in Figure 2 and Figure 3. In the first embodiment, Figure 2, the electroconductive textile thread is electrically insulated and allows the thread to overlap at certain points (A, B, C, D) without electrical contact. For the second embodiment, Figure 3, the geometry of the UHF-SHF antenna also allows for the use of an uninsulated electroconductive textile thread. Both embodiments are achieved through embroidery.

[0017] In the first constructive embodiment, Figure 2, the double loop 5 of the UHF antenna 2 through which the inductive coupling with the encapsulated RFID transponder 3 is achieved allows for the execution of an effective UHF antenna in terms of power transfer and ensuring information integrity, with a substantially reduced construction size. There is no electrical contact at points A, B, C, and D.

[0018] In the second constructive embodiment of the UHF/SHF antenna, Figure 3, the embroidery is designed in such a way so as to allow the electroconductive textile thread to be continuously embroidered, without crossing over. After the embroidery phase, by bending on the dotted line and overlapping the two P and Q loops, a double loop (5) is formed. The P loop has a smaller diameter than the Q loop. We can see that, after bending and overlapping, the currents in the two loops have the same direction, contributing together to achieving an effective inductive coupling. Before bending the two P and Q loops, the encapsulated transponder 3 will be attached with adhesive onto the P loop. After bending and overlapping, the encapsulated transponder 3 will be attached between the two P and Q loops.

[0019] This patent complements the patent no. a 2016 00791, which proposed an RFID transponder designed to operate in harsh environments. The RFID transponder was described as designed to be used both independently, in the case of RFID applications for which the reading distance spans centimeters, and with a UHF-SHF antenna, in the case of RFID applications for which the reading distance spans meters.

[0020] The design of this tag, by incorporating in its structure the encapsulated transponder 3, subject to patent a 2016 00791, overcomes the issues created by the difference in size between the very small integrated circuits and the antennas to which they are galvanically connected, which requires the use of expensive connection technologies (wire bonding) or of technologies that are unsuitable for the harsh environment of industrial laundries (gluing with conductive adhesives).

[0021] The design of the tag seeks to achieve a balance between the size of the objects that it identifies and the size of the tag itself. It does not fall into the trap of excessive miniaturization when it is not required.

[0022] A maximal design is proposed - the maximum achievable using currently available components.

- a transponder with a minimum number of galvanic contacts, two, equal to the number of active pins of the integrated circuit, robust galvanic contacts, using an integrated circuit placed in the SOT323 housing, which is welded, using cost-effective and mature SMT technology, to the terminals of the near field antenna, encapsulated and protected against the harsh environment of industrial laundries,

- inductive coupling between the encapsulated transponder 3 and the UHF-SHF antenna 2,

- homogeneity of the components of the UHF-SHF antenna 2- fabric substrate assembly, both made of fabric,

- a substantially reduced tag length, by using the double loop of the UHF antenna.

- a tag that is ideally suited to the textile field, both due to the materials used (textile thread on fabric support) and the execution methods (embroidery of electroconductive textile thread onto the fabric support).

References

Quoted patent	Date of registration	Date of publication	Applicant	Title
EP 2405054 A1	07/07/2010	01/11/2012	Datamars SA (CH)	Textile item Identification tag
DE 102007026720 A1	06/06/2007	12/11/2008	Bielomatik	Chip module for an RFID system
US 20090079574 A1	09/19/2008	03/26/2009	Noriyuki	Rfid tag
WO 2013128299 A1	03/02/2012	09/06/2013	Usta	Enhanced antenna structure for RFID tags

AMENDED CLAIMS

1. RFID tag (1) intended for use in harsh environments, consisting of a UHF-SHF antenna (2) made of an electroconductive, electrically insulated textile thread, embroidered onto a fabric support, an RFID transponder (3), and a fabric substrate (4) on which the RFID transponder (3) and the UHF-SHF antenna (2) are placed, the entire assembly being sealed by hot gluing a second fabric substrate, in which the UHF-SHF antenna (2) is placed in the central area formed by a double loop (5) that is inductively coupled to the encapsulated RFID transponder (3)

2. RFID tag (1), per claim 1, characterized by the fact that the UHF-SHF antenna (2) is made of an electroconductive, electrically insulated textile thread, embroidered continuously, from one side to the other, which has a single loop at the ends and a double loop (5) in the center, consisting of a first loop with a smaller diameter, followed by a second concentric loop with a larger diameter.

3. RFID tag (1), per claim 1, characterized by the fact that the UHF-SHF antenna (2) does not have electrical contacts neither at the crossing points C and D when forming the loops located at the ends, nor at the crossing points A and B of the central double loop (5).

4. RFID tag (1), per claim 1, characterized by the fact that the UHF-SHF antenna (2) is executed by the continuous embroidery of the electroconductive textile thread in the shape of two open loops located on an upper plane in relation to the longitudinal direction and two open loops located on a lower plane in relation to the same longitudinal axis.

5. RFID tag per claim 4, characterized by the fact that, in the central area, the (P) loop located on the upper plane has a smaller diameter than the (Q) loop located on the lower plane, the transponder (3) being attached and centered on the upper plane loop, and the (Q) loop located on the lower plane overlaps the (P) loop on the upper plane by bending on the longitudinal axis, including the transponder (3) between the two planes, this overlap creating the double loop (5).

DRAWINGS

Figure 1

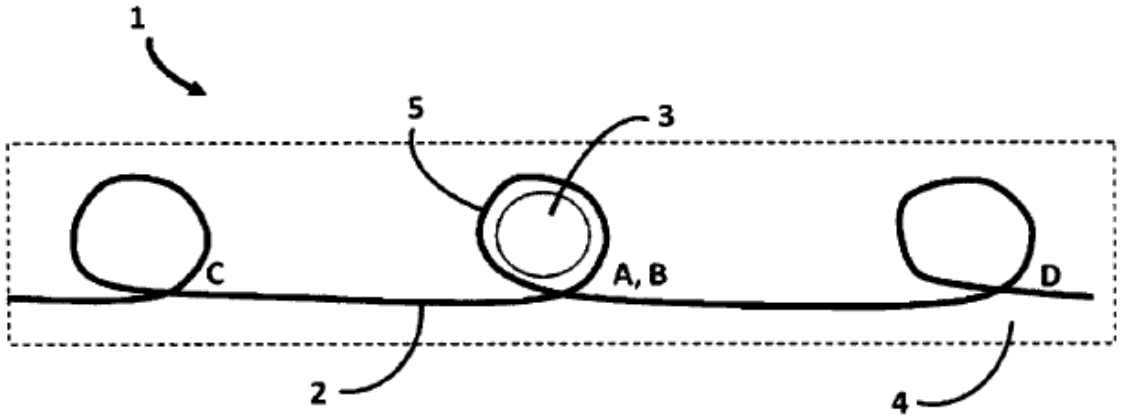


Figure 2

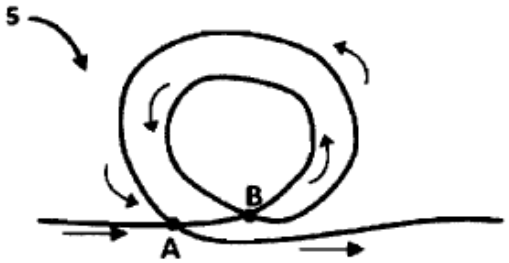


Figure 3

