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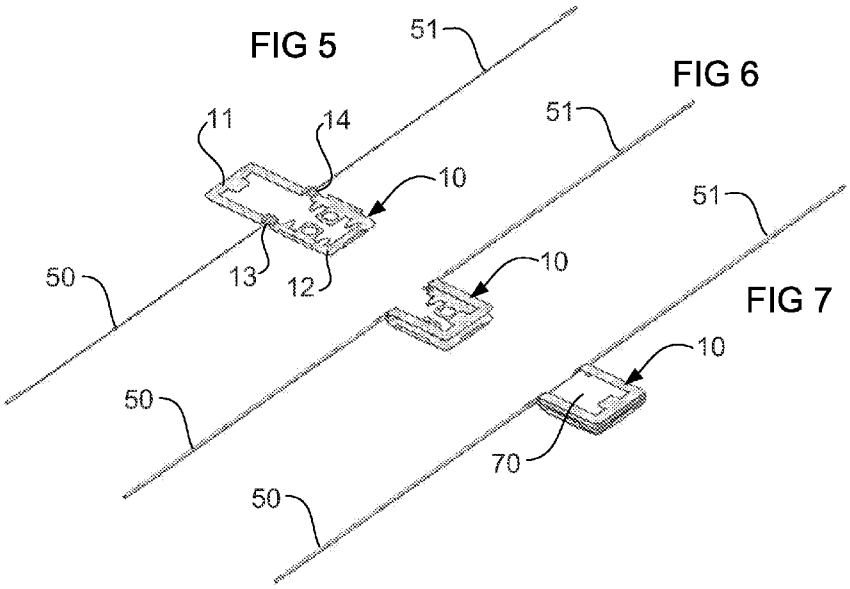
(54) Title: RFID TAG ASSEMBLY AND LABEL PROCESS



(57) Abstract: A tag assembly is disclosed for attaching an RFID tag including a primary antenna to a flexible surface such as fabric, textile or an item of clothing. The tag assembly has a receptacle including a frame (10) for securely holding the RFID tag (70), a secondary antenna, and attachment means for attaching the frame to the surface, wherein the frame forms part of the secondary antenna. A method of attaching an RFID tag to a flexible surface is also disclosed.

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RFID TAG ASSEMBLY AND LABEL PROCESS

TECHNICAL FIELD

The present invention relates to a tag assembly for attaching an RFID tag to a surface including a flexible surface such as textile or fabric and a process for producing an RFID label.

CROSS REFERENCE TO RELATED APPLICATION

The present invention is related to the following international patent application assigned to the present applicant the disclosure of which is incorporated herein by cross reference: PCT/AU2010/000373 – RFID TAG ASSEMBLY AND METHOD.

BACKGROUND OF THE INVENTION

Use of a generic RFID tag on a flexible surface such as textile or fabric typically involves stitching or bonding the tag directly to the fabric or enclosing it within a patch to provide an enclosure for the tag. However this often leads to cumbersome and inflexible solutions particularly with a clothing garment that may be uncomfortable to wear.

In one prior art solution, a conductive thread is used to provide a secondary antenna and a plastics encapsulated RFID tag in the form of a traditional clothing button is stitched to the fabric in order to couple to the secondary antenna to form a larger overall tag system. While this solution is flexible and comfortable the thread link holding the button to the fabric loosens over time with repeated washing cycles and the button can rock about or tilt, deteriorating electromagnetic coupling between a primary antenna on the RFID tag and the secondary antenna associated the fabric.

An object of the present invention is to at least alleviate the disadvantages of the prior art.

SUMMARY OF THE INVENTION

The present invention may provide a two part tag solution, namely an RFID tag such as AK module or QFP package including an associated or primary antenna and means for attaching the tag to a surface such as fabric or cardboard. In some embodiments the primary antenna may couple to a secondary antenna provided on or with the surface. This solution may be particularly useful since use of ultra high frequency (UHF) as a carrier frequency for RFID tags has become more widespread following introduction of international UHF RFID standards. Although RFID protocols have converged, allowed regional UHF carrier frequencies have not. A separate secondary antenna may be useful for longer range operation because it may allow itself and thus the overall tag assembly, to be optimised for an operating region, using a common and economically manufacturable generic tag such as an AK module/ QFP package which may account for most of the total cost.

The present invention may address problems of the prior art by providing a tag assembly including a receptacle or casing for receiving the RFID tag to replace the unstable button. The receptacle or casing may hold the RFID tag firmly in place to maintain a relatively consistent electromagnetic coupling between the primary antenna associated with the RFID tag and a secondary antenna associated with a flexible surface such as textile or fabric. The coupling may be substantially maintained throughout many washing cycles of service life of a fabric item.

According to one aspect of the present invention there is provided a tag assembly for attaching an RFID tag including a primary antenna to a surface, said assembly having a receptacle including a frame for securely holding the RFID tag, a secondary antenna, and attachment means for attaching the frame to said surface wherein said frame forms part of said secondary antenna.

The secondary antenna may include a dipole antenna. The surface may be flexible such as fabric or textile or it may be relatively rigid such as cardboard. The surface may include an item of clothing.

The RFID tag may include a separately formed adaptive kernel (AK) module (UHF tag) manufactured by Tagsys SAS. The AK module may be conveniently encapsulated via plastics molded packaging in any suitable manner and by any suitable means. In preferred embodiments the packaging for the AK module may include a quad flat package (QFP), a thin quad flat package (TQFP) or a low profile QFP package (LQFP).

The frame may be formed with a plurality of like frames by die stamping from a continuous roll of a conductive material. The conductive material preferably includes a relatively rigid and resilient material such as stainless steel.

The attachment means may include a plurality of legs or barbs connected to the frame. The free end of each leg or barb may include a sharpened lead to penetrate a surface such as textile or fabric and/or an eyelet or eyelets for receiving stitches. The tag assembly may include a backing plate for receiving the legs or barbs. The backing plate may include apertures to accommodate the legs or barbs.

The attachment means may be adapted to attach the frame to the surface such that the primary antenna substantially maintains electromagnetic coupling with the secondary antenna when the surface flexes in use or is subject to physical manipulation such as may take place during repeated washing cycles. The secondary antenna may include a pair of conductors attached to the frame.

According to a further aspect of the present invention there is provided a method of attaching an RFID tag including a primary antenna to a surface, said method including forming a tag assembly having a receptacle including a frame for securely holding the RFID tag, a secondary antenna, and attachment means for attaching the frame to said surface, wherein said frame forms part of said secondary antenna. The secondary antenna may include a dipole antenna. The surface may be flexible such as fabric or it may be relatively rigid such as cardboard.

The receptacle may include a frame for securely holding the RFID tag (AK module or QFP package) and attachment means for attaching the frame to a surface such as textile or fabric. The frame may include resiliently biased upper and lower frame

portions. The upper and lower frame portions may be biased to hold the RFID tag therebetween. In one form each upper and lower frame portion may be substantially in the shape of a U. The upper and lower frame portions may be resiliently joined at the legs of each U.

In some embodiments the RFID tag may be applied to the surface in the vicinity of a structure associated with the surface which structure may function as a secondary antenna. The secondary antenna may be formed by stitching a suitable antenna pattern using conductive thread around the receptacle or casing such that the secondary antenna is flexible and relatively comfortable for a garment wearer.

The tag assembly may be adapted to be attached to a flexible material such that an associated or primary antenna substantially maintains electromagnetic coupling with the secondary antenna when the surface flexes in use or is subject to repeated physical manipulation such as may take place during washing cycles. When attaching the frame to the surface the primary antenna associated with the RFID tag held in the frame is aligned with the secondary antenna associated with the surface.

In some embodiments the secondary antenna may be attached to or formed with the receptacle or casing. The secondary antenna may include a dipole. The secondary antenna may include a pair or conductors attached to the frame. Each conductor may be substantially straight and/or preformed with a shape such as a helical shape. In one form each conductor may be formed with or attached to a leg of the U shaped frame portions such that the receptacle/frame forms part of the secondary antenna.

In an alternative method an RFID label may be provided having associated with it a secondary antenna structure for attachment to a flexible surface such as textile or fabric. The present invention may include a process for producing an RFID label. The label may be flexible. The process may include forming a label substrate and providing a secondary antenna structure in association with the substrate. The process may include fusing at least a portion of the substrate to locate an RFID tag such as an AK module or QFP package relative to the label and/or said secondary antenna structure.

According to a further aspect of the present invention there is provided a process for producing an RFID label including an RFID tag such as an AK module or QFP package, for attaching to a flexible surface such as textile or fabric, said process including forming a label substrate, providing a secondary antenna structure in association with the label substrate, attaching said RFID tag to the label substrate, folding at least a portion of the label substrate over the RFID tag and fusing the label substrate to locate an RFID tag relative to the label and/or said secondary antenna structure. The secondary antenna structure may be provided by weaving, knitting and/or stitching conductive wire in association with the label substrate.

In an alternative method the label substrate may be provided in the form of two or more separate layers or ribbons. The layers or ribbons may be joined together in a continuous reel-to-reel process by means of an adhesive, ultrasonic welding or the like.

The process may include fusing the substrate at least partly around the RFID tag to create a pocket between the folded or joined layers of label substrate. The pocket may include four spot welds around the RFID tag.

According to a further aspect of the present invention there is provided a process for producing an RFID label including an RFID tag such as an AK module or QFP package, for attaching to a flexible surface such as textile or fabric, said process including providing a label substrate including two separate layers, providing a secondary antenna structure in association with at least one layer of the label substrate, attaching said RFID tag to one layer of the label substrate, and fusing the layers of the label substrate to locate an RFID tag relative to the label and/or said secondary antenna structure. Each layer may comprise a ribbon of fabric or textile.

According to a further aspect of the present invention there is provided a process for producing an RFID label including an RFID tag, such as an AK module or QFP package, for attaching to a flexible surface such as textile or fabric, said process including forming a label substrate, providing a secondary antenna structure in association with the label substrate, forming a cavity in association with the label

substrate for receiving said RFID tag, locating said RFID tag in said cavity and sealing said cavity and RFID tag with a cover.

The cover may include clear or opaque film or ribbon such as polyester. The secondary antenna structure may be provided by weaving, knitting and/or stitching conductive wire in association with the label substrate. The cavity may be formed by locally melting the label substrate. The local melting may be produced by means of a sonotrode or die head. The sonotrode or die head may be vibrated ultrasonically. The cavity may comprise a rectangular, square or round tub.

According to a further aspect of the present invention there is provided a process for attaching an RFID tag such as an AK module or QFP package to a flexible surface such as textile or fabric, said process comprising: providing a heat fusible label including at least a) a first layer having a first adhesive layer; b) a substrate layer including a secondary antenna structure; and c) a heat activated second adhesive layer; positioning said RFID tag on said flexible surface; positioning said heat fusible label on said flexible surface over said RFID tag; and applying heat and pressure to said heat fusible label to melt said heat activated layer and to fuse said label to said flexible surface.

The heat fusible label may further include a printable and waterproof upper polycarbonate sheet or layer applied over the first layer. The first layer may include a woven polymeric or synthetic material. The secondary antenna structure may be provided by weaving, knitting and/or stitching conductive wire in association with the substrate layer. The substrate layer may include a polymeric layer (PEN) or a knitted or woven layer. The RFID tag may include an AK module or QFP package.

According to a further aspect of the present invention there is provided a heat fusible RFID label assembly suitable for attachment to a flexible surface such as textile or fabric, said label comprising: a first layer including a first adhesive layer; a substrate layer including a secondary antenna structure; a heat activated second adhesive layer; and an RFID tag.

BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1A and 1B show a basic receptacle or casing for an RFID tag;

Fig. 2 shows an RFID tag being received in the receptacle or casing of Fig 1;

Fig. 3 shows an RFID tag being retained in the receptacle or casing;

Fig. 4 shows a backing plate associated with the receptacle or casing of Figs.1 to 3;

Figs. 5 and 6 show a dipole antenna associated with the receptacle or casing of Figs.1 to 3;

Fig. 7 shows an RFID tag associated with the receptacle or casing and antenna of Fig.6;

Fig. 8 shows an alternative dipole antenna associated with the receptacle or casing of Figs.1 to 4;

Fig. 9 shows an RFID tag being received in the receptacle or casing of Fig.8;

Fig. 10 shows an RFID tag associated with the receptacle or casing and antenna of Fig 8;

Figs. 11 to 14 show a process for producing an RFID label;

Fig. 15 shows a thermosonic tool for performing welding associated with an RFID tag;

Figs. 16A, 16B, 16C show examples of tag labels that have been cut to accommodate short, medium and long antenna tracks respectively;

Figs. 17 to 22 show a further process for producing an RFID label;

Figs. 23 and 24 show a further process for producing an RFID label;

Fig. 25 shows details of a tape substrate being woven; and

Fig. 26 shows details of a conductive yarn.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Figs. 1A and 1B, a basic receptacle or casing for an RFID tag (such as an AK module or QFP package) comprises a frame 10 including upper frame portion 11 and lower frame portion 12. Each frame portion 11, 12 is substantially in the shape of a U. Frame portions 11, 12 are joined at the legs of each U via junctions 13, 14. Frame portions 11, 12 may be formed by die stamping from a roll or sheet of stainless steel. The junctions 13, 14 are integrally formed during the die stamping operation. Junctions 13, 14 are adapted to receive a dipole antenna as described below.

Frame 10 includes turned side portions 15, 16 formed by turning edges of lower frame portion 12. Side portions 15, 16 are adapted to at least laterally restrain an RFID tag received in the receptacle or casing. Frame 10 includes integrally formed legs 17-20 for attaching the frame to a flexible surface such as fabric. Each leg 17 to 20 is sharpened at its free end for penetrating the surface. Frame 10 includes eyelets 21, 22 suitable for attaching the receptacle or casing to a flexible surface via stitching or the like.

The frame 10 may be die stamped substantially in a flat configuration as shown in Fig.5 with integral frame portions 11, 12, junctions 13, 14, side portions 15, 16, legs 17 to 20 and eyelets 21, 22. Frame portions 11, 12 may subsequently be turned towards each other to form the clip configuration shown in Figs 1 to 3 and 6 to 10.

Fig. 2 shows an RFID tag 23 being received in frame 10. RFID tag 23 may include a separately formed adaptive kernel (AK) module (UHF tag) manufactured by Tagsys SAS. The AK module is conveniently provided in the form of a quad flat pack (QFP) kernel. Frame portion 11 may be forced open from the rest position shown in Fig. 1 relative to frame portion 12 against a resilient restoring force provided via junctions

13, 14. Following insertion of tag 23, the restoring forces returns frame portion 11 to its rest position to securely hold tag 23 between frame portions 11, 12, as shown in Fig.3.

Fig. 4 shows a backing plate 40 including apertures for receiving legs 17 to 20 associated with the receptacle or casing of Figs.1 to 3. Backing plate 40 may be formed from any suitable material such as plastics. Backing plate 40 may be positioned on the underside of a flexible surface such as fabric or textile. Following attachment of the receptacle or casing to a surface, legs 17 to 20 may be passed through the apertures of backing plate 40 and turned approximately 90 degrees as shown in Fig.4 to secure the receptacle or casing to the flexible surface.

Fig. 5 shows a pair of substantially straight conductors 50, 51 electrically welded to frame 10 to form a dipole antenna. Conductors 50, 51 may be adapted to make a long dipole antenna if required. Conductors 50, 51 are welded to frame 10 at junctions 13, 14 respectively. Welding of conductors 50, 51 may be performed after stamping of frame 10. Following welding, frame portions 11, 12 are subsequently turned towards each other to form a tag assembly as shown in Fig 6. Fig. 7 shows an RFID tag 70 in association with the tag assembly of Fig.6 suitable for attachment to a flexible surface or the like.

Fig. 8 shows a pair of preformed helical conductors 80, 81 electrically welded to frame 10 to form a dipole antenna. Conductors 80, 81 are welded to frame 10 at junctions 13, 14 respectively. The welding may be performed after stamping of frame 10. Following welding frame portions 11, 12 may subsequently be turned towards each other to form a tag assembly as shown in Fig 8. Fig. 9 shows an RFID tag 90 being inserted into the tag assembly of Fig.8. Helical conductors 80, 81 may be adjusted in length to suit tag 90 by stretching. Fig. 10 shows RFID tag 90 in association with the tag assembly of Fig.8 suitable for attachment to a flexible surface or the like.

Fig.11 shows tape substrate 110 being woven or knitted on a loom (not shown). Tape substrate 110 comprises a plurality of yarns including synthetic yarns such as polyester nylon, polyamide and carbon and conductive yarns such as stainless steel suitable for industrial washing liquids. The conductive yarns may be woven, knitted

and/or stitched in association with tape substrate 110 to form an antenna pattern 111. The antenna pattern 111 may form plural separate antennas after tape substrate 110 is singulated into individual labels. Each label may be attached to an article such as an item of clothing. The tape substrate may include a printed logo. The logo may be laser printed onto the singulated label during assembly or it may be printed onto a reel of tape substrate before assembly.

Fig. 12 shows a production line process for attaching RFID tags 120 to tape substrate 110 such as by means of a multi-step online machine. The process includes supplying individual tags 120 via a bowl feeder or the like and testing and programming each tag 120 at a testing station 121 prior to attaching the tags 120 to tape substrate 110. Each tag 120 is attached to tape substrate 110 via a layer of adhesive 122 applied to tape substrate 110. This is followed by accurate positioning of each tag 120 relative to antenna pattern 111 to ensure good electromagnetic coupling to a primary antenna associated with tag 120.

Fig.13 shows a fusing station 130 which follows a tape folding station (not shown) for folding tape substrate 110 in half over tags 120. Fusing station 130 includes fusing tool 131 including four sonotrodes (raised portions). The sonotrodes cooperate with an anvil (not shown) to make four spot welds around RFID tag 120. The four spot welds create a pocket between the folded layers of tape substrate 110 for locating RFID tag 120 in the pocket. Fig.13 includes an ultrasonic welding station 132 for continuously sealing the open seam comprising folded layers of tape substrate 110. This is followed by testing of each label with tag 120 at testing station 133. Labels that do not pass the test may be marked with a black dot or punched with a hole for identification. Fig 13 includes a winding station 134 for winding the tested labels onto roll 135 suitable for subsequent automatic deposition of labels.

Fig.14A shows a modification of the process shown in Fig.13 including singulation station 140 for cutting tape substrate 110 into individual labels 141. The modified process in Fig 14 is suitable for manual deposition of individual labels 141.

An alternative method is described below with reference to Figs. 14B and 14C. In the alternative method the label substrate 110 may be produced from a plurality of

separate layers 142-146. The layers 142-146 may be supplied in the form of tapes or ribbons from respective input reels 142a-146a. Layer 142 includes a printable protective polymeric overlay. Layer 143 includes an adhesive. Layer 144 includes a woven substrate (fabric or textile) 144b with conductive thread woven therein to provide a secondary antenna inlay 144c. Alternatively layer 144 may include a polymeric or synthetic substrate (PEN) 144d with an etched copper or aluminium track to provide the secondary antenna inlay 144e. Layer 145 includes a silicon liner 145b with preformed islands of heat activated adhesive 145c.

Layer 146 includes a silicon impregnated paper carrier or the like. Layers 142-146 may be joined together by means of pressing rollers 147 to cold laminate the separate layers into a composite label assembly 147a. The composite assembly may be pre-cut into separate labels 148 at a cutting station 149 via a cutting tool 149a. The finished product is wound onto output reel 154.

Fig. 15 shows a welding tool 150 including a peripheral sonotrode 151 for fusing together upper and lower tapes or ribbons such as the folded layers of tape substrate 110 shown in Figs. 13 and 14a. Welding tool 150 may be used in place of fusing tool 131 described above in connection with Fig. 13. Welding tool 150 also includes four spot sonotrodes 152 adapted to make four spot welds around RFID tag 120 similar to fusing tool 131 to create a pocket between the upper and lower tapes or ribbons for locating RFID tag 120 in the pocket. Welding tool 150 also includes partition sonotrodes 153 adapted to partition a label to accommodate short (42mm), medium (59mm) or long (72mm) antenna tracks respectively. Examples of label 141 that has been cut to accommodate short, medium and long antenna tracks are shown in Figs. 16A, 16B and 16C respectively.

Figs. 17 to 22 show a modification to the production line process in Figs. 12 to 14. Fig 17 includes cavity forming station 170 for forming a tub cavity in tape substrate 110. The tub cavity may be adapted to receive an RFID tag. The tub cavity may be approximately 1-2mm deep and dimensioned to receive the RFID tag. Cavity forming station 170 includes sonotrode or die head 171, clamp 172 and matrix 173 (anvil). Die head 171 includes base 174 adapted to form a rectangular cavity in tape substrate 110. Matrix 173 includes cavity 175 in a shape of a rectangular tub for

receiving base 174 of die head 171. Clamp 172 is adapted to hold tape substrate 110 against matrix 173 during a cavity forming operation. During the cavity forming operation, base 174 of die head 171 is vibrated ultrasonically (e.g. at 40-60 KHz) and pressed against tape substrate 110, causing tape substrate 110 to heat and deform locally against cavity 175 in matrix 173. Ultrasonic vibration may be provided by means of a piezoelectric transducer or the like. In some versions die head 171 and matrix 173 may be adapted to form a round instead of a rectangular cavity.

Fig. 18 shows a view of tape substrate 110 including cavity 180 formed with an antenna pattern 111 passing around cavity 180. Fig. 19 shows RFID tag 190 after testing positioned above cavity 180 in tape substrate 110 and before being dropped into cavity 180. Fig. 20 shows RFID tag 190 after it is dropped into cavity 180 in tape substrate 110. Fig 21 shows a polyester film cover 210 comprising clear or opaque ribbon positioned over tape substrate 110 and RFID tag 190 in cavity 180. Film cover 210 may be ultrasonically welded to tape substrate 110 via seams 220 as shown in Fig. 22.

An alternative tag assembly method that does not require a tape substrate or cavity is described below with reference to Figs 23 and 24. Fig. 23 shows a thermo patch assembly 230 comprising at least the following layers:

1. a top woven polymeric sheet or synthetic layer 231;
2. an adhesive layer 232 for a secondary antenna layer;
3. a secondary antenna layer 233; and
4. a heat activated adhesive layer 234 such as a polyurethane adhesive layer.

Secondary antenna layer 233 may be provided on a woven (textile or fabric) or plastics (PEN) substrate. An optional overlayer 235 such as polycarbonate sheet and a polyurethane primer layer 236 may be applied over top layer 231 to make the patch assembly 230 printable and/or waterproof. The thermo patch assembly 230 may be used to apply an RFID tag 240 to a garment or fabric as shown in Fig. 24.

In Fig. 24 an RFID tag 240 is sandwiched between a flexible surface 241 such as fabric, textile or a garment and an opaque and printable thermo patch 230. As

described above, thermo patch 230 includes a layer of heat activated adhesive 234 on its underside adapted to hold antenna layer 233. Antenna layer 233 comprises a polymeric substrate such as polyethylene napthalate (PEN) with an antenna pattern 242 applied thereto. Antenna pattern 242 comprises a conductor such as copper or aluminium. Heat activated adhesive 234 is interposed between layer 233 and surface 241 for heat sealing patch 230 to hold antenna layer 233 and RFID tag 240 in position against surface 241. Each tag 240 should be placed accurately relative to antenna pattern 242 to ensure good electromagnetic coupling to a primary antenna associated with tag 240.

The method of attaching thermo patch 230 to surface 241 may be performed manually using heat sealing equipment set at around 180-200°C to press and activate the adhesive. The patch assembly may then be resistant to washers and driers. The process may use a conventional etched aluminium or copper conductive antenna on a PEN substrate (the latter may withstand higher temperatures than PET) which is adhered to a thermo sealing patch. Printable patches 230 with secondary antenna already attached and covered with heat activated adhesive such as hot melt glue may be supplied to an operator ready for attachment to garment/fabric surface 241 or the like.

The operator may initially place RFID tag 240 (QFP/TQFP) on top of garment/fabric surface 241, and then cover it with a thermo patch 230 including secondary antenna layer 233 and pattern 242. Thermal sealing equipment may then be used to press and heat thermo patch 230 on top of garment/fabric surface 241 causing thermo patch 230 and RFID tag 240 to be attached to garment/fabric surface 241.

Fig. 25 shows a tape substrate such as tape substrate 110 in Fig. 11, being woven on a loom (not shown). Tape substrate 110 includes a plurality of warp yarns 250 stretched on a loom and weft yarns 251 being drawn through the warp yarns 250. Tape substrate 110 includes a conductive yarn 252 drawn through loops 253 in warp yarns 250 to create a secondary antenna pattern such as antenna pattern 111 in Fig. 11.

Fig. 26 shows an example of conductive yarn 252 including a bundle of stainless steel filaments or wires 260. Each stainless steel filament or wire in bundle 260 may be a few hundred μm in diameter. Each bundle 260 may include a few tens of stainless steel filaments or wires wrapped with synthetic threads or filaments 261 such as polyamide or polyester, to form a synthetic sheath 262. To maintain the stainless steel filaments bundled together, they are shown double wrapped clockwise and anti-clockwise with the synthetic threads or filaments 261. As well as keeping the stainless steel filaments bundled together the synthetic sheath 262 helps to reduce damage to synthetic yarns of tape substrate 110 due to cutting that may be caused by the edges of the stainless steel filaments as the latter is woven into tape substrate 110.

Finally, it is to be understood that various alterations, modifications and/or additions may be introduced into the constructions and arrangements of parts previously described without departing from the spirit or ambit of the invention.

CLAIMS

1. A tag assembly for attaching an RFID tag including a primary antenna to a surface, said assembly having a receptacle including a frame for securely holding the RFID tag, a secondary antenna, and attachment means for attaching the frame to said surface wherein said frame forms part of said secondary antenna.

2. A tag assembly according to claim 1 wherein said surface is flexible.

3. A tag assembly according to claim 1 or 2 wherein said secondary antenna includes a dipole antenna.

4. A tag assembly according to claim 1, 2 or 3 wherein said frame is formed with a plurality of like frames by die stamping from a roll of conductive material.

5. A tag assembly according to claim 4 wherein said conductive material includes stainless steel.

6. A tag assembly according to any one of the preceding claims wherein said attachment means includes a plurality of legs connected to said frame.

7. A tag assembly according to claim 6 wherein the free end of each leg includes a sharpened lead to penetrate said surface.

8. A tag assembly according to claim 6 or 7 including a backing plate for receiving the plurality of legs.

9. A tag assembly according to claim 8 wherein said backing plate includes apertures to accommodate said legs.

10. A tag assembly according to any one of the preceding claims wherein said assembly includes said RFID tag.

11. A tag assembly according to any one of the preceding claims wherein said surface includes fabric, textile or an item of clothing.

12. A tag assembly according to any one of the preceding claims wherein said attachment means is adapted to attach said frame to said surface such that said primary antenna substantially maintains electromagnetic coupling with said secondary antenna when said surface flexes in use or is subject to repeated physical manipulation such as may take place during washing cycles.

13. A tag assembly according to any one of the preceding claims wherein said secondary antenna includes a pair or conductors attached to said frame.

14. A method of attaching an RFID tag including a primary antenna to a surface, said method including forming a tag assembly having a receptacle including a frame for securely holding the RFID tag, a secondary antenna, and attachment means for attaching the frame to said surface, wherein said frame forms part of said secondary antenna.

15. A method according to claim 14 wherein said surface is flexible.

16. A method according to claim 14 or 15 wherein said secondary antenna includes a dipole antenna.

17. A method according to claim 13, 14 or 15 including forming said frame with a plurality of like frames by die stamping from a roll of conductive material.

18. A method according to any one of claim 17 wherein said conductive material includes stainless steel.

19. A method according to any one of claims 14 to 18 including forming the attachment means as a plurality of legs connected to said frame.

20. A method according to claim 19 including forming the free end of each leg with a sharpened lead to penetrate said material.

21. A method according to any one of claims 14 to 20 wherein said RFID tag is provided in association with said frame.

22. A process for producing an RFID label including an RFID tag such as an AK module or QFP package, for attaching to a flexible surface such as textile or fabric, said process including forming a label substrate, providing a secondary antenna structure in association with the label substrate, attaching said RFID tag to the label substrate, folding at least a portion of the label substrate over the RFID tag and fusing the label substrate to locate an RFID tag relative to the label and/or said secondary antenna structure.

23. A process for producing a RFID label according to claim 22 wherein said secondary antenna structure is provided by weaving, knitting and/or stitching conductive wire in association with said label substrate.

24. A process for producing a RFID label according to claim 22 or 23 including fusing said substrate at least partly around said RFID tag to create a pocket between the folded layers of label substrate.

25. A process for producing a RFID label according to claim 24 wherein said pocket includes four spot welds around said RFID tag.

26. A process for producing an RFID label including an RFID tag such as an AK module or QFP package, for attaching to a flexible surface such as textile or fabric, said process including providing a label substrate including two separate layers, providing a secondary antenna structure in association with at least one layer of the label substrate, attaching said RFID tag to one layer of the label substrate, and fusing the layers of the label substrate to locate an RFID tag relative to the label and/or said secondary antenna structure.

27. A process according to claim 26 wherein each layer comprises a ribbon of fabric or textile.

28. A process for producing a RFID label according to claim 26 or 27, wherein said secondary antenna structures is provided by weaving, knitting and/or stitching conductive wire in association with said label substrate.

29. A process for producing a RFID label according to claim 26, 27 or 28, including fusing said substrate at least partly around said RFID tag to create a pocket between the folded or layers of label substrate.

30. A process for producing a RFID label according to claim 29 wherein said pocket includes four spot welds around said RFID tag.

31. A process for producing an RFID label including an RFID tag, such as an AK module or QFP package, for attaching to a flexible surface such as textile or fabric, said process including forming a label substrate, providing a secondary antenna structure in association with the label substrate, forming a cavity in association with the label substrate for receiving said RFID tag, locating said RFID tag in said cavity and sealing said cavity and RFID tag with a cover.

32. A process for producing a RFID label according to claim 31 wherein said cover includes clear or opaque film or ribbon.

33. A process for producing a RFID label according to any one of claims 26 to 32 wherein said secondary antenna structure is provided by weaving, knitting and/or stitching conductive wire in association with said label substrate.

34. A process for producing a RFID label according to claim 31, 32 or 33 wherein said cavity is formed by locally melting said label substrate.

35. A process for producing a RFID label according to any one of claims 31 to 34 wherein said cavity is formed by means of a sonotrode or die head.

36. A process for producing a RFID label according to claim 35 wherein said sonotrode or die head is vibrated ultrasonically.

37. A process for producing a RFID label according to any one of claims 31 to 36 wherein said cavity comprises a rectangular, square or round tub.

38. A process for attaching an RFID tag such as an AK module or QFP package to a flexible surface such as textile or fabric, said process comprising:

providing a heat fusible label including at least a) a first layer having a first adhesive layer; b) a substrate layer including a secondary antenna structure; and c) a heat activated second adhesive layer;

positioning said RFID tag on said flexible surface;

positioning said heat fusible label on said flexible surface over said RFID tag; and

applying heat and pressure to said heat fusible label to melt said heat activated layer and to fuse said label to said flexible surface.

39. A process for attaching an RFID tag according to claim 38 wherein said heat fusible label further includes a printable and waterproof upper polycarbonate sheet or layer applied over said first layer.

40. A process for attaching an RFID tag according to claim 39 or 40 wherein said first layer includes a woven polymeric or synthetic material.

41. A process for attaching an RFID tag according to claim 39, 40 or 41, wherein said secondary antenna structure is provided by weaving, knitting and/or stitching conductive wire in association with said substrate layer.

42. A process for attaching an RFID tag according to any one of claims 38 to 41 wherein said substrate layer includes a polymeric layer (PEN) or a knitted or woven layer.

43. A process for attaching an RFID tag according to any one of claims 38-42 wherein said RFID tag includes an AK module or QFP package.

44. A heat fusible RFID label assembly suitable for attachment to a flexible surface such as textile or fabric, said label comprising:

a first layer including a first adhesive layer;

a substrate layer including a secondary antenna structure;

a heat activated second adhesive layer; and

an RFID tag.

45. A heat fusible RFID label assembly according to claim 44 further including a printable and waterproof upper polycarbonate sheet or layer applied over said first layer.

46. A heat fusible RFID label assembly according to claim 44 or 45 wherein said first layer includes a woven polymeric or synthetic material.

47. A heat fusible RFID label assembly according to claim 44, 45 or 46, wherein said secondary antenna structure is provided by weaving, knitting and/or stitching conductive wire in association with said substrate layer.

48. A heat fusible RFID label assembly according to any one of claims 44 to 47, wherein said substrate layer includes a polymeric layer (PEN) or a knitted or woven layer.

49. A heat fusible RFID label assembly according to any one of claims 44 to 48 wherein said RFID tag includes an AK module or QFP package.

50. A tag assembly or label substantially as herein described with reference to the accompanying drawings.

51. A method of producing a tag assembly or label substantially as herein described with reference to the accompanying drawings.

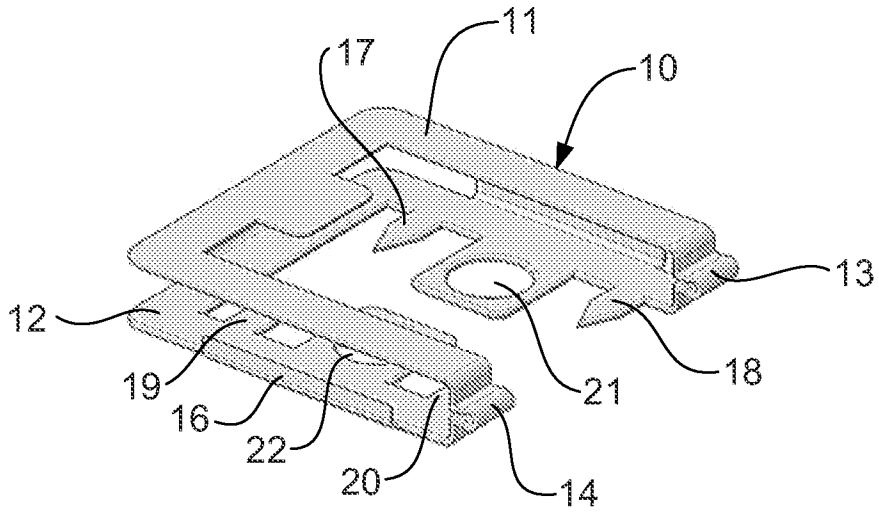

FIG 1A

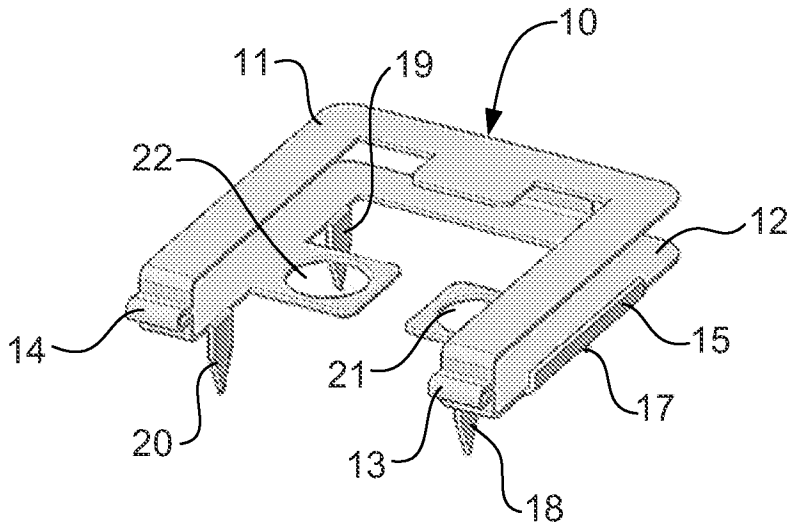

FIG 1B

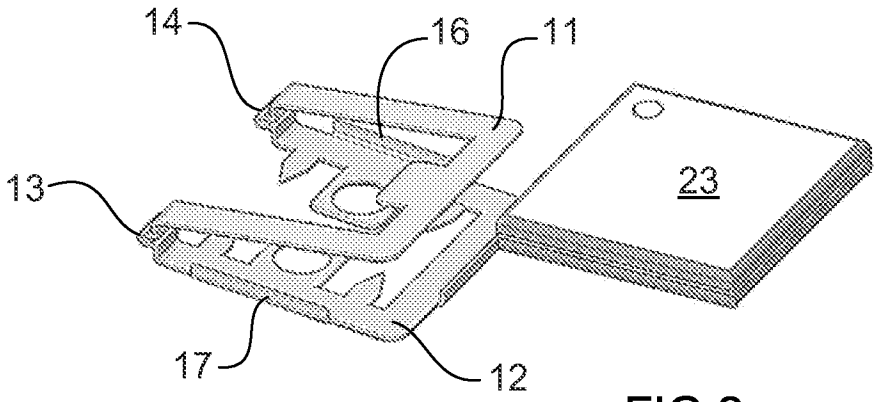

FIG 2

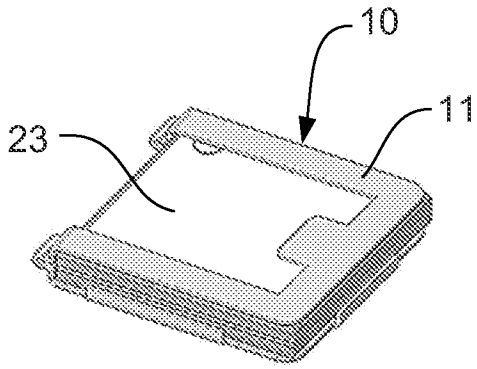

FIG 3

FIG 4

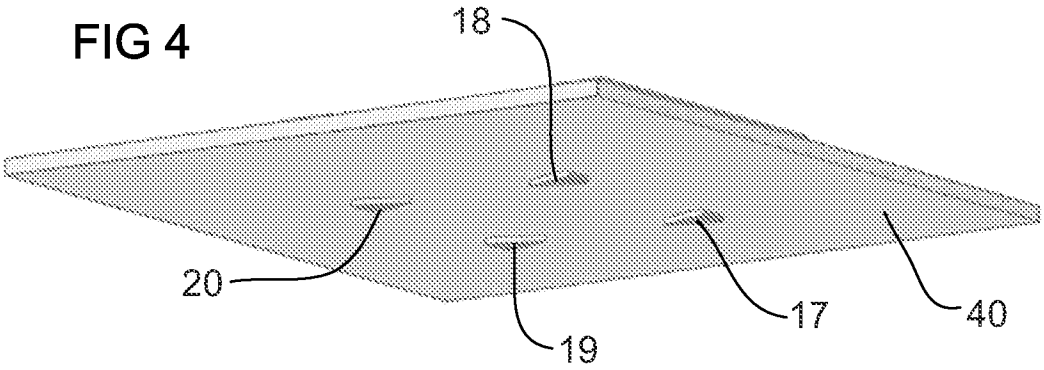

FIG 5

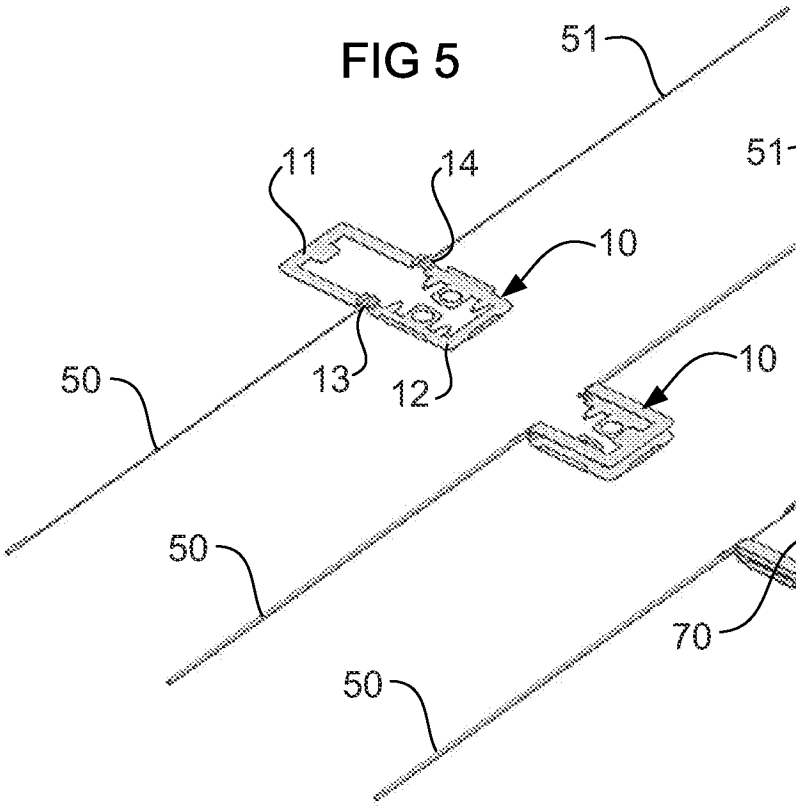

FIG 6

FIG 7

FIG 10

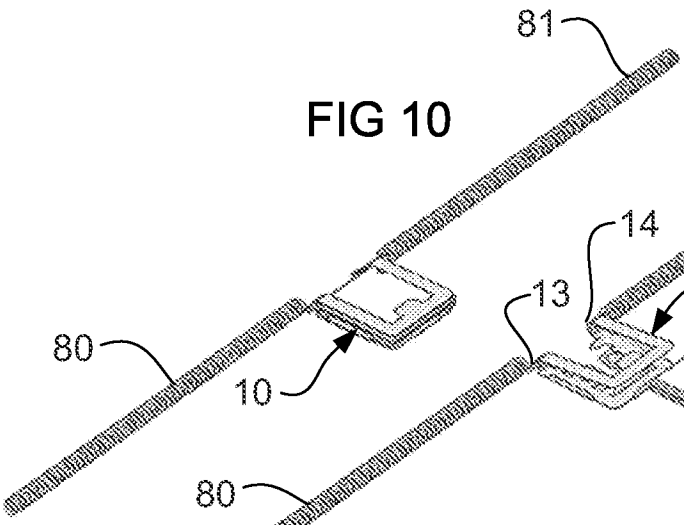

FIG 9

FIG 8

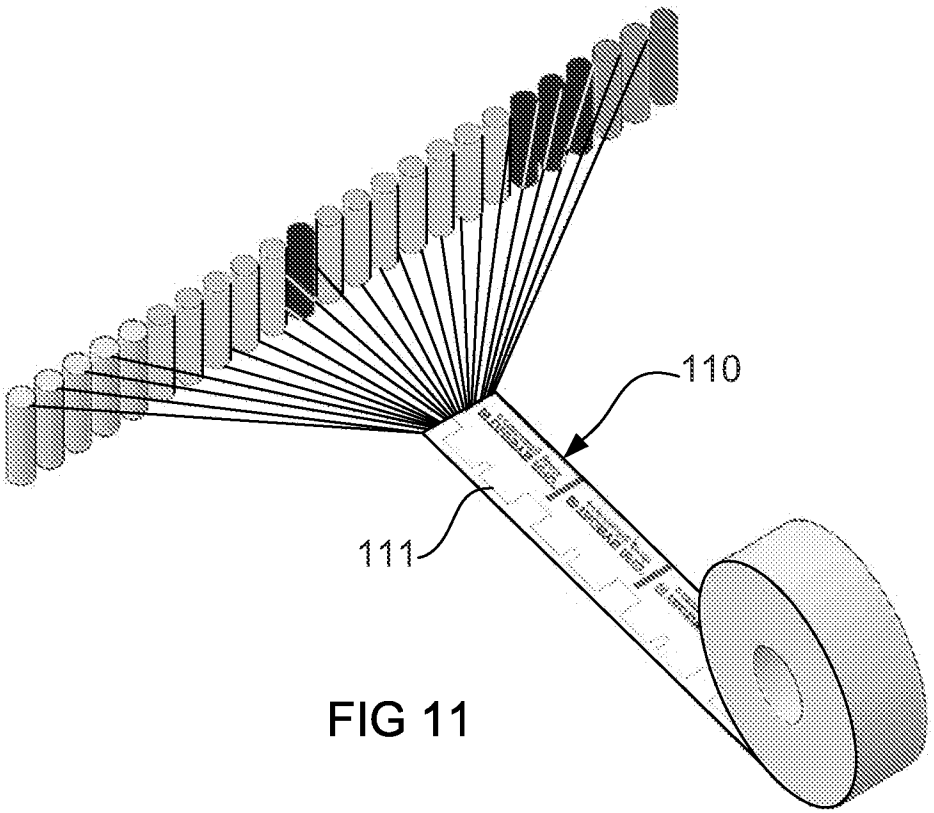

FIG 11

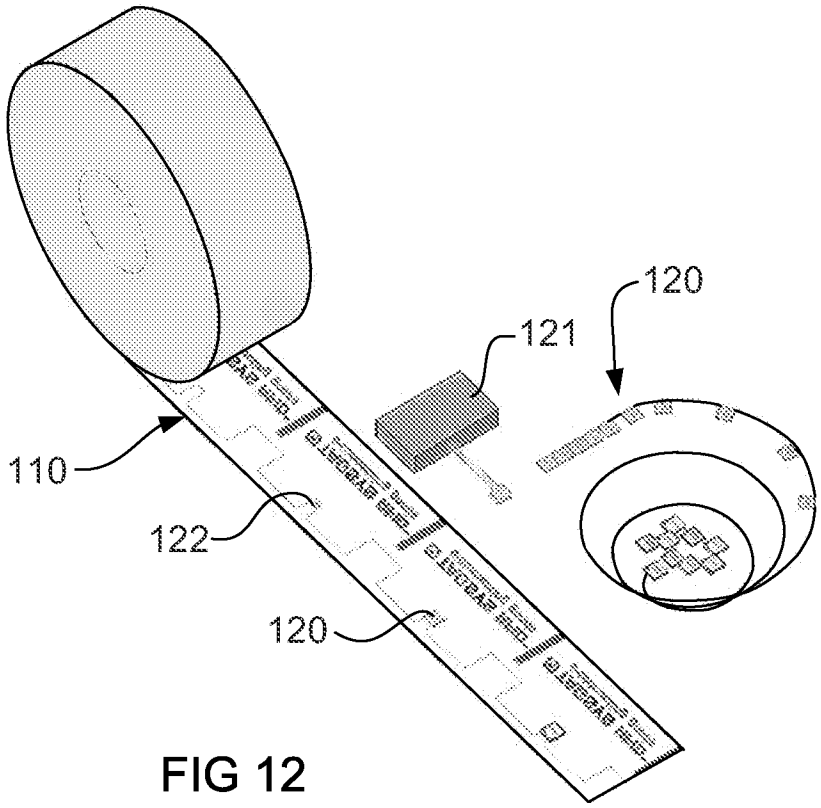

FIG 12

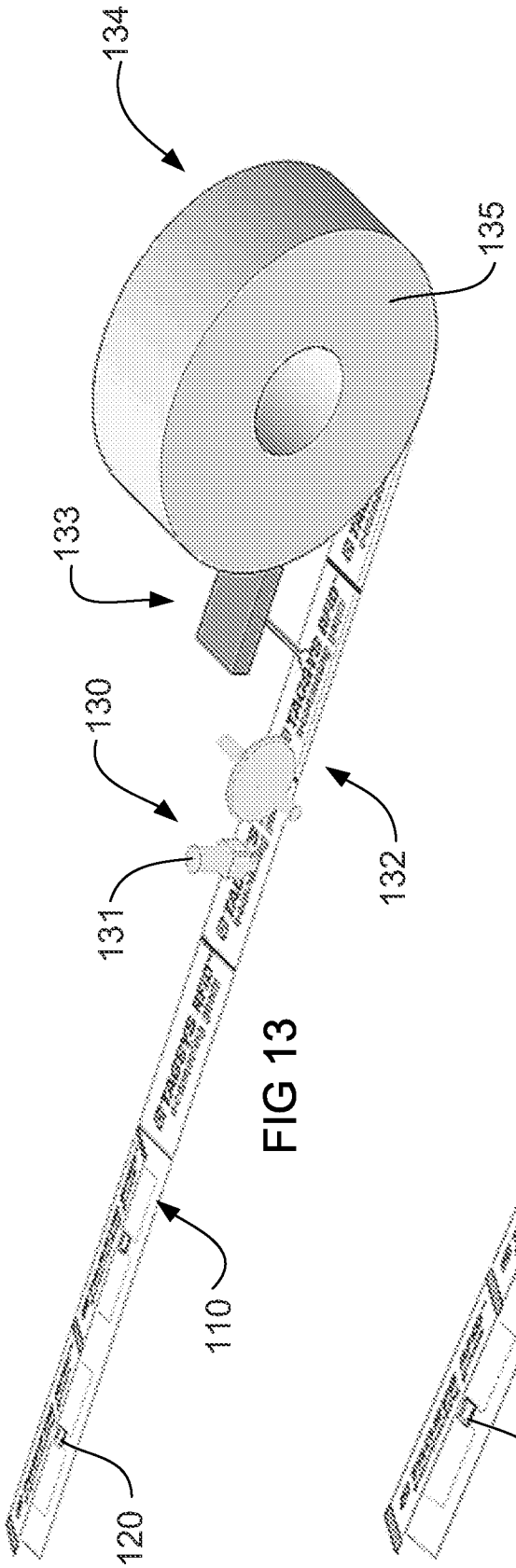

FIG 13

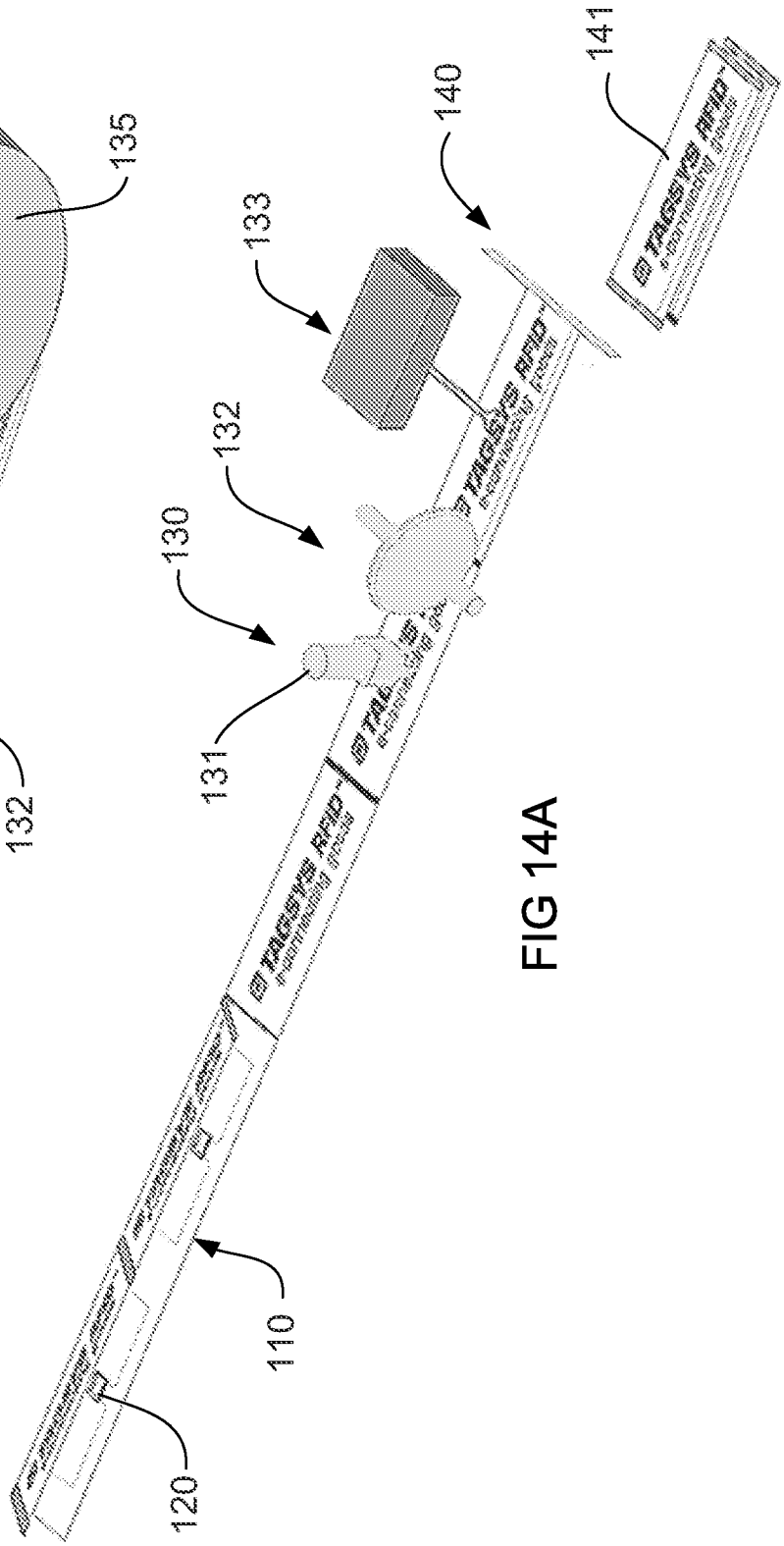

FIG 14A

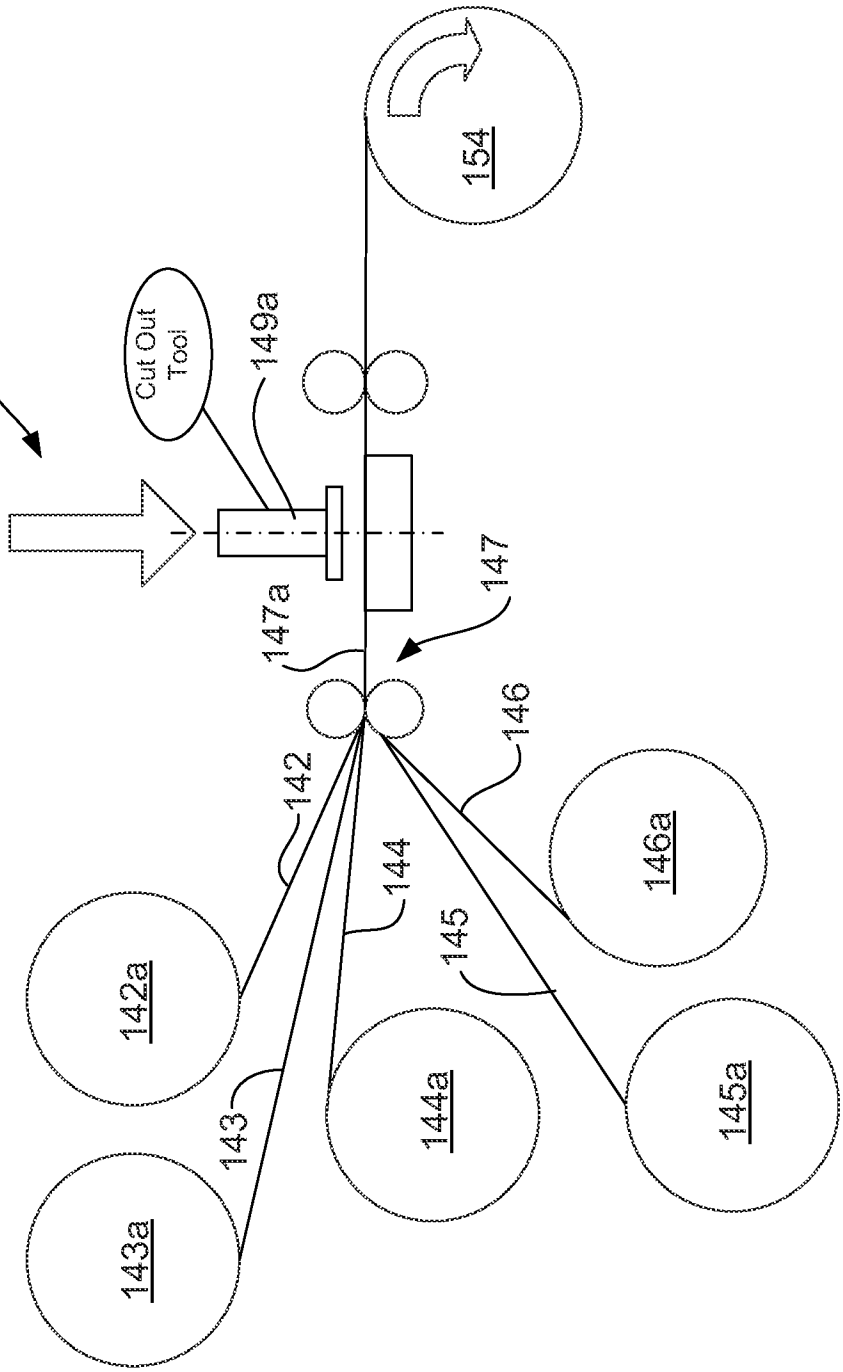
154
149
Cut Out Tool
149a
147
147a
146
142
144
145
146a
142a
144a
145a
143
143a

FIG 14B

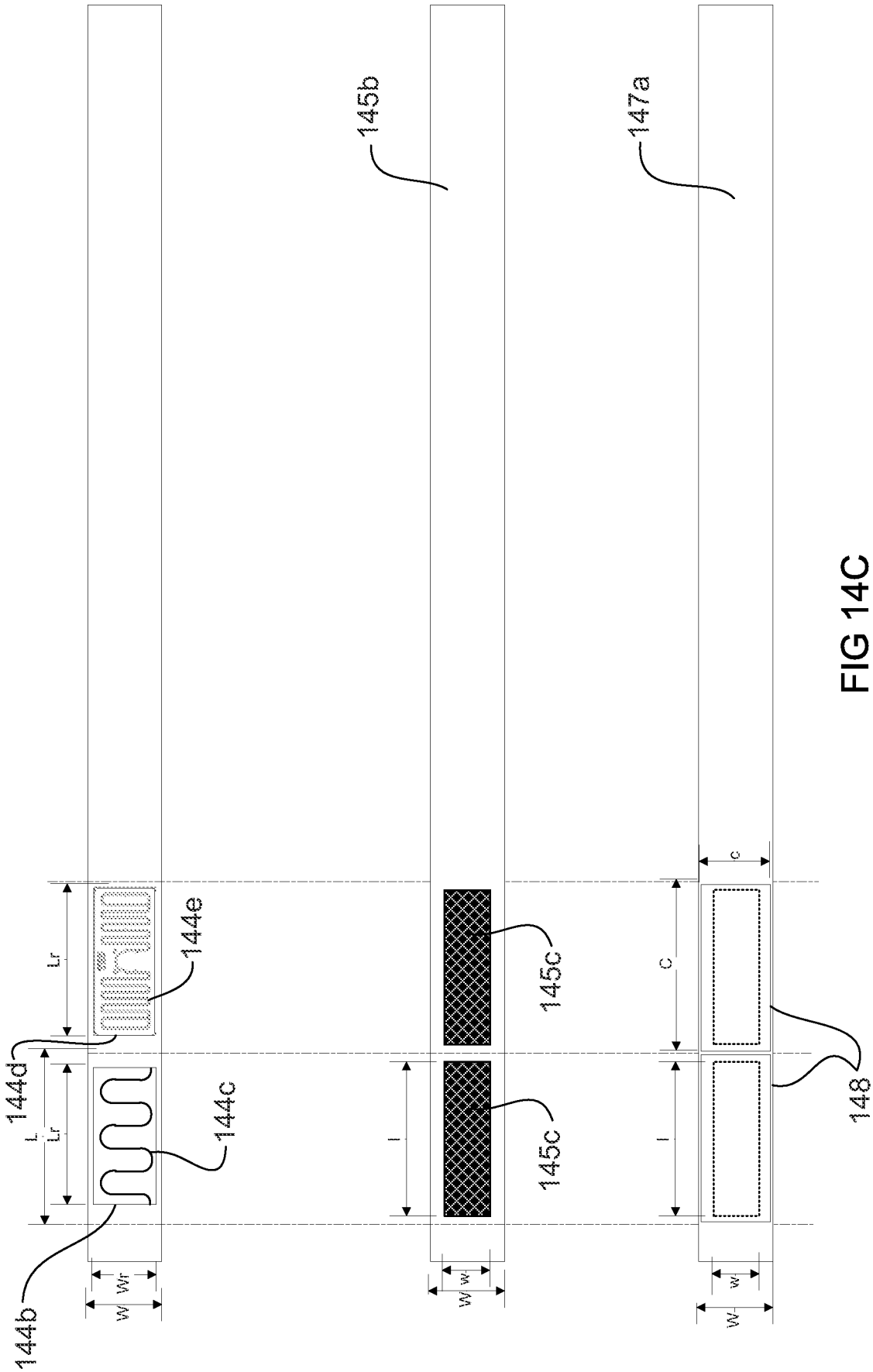
145b
147a
144e
144d
144c
144b
145c
145c
148
Lr
L
Lr
l
l
c
c
Wr
W
Wr
W
Wr
W

FIG 14C

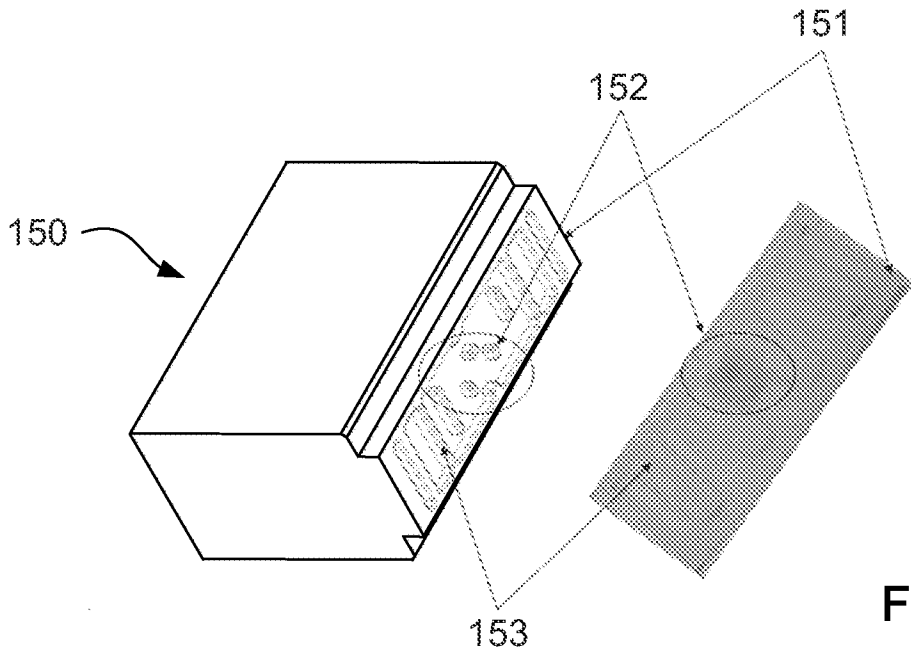

FIG 15

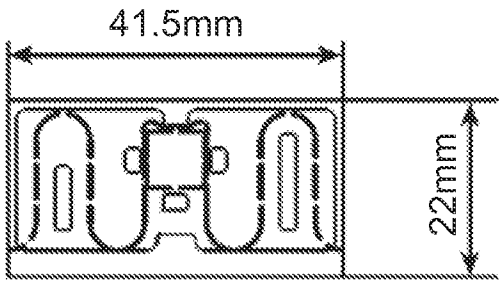

FIG 16A

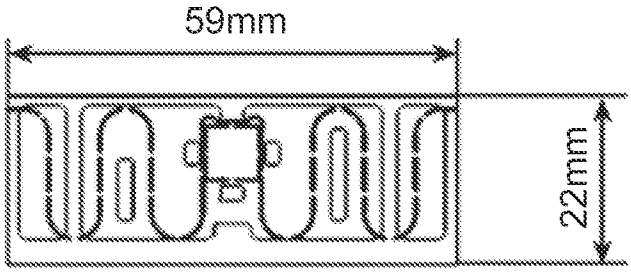

FIG 16B

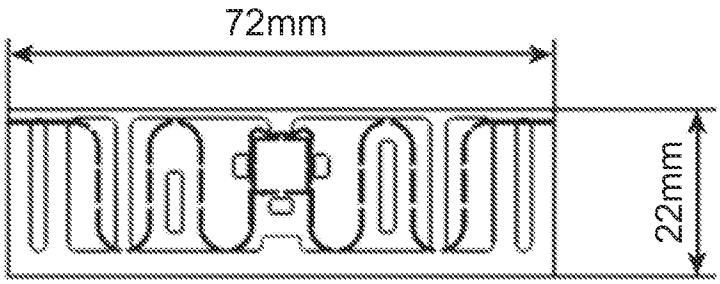

FIG 16C

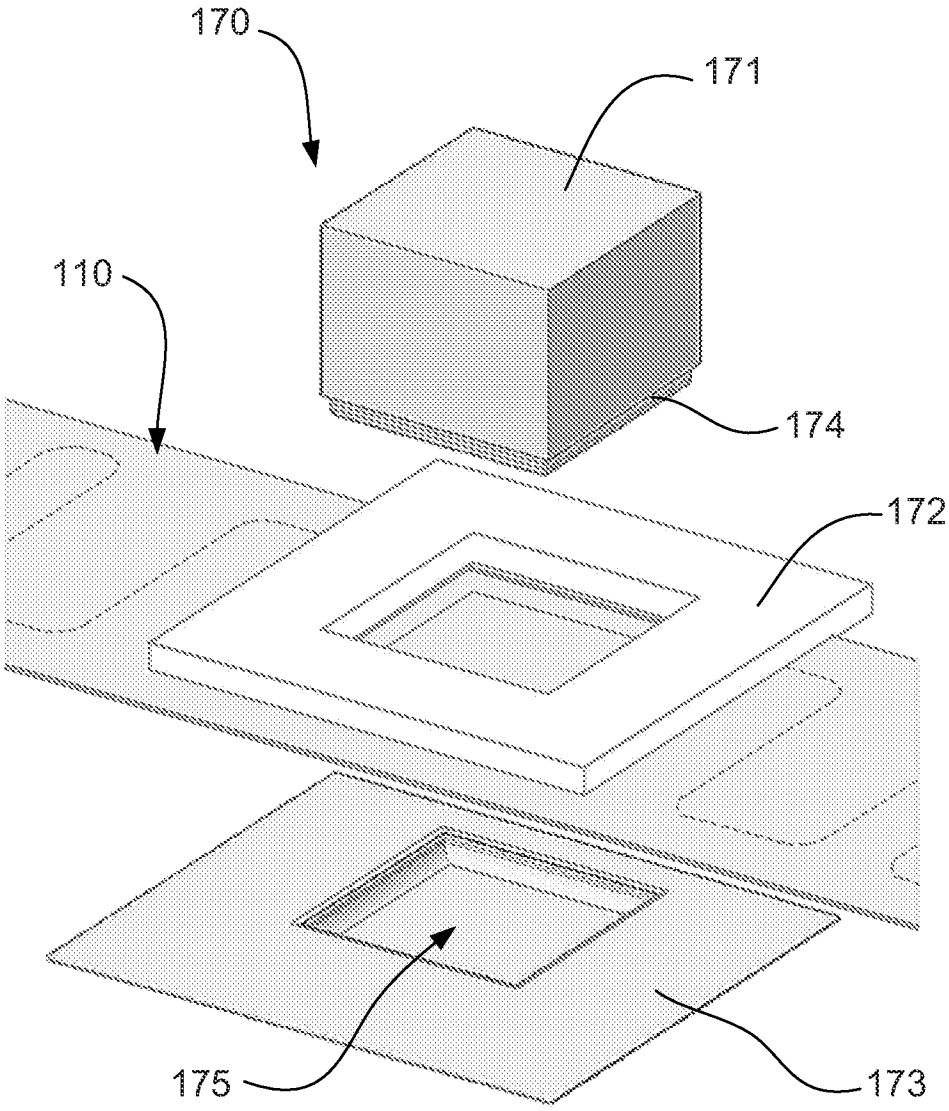

FIG 17

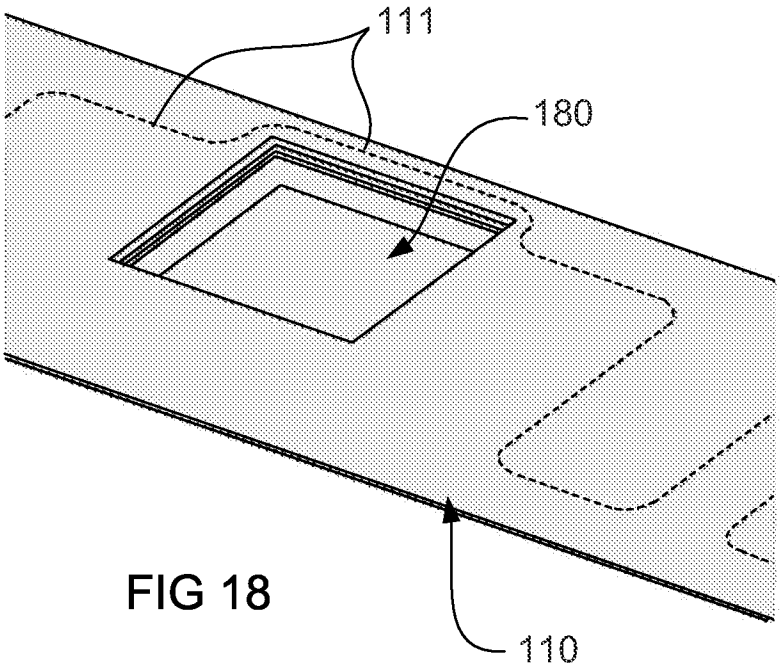

FIG 18

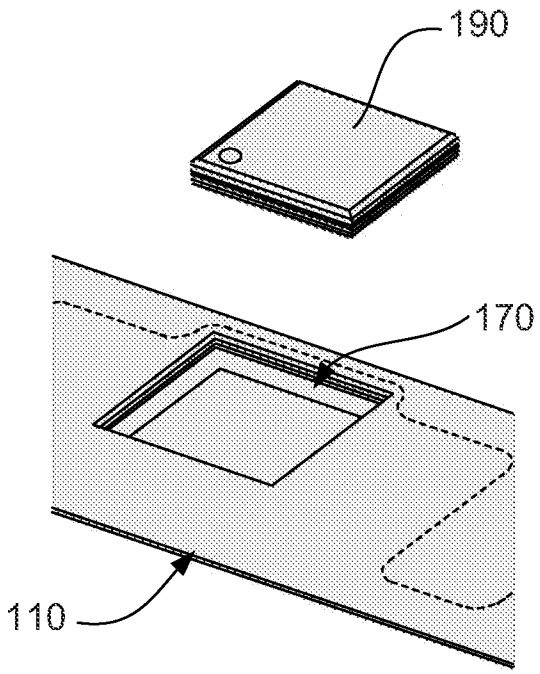

FIG 19

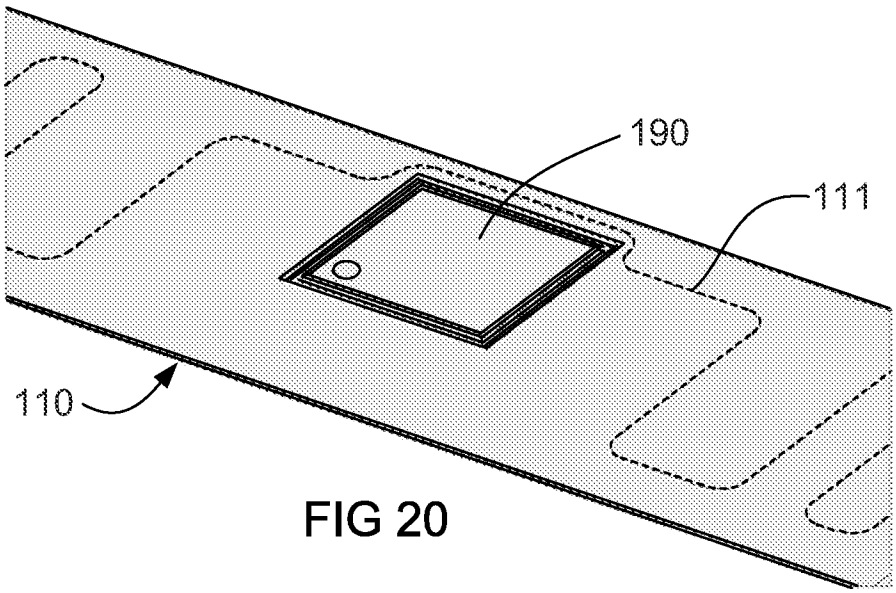

FIG 20

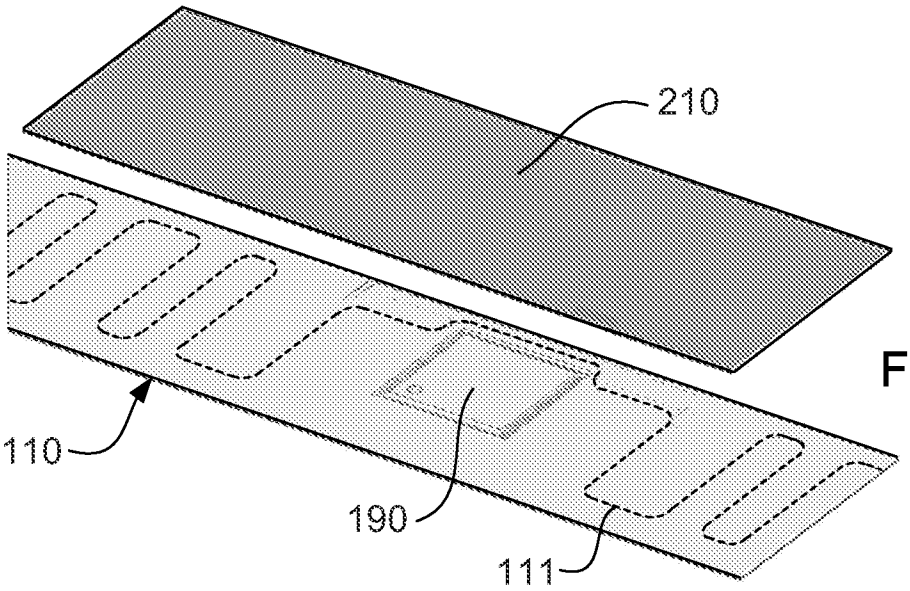

FIG 21

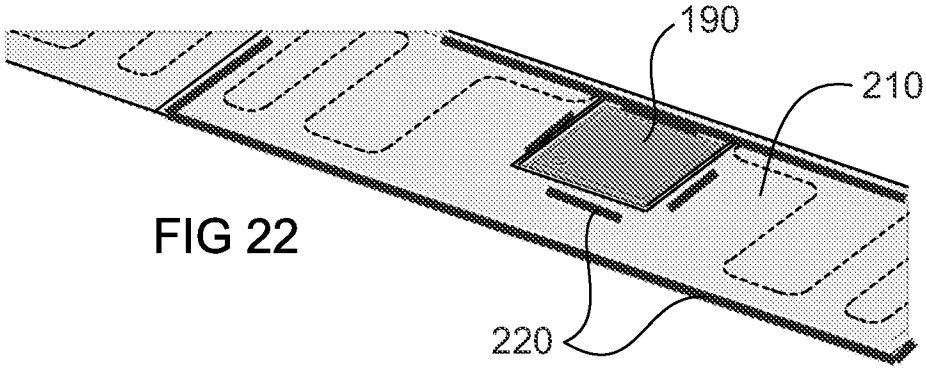

FIG 22

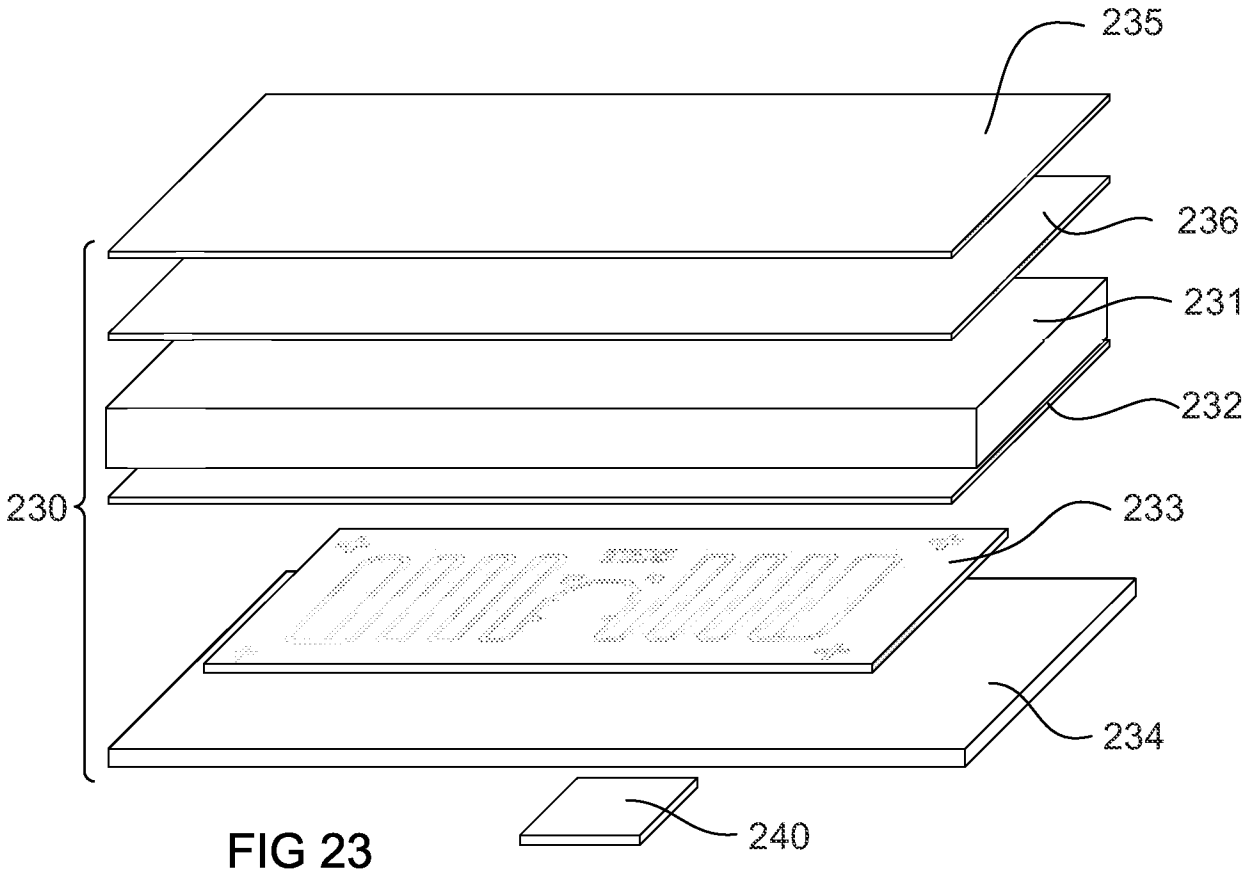

FIG 23

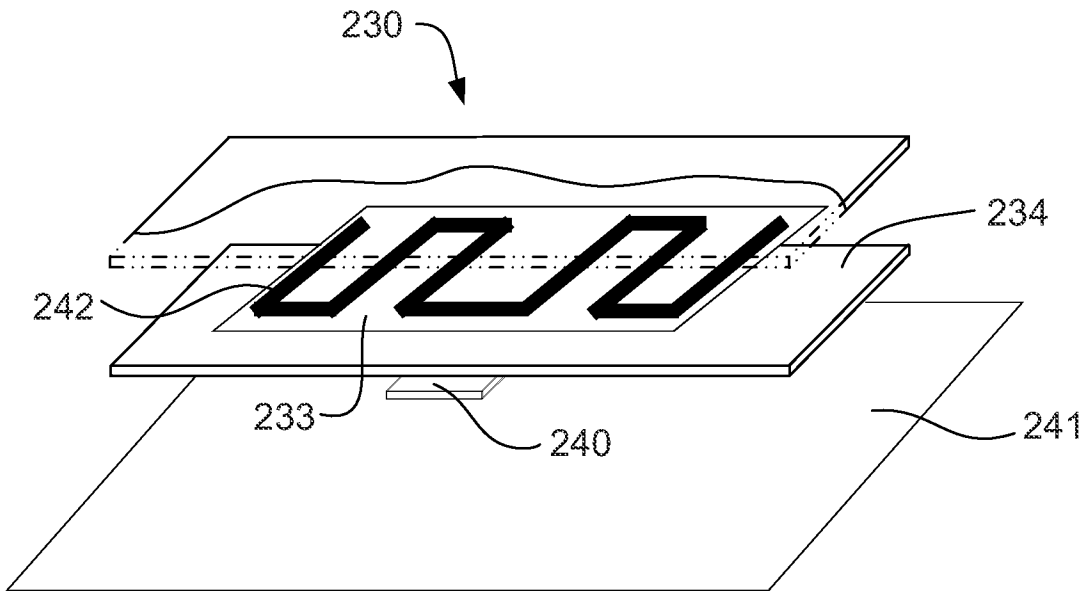

FIG 24

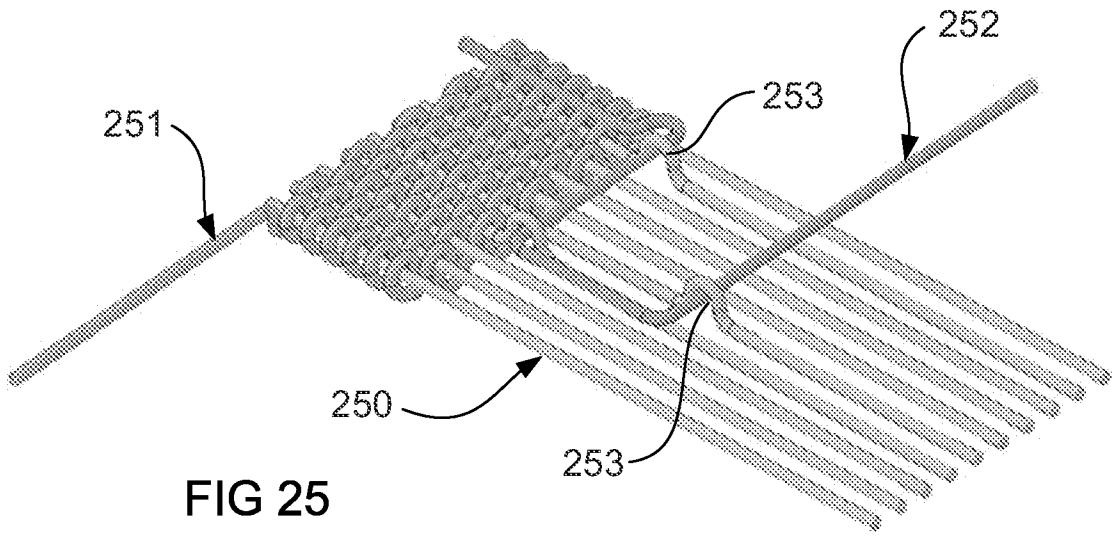

FIG 25

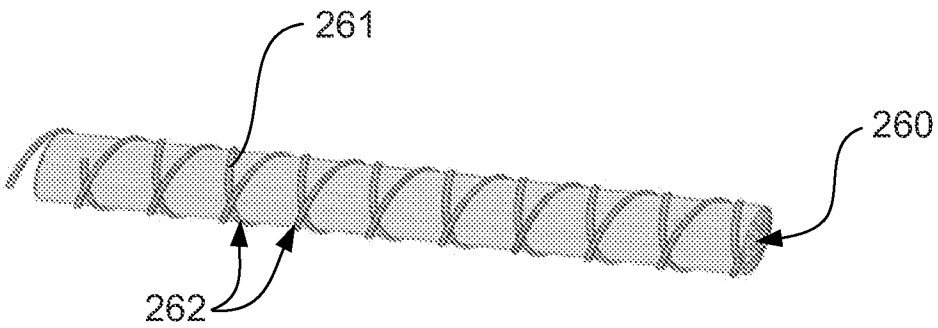

FIG 26

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2012/000305

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

G06K 19/02 (2006.01) ***G06K 19/18*** (2006.01) ***H01Q 1/22*** (2006.01)
G06K 19/00 (2006.01) ***H01Q 1/20*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPODOC and WPI, Google, Google Scholar, Google Patents, www.freepatentsonline.com, ESPACE: RFID, radio, frequency, identification, tag, label, receptacle, frame, antenna, integrated, bracket and other similar terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2010/111743 A1 (TAGSYS SAS et al) 7 October 2010 (see, for example, the abstract, claims 1, 6-9, 12 and 16, page 3 lines 10-17, page 4 lines 5-10, page 10 lines 29-34, figure 18)	22-25, 44-49
A	US 2009/0230196 A1 (JOHNSON et al) 17 September 2009 (see, for example, the abstract)	
Y	US 6827817 B2 (BLECKMANN et al) 7 December 2004 (see, for example, the abstract, column 1 lines 15-20, column 2 lines 62-64, column 10 lines 15-21)	22-25
Y	EP 2058753 A1 (FUJITSU LIMITED) 13 May 2009 (see, for example, the abstract, paragraph [0013], figures 1A-1B, claim 1)	44-49

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 May 2012	30 May 2012
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer **ANDREW MUNRO** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 3 9935 9620

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2012/000305

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 7906189 B2 (TSAI et al) 15 March 2011 (see, for example, the abstract, column 3 lines 39-47, column 23 lines 4-10, column 24 lines 50-53, figures 13-14)	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2012/000305

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [ ] Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. [X] Claims Nos.: **50-51**
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

The claims 50 and 51 do not comply with Rule 6.2(a) because they rely on references to the description and/or drawings.

3. [ ] Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
See Supplemental Box 1

1. [X] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. [ ] As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[X] No protest accompanied the payment of additional search fees.

Supplemental Box 1
(To be used when the space in any of Boxes I to IV is not sufficient)

Continuation of Box No III:

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

In assessing whether there is more than one invention claimed, I have given consideration to those features which can be considered to potentially distinguish the claimed combination of features from the prior art. Where different claims have different distinguishing features they define different inventions.

This International Searching Authority has found that there are different inventions as follows:

- Claims 1-21 are directed towards a tag assembly for attaching an RFID tag including a primary antenna to a surface, said assembly having a receptacle including a frame for securely holding the RFID tag, a secondary antenna, and attachment means for attaching the frame to said surface wherein said frame forms part of said secondary antenna. It is considered that *a tag assembly for attaching an RFID tag including a primary antenna to a surface, said assembly having a receptacle including a frame for securely holding the RFID tag, a secondary antenna, and attachment means for attaching the frame to said surface wherein said frame forms part of said secondary antenna* comprises a first distinguishing feature.
- Claims 22-37 are directed towards a process for producing an RFID label including an RFID tag, for attaching to a flexible surface, said process including forming a label substrate, providing a secondary antenna structure in association with the label substrate, attaching said RFID tag to the label substrate, folding at least a portion of the label substrate over the RFID tag and fusing the label substrate to locate an RFID tag relative to the label and/or secondary antenna structure. It is considered that *a process for producing an RFID label including an RFID tag, for attaching to a flexible surface, said process including forming a label substrate, providing a secondary antenna structure in association with the label substrate, attaching said RFID tag to the label substrate, folding at least a portion of the label substrate over the RFID tag and fusing the label substrate to locate an RFID tag relative to the label and/or secondary antenna structure* comprises a second distinguishing feature.
- Claims 38-49 are directed towards a heat fusible RFID label assembly suitable for attachment to a flexible surface, said label comprising a first layer including a first adhesive layer, a substrate layer including a secondary antenna structure, a heat activated second adhesive layer and an RFID tag. It is considered that *a heat fusible RFID label assembly comprising a first layer including a first adhesive layer, a substrate layer including a secondary antenna structure, a heat activated second adhesive layer and an RFID tag* comprises a third distinguishing feature.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

Each of the abovementioned groups of claims has a different distinguishing feature and they do not share any feature which could satisfy the requirement for being a special technical feature. Because there is no common special technical feature it follows that there is no technical relationship between the identified inventions. Therefore the claims do not satisfy the requirement of unity of invention a priori.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2012/000305

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	2010111743	EP	2415039				
US	2009230196	CN	101142588	EP	1864250	JP	2008533940
		US	8146830	WO	2006100614		
US	6827817	CA	2447318	EP	1390926	US	2002189750
		US	2004238098	US	2005139325	WO	02093524
EP	2058753	JP	2009116670	US	2009115611	US	8062926
US	7906189	AU	2003297620	CA	2508202	CN	1741862
		EP	1578542	EP	2267218	EP	2270277
		HK	1087376	JP	2007276486	JP	2006507962
		JP	2008120086	JP	2008207558	JP	2011126281
		MX	PA05005811	US	2007009732	US	2005100689
		US	2007275319	US	2011079651	WO	2004050262

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX