US 20050146435A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2005/0146435 A1

Girvin et al. (43) Pub. Date: Jul. 7, 2005

(54) NON-REUSABLE IDENTIFICATION DEVICE

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(21) Appl. No.: **11/070,072**

(22) Filed: **Mar. 1, 2005**

**Related U.S. Application Data**

(63) Continuation of application No. 10/400,049, filed on Mar. 26, 2003.

**Publication Classification**

(51) Int. Cl.[7] .................................................... **G08B 13/14**

(52) U.S. Cl. .................. **340/568.2**; 340/572.8; 340/10.1

(57) **ABSTRACT**

A non-reusable tamper-resistant identification device, such as may be fastened around a limb of a user. A Radio Frequency Identification (RFID) circuit is disposed in a band of material, such as is suitable for use as a wristband. The RFID circuit comprises an antenna and a transponder, disposed adjacent the antenna and cooperating therewith for emitting and receiving a wireless signal. An electrically conductive loop forms at least a portion of a connection between the antenna and the transponder. In addition, the electrically conductive loop forms a continuous conductive path along substantially the entire length of the band. The conductive loop is preferably frangible and easily broken in response to an attempt to remove the band from the wearer's limb.

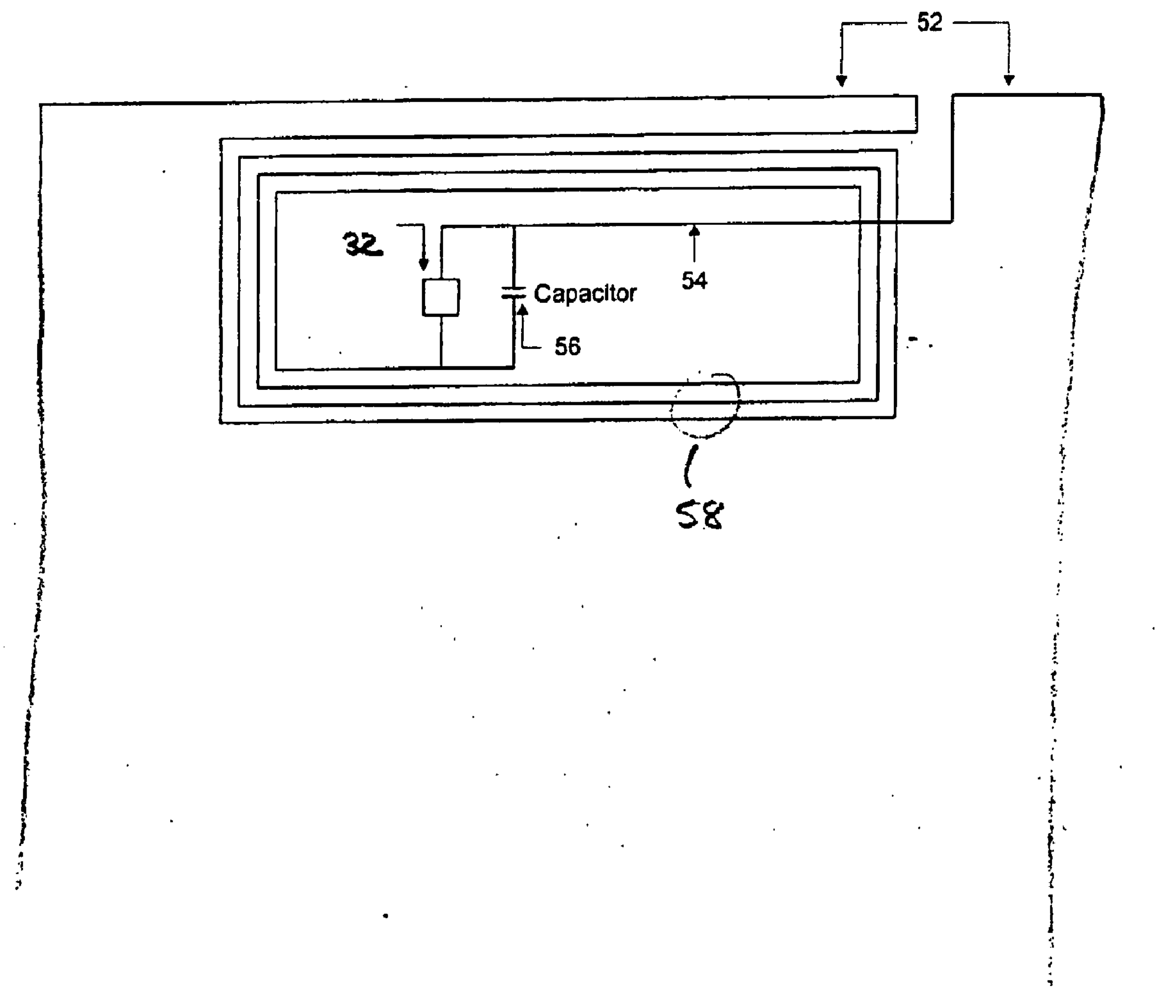


Figure 1

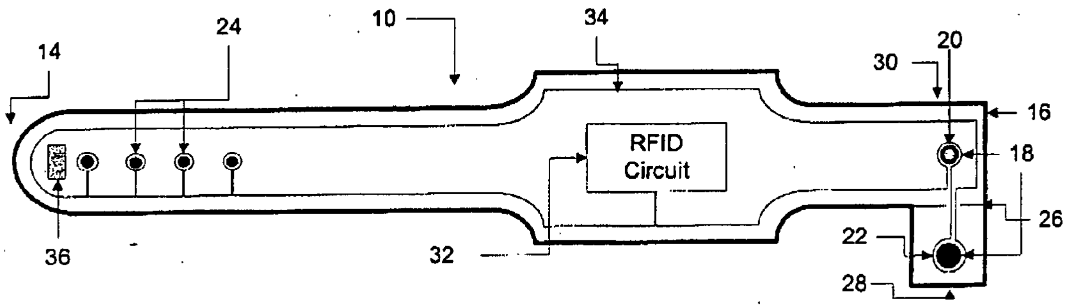
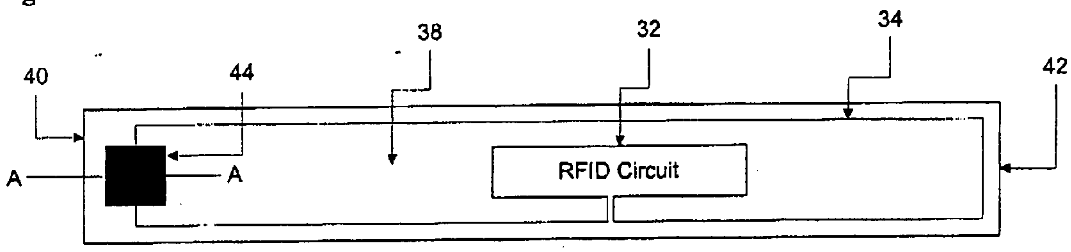


Figure 2



# Figure 2A

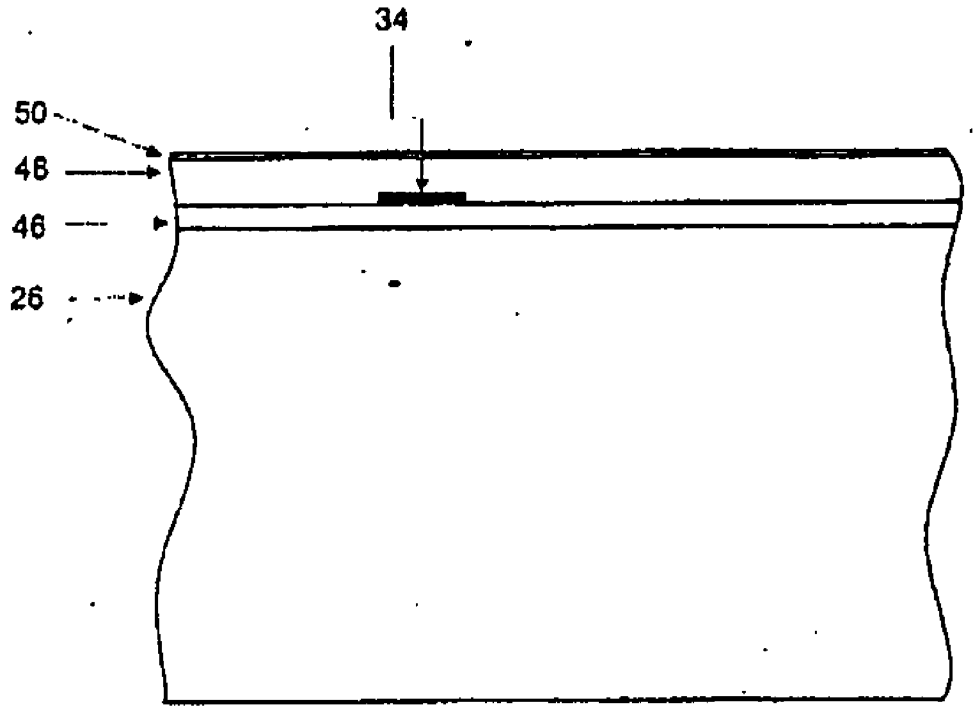
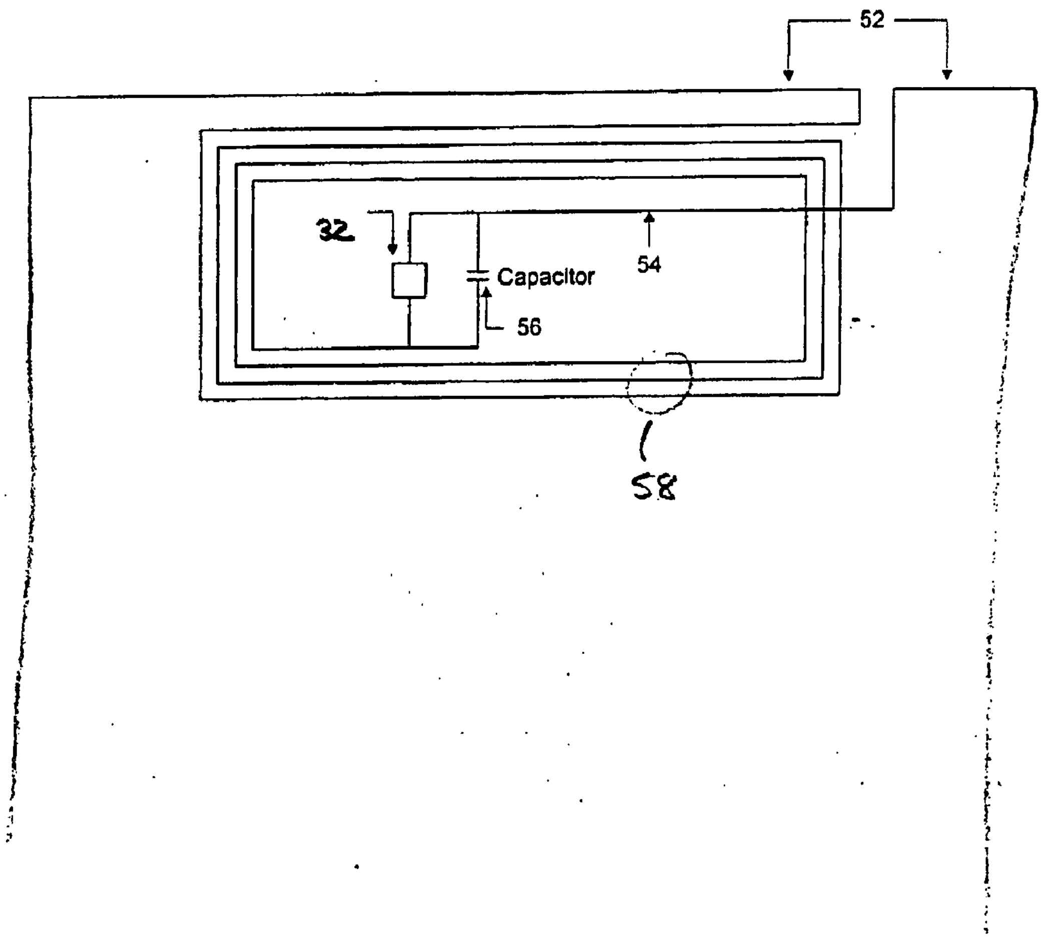


Figure 3



# NON-REUSABLE IDENTIFICATION DEVICE

## RELATED APPLICATIONS

[0001] This application is a continuation of U.S. application Ser. No. 10/400,049, filed Mar. 26, 2003. The entire teachings of the above application are incorporated herein by reference.

## FIELD OF THE INVENTION

[0002] The present invention deals with a non-reusable identification device for attachment to a body part or to an article of apparel of a wearer and that prevents the wearer from being able to re-use the device once it has been separated from the body part or article of apparel.

## BACKGROUND OF THE INVENTION

[0003] Disposable bracelets have been used for such things as identification, purchasing goods, and age verification for a number of years. For example, disposable radio-frequency identification (RFID) bracelets are used in water parks and theme parks to quickly and uniquely identify patrons. Unique identification of patrons can be used to control access to restricted areas or limit access to certain rides or attractions. For example, a patron of legal drinking age could purchase a bracelet that indicates that the patron is of legal age and grants the patron access to restricted areas such as beer sales areas. RFID bracelets issued to minors would lack the identification codes that would permit their wearers from gaining access to such areas. As another example, children under a certain age could be issued bracelets with codes that prevent them from gaining access to rides or amusements that are unsafe or otherwise inappropriate for young children. Such bracelets can also be used to locate the wearer, so that lost children can be easily located or so children can be prevented from leaving the amusement park unless accompanied by an authorized adult.

[0004] RFID bracelets can be used to allow the purchase of items without the exchange of currency or need for a credit/debit card, or to allow secure communication and monetary exchange among patrons (for example, a parent may authorize credit of funds to a child to allow a purchase up to a preselected amount). Upon entering a park or other venue, a patron can request that the bracelet issued to the patron or the patron's family members be credited for purchases up to a preselected amount. Purchases up to the preselected amount can then be made using the bracelet instead of using cash or credit/debit cards. The bracelet could also be coded so that a wearer would be prevented from making certain purchases, or from making a single purchase above a chosen limit, so that children, for example, are encouraged to spend their allotted funds wisely.

[0005] Bracelets of the type described are most often made to be disposable, so that they are inexpensive to produce and easy to use. However, such bracelets are susceptible to misuse and unauthorized use. Some bracelets are easy to remove, yet still function after removal. A bracelet that still functions after it has been removed provides the opportunity for patrons to exchange bracelets. This could provide patrons with the opportunity to give access to a restricted area to an unauthorized patron. A patron with an "adult" bracelet that would allow access to beer sales, for example, could remove and give or sell that bracelet to a patron not of legal drinking age. As another example, a thoughtlessly discarded bracelet that still has funds credited to it could be retrieved and used by an unauthorized individual to purchase goods or services using someone else's account. A bracelet that is rendered non-functional after removal would destroy its value for transfer to another patron, and would safeguard against unauthorized use of bracelets.

[0006] A number of mechanical measures have been taken to prevent such bracelets from being transferred. Most prominent are the single-use locking button mechanism found on some plastic bracelets. An example of this approach is found in U.S. Pat. No. 5,973,600. Also known are adhesive locking mechanisms with slits that prevent the wearer from peeling the adhesive back and reattaching it. An example of that approach is found in U.S. Pat. No. 6,474,557. Those mechanisms render tampering with the locking device obvious to a visual inspection of the bracelet and, in most cases, render the bracelet unwearable after removal. However, tampering with the band portion of the bracelet is not prevented by those mechanisms, nor is the bracelet rendered otherwise inoperative if those mechanisms are tampered with. It is possible for the bracelet to be cut or torn, and reattached with a simple piece of transparent tape. To detect this sort of tampering, the person checking the bracelet would need to either make a full visual inspection of the bracelet or tug very firmly on the bracelet. This is slow, inconvenient, and impractical, especially when large numbers of people require identification. Furthermore, such a visual inspection is subject to human error, the most obvious being the failure of the bracelet checker to perform adequate inspection.

[0007] To enhance the capabilities of these bracelets, additional technologies such as bar codes and RFID have been integrated into the bracelets. The use of such technologies has made the process of identifying the bracelet wearer faster and more secure, resulting in an increased use of bracelets for identification purposes and for facilitating transactions. However, this can lead to complacency among those responsible for checking the bracelets, and has a tendency to reduce the likelihood that the person checking the bracelet wearer will perform an adequate visual or physical inspection. To date, disposable wristbands with added identification technologies have depended upon the previously described mechanical restrictions for transferability.

[0008] Special electronic bracelets that prevent transferability for ensuring that hospital patients or prisoners remain within a given proximity of their quarters are known. However, such designs are prohibitively bulky, expensive, and overly complex for use in high-volume applications with short-term use. For example, U.S. Pat. Nos. 5,471,197 and 5,374,921 disclose the use of fiber optics to ensure that the bracelet is not removed. U.S. Pat. No. 6,144,303 describes a capacitive coupling between the bracelet and the wearer's skin. When the capacitance changes, indicating bracelet removal, an alarm is tripped. The methods and devices disclosed in those patents are unnecessarily complex and prohibitively expensive for disposable use.

[0009] U.S. Pat. Nos. 4,973,944 and 4,980,671 describe bracelets with DC current paths that run around the bracelet and form a closed circuit when the ends of the bracelet are brought together. This method involves complications when one attempts to use it with conventional disposable bracelet designs because it requires a large metal contact area to enable size adjustment of the bracelet. It also does not necessarily solve the problem of tampering because such bracelets are designed to activate an alarm when removed, not necessarily to prevent reattachment. The metal to metal contact surfaces could be easily reattached on a limb of a different user.

## SUMMARY OF THE INVENTION

[0010] The present invention encompasses an identification device comprising a band and a non-reusable tamper-resistant fastening arranged to join opposite end regions of the band to fasten it around a limb of a user. A transponder circuit is attached to the band, and is responsive to a received wireless signal. In response to the received wireless signal, the transponder emits a wireless signal representative of information pre-stored in the transponder.

[0011] In one preferred embodiment, a Radio Frequency Identification (RFID) circuit is disposed in a band of material, such as is suitable for use as a wristband. The RFID circuit comprises an antenna and a transponder, disposed adjacent the antenna and cooperating therewith for emitting and receiving a wireless signal. An electrically conductive loop is connected to the antenna such that electric current must flow through the conductive loop in order for electric current to flow through the antenna. In addition, the electrically conductive loop forms a continuous conductive path along substantially the entire length of the band such that any attempt to remove the band breaks the conductive loop.

[0012] Alternatively, the antenna itself can be utilized to prevent tampering in the same manner as the electrically conductive loop.

[0013] Portions of the band of material whereon the antenna is present do not require the electrically conductive loop to be present for disabling. In other words, when the antenna itself is broken or cut, current can no longer flow through the antenna, and thus the RFID circuit can no longer serve the function of sending and receiving wireless signals. Therefore, so long as the combination of the antenna and the conductive loop span substantially the entire length of the band, the invention will work as intended.

[0014] The conductive loop and antenna are preferably frangible and easily broken in response to an attempt to remove the band from the wearer's limb. The antenna and conductive loop are preferably made of the same material to simplify manufacturing.

[0015] In one embodiment, the conductive loop is disposed so as to form part of a series electrical circuit with the antenna and the transponder. However, other arrangements are possible such that the transponder is arranged to become inoperative and disabled conductive if the loop is broken.

[0016] The antenna and transponder can be disposed on the same integrated circuit chip. In this configuration, the antenna can typically be formed as a conductive coil that encircles the transponder circuitry.

[0017] The RFID circuit is also preferably disposed at or near a first end of the band of material, with the conductive loop thus extending away from the first end.

[0018] For ease of description, the invention will be described in terms of an RFID bracelet, but it should be understood that the device of the present invention is not limited to RFID or to a bracelet but extends to any device that can be attached to a limb or other body part of a wearer, or to an article of clothing and may include a necklace, an anklet, a belt, or the like.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0019] **FIG. 1** is a schematic representation of one embodiment of the present invention.

[0020] **FIG. 2** is a schematic representation of another embodiment of the present invention.

[0021] **FIG. 2A** is an enlarged sectional view taken along line A-A of **FIG. 2**

[0022] **FIG. 3** is a schematic representation of a transponder circuit for use in the present invention.

[0023] The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of preferred embodiments of the invention, as illustrated in the accompanying drawings in which like reference characters refer to the same parts throughout the different views. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention.

## DETAILED DESCRIPTION OF THE INVENTION

[0024] Referring now to the drawings in detail, wherein like numerals indicate like elements throughout, there is shown in **FIG. 1** one embodiment of the present invention. The invention comprises a bracelet **10** in the form of elongated band **12** with opposite ends **14**, **16** that can be brought together and fastened to form a closed loop. Bracelet **10** comprises a mechanical non-reusable tamper-resistant locking mechanism **18** to fasten the opposite ends **14**, **16** together and to prevent the user from attempting to open the locking mechanism **18** to remove the bracelet **10** without rendering those tampering efforts visually obvious. Locking mechanism **18** comprises a barbed peg **20** and a locking hole **22** in flap **28** at one end of said band and at least one adjustment opening or adjustment hole **24** at the opposite end of said band. Adjustment holes **24** can be used to adjust the bracelet **10** to conform to body parts of different circumferences. When ends **14**, **16** are brought together, the barbed peg **20** is arranged to pass through a selected hole **24** as required for a snug fit. The flap **28** is then folded along imaginary line **26** and barbed peg **20** is then passed through locking hole **22**. Peg **20** is shaped to resist removal from said hole **22** without also destroying the locking mechanism **18** and rendering it incapable of being refastened. Alternatively, or in addition, adjustment holes **24** can be designed to replace or supplement locking hole **22** by configuring them in such a way that attempts to remove the bracelet from the barbed peg **20** would also destroy the hole **24**, thereby disabling the bracelet and rendering it incapable of being refastened.

[0025] Bracelet **10** also includes a transponder **32**. Transponder **32** contains circuitry that responds to an RF interrogation signal and in response emits an RF signal representative of information pre-stored or pre-programmed into the transponder. For example, the information could include the date the bracelet is issued, the date the bracelet expires and will not longer be usable for access, the age status of the wearer, and whether the bracelet can be used for purchasing goods or services. Any other desired information, depending on the context in which the bracelet is to be used, may be pre-stored or pre-programmed in the transponder. The signal may also be used to access information stored in a database

[0026] The transponder **32** is electrically connected to and derives power, in known fashion, from a loop antenna in the form of a continuous electrically conductive loop **34** that extends from the transponder and forms an electrically conductive continuous path along substantially the entire length of the band **12** of bracelet **10**. Consideration should be given to the distance between the sections of the loop antenna that form loop **34** in order to minimize inductance that can lead to possible interference with the operation of the circuit. Loop **34** is preferably, but not necessarily, made from printed conductive ink that is robust enough to withstand normal handling but fragile enough that it will be broken if a user attempts to remove the bracelet. Alternatively, loop **34** may be a thin wire such as copper wire, a thin foil, or other suitable electrically conductive material that will form an electrically continuous path but will break as a result of tampering. Forming loop **34** with frangible zones, where stresses from tampering attempts are most likely to occur, may facilitate breakage of the conductor. Of course, if the user attempts to remove the bracelet **10** with a cutting implement, the conductor forming loop **34** will also be severed as band **12** is severed.

[0027] It will be appreciated that, if the loop **34** is broken and the continuity of the electrical path defined by loop **34** is broken, transponder **32** will be rendered inoperative and the bracelet **10** rendered unusable. Preferably, although not necessarily, loop **34** runs closely around the barbed peg **20** and the locking hole **22** of locking mechanism **18** and also closely around each adjustment hole **24**. This prevents a user from making a small incision in the band **12** near an adjustment hole **24** or near locking mechanism **18**, and sliding the barb **20** out of the bracelet **10** without also severing loop **34**. Bracelet **10** may also be fitted with an adhesive pad **36** to hold the excess band in a tight loop around the wearer's limb. Although this is not necessary for the bracelet to function, it is a necessary alternative to cutting and removing the excess bracelet, which is standard practice in many cases.

[0028] **FIGS. 2 and 2**A show an alternative embodiment for a bracelet **38** that uses an adhesive to fasten opposite ends, **40** and **42**, of the bracelet together. As in the first embodiment, the bracelet **38** comprises a wire loop **34** that runs all the way along the length of the bracelet **38**. However, in this embodiment, the loop **34** runs through an adhesive patch **44** attached to one side of the bracelet **38** at a first end **40**. The opposite ends **40**, **42** of the band can be brought together in overlapping fashion and joined by pressing the adhesive patch **44** against the other end of the bracelet. The adhesive patch **44** has two different adhesives. A first adhesive **46** is initially in contact with one side of the bracelet **38**. A portion of loop **34** is passed between first adhesive **46** and a second adhesive **48**, which overlies adhesive **46** and makes contact with the opposite side of bracelet **38** at end **42** when the ends are brought together. Adhesive **46** can be weaker either in formula or in quantity than the adhesive **48** which makes contact with the opposite side of bracelet **38**. The strength of the bond between the two adhesives **46** and **48** is selected to be greater than the bond between adhesive **46** and bracelet **38**. The different adhesive strengths ensures that upon removal, the adhesive patch originally attached to end **40** of the bracelet **38** will remain attached to end **42** of bracelet **38**, but will separate from end **40**, thereby severing the portion of the conductor that is contained within the adhesive patch from the rest of conductive loop **34**. As with the previously described embodiment, conductor **34** can be provided with frangible areas to facilitate breaking. The adhesive patch **44** can be covered with a non-stick releasable seal **50** until it is time to secure the bracelet **38** to the wearer.

[0029] In a variation of this embodiment, the adhesive patch **44** can be made from a single adhesive. In that variation the conductor forming loop **34** must still run through or over the adhesive. The adhesive must necessarily be designed such that it will remain attached to the opposite end of the band **38** when any attempt to peel the band apart is made. That way, attempts to peel apart the adhesive will necessarily cause the conductor to break.

[0030] Once the bracelet **38** is attached by overlapping the ends **40**, **42** and pressing the adhesive patch against the opposite end of the bracelet, it cannot be removed without breaking the loop **34** and thus disabling the transponder **32**. If the user attempts to pull off the bracelet **38**, as the user pulls the two ends **40**, **42** of the bracelet **38** apart the conductor forming loop **34** and completing the electrical circuit to transponder **32** will break, rendering the bracelet **38** non-operational.

[0031] **FIG. 3** shows a modification of the present invention. Here the transponder chip **32** and wire loop **52** typically have an associated capacitor **56**, and an antenna **58**. The capacitor **56** acts as a power supply. One modification here involves extending a wire **54** that connects capacitor **56** and transponder chip **32** to the beginning of the wire loop **52** so that it runs along the length of the bracelet **10**. This point of connection is ideal when a wire etched antenna **58** is used, because it requires minimum modification of the circuit. This is also an ideal connection point because it requires only one wire **54** to cross over the electrical traces that make up the antenna **58**. Such minimal modification clearly is advantageous because it facilitates manufacture.

[0032] In operation, one uses the bracelet in the same manner in which conventional RFID bracelets are used. The bracelet is attached to the wrist or other body part of a user and then, when unique identification is necessary, the user must bring the bracelet within a certain distance of an RFID reader, which transmits a wireless signal. When within that distance, the transponder **32** will be powered by the wireless signal from the RFID reader and, in response, transmit to the RFID reader its own wireless signal representative of the unique information pre-stored or pre-programmed in the transponder. The reader may be linked to a microprocessor having a database of relevant information pertaining to the unique bracelet identification. If the bracelet of the present invention is used in a nightclub setting, for example, the information encoded may include: age to allow access to age-restricted areas, debit account balance for payment of food and drink, and identification of the patron's favorite drink to facilitate placing orders in loud, crowded areas.

Another example of an application of the bracelet of the present invention is in a hospital setting. The RFID reader may be interfaced with a database of hospital records that would not otherwise be readily available. A physician may require, for example, family medical history records or a listing of previous medications that may have an influence on the immediate diagnosis. Such information is usually found at a patient's family doctor and is not always readily available. The database may also include a photo of the patient for positive identification and to reduce the possibility of human error.

**[0033]** The present invention may be embodied in other specific forms without departing from the spirit thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification, as indicating the scope of the invention.

**[0034]** Although two embodiments of the identification device have been described and shown in the drawings, those skilled in the art will understand how features from the two embodiments may be combined and interchanged, without departing from the scope of the invention encompassed by the appended claims.

What is claimed is:

**1**. An identification apparatus comprising:

a band of material;

a Radio Frequency Identification (RFID) circuit disposed in the band, the RFID circuit comprising:

an antenna; and

a transponder chip, disposed adjacent to the antenna and cooperating therewith for emitting and receiving a wireless signal; and

an electrically conductive loop directly connected to the antenna, the electrically conductive loop forming an electrically conductive continuous path along substantially the entire length of the band.

**2**. The apparatus of claim 1, wherein a non-reusable tamper resistant fastening mechanism is used to join opposite end regions of the apparatus.

**3**. The apparatus of claim 2, wherein the non-reusable, tamper resistant fastening mechanism is an adhesive layer.

**4**. The apparatus of claim 2, wherein the non-reusable, tamper resistant fastening mechanism comprises a hole formed in at least one end of the band and a barbed peg formed on the other end of the band, with the barbed peg arranged to pass through the hole and lock into a mating hole and shaped to resist removal from the mating hole.

**5**. The apparatus of claim 4, wherein the electrically conductive loop closely encircles the holes formed in the band.

**6**. The apparatus of claim 4, further comprising a plurality of holes formed in the band such that the band may be adjustably fitted to a wrist by passing the peg through a selected one of the holes.

**7**. The apparatus of claim 6, wherein the electrically conductive loop closely encircles each one of the holes.

**8**. The apparatus of claim 6, wherein a portion of the electrically conductive loop closely encircles the peg.

**9**. The apparatus of claim 1, wherein the electrically conductive loop runs along at least two edges of the band.

**10**. The apparatus of claim 6, wherein the electrically conductive loop encircles each of the holes and the peg as a single conductive wire trace.

**11**. The apparatus of claim 1, wherein the transponder chip and the antenna are located on the same integrated circuit.

**12**. The apparatus of claim 1, wherein the RFID circuit is located on a portion of the band inboard of a respective one of the ends.

**13**. The apparatus of claim 12, wherein the electrically conductive loop extends as a continuous wire loop outward along the band to an opposite end thereof.

**14**. The apparatus of claim 1, wherein the antenna is formed as a conductive coil.

**15**. The apparatus of claim 14, wherein the conductive coil antenna encircles the transponder chip.

**16**. The apparatus of claim 1, wherein the electrically conductive loop is frangible and easily broken.

**17**. The apparatus of claim 1, wherein the transponder chip and antenna are located on a different substrate than the electrically conductive continuous path.

**18**. The apparatus of claim 1, wherein the connection provided by the electrically conductive loop is a series connection between the transponder chip and the antenna.

**19**. The apparatus of claim 1, wherein the electrically conductive loop is frangible and easily broken in response to an attempt to remove the apparatus from a wearer's limb.

**20**. The apparatus of claim 1, wherein the transponder chip is arranged to become inoperative and disabled if the electrically conductive loop is broken.

**21**. An identification apparatus comprising:

a band of material;

a Radio Frequency Identification (RFID) circuit disposed in the band, the RFID circuit comprising:

an antenna; and

a transponder chip, cooperating therewith for emitting and receiving a wireless signal; and

an electrically conductive loop directly connected to the antenna, the combination of the electrically conductive loop and the antenna spanning substantially the entire length of the band.

**22**. The apparatus of claim 21, wherein a non-reusable tamper resistant fastening mechanism is used to join opposite end regions of the apparatus.

**23**. The apparatus of claim 22, wherein the non-reusable, tamper resistant fastening mechanism is an adhesive layer.

**24**. The apparatus of claim 22, wherein the non-reusable, tamper resistant fastening mechanism comprises a hole formed in at least one end of the band and a barbed peg formed on the other end of the band, with the barbed peg arranged to pass through the hole and lock into a mating hole and shaped to resist removal from the mating hole.

**25**. The apparatus of claim 24, wherein the electrically conductive loop closely encircles the holes formed in the band.

**26**. The apparatus of claim 24, further comprising a plurality of holes formed in the band such that the band may be adjustably fitted to a wrist by passing the peg through a selected one of the holes.

**27**. The apparatus of claim 26, wherein the electrically conductive loop closely encircles each one of the holes.

**28**. The apparatus of claim 26, wherein a portion of the electrically conductive loop closely encircles the peg.

**29**. The apparatus of claim 21, wherein the electrically conductive loop runs along at least two edges of the band.

**30**. The apparatus of claim 26, wherein the electrically conductive loop encircles each of the holes and the peg as a single conductive wire trace.

**31**. The apparatus of claim 21, wherein the transponder chip and the antenna are located on the same integrated circuit.

**32**. The apparatus of claim 21, wherein the RFID circuit is located on a portion of the band inboard of a respective one of the ends.

**33**. The apparatus of claim 32, wherein the electrically conductive loop extends as a continuous wire loop outward along the band to an opposite end thereof.

**34**. The apparatus of claim 21, wherein the antenna is formed as a conductive coil.

**35**. The apparatus of claim 34, wherein the conductive coil antenna encircles the transponder chip.

**36**. The apparatus of claim 21, wherein the electrically conductive loop is frangible and easily broken.

**37**. The apparatus of claim 21, wherein the transponder chip and the antenna are located on a different substrate than the conductive loop.

**38**. The apparatus of claim 21, wherein the connection provided by the electrically conductive loop is a series connection between the transponder chip and the antenna.

**39**. The apparatus of claim 21, wherein the electrically conductive loop is frangible and easily broken in response to an attempt to remove the apparatus from a wearer's limb.

**40**. The apparatus of claim 21, wherein the transponder chip is arranged to become inoperative and disabled conductive if the electrically conductive loop is broken.

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