



159159

INVENTION DISCLOSURE DESCRIPTION

Title: SECURABLE WRIST-STRAP RFID ASSEMBLY

1. FIELD OF THE INVENTION

Radio Frequency Identification (RFID) is an advanced wireless technology that has been successful in many fields of application. However, the application of RFID technology to securely tag people is relatively new and can be further exploited. This invention proposes a wrist watch-like tag which uses radio frequency identification and having a case integrated type bangle type strap and, more particularly, to a means for securing the bangle type strap onto itself around the user's wrist.

A RFID system carries data in suitable transponders, generally known as tags, and retrieves data, by machine-readable means, at a suitable time and place to satisfy particular application needs.

Data within a tag may identify an item in manufacture, goods in transit, a location, a vehicle, an animal or individual. Additional data support applications through item-specific information or instructions immediately available on reading the tag. For example, health record of the particular person, or the processes that the person has passed through, such as access control.

2. BACKGROUND TO INVENTION

Identification or Tagging of People using RFID

Conventionally, paper or plastic cards are used in visually identifying persons and objects, but only a very limited amount of information can be displayed on such cards. For this reason, RFID tags have been issued to and carried by people, e.g. as employee passes to enter company premises. The tag for identification comprises an IC chip and an antenna, electrically connected to the IC chip, making it possible to store a wide variety of information on the tag. For example, incoming/outgoing persons with such tags can be monitored and their access controlled by placing RFID readers at strategic locations that are integrated with access control devices, and automatically reading the information stored in the IC chips when the person carrying or wearing the tag approaches the reader.

The Problem

In order to minimise monitoring and access control errors, the tags have to be kept on, or at least very near, to the person being 'tagged'. Thus some means of securing the tag is needed. Furthermore, for persons being tagged against their will (e.g. felons or prison inmates), or who may not appreciate the need to be constantly tagged (e.g. young children), tamper-proof and even irreversible and permanent means of securing the tag is necessary. Likewise, some method to alert if the tag has been tampered with, inactivated, cut, or destroyed has to be developed.



There are attempts to incorporate tags into devices similar to the wrist watch, and such tags for identification could be fitted to a person's wrist, potentially increasing its conventional field of use.

Another current problem with RFID tags that are meant to be worn around the wrist is sensitivity. Among other factors, the read or write range of RFID depends on the tag's antenna. The small form factor wrist-type tags severely limit the design of its antenna.

Current Known Solutions

Current wrist-type RFID tags available for secure tamper-proof tagging are of single-use only. That is, while cutting the strap of a wrist-type RFID tag will normally trigger an alert, but the entire assembly wrist-type RFID tag is rendered useless and has to be discarded. These are also single-mode in that the 'locking' is always permanent.

What is needed is an inexpensive, simple and effective means of allowing temporary or permanent locking of wrist-type RFID tags around a person's wrist. Another objective is to improve the read or write range of such wrist-type RFID tags.

3. SUMMARY OF THE INVENTION

By means of a unique design and assembly of the components of wrist-type RFID tags, this invention overcomes the above-identified problems as well as other shortcomings and deficiencies of existing technologies for secure tagging of persons.

This invention aims to provide a wrist watch-type device which contains an RFID tag having high antenna sensitivity, and is durable, secure and flexible (or dual ability) in use.

This invention is a portable wrist-mounting type RFID tag assembly comprising of a main watch-like case with integral strap, an internal separator piece, a base-lid, and a plunger.

The main moulded watch-like case can be circular or square shaped. The watch-case is a container not only for simply housing and mounting the RFID tag IC and antenna, but also realizing the properties of tamper-proof, water-resistant, oil-resistant, pressure-resistant, impact-resistant, durability and the like of the assembly. The watch-case has an integral bangle type strap with equally-spaced perpendicular raised ridges on the upper surface towards its free end. A small hollow cavity or groove runs inside along the strap from its free end to the watch-case. This cavity is to accommodate the antenna. When placed around a person's wrist, the free end of the strap can be inserted back into a corresponding aperture on the other end of the watch-case.

The internal separator piece is a flat trapezoidal-shaped moulded or stamped durable plastic with two holes each at its far ends. It serves to separate and insulate the RFID tag IC from the base-lid. The four holes are intended for screws to pass through. With the internal separator affixed to the watch-case, the RFID tag IC is protected against dust, dirt, water droplets, and other contaminants.

The base-lid seals off the bottom side of the watch-case. Four screws can be used to firmly and securely affix the base lid onto the watch-case.

The locking plunger is a T-shaped piece with a forked tail. The tail is moulded into 2 narrow ends, i.e. forks, with outward-facing hooks on each end. The hooks are chamfered. The cross-sectional dimensions of the plunger are slightly smaller than a corresponding slot on the smaller peripheral side of the watch-case. With the free end of the strap placed back into the watch-case, the plunger is then inserted tail-end first into the corresponding slot in the watch-case. The chamfered ends of the tail ends allow easy insertion. The body of the plunger will thus come to rest in-between any two raised ridges at the end of the strap. When fully inserted, the hook ends of the plunger will be clear of the strap, and will spring out slightly by virtue of its natural elasticity to catch, and then wedge, onto two small protusions on the base-lid. This locks the plunger, and thus the strap, securely onto the base-lid.

Since the watch-case with integral strap, internal separator, base and locking plunger are all comprised of electrically insulated materials, they do not obstruct the radio waves which are to be received by the RFID antenna accommodated inside the strap. There are no inductive current flows, thereby ensuring that the sensitivity of the antenna does not deteriorate.

Further, since the coil of the antenna is wound along the inner face of the strap surrounding a person's wrist when in use, the magnetic axis of the antenna becomes perpendicular to the watchface, increasing the sensitivity of the RFID tag and achieving a comparatively long operating range.

A more complete understanding of such a wrist-mounted RFID assembly will be afforded to those skilled in the art, as well as a realization of additional advantages and objects thereof, by a consideration of the following description of the preferred embodiment. Reference will be made to the appended sheets of pictures which will first be described briefly.

4. BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows an external view of the invention when ready for use, e.g. to be secured around a person's wrist.

Figure 2 shows the view from top with components of the invention laid out.

Figure 3 shows the view from side with components of the invention laid out.

Figure 4 shows the components of the invention laid out and including the RFID electronic assembly.

Figure 5 shows the the view from top of the moulded watch case and integral strap.

Figure 6 shows the moulded watch-case – close-up of underside view showing internal hollow cavity.

Figure 7 shows the RFID electronic assembly custom-made to fit snugly inside the watch-case.

Figure 8 shows the RFID assembly as placed inside the cavity of the watch-case.

Figure 9 shows the moulded watch-case – close-up of outside side view.

Figure 10 shows the plan view of the internal separator piece, with the four holes for screws to pass through.

Figure 11 shows the outside (external) view of the (bottom) base lid, with the four holes for four corresponding screws.

Figure 12 shows the view of the other (internal) face of the (bottom) base lid, with the protusions as indicated.

Figure 13 shows the invention assembled, with the base-lid secured with four screws onto the watch-case.

Figure 14 shows the securing plunger that is used to lock the free end of the strap.

Figure 15 shows the securing plunger ready to be inserted into the corresponding slot of the watch-case.

Figure 16 shows the top view of the final assembled invention, with the free end of the strap inserted back into the corresponding aperture on the watch-case.

Figure 17 shows the bottom view of the final assembled invention, showing the four screws holding the base lid, internal separator piece, and watch-case together.

5. DESCRIPTION OF THE PREFERRED EMBODIMENT

Fabrication of the Invention

The watch-case and integral strap can be made together in a single piece by injection-molding or compression-molding of the compound material. This simplifies the manufacturing process, making it possible to obtain a comparatively inexpensive wrist tag. Injection-molding or compression-molding allows forming in any given shape.

The internal separator piece, base-lid and plunger similarly can also be made by injection-molding or compression-molding of the compound material, all as individual items.

Thus the components of this invention can be achieved without the requirement of a welding step or an adhering step using an adhering agent and, therefore, the fabrication cost can be reduced.

The compound material can be a highly workable plastic with good thermoplasticity and electrically-insulating. Alternatively, a heat-resistant thermohardening plastic and the like can be used instead. If desired, after putting in and wiring up the RFID electronic assembly, the internal cavity can be filled with a nonconductive resin or sealant or encapsulating compound.

Industrial Applicability

This invention can be used in RFID systems for:

- Correctional institutions such as prisons, to tag inmates and prison officers, or drug inmate on home detention.
- Healthcare facility, to tag patients and healthcare professionals.
- As identification device at entrance gates of museums, art galleries, or rides in amusement parks.
- As a ticket or commuter pass for trains, buses and ferries.

The securable feature allows the wrist-tag to be used both voluntarily/removable (e.g. prison officers), or permanent/tamper-proof on those against their will (e.g. prison inmates) or simply acquiescent (e.g. patients).

By using this type of wrist-tag for identification in entrance gates or public transportation systems, passengers attempting to enter a facility, board a bus or train, can identify themselves as legitimate passengers by a simple act of extending their arm with the tags near to an identification unit, provided at the gate.

Moreover, more additions to the wrist-tag can even extend its use as a wrist-watch (time-piece), an altimeter, a heart-beat meter, GPS receivers or the like.

When and How to Use

As shown in figure 1, the invention when assembled resembles a wrist-watch worn around a person's wrist.

As shown in figures 2 to 4, the invention comprises a watch-like case with integral strap, an internal separator piece, a base lid, and a specially-shaped plunger. All these components are made from electrical insulating material (e.g. plastic).

As show in figures 4, 6, 7 and 8, an RFID electronic assembly comprising of an IC chip on a custom-made radio frequency (RF) circuit board can be accommodated snugly in the internal cavity of the watch-case. The wire-like antenna is threaded through a hollow cavity along the strap and electrically connected to the RFID assembly in the watch-case. The RFID assembly stores information relating to the wearer of the wrist-tag. The RFID with antenna can receive and transmit radio waves at a specific frequency (the frequency which the resonance circuit

resonates at). Data can be read/written to and from the RFID memory in accordance with read/write commands sent by radio wave data transmission from a RFID reader (explained later) in compliance with the chip CPU.

Both passive tags (i.e. the tag is powered by the electromagnetic field provided by a reader) or active tags (i.e. contain an internal power source such as a battery) may be used.

As shown in figure 5, the free end of the strap has four or more transverse raised ridges equally spaced apart; this embodiment shows four such ridges. The distance between any two ridges is slightly larger than the width of the plunger. As indicated in figures 6 and 9, the front face of the watch-case opposite the strap has a corresponding rectangular aperture cut into it. When in use, the free end of the strap can be inserted into this aperture. The provision of four or more raised ridges (instead of just two) allows the strap to accommodate human wrists of varying sizes.

After the RFID assembly and antenna placed in the watch-case and strap respectively are electrically connected, the internal separator piece (figure 10) is placed inside the watch-case cavity on top of the RFID assembly. This separator piece serves to shield and protect the sensitive RFID assembly. Next the base lid (figures 11 and 12) is fitted onto the watch case, over the separator piece. As shown in figure 13, four screws are then used to secure the base lid and separator piece onto the watch case.

To further improve the water-proofing, resin can be added to fill up the rest of the cavity. Then a rubber seal or packing can be placed around the inside edge of the watch-case cavity, before internal separator piece is fitted in. Thereafter, the four screws are tightened, compressing the base lid, internal separator piece, and rubber seal onto the watch-case.

The specially shaped plunger (figure 14) is designed to fit into a corresponding slot on one side face of the watch case. Figure 15 shows the plunger before being inserted into the slot.

When fully pushed in, the plunger will come to rest in-between any two ridges of the free end of the strap inserted into the watch-case. In this position, the plunger is also in-between the internal separator piece and the base lid. The forked hooks of the tail end of the plunger are caught inside corresponding protusions in the moulded base lid. This makes it impossible to extract the plunger from the watch-case. That is, the assembly is permanently secured.

For temporary use, i.e. where the invention is to be easily removed from a person's wrist, the tail end of the plunger is first snipped or cut off above the two forks. Thus, when such a truncated plunger is pushed into watch-case, there is nothing to catch onto the protusions on the moulded base lid.

One current ideal use of this invention is in correctional institutions, e.g. a prison. A method for using the invention will now be explained.

Before putting on the wrist-tag, this tag will be associated with that particular inmate. The purpose of this embodiment is to track movement and location and access control of the inmate. The programmed wrist-tag is then placed around the wrist of the inmate, the free end of the strap inserted into the corresponding aperture of the watch-case, and the unmodified

plunger pushed fully into the corresponding slot in the watch-case. In this manner, whether the forked tail end of the plunger has been cut off or not is not apparent from external view.

The wrist-tag is thus locked and secured around the inmate's wrist. Any attempt to tamper with it, e.g. by cutting off the strap, will trigger an alarm. The wrist-tag is durable and resists water, oil, and other solvents. When worn snugly around the inmate's wrist, the four screws on the base-lid cannot be accessed.

RFID readers are installed at strategic locations with the prison compound, e.g. at gates, doorways, and within rooms. The exact locations and detection range capability of these readers are noted. When a person who is wearing the wrist-tag approaches any such reader, the presence of the wrist-tag is captured. By means of simple time/space computations, suitable software can then track the inmate's locations and movements. Furthermore, if one individual tag is not read by all of the readers for a given period of time, the software can consider this tag as missing and raise an alarm.

The usage of the wrist-tag is similar for prison officers, except that the forked tail end of the plunger is cut off before pushing into the watch-case.

Features and advantages of the invention will be apparent from the above description of the invention and the preferred embodiment. The invention is not limited to the particular forms disclosed, and not all features of an actual implementation are described here. All modifications, equivalents, variations and alternatives should be covered within the spirit and scope of the invention as defined by the associated claims.

Moreover, it will be appreciated that implementation-specific decisions, even if complex and time-consuming, would be a routine undertaking for those ordinarily skilled in the pertinent arts and having the benefit of this disclosure.

CLAIMS

SECURABLE WRIST-STRAP RFID ASSEMBLY

We claim:

1. A system that, comprising of:
 - a. a wrist-watch-like hollow case with an integral flexible bangle-type strap on one side extending out, the free end of said strap is capable of being inserted into a corresponding aperture on the other side of the watch-like case;
 - b. an internal separator piece which fits onto and can be used to divide the internal cavity of the watch-like case into two compartments;
 - c. a base lid which fits onto and can be used to seal off the bottom of the watch-like case by means of screws;
 - d. a separate locking plunger of unique design that can be used to lock the free end of the strap when the strap is placed around an object such as a human wrist and with the free end inserted into a fitting aperture on the other end of the watch-like case;
 - e. a custom-built RFID tag comprising of an IC chip on a circuit board which can be accommodated inside the watch-like case and an antenna which runs longitudinally along a cavity in the sealed inner face of said strap.
2. The watch-case and integral strap as described in claim 1, said member being formed together in one piece by injection-moulding or compression-moulding of a compound material such as non-electrically conductive plastic material or resin.
3. The internal separator piece as described in claim 1, said member being formed in one piece by injection-moulding or compression-moulding of a compound material such as non-electrically conductive plastic material or resin.
4. The base lid as described in claim 1, said member being formed in one piece by injection-moulding or compression-moulding of a compound material such as non-electrically conductive plastic material or resin.
5. The plunger as described in claim 1, said member being formed in one piece by injection-moulding or compression-moulding of a compound material such as non-electrically conductive plastic material or resin.
6. The said watch-case as described in claim 1 has a multitude of screw holes on the bottom-side for receiving screws;
 - a. The said base lid which can be firmly affixed to the watch case by means of the screws;

- b. These screws may be cross-head screws, philips head screws, or allen-key head screws;
- c. The said bottom lid when firmly affixed onto the watch-case makes the assembly water resistant and dust resistant;

7. The said bangle-type strap as described in claim 1,

- a. has a hollow bore or cavity along the strap that can accommodate the wire-like antenna;
- b. is of adequate length and flexibility to allow it to be placed around a human wrist or ankle or similar object in the manner of a wristband or bracelet or anklet;
- c. has four or more raised ridges perpendicular (transverse direction) to the strap, and are intended to guide the said locking plunger;
- d. has the distance between any two adjacent ridges are slightly wider than the width of the said plunger;
- e. has the height of each raised ridge slightly more than the thickness of said plunger;
- f. when in use, the said plunger is slid in and nested in-between any two of the said ridges;

8. The said locking plunger as described in claim 1,

- a. is a T-shaped piece with a forked tail, i.e. slit into 2 narrow ends with outward-facing hooks on each end, and with the outside face of the hooks chamfered;
- b. has cross-sectional dimensions slightly smaller than a corresponding slot on one side of the watch-case;
- c. when pushed in its entirety, tail-end first, into the said slot of the watch-case after the free end of the strap is placed around a human wrist or ankle or similar object and inserted back into the watch-case, secures the strap end permanently inside the watch-case;
- d. the locking effect is achieved by means of the forked hook ends of the plunger catching on to two internal protusions on the base-lid;
- e. with the free end of the strap inserted back into the watch-case before the plunger is pushed in, the body of the plunger will lie across the strap in-between any two raised ridges on the free end of the strap;
- f. with its hooked tail end cut off, and the resulting truncated plunger pushed into the corresponding slot of the watch-case after the free end of the strap is placed around a human wrist or ankle or similar object and inserted back into the watch-case, secures the strap end temporarily inside the watch-case.

9. The said internal separator piece as described in claim 1, has multitude of holes for the screws to pass through.

10. The said base lid as described in claim 1,

a. has multitude of holes for the screws to pass through.

b. has two protusions on both internal facing sides intended to catch the forked hook ends of the plunger when fully inserted into the watch-case;

11. The said situation as described in claim 8c, with the base-lid when firmly secured onto the watch-case and the assembly worn snugly around a person's wrist makes it near impossible to reach the screws and the plunger locked permanently onto the strap thereby ensuring that the assembly cannot be removed without physically cutting the strap, thus creating a secure, tamper-proof mounting;

12. The said situation as described in claim 8f, the plunger can be easily extracted without any additional tool thereby allowing the free end of the strap to be pulled out of its aperture, thus allowing the assembly to be removed without physically cutting the strap, thus permitting re-use of the assembly;

13. The system of claim 1,

a. wherein no additional power supply source is needed if the selected RFID tag is passive;

b. the antenna is capable to receiving and transmitting radio frequency signals from/to a RFID reader in the vicinity

14. The system of claim 1, where the functions of the invention include, but are not limited to:

a. secure, single-use tagging of humans in that the invention is tamper-proof once the plunger is locked onto the base-lid affixed by means of screws to the watch-case;

b. removable, temporary tagging of humans in that the the invention can be disengaged from the wearer's wrist without destruction of any part of the invention, if the forked tail end of the plunger is truncated before use;

c. secure, single-use tagging of inanimate objects in that the invention is tamper-proof once the plunger is locked onto the base-lid l affixed by means of screws to the watch-case;

d. removable, temporary tagging of inanimate objects in that the the invention can be disengaged from the object without destruction of any part of the invention, if the forked tail end of the plunger is truncated before use;

15. The system of claim 1,

a. wherein the entire assembly is impact and pressure resistant, durable, water and oil resistant, tamper-proof, rugged, and eminently suitable for use in harsh environments.