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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application
for
United States Letters Patent

Inventory & Location System

CERTIFICATE OF MAILING BY U.S.P.S. EXPRESS MAIL

Mailing Label Number
EL 776 132 875 US

Date of Deposit
20 May 2002

The undersigned hereby certifies that
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with the United States Postal Service
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The Assistant Commissioner for Patents,
Box PATENT APPLICATION, Washington, D.C. 20231.

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SUMMARY OF THE INVENTION

The present invention comprises methods and apparatus for locating items using passive transponders called radio frequency identification devices or "RFIDs." In a first embodiment of the invention, a small business like a law firm or doctor's office can use self-adhesive RFID labels to keep track of files and important papers. In a second embodiment, items purchased from a retailer which are already attached to an RFID label are automatically detected and tracked by a wireless sniffer when the purchases are brought home. In a third embodiment, a retailer uses the RFID labels to conduct an automatic wireless inventory. In a fourth embodiment, the retailer uses the same system to reduce losses due to theft of merchandise. In a fifth embodiment, the retailer uses the RFID labels to provide automatic wireless check-out. In a sixth embodiment, the retailer analyzes the inventory of goods within a customer's home to enhance sales and marketing strategies. In a seventh embodiment, the retailer uses the home inventory data to furnish automatic order fulfillment. In an eighth embodiment, the customer uses the portable sniffer to retrieve information about a product stored in an RFID.

An appreciation of the other aims and objectives of the present invention and a more complete and comprehensive understanding of this invention may be obtained by studying the following description of a preferred embodiment, and by referring to the accompanying drawings.

A DETAILED DESCRIPTION OF PREFERRED & ALTERNATIVE EMBODIMENTS

1. Overview of the Invention

The present invention comprises methods and apparatus for locating items using passive transponders called radio frequency identification devices or "RFIDs." In a first embodiment of the invention, a small business like a law firm or doctor's office can use self-adhesive RFID labels to keep track of files and important papers. In a second embodiment, items purchased from a retailer which are already attached to an RFID label are automatically detected and tracked by a wireless sniffer when the purchases are brought home. In a third embodiment, a retailer uses the RFID labels to conduct an automatic wireless inventory. In a fourth embodiment, the retailer uses the same system to reduce losses due to theft of merchandise. In a fifth embodiment, the retailer uses the RFID labels to provide automatic wireless check-out. In a sixth embodiment, the retailer analyzes the inventory of goods within a customer's home to enhance sales and marketing strategies. In a seventh embodiment, the retailer uses the home inventory data to furnish automatic order fulfillment. In an eighth embodiment, the customer uses the portable sniffer to retrieve information about a product stored in an RFID.

2. Preferred & Alternative Embodiments of the Invention

In general, an RFID is a relatively small, thin, planar device comprising a substrate and a conductor as depicted schematically in Figure 1. The conductor may be configured as a spiral, some other different continuous pattern, or a set of separate conductors. The design of the conductor is generally based on the response signal which the RFID will emanate when stimulated. In general, each RFID is characterized by a unique serial number which may be associated with other information using a software database. In an alternative embodiment of the invention, an RFID pattern may be printed or applied directly on the surface of a package using a generally conductive ink. An RFID may also be incorporated directly into the surface or body of a product during the manufacturing process.

Passive RFIDs do not require a power source like a battery. The preferred embodiment of the invention generally utilizes passive RFIDs, although some situations may call for the use of an active, powered RFID. Generally planar, limited-life batteries may be incorporated into the RFID during the manufacturing process.

In general, RFIDs are transponders which emit a response signal when they are stimulated or illuminated by an external signal. Although the preferred embodiment of the invention employs transponder devices which operate in the radio frequency bands, other transponders that may employ acoustic, ultrasonic, infrared or other optical signals or any other kind of sensible response may be utilized to practice the invention. In the simplest terms, an RFID takes some of the energy of an external signal, and converts it to a particular emanation or reflection that can be sensed by a detector. In this Specification and in the Claims that follow, this detector is usually

called a "sniffer." This sniffer is usually automatic, and may be wired or wireless. The sniffer may be powered by batteries, or may require a standard cable and plug for a 110VAC electrical outlet. In one embodiment of the invention, the sniffer communicates wirelessly with a personal computer. In this Specification and in the Claims that follow, the terms "RFID" or "transponder" generally comprise any device, apparatus, method or means, whether passive or active, which enables a first signal, wave or field to be varied, reflected, returned, emitted, emanated or propagated in a way that enables the remote detection, sensing or identification of a particular item. Each RFID may be manufactured with a slightly different conductor pattern, so that each uniquely configured RFID in a set of many RFIDs will return a unique signal when they each encounter the external signal. The invention may also utilize RFIDs that are configured so that they all simultaneously respond to a single "all-hands" or "inventory" signal.

In a preferred embodiment of the invention, a sniffer is a wireless device which emits a generally continuous "interrogation" radio frequency signal. The effective range of the sniffer may be a few feet, or may encompass a large range to incorporate a single room, an entire house, or a very large retail store. The area of operation of the sniffer comprises an interrogation zone. As shown in Figure 2, a sniffer generally includes a transmitter that is capable of emitting this interrogation signal. When each RFID within the operating range of the sniffer emits its unique response, the sniffer detects all of these responses. In the preferred embodiment of the invention, the sniffer is also capable of communicating wirelessly with a personal computer. The personal computer is loaded with database software which associates the unique RFID

serial number with identifying information about the object or item which is attached to a particular RFID label. Based on instructions from the computer user, the database software can instruct the sniffer to listen only for one particular response signal, which enables the user to find a particular item using the sniffer.

Figure 2A is a schematic diagram showing the generalized circuit details of one embodiment of a sniffer. An external antenna is coupled to circuit stages which generate an interrogation signal, receive RFID response signals, and communicate with a personal computer. In alternative embodiments, the sniffer may communicate with other devices, such as personal digital assistants, televisions, telephones or kitchen appliances such as refrigerators. Other sections of the sniffer's internal circuitry may include a control chip, a memory, a rechargeable battery, and an audio beeper. In one embodiment, the sniffer is powered by a battery which receives power through contacts that mate with similar contacts on the sniffer's desktop cradle.

3. First Embodiment: Finding Files in an Office

In a first embodiment of the invention, a small business like a law firm or doctor's office can use self-adhesive RFID labels to keep track of files, papers, equipment or other objects. As shown in Figure 3, a customer purchases a roll of self-adhesive RFID labels at a hardware store. In an alternative embodiment of the invention, the customer can use RFID label software to print his own labels using a printer that employs conductive ink. Figure 4 shows the customer applying an RFID label to a file or other object that he wishes to track. Figure 5 depicts a table in the customer's office. A personal computer on the floor under the table is attached by a

USB cable to a sniffer cradle that holds and powers a sniffer. In an alternative embodiment, the connection between the personal computer and the sniffer may be a wireless connection that uses WiFi (802.11b), Bluetooth, or a 900 MHz band transceiver, or some other wireless communication means. The customer has installed database software on the personal computer which associates a set of RFID serial numbers to information supplied and input by the customer.

When the file bearing the RFID label is brought within the operating range of the desktop sniffer for the first time, the sniffer detects the new label, and reports its presence to the database software. Figure 6 shows the screen of the personal computer, which now displays a prompt for the user to enter some identifying information about the object to which he has just attached an RFID label. Since the object in this case is a file containing important papers, the software requests the user to enter a "file identification number." As shown in Figure 7, the user responds to the prompt by entering file ID number "XYZ123." The software then automatically associates this FID with the serial number on the RFID to which it is attached. Once this association is stored in the database, the software determines that this particular RFID label is no longer new. After this event occurs, a response signal from the RFID that is detected by the sniffer will generally be ignored, so that the software no longer identifies this RFID as a "new" RFID which requires user intervention and identification.

At some time in the future, the customer has lost or misplaced file XYZ123. He then turns to the database software for assistance. Figure 8 shows the customer entering a query, which requests the database software to find the RFID serial number

that is uniquely associated with file XYZ123. The software quickly retrieves the serial number, which has been stored in a file on the personal computer's hard drive, and issues instructions to the sniffer. These instructions tell the sniffer to emit an "interrogation signal" that will stimulate a response from all the RFIDs within the operating range of the sniffer. Most importantly, the sniffer is instructed to "listen for" only the response of the RFID that is attached to file XYZ123. All other responses are then ignored until the missing file is found.

As shown in Figure 9, the software displays a message which prompts the user to pick the portable sniffer up out of its desk top cradle. The sniffer then begins to emit its interrogation signal. The user then walks around the office holding the sniffer. When the response from the missing file is detected, the sniffer begins to emit an audible beep. Figure 10 depicts the user as he "homes in" on the missing file. As he does so, the beeping becomes louder, leading the user toward the wayward file. In an alternative embodiment of the invention, small repeaters may be placed in metal file cabinets to assist this process. These repeaters, which comprise an external antenna and an internal radiator, illuminate files stored in a file cabinet which may impede the penetration of an external interrogation signal. Figure 11 shows the user as he finds the lost file in a stack on another table in the office. Once the file is found, the user can press a button on the sniffer or enter a command at the computer to indicate that the locating process has been successfully completed. This method is not limited to files, but may also be utilized to find objects like staplers, scissors, discs, diaries, separate pieces of paper or virtually any other object that may be attached to an RFID label.

4. Second Embodiment: Finding Items at Home

In a second embodiment, items purchased from a retailer which are already attached to an RFID label are automatically detected and tracked by a wireless sniffer when the purchases are brought home. Figure 12 portrays a customer as he leaves a Big Hardware Store, carrying his new purchase, a Skil® Saw. Figure 13 shows the customer entering the front door to his home. The manufacturer or the retailer has already placed or printed an RFID on the box which encloses the saw. As the customer enters the door to his residence, a sniffer placed on the floor near the doorway detects the new purchase. In a preferred embodiment, this wireless sniffer automatically and continuously emits an interrogation signal that searches for an RFID label which it has never seen before. The user's house may contain many sniffers, which all communicate wirelessly with a personal computer. A sniffer could even be installed in the user's car. This mobile sniffer would be able to report new purchases as the car enters the driveway or garage. In each case, the first job of these "front-door" sniffers is to detect new RFID labels once and once only. As described above in Section 3, the database software running on the customer's personal computer makes an entry in a database as soon as a new RFID, which has a new unique serial number that has never been sensed previously, has been detected for the first time. Figure 14 exhibits a message displayed by the personal computer, which indicates that the new purchase has been automatically logged without any user intervention. This automatic recordation is made possible by the fact that the RFID on the Skil® Saw box contains information about the new saw. This information is reported automatically to the computer. Just as printed barcodes each convey

particular information about items or packaging, the present invention allows RFIDs to be used to automatically identify new additions to a household inventory. The invention also enables the composition of a master library of RFID "words" and data, which are uniquely defined and universally utilized to represent fields of information.

In an alternative embodiment of the invention, the "front door" sniffer can be configured to sense RFIDs as they pass out of the house. The location method may be enhanced if each room or closet in the house has its own sniffer.

5. Third Embodiment: Automatic Wireless Inventory

In a third embodiment, a retailer uses the RFID labels to conduct an automatic wireless inventory. Figure 15 provides a general view of the inside of the Great Big Hardware Store. A sniffer is mounted on the ceiling. Every item of stock inside the store has an RFID label attached. When the sniffer is activated and emits an interrogation signal, every RFID responds by issuing a return signal. The sniffer is coupled to a local computer, or perhaps to a central, remote computer at corporate headquarters. This method enables automatic, continuous inventory without the enormous labor cost of a manual inventory. This embodiment of the invention is applicable to any retailer, warehouse, storeroom, factory, library or any other site or environment where many items need to be tracked or located.

6. Fourth Embodiment: Loss Mitigation

In a fourth embodiment, the retailer uses the same system to reduce losses due to theft of merchandise. Figure 16 shows a sniffer mounted over a door at the same

retailer. Any time an article of merchandise attached to an RFID label approaches an exit without having first been purchased, an alarm is activated. A computer running database software is able to keep track of which items leaving the store have been paid for, and of those which have been pilfered. This method provides loss mitigation by reducing shoplifting or theft by employees or vendors. This method may be improved by using RFIDs which have been embedded in the body or surface of the merchandise, rather than simply placing RFIDs on boxes or packaging. As an example, the Skil® Saw described in Section 3 may be manufactured with its RFID embedded in its body or handle.

7. Fifth Embodiment: Automatic Wireless Check-Out

In a fifth embodiment, the retailer uses the RFID labels to provide automatic wireless check-out. Figure 17 depicts a shopper who is ready to ring up the items in her shopping cart at the check-out counter in the Great Big Hardware Store. Every item in the cart has an RFID attached to it. A sniffer mounted overhead is capable of detecting only the items in the shopping cart below it. The sniffer wirelessly totals the purchases, and reports the sales data to the cash register. This method may also be employed at the loading dock in the back of the store to track goods as they are delivered to the retailer. In that variation of this embodiment, sniffers mounted over loading bay doors tally the arrival of goods from suppliers wirelessly and automatically. Figure 17A depicts another alternative embodiment, which could be used to tally inbound shipments in the Receiving Department of the store.

8. Sixth Embodiment: Automatic Home Inventory

In a sixth embodiment, the retailer analyzes the inventory of goods within a customer's home to enhance sales and marketing strategies. Figure 18 depicts a consumer's house. The consumer has purchased items at Big Co., a retailer whose merchandise bears RFIDs. When the consumer brings these items home, sniffers inside the house automatically report the purchases to the personal computer inside the house. In this embodiment of the invention, automatic reporting software has been installed on the personal computer. This software automatically compiles a household inventory of all the purchased items in the consumer's home, and reports the inventory to a central computer at Big Co. using a modem and a conventional telephone line. Large computers at Big Co.'s computer center analyze the inventories reported from the homes of many consumers. All this data is analyzed to improve Big Co.'s sales and marketing methods. The data reported to Big Co. enables the retailer to better understand brand affinities, purchasing habits and sales demographics. This data may be shared with or sold to Big Co.'s suppliers. Big Co. may offer a discount on purchases at its stores for consumers who agree to participate in this home inventory reporting.

9. Seventh Embodiment: Automatic Order Fulfillment

In a seventh embodiment, the retailer uses the home inventory data described in Section 8 to furnish automatic order fulfillment. Once Big Co. has received home inventory data for specific houses, it is able to automatically fill orders to restock household items that are in short supply. The customer can create a standing order

that is filled periodically, or deliveries may be dispatched when supplies run low. The orders may be filled directly by Big Co.'s suppliers as shown in Figure 19, who can ship the goods to the consumer's home using couriers like UPS® or Federal Express.® This method of the invention enables the retailer to generate additional sales without incurring the overhead costs normally associated with stocking the store shelf with merchandise.

10. Eighth Embodiment: Retrieving Product Information

In an eighth embodiment, the customer uses the portable sniffer to retrieve information about a product stored in an RFID. Figure 20 shows a customer using a sniffer to retrieve information from an RFID attached to a television. The RFID may be programmed to store information about the television set, including the model number, manufacturing date, serial number and purchase information. The RFID can also store phone numbers that the customer can use to obtain warranty or repair service or to obtain technical support.