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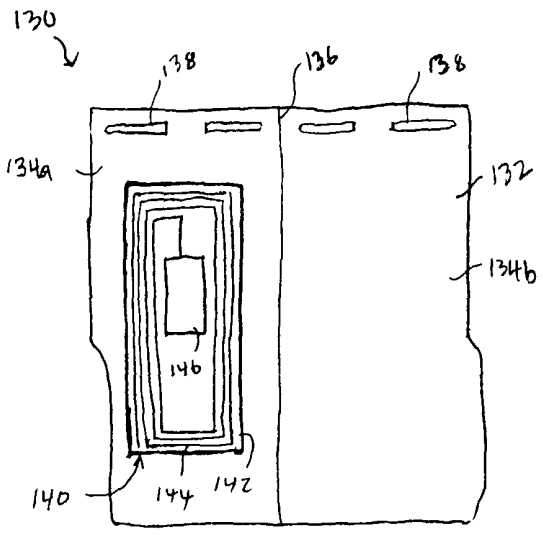
(54) Title: TRACKABLE FILES AND SYSTEMS FOR USING THE SAME



(57) Abstract: A system for tracking files at a site having a plurality of locations includes a plurality of antenna arrays and a plurality of files. Each of the antenna arrays generates an energizing field and is disposed at or near one of the locations. Each of the files includes a body including a pair of covers and a transponder assembly. The transponder assembly may include a substrate, an antenna disposed on one of the sides of the substrate, a circuit coupled to the antenna and having an identifier code, and an adhesive layer disposed on the other side of the substrate. The transponder assembly may be attached to one of the covers by the adhesive. The identifier code is unique for each of the files. In operation, each of the transponder assemblies is activated by the energizing field of one of the antenna arrays when moved within an operative distance thereof. An activated transponder assembly responsively transmits a signal indicative of the identifier code. A reader in communication with the antenna arrays receives the signal from the activated transponder assembly. An administrator may be provided in communication with the reader for receiving information from the reader indicative of the location of the file associated with the transponder assembly transmitting the signal. Accordingly, each of the files of the system may be tracked as the files are moved throughout a site.

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TRACKABLE FILES AND SYSTEMS FOR USING THE SAME

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates radio-frequency identification (RFID) systems, particularly such systems configured to track objects. The present invention also related to files, such as file folders for use in retaining documents. The present invention also relates to methods and apparatus for managing files in a document-management system. The files of the present invention include an RFID transponder that enables the files to be tracked and managed across an installation site such as a courthouse or an office building.

Description of the Related Art

[0002] The field of radio-frequency identification (RFID) includes a wide variety of technologies for various applications. For example, RFID may be applied in the high-speed reading of railway containers in livestock control. RFID is based on electromagnetic propagation. An energizing field, either electric or magnetic, is generated by a reader. The field activates a transponder attached to and associated with an object. In response, the transponder transmits an identifier code to the reader to indicate the presence of the object to which it is attached. Because of the characteristics of electromagnetic energy, there does not have to be a direct line of sight between the reader and the transponder. An in-depth discussion of RFID systems and transponders may be found on a web site maintained by Trolley Scan (Pty) Ltd. of South Africa and located at *http://rapidttp.com/transponder*, the entire contents and all linked web pages of which are incorporated herein by reference.

[0003] Conventional document- or file-tracking systems typically employ barcode technology. For example, a label with a barcode printed thereon is applied to the face of a document or to the outside of a file. In an office environment with a file room, the barcode is scanned by hand with a wand when a file is removed from the file room. Information is then entered into a computer to indicate who has removed the file and where the file may be located. When the file is returned, the barcode is scanned again, and information is entered again into a computer to indicate that the file has been returned.

[0004] One of the drawbacks of such a file-tracking system is that the barcode on the file needs to be scanned each and every time by hand by a file room supervisor, and information indicative of the employee who is in possession of the file needs to be entered. This is time consuming and susceptible to human error. Also, once the file leaves the file room, it is impossible to track the movement of the file throughout the office building unless the barcode is continually scanned at various points in the building. For example, there is no way to know if an employee removes the file from the building. In addition, if a large number of files needs to be removed (e.g., on a push cart), then the barcode on each file needs to be scanned, which is time consuming and labor intensive.

[0005] Long-term storage of files presents additional drawbacks to conventional barcode systems. When inactivated for long-term storage, files are often placed in boxes and moved off site to a storage facility. To locate an inactive file in long-term storage in the future requires a user to search for the correct box and then to search through the files stored in the box to locate the desired file. This process is time consuming. In addition, over time the accuracy of the location system deteriorates as files are removed and misplaced.

[0006] In view of the foregoing, there remains a need in the art for trackable files that are inexpensive to manufacture, customizable by the end user, automatically trackable over an entire site, and manageable in large numbers over an indefinite or extended period of time.

BRIEF SUMMARY OF THE INVENTION

[0007] The present invention provides trackable files and systems for monitoring and tracking such files. The files and systems of the invention are configured to utilize a radio-frequency identification (RFID) technology.

[0008] According to one aspect of the invention, a trackable file includes a body with a pair of covers and a transponder assembly disposed on the body of the file. The transponder assembly may include a substrate, an antenna disposed on one of the sides of the substrate, a circuit coupled to the antenna, and an adhesive layer disposed on the other the side of the substrate. The transponder assembly may be attached to one of the covers by the adhesive. Alternatively, the transponder assembly may be embedded in the body during fabrication of the file, thereby eliminating the adhesive layer.

[0009] According to another aspect of the invention, a system for tracking objects at a site having a plurality of locations includes a plurality of antenna arrays and a plurality of files. Each of the antenna arrays generates an energizing field and is disposed at or near one of the locations. Each of the files includes a body including a pair of covers and a transponder assembly. The transponder assembly may include a substrate, an antenna disposed on one of the sides of the substrate, a circuit coupled to the antenna and having an identifier code, and an adhesive layer disposed on the other the side of the substrate. The transponder assembly may be attached to one of the covers by the adhesive. The identifier code is unique for each of the files.

[0010] In operation, each of the transponder assemblies is activated by the energizing field of one of the antenna arrays when moved within an operative distance thereof. An activated transponder assembly responsively transmits a signal indicative of the identifier code. A reader in communication with the antenna arrays receives the signal from the activated transponder assembly. An administrator may be provided in communication with the reader for receiving information from the reader indicative of the location of the file associated with the transponder assembly transmitting the signal. Accordingly, each of the files of the system may be tracked as the files are moved throughout a site.

[0011] According to another aspect of the invention, a transponder label assembly includes a transponder assembly and a backing sheet. The transponder assembly includes a substrate, an antenna disposed on one of the sides of the substrate, a transponder circuit coupled to the antenna and having an identifier code, and an adhesive layer disposed on the other the side of the substrate. The backing sheet is releasably attached to the adhesive layer of the transponder assembly. Accordingly, a user may apply the transponder assembly to an object so that the object can be tracked.

[0012] Additional aspects, features, and advantages of the present invention will become apparent to those skilled in the art from a consideration of the following detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0013] FIG. 1 is a schematic block diagram of a radio-frequency identification (RFID) object-tracking system configured in accordance with the present invention;

[0014] FIG. 2 is a schematic plan view of antenna arrays and a reader disposed in relation to portals in accordance with the present invention;

[0015] FIG. 3 is a cross-sectional view along line 3—3 of FIG. 2;

[0016] FIG. 4 is a schematic view of a trackable file shown according to an exemplary embodiment of the invention;

[0017] FIG. 5 is an enlarged fragmentary cross-sectional view of the trackable file of FIG. 4;

[0018] FIG. 6 is a schematic view of a trackable file shown according to another exemplary embodiment of the invention;

[0019] FIG. 7 is an enlarged fragmentary cross-sectional view of the trackable file of FIG. 6;

[0020] FIG. 8 is a schematic view of an active RFID label according to an exemplary embodiment of the present invention;

[0021] FIG. 9 is a schematic block diagram illustrating an exemplary administrator configured to track files in accordance with the present invention;

[0022] FIG. 10 is a schematic block diagram of a portable reader configured according to the principles of the present invention;

[0023] FIG. 11 is a perspective view of a transponder label assembly configured in accordance with the present invention;

[0024] FIG. 12 is an enlarged cross-sectional view of a transponder label assembly taken along line 12—12 of FIG. 11;

[0025] FIG. 13 is a block diagram of an object tracking system of the invention, particularly illustrating a system with an alarm for security in restricted installations;

[0026] FIG. 14 is a flow chart illustrating exemplary object-tracking methodology of the invention;

[0027] FIG. 15 is a table illustrating a representative database output configured in accordance

with the invention;

[0028] FIG. **16** is a table illustrating an alternative database output of the invention, particularly an output for tracking the history of an object; and

[0029] FIG. **17** is a flow chart illustrating in detail methodology for tracking object in accordance with a passive embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0030] Referring more particularly to the drawings, a non-optical automatic-identification object-tracking system configured in accordance with the principles of the present invention is illustrated schematically in FIG. **1** and indicated by reference numeral **100**. Exemplary object-tracking system **100** of the present invention is able to monitor the movement of objects (e.g., files) around a site (e.g., a courthouse building) and to maintain records of such movement so that the general—if not the exact—location of objects is known or may be determined in a relatively short amount of time and with relatively little effort. Accordingly, if personnel (e.g., a docket clerk) need to physically locate an object, then the system **100** may be referenced to access information indicative of the present location of a desired object. Details of exemplary physical embodiments and methodology of the present invention are described below.

[0031] Exemplary system **100** of the invention includes one or more sites **102a**, **102b**, ..., **102*s*** connected to an administrator **104** through a communication medium or media **106**. Each of the sites **102** may include one or more installations **108a**, **108b**, ..., **108*i*** connected to a site manager **110**, which, in turn, is in communication with the administrator **104** via media **106**. Each of the installations **108** is disposed in connection with one or more rooms **112a**, **112b**, ..., **112*r*** each accessible by one or more portals **114a**, **114b**, ..., **114*p***.

[0032] With additional reference to FIGS. **2** and **3**, each of the installations **108** includes at least one reader **116** in communication with at least one antenna array **118** disposed at or near one of the portals **114**. Each antenna array **118** may include one or more antennae **120a**, **120b**, ..., **120*t*** connected to a controller **122**. The antennae **120** are tuned to receive a signal S transmitted by a transponder **124** disposed on an object **126** such as a file folder as shown in FIG. **3**. The signal S, which is a radio-frequency (RF) signal (i.e., not requiring a line of sight), carries an identifier

code unique to the object **126** with which the transponder **124** is associated. In a passive embodiment of the invention, the antennae **120** propagate energy from the controller **122** to generate an electric field which energizes or activates the transponder **124** to transmit the signal S when the object **126** is within the range of the array. Upon receipt of the signal S, the antenna array **118** transmits a signal T to the reader **116**. As shown in FIG. **1**, each of the readers **116** is in communication with the site manager **110** and transmits information to the manager when a signal T is received. The communication media **106**, as well as the media interconnecting the reader **116**, the antennae **120**, the controller **122**, may be either hardwired or wireless, or any combination thereof, as desired.

[0033] The term "portal" is used herein to describe not only a traditional doorway as shown in FIGS. **2** and **3** but also areas and spaces through which objects may customarily pass. For example, windows, cubicle entrances, stairways, area dividers, book cases, and so on may all be thought of as portals. Accordingly, in a more general sense, the term "portal" is used herein to indicate the area within an operative distance of an antenna array **118**.

[0034] In operation, when the object **126** passes through the portal **114**, the signal S from the transponder **124** is received by the antenna array **118**, which, in turn, transmits a signal T to the reader **116**. The reader **116** then relays information to the manager **110** indicating that a particular object **126** with a unique identifier code has passed through a particular portal **114** in a particular direction (either in, as indicated by arrow I, or out, as indicated by arrow O, in FIG. **3**). The manager **110**, which may include a computer with memory, maintains a record that the particular object **126** has passed through a particular portal **114** and is now present in a particular room **112** in a particular installation **108**. The manager **110** may then transmit information indicative of the same to the administrator **104**. The administrator **104**, which, like the manager, may include a computer with memory, may also maintain a record of the location of the object **126**.

[0035] Accordingly, exemplary system **100** of the present invention is configured to monitor the movement of objects and to maintain records of such movement so that the location of any number of objects is always known and accessible. For example, with reference to FIG. **1**, if an object **126** is transported in through portal **114a** of room **112a** of installation A **108a** of site A **102a**, then the manager **110** (or administrator **104**) records that the object **126** is presently in that

particular room. If the same object **126** then passes through portal **114b** of room **112a** and into room **112b**, then the antenna array (not shown in FIG. **1**) receives a signal S from the transponder **124** disposed on the object and transmits a signal T to the nearest reader **114b**. Reader **114b** then relays information to the site manager **110** indicative of the present location of the object **126**, i.e., in room **112b**. The site manager **110** then maintains a record of such movement.

[0036] In accordance with one exemplary embodiment of the invention, the object **126** is a file for holding paper, an example of which is illustrated in FIG. **4** and indicated by reference numeral **130**. Exemplary file **130** includes a body **132** which has a pair of covers, for example, a front cover **134a** and a back cover **134b**, which are pivotal with respect to each other along a fold line **136**. The file **130** may include any type of known binding means to retain documents therein, such as prongs **136**, although the file may be configured with other types of document retainers, such as sheet protectors, ring binders, and so on. In addition, the file **130** may be configured as a tri-fold file, an accordion file, an expanding file, etc. In accordance with the present invention, exemplary folder **130** includes a transponder assembly **140** attached thereto.

[0037] With additional reference to FIG. **5**, exemplary transponder assembly **140** includes a substrate **142**. An antenna **144** coupled to a transponder circuit **146** is disposed on one side of the substrate **142**, and a layer of adhesive **148** is disposed on the other side of the substrate **142** for affixing the assembly **140** to the file **130**. For example, the transponder assembly **140** may be positioned and adhered on an inside face of the front cover **134a**. The transponder circuit **146** includes an identifier code unique to the file to which it is attached. A top coat **150** may be applied to protect the antenna **144** and the circuit **146** from damage. Alternatively, a lamination sheet may be applied over the transponder circuit **146** to maintain integrity thereof. Exemplary transponder assembly **140** may be attached to one of the covers **134** during manufacture or after purchase by an end user. According to the latter, the transponder assembly **140** may comprise an adhesive label including a backing sheet (not shown) with a release layer applied to the adhesive **148** which may be removed by the user prior to adhering the assembly to a file, which will be discussed in more detail below.

[0038] In addition to the unique code assigned to the object **126** by the transponder assembly **140**, the transponder circuit **146** may be encrypted to create an electronic signature. Encrypted electronic signatures may be used, for example, to authenticate or substantiate a chain of custody

of an object **146**, and to deter forgeries. The chain of custody may then be maintained in a database, which will be discussed in more detail below.

[0039] An alternative embodiment of a file of the invention is shown in FIGS. **6** and **7**. Rather than including a transponder assembly configured as a label as described above, exemplary file **130'** includes an integral transponder assembly **152** which is incorporated into the file during manufacture. Exemplary assembly **152** includes an antenna **154** embedded within one of the covers, e.g., the front cover **134a'**. The cover **134'** may include channels **156** for accommodating the antenna **154**.

[0040] The antenna **154** may be coupled directed to a transponder circuit during manufacture analogous to that described above. Alternatively, the transponder assembly **152** may include a separate transponder circuit **158** with contacts **160** for coupling with contacts **162** disposed on the file **130'**, one of which in connected to the antenna **154**. The file **130'** may include a recess **164** configured to receive the circuit **158** when coupled with the contacts **162**. According to the embodiment of the invention illustrated in FIG. **6**, the file **130'** may be generically produced with the embedded antenna **154**. The end user may then acquire separate transponder circuits **158** configured to couple with the contacts **162**.

[0041] Both of the transponder assemblies **140** and **152** are configured as passive transponders, that is, the assemblies do not include a power supply. The power required to activate the transponder circuits **146** and **158** is provided by the electric field generated by the antenna array **118**. However, the present invention also provides active transponder assemblies, an example of which is shown in FIG. **8**. Exemplary active transponder assembly **164** includes a substrate **166** on which an antenna **168** coupled to a transponder circuit **170** is disposed. A battery **172** is connected to the circuit **170** to provide power. A capacitor **174** may be provided to tune the assembly. Analogous to the embodiment shown in FIGS. **4** and **5**, exemplary active assembly **164** may be configured as a label with adhesive and a backing sheet for application to a file. The battery **172**, which may be rechargeable or non-rechargeable as desired, may be configured in accordance with advanced conventional battery technology, including paper-based and thin-film batteries.

[0042] In addition to sending a signal S, the active transponder assembly **164** may be configured

to receive a signal from the antenna assembly **118**. More specifically, with on-board power from the battery **172**, the information carried by the transponder circuit **170** may be varied along the route the file takes through a site **102**. Accordingly, the circuit **170** may include memory and logic for retaining memory when not in the presence of the electric field generated by an antenna array **118**. The memory may be powered by the battery **172** or, alternatively, may be magnetic based that is able maintain data when not powered. In addition to memory, the active circuit **170** may also include a receiver, a crystal clock, and a microprocessor depending upon the design requirements of a particular application.

[0043] Depending upon the strength of the antenna array **118**, exemplary transponder assemblies **140** and **152** may range from about 3 inches in width and about 5 inches in height to about 7 inches in width to about 10 inches in height. This size of the array **118** conforms to conventional file sizes for use with letter-size (i.e., 8½ by 11 inches or A4) and legal-size (i.e., 8½ by 14 inches) paper. The label assembly **140** may include removable-type pressure-sensitive adhesive so as to be removable and reusable, which is particularly useful if file is to be placed in long-term inactive storage. In addition to file folders, the transponder assemblies **140** and **152** may be applied to or integrated with any number of stationery products associated with files, such as file dividers, binders, tab dividers, index tabs, color-coded tracking labels, file pockets, sheet protectors, file storage boxes, and so on. The transponder assemblies **140** and **152** may also be integrated into a variety of documents or document carriers, such as shipping manifests, invoices, shipping labels, and so on.

[0044] An exemplary embodiment of the administrator **104** is illustrated in FIG. **9** and may include a processor **180** connected between an input **182** and an output **184** and coupled to a memory device **186**. The input **182** and the output **184** may be configured to couple with and respectively receive and transmit appropriate signals on any type of communication medium known in the art. Upon receiving information from the readers **116**, the processor **180** updates a database in the memory **186** of the movement of the objects **126**. A user may then access the administrator **104**, which may be desktop computer, according to conventional means. Such access of information is typically remote from the actual location of the object in question.

[0045] With reference to FIG. **10**, in addition to placing the physical location of an object within a given room, the system **100** according to a preferred embodiment is also capable of locating the

object within a particular room by using a portable reader **200**. Exemplary portable reader **200** is particularly beneficial in situations where a large number of objects such as files **130** (which look the same) are located in the same room **112**. In this case, a user knows that the file **130** is in the particular room but would need to visually look at every file until the desired file is found. This can be time consuming. Accordingly, exemplary reader **200** is configured to be hand held so that a user may carry the reader into a room and locate a desired file.

[0046] More specifically, exemplary portable reader **200** includes a transmit antenna **202** and a receive antenna **204**. A user may enter information regarding the desired file, e.g., the identifier code, in question into the reader with an input **206**, e.g., a keypad. The transmit antenna **202** then generates an energizing field which activates the transponder assemblies **140** within range. Each of the transponder assemblies **140** activated by the transmit antenna **202** responsively transmit a signal S which is received by the receive antenna **204**. A processor **208** receives the signals S via a system bus **210** and provides a signal to an output device, either a display **212** or a speaker **214**, when a signal S is received from the transponder assembly associated with the desired file **130**.

[0047] Accordingly, a user may move about a room with the portable reader **200** in hand until informed, either by a visual signal on the display **212** or by an audio signal from the speaker **214**, that the file in question is near. The signals may indicate the proximity of the file in question. Exemplary portable reader **200** may also include memory **216** and a power supply **218**. An output **220** may also be provided to communicate location information to the site manager **110** or to the administrator **104**.

[0048] The portable reader **200** may also be configured to query the administrator **104** or the site manager **110**, preferably wirelessly, of the location of a file **130**. If the file **130** is in a file room, then the user may place an order for the file with the portable reader **200** to have the file sent to a desired location. The output **220** of the portable reader **200** may be configured to communicate with any number of current communication technologies, such as the Internet, "Blue Tooth" wireless, wireless cellular, etc.

[0049] As mentioned above, exemplary transponder assembly **140** may be configured as a label. Accordingly, referencing FIGS. **11** and **12**, a transponder label assembly **222** of the present

invention includes a transponder assembly **140** mounted on a backing sheet **224** with a release layer **226**. Analogous to the description above in relation to FIG. **5**, the transponder assembly **140** is disposed on a substrate **142** with an adhesive layer **148**. Accordingly, a user may employ the transponder label assembly **222** in retrofitting objects for tracking by peeling the transponder assembly **140** off of the backing sheet **224** for adhering to an object.

[0050] According to a preferred embodiment, one or more of the installations **108** may be defined as a restricted area. For example, objects located in an installation so designated may be restricted to that particular installation and prohibited from being taken off the premises. To enhance the security of such an embodiment, referencing FIG. **13**, each of the portals **114** in a restricted installation **108** may include an alarm system **230**. Accordingly, if an object passes through a portal **114** out of (or into) a restricted installation **108**, the reader **116** or the manager **110** may trigger the alarm **230** to sound. The alarm may include audio and visual signals.

[0051] Exemplary methodology of the present invention is illustrated in FIG. **14**. As mentioned above, exemplary system **100** is configured to track objects **126** (step **S50**) and if an object **126** is moved through a portal **114** with an antenna array **118** (step **S52**), a database stored in memory (e.g., memory **186** of the administrator **104**) is updated indicating the same (step **S54**). An exemplary database output according to the invention is illustrated in FIG. **15** and indicated by reference **240**. The database may include fields for the unique object number **242**, a person responsible for the object **244**, a date of the last update **246**, the current location of the object **248**, and the previous location of the object **250**. The administrator **104** of the manager **110** may then be queried (step **S56**). A record **252** including data from one or more of the fields **242–250** may then be retrieved (step **S58**) and transmitted (step **S60**) to the querying party.

[0052] As shown in FIG. **16**, the database may be caused to generate a "genealogy" or tracking history output **260** of a particular object **126**. Exemplary database output **260** may include information and data indicative of a "chain of custody" and movement of a particular object. For example, fields directed to date **262**, time **264**, location **266**, direction, **268**, and array identification number **270**, as well as responsible person **244** (shown in output **240**), may be included in the database output **260**. Accordingly, database output **260** provides a trace of all the locations at which an object **126** has been located over time, or all the persons who have had custody over time. Genealogy information may be used in applications for routing history or

locating documents relating to a given topic or subject. Thus the system might be able to locate documents or files of interest to a given user, based on the database design. For example, sensitive documents such as medical documents in emergency rooms or X-rays may be accurately traced if desired. Regarding array ID **270**, each of the antenna arrays **118** may include a unique ID included in signal T so that specific tracking information may be obtained.

[0053] With reference to FIG. **17**, exemplary methodology incorporating representative elements of the tracking system **100** of the invention is illustrated. As described above, in a passive embodiment, each array **118** generates and provides an energizing field (step **S62**) and waits until a signal from a transponder assembly **140** is detected (step **S64**). Complementarily, when the transponder assembly **140** is energized by an antenna array **118** (step **S66**), a signal S is transmitted (step **S68**). Upon detecting the signal S (step **S64**), the antenna array **118** transmit a signal T to a reader **116** (step **S70**). Upon detecting the signal T (step **S72**), the reader **116** transmits a signal to the manager **110** (step **S74**).

[0054] Upon receiving the signal from the reader **116** (step **S76**), the manager **110** may update the location of the object **126** in the database (step **S78**). As an alternative or in addition to, the manager **110** may then transmit data indicative of the movement of the object **126** (step **S80**) to the administrator **104**. Upon receipt (step **S82**), the administrator **104** may then update the database as well (step **84**). The manager **110** may then be queried (step **S86**) regarding a particular object **126**, thereafter retrieving (step **S88**) and providing (step **S90**) data specific to the object to the querying party. In addition, the administrator **104** may be queried (step **S92**) regarding a particular object **126**, thereafter retrieving (step **S94**) and providing (step **S96**) data specific to the object to the querying party. The data provided to the querying party may be in the form of the database outputs **240** and **260** shown in FIGS. **15** and **16**.

[0055] The system **100** of the present invention may be configured to satisfy the needs of any type of installation and load. For example, the system **100** may be configured to read a large number of transponder assemblies **140** and **152**. In this regard, the entire disclosure of U.S. Patent No. 5,726, 630 entitled "Detection of Multiple Articles" is incorporated herein by reference. In this regard, the entire disclosure of each of the following United States patents are also incorporated herein by reference: U.S. Patent No. 5,699,066 entitled "Synchronized Electronic Identification System" and U.S. Patent No. 5,995,107 entitled "Electronic

Identification System Confirming Valid Code."

[0056] The transponder assembly **140** of the invention may be fabricated according to technology known as "nanoblock" technology, which enables RFID devices to be assembled in a fluid, self-assembly process way of embedding one or more circuit devices (i.e., "nanoblocks") in an RFID substrate **142**. In this regard, Alien Technology Corporation of Morgan Hills, California, has developed significant techniques for manufacturing microelectronic elements or nanoblocks. The nanoblocks are deposited on the substrate **142** at precisely determined locations using a technique known as fluidic self-assembly, or FSA. In particular, Alien Technology fabrication methodology includes forming nanoblocks, forming a substrate with recesses complementary in shape to the nanoblocks, and then transferring the nanoblocks via a fluid or slurry onto a top surface of the substrate **142** having the recessed regions (or binding sites or receptors). Upon transference, the nanoblocks self-align through shape into the recessed regions and integrate thereon.

[0057] The compositions and the various processing techniques used to produce the nanoblocks, the underlying substrates, and subsequent processing operations are disclosed in a number of patents owned by or licensed to Alien Technology, including U.S. Patent Nos. 5,783,856; 5,824,186; 5,904,545; and 5,545,291, as well as published international applications filed under the Patent Cooperation Treaty (PCT), including WO 00/49421, WO 00/49658, WO 00/55915, and WO 00/55916, the entire disclosure of each patent and published application is incorporated herein by reference. A recent publication about the Alien processing technique may be found in the journal SOCIETY FOR INFORMATION DISPLAY, Vol. 16, No. 11, at pages 12–17.

[0058] Those skilled in the art will understand that the preceding exemplary embodiments of the present invention provide the foundation for numerous alternatives and modifications thereto. These and other modifications are also within the scope of the present invention. Accordingly, the present invention is not limited to that precisely as shown and described above but by the scope of the appended claims.

CLAIMS

What is claimed is:

1. A file for use in a radio-frequency identification (RFID) system, the file comprising:

a body including a pair of covers; and

a transponder assembly including:

a substrate having a pair of sides;

an antenna disposed on one of the sides of the substrate;

a circuit coupled to the antenna and having an identifier code; and

an adhesive layer disposed on the other the side of the substrate;

the transponder assembly being attached to one of the covers by the adhesive.

2. A file for use in a radio-frequency identification (RFID) system, the file comprising:

a body including a pair of covers; and

a transponder assembly including:

an antenna embedded on one of the covers; and

a circuit coupled to the antenna and having an identifier code.

3. A system for tracking objects at a site having a plurality of locations, the system comprising:

a plurality of antenna arrays each for generating an energizing field, each of the antenna arrays being disposed at or near one of the locations;

a plurality of files each including:

a body including a pair of covers; and

a transponder assembly including:

a substrate having a pair of sides;

an antenna disposed on one of the sides of the substrate;

a circuit coupled to the antenna and having an identifier code; and

an adhesive layer disposed on the other the side of the substrate;

the transponder assembly being attached to one of the covers by the adhesive;

the identifier code being unique for each of the files;

each of the transponder assemblies being activated by the energizing field and

responsively transmitting a signal indicative of the identifier code;

a reader in communication with the antenna arrays for receiving the signal when one of transponder assemblies is activated by one of the antenna arrays; and

an administrator in communication with the reader for receiving information from the reader indicative of the location of the file associated with the transponder assembly transmitting the signal.

4. A transponder label assembly comprising:

a transponder assembly including:

a substrate having a pair of sides;

an antenna disposed on one of the sides of the substrate;

a transponder circuit coupled to the antenna and having an identifier code; and

an adhesive layer disposed on the other the side of the substrate;

a backing sheet releasably attached to the adhesive layer of the transponder assembly.

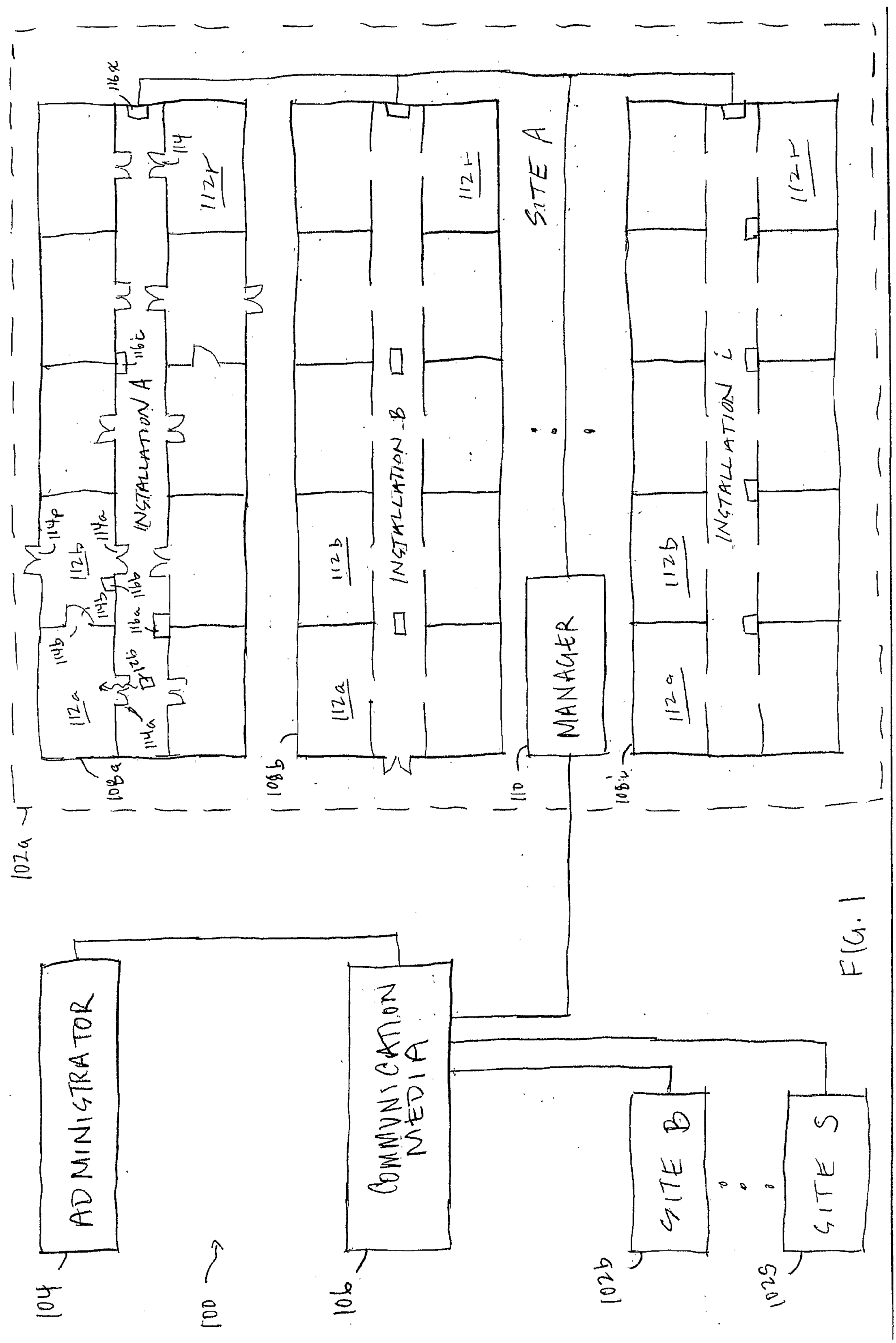

ADMINISTRATOR
COMMUNICATION MEDIA
SITE B
SITE S
SITE A
MANAGER
INSTALLATION A
INSTALLATION B
INSTALLATION i
100
102a
102b
102S
104
106
108a
108b
108i
110
112a
112b
112r
114
114a
114b
116a
116b
116c
116x

FIG. 1

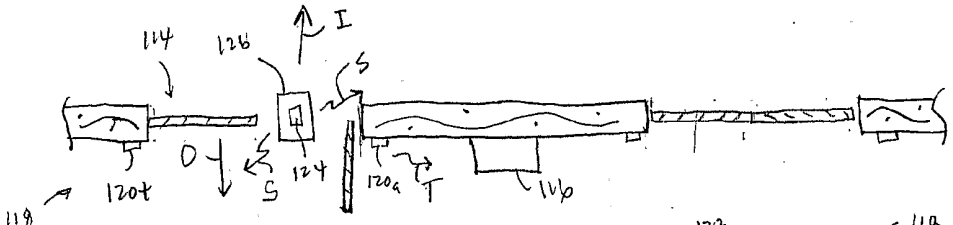


FIG. 3

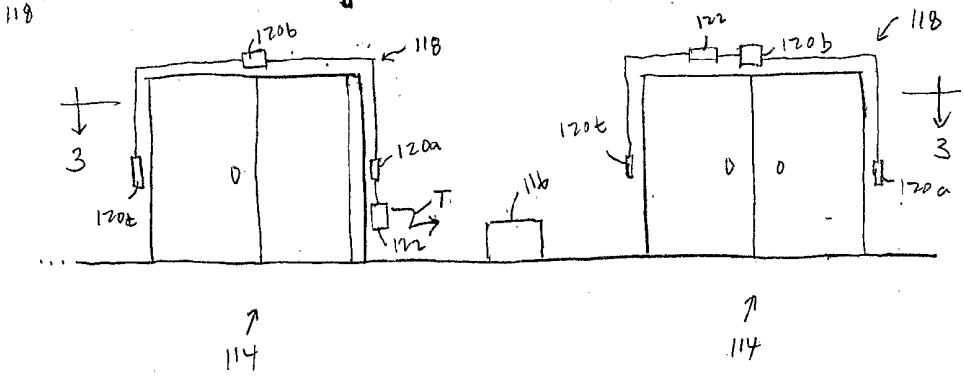


FIG. 2

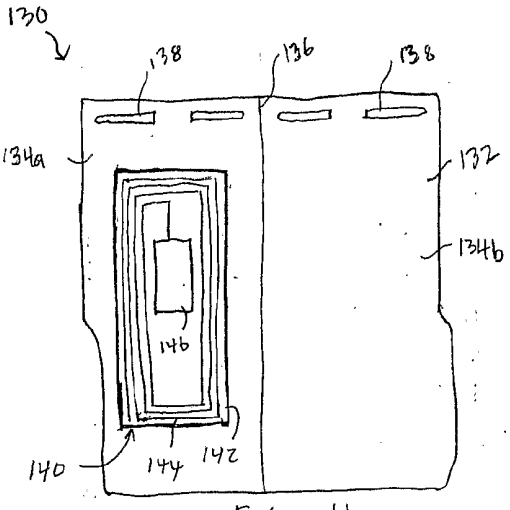


FIG. 4

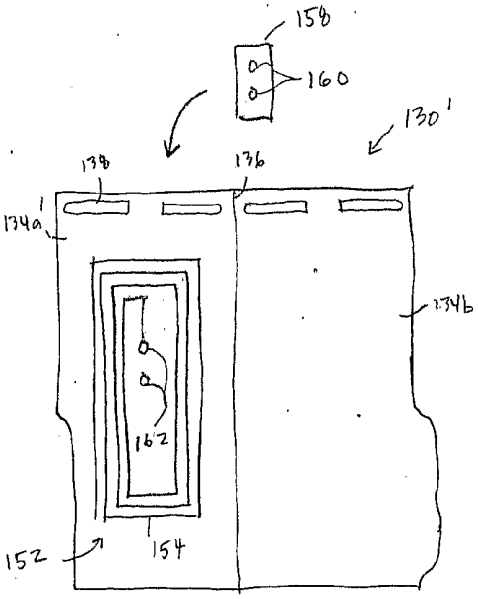


FIG. 6

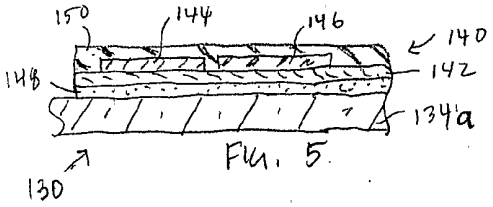


FIG. 5

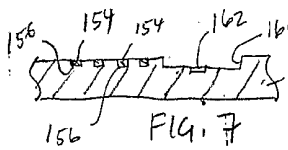


FIG. 7

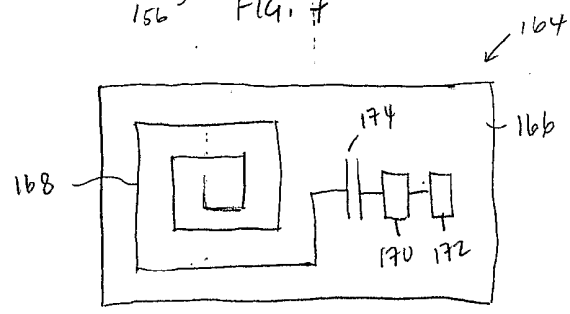


FIG. 8

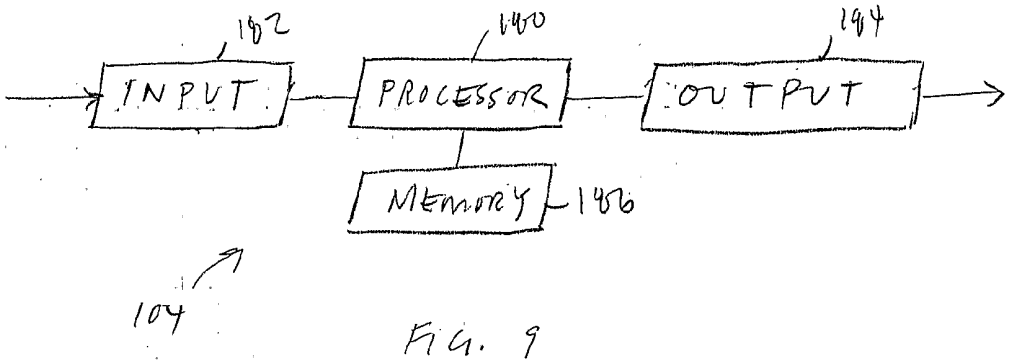

182
180
184
INPUT
PROCESSOR
OUTPUT
MEMORY
186
104

FIG. 9

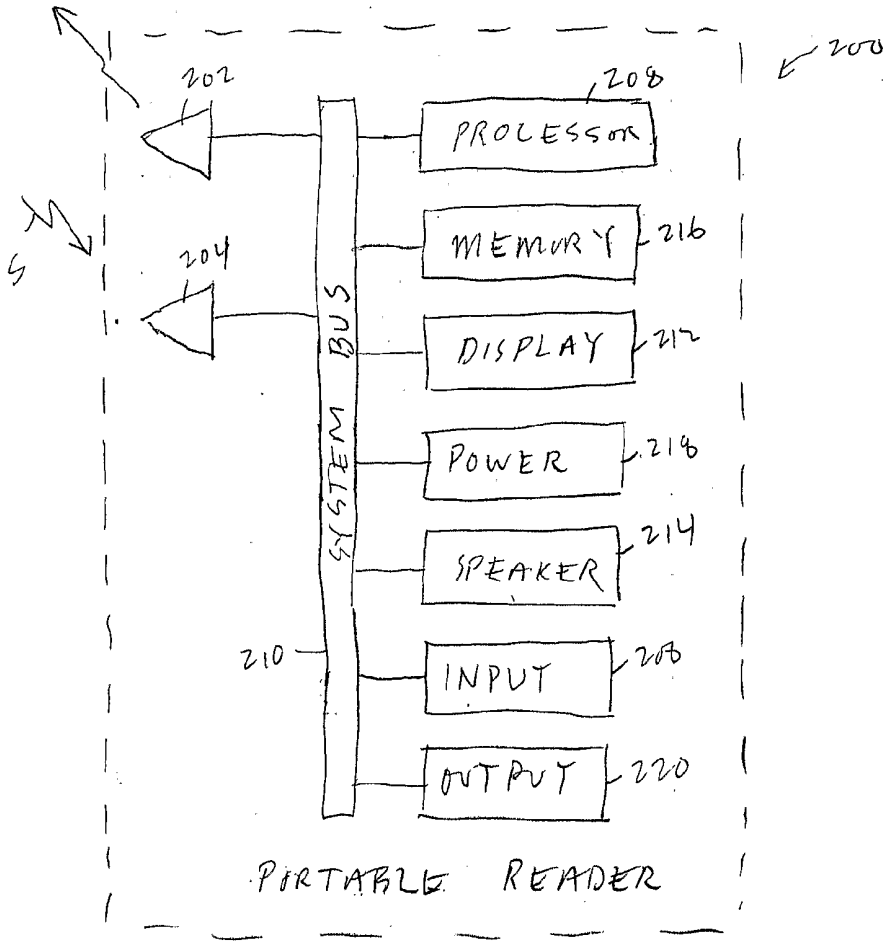

200
202
208
PROCESSOR
MEMORY
216
204
DISPLAY
212
POWER
218
SPEAKER
214
SYSTEM BUS
210
INPUT
206
OUTPUT
220
PORTABLE READER

FIG. 10

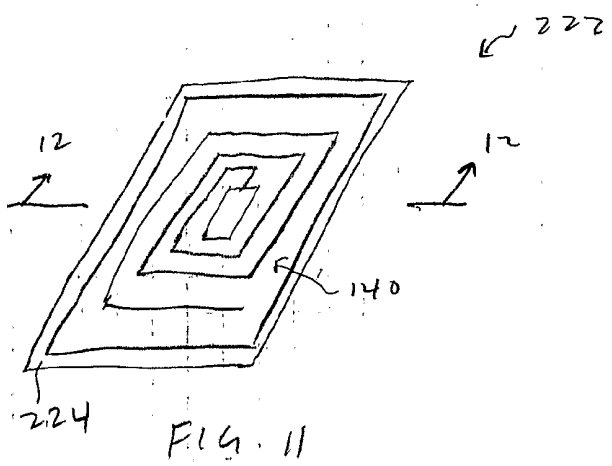


FIG. 11

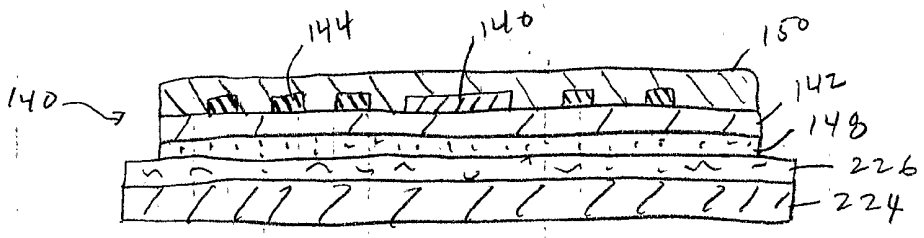


FIG. 12

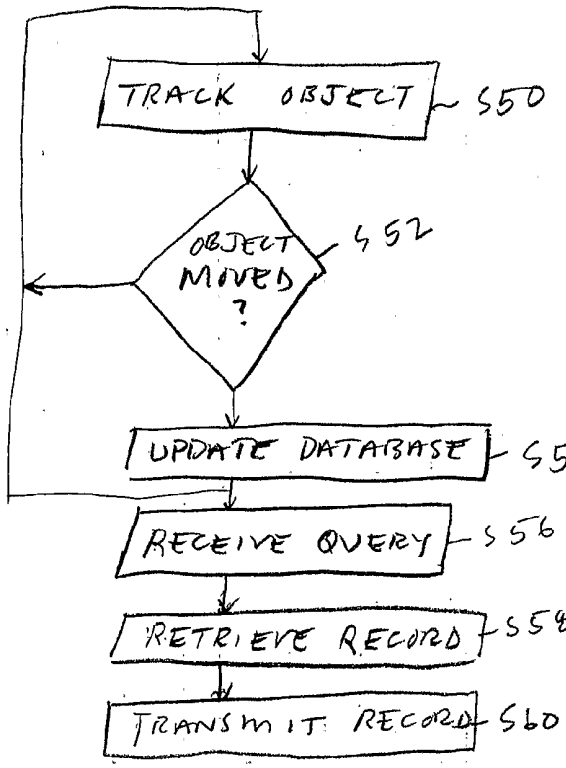


FIG. 14

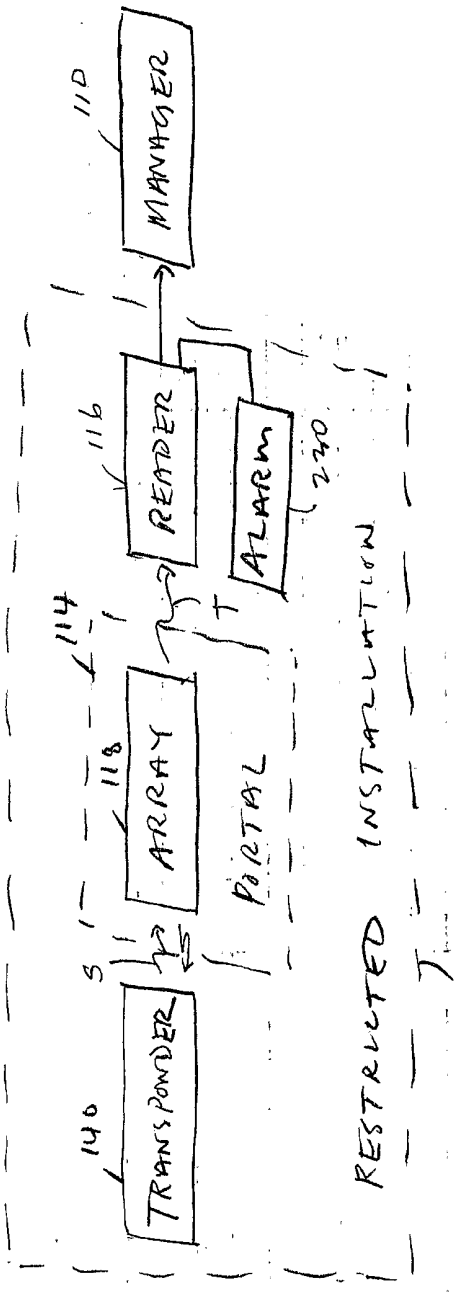
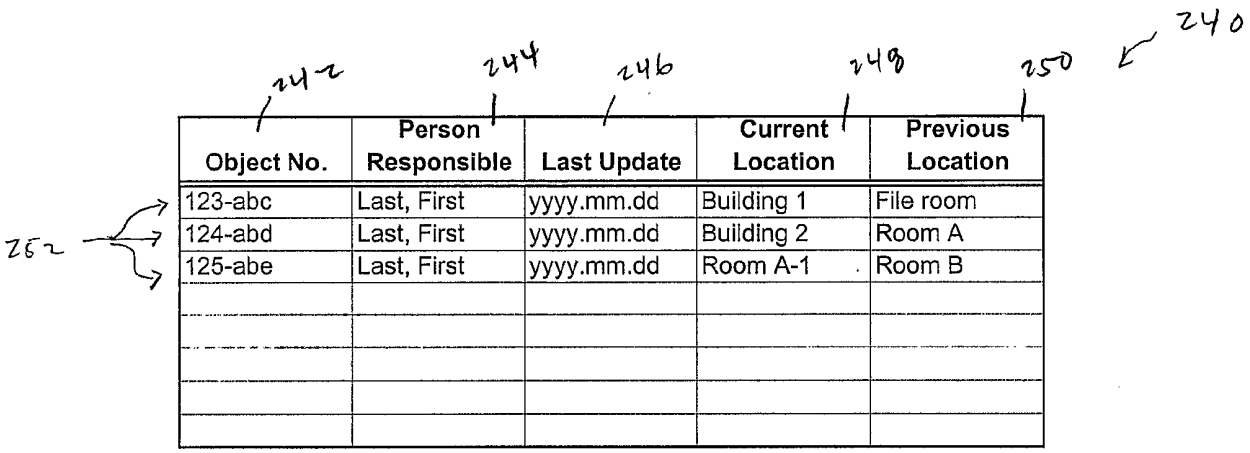
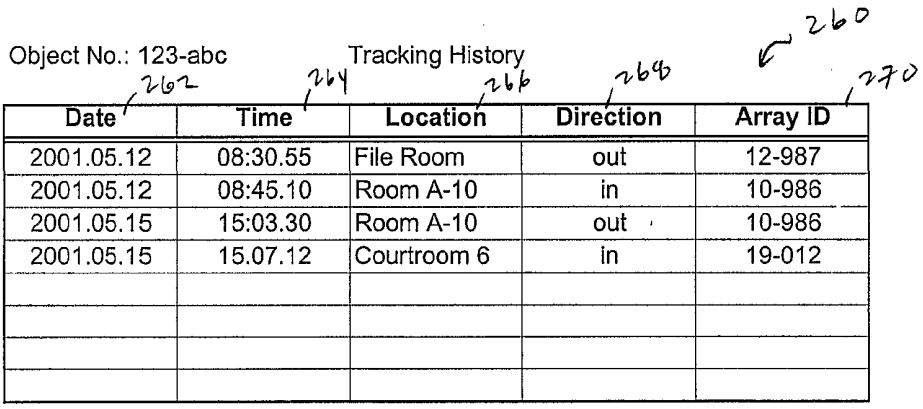

RESTRICTED INSTALLATION
TRANSPONDER
140
ARRAY
118
114
PORTAL
READER
116
ALARM
240
MANAGER
110
108

FIG. 13



Object No.	Person Responsible	Last Update	Current Location	Previous Location
123-abc	Last, First	yyyy.mm.dd	Building 1	File room
124-abd	Last, First	yyyy.mm.dd	Building 2	Room A
125-abe	Last, First	yyyy.mm.dd	Room A-1	Room B

FIG. 15



Date	Time	Location	Direction	Array ID
2001.05.12	08:30.55	File Room	out	12-987
2001.05.12	08:45.10	Room A-10	in	10-986
2001.05.15	15:03.30	Room A-10	out	10-986
2001.05.15	15.07.12	Courtroom 6	in	19-012

FIG. 16

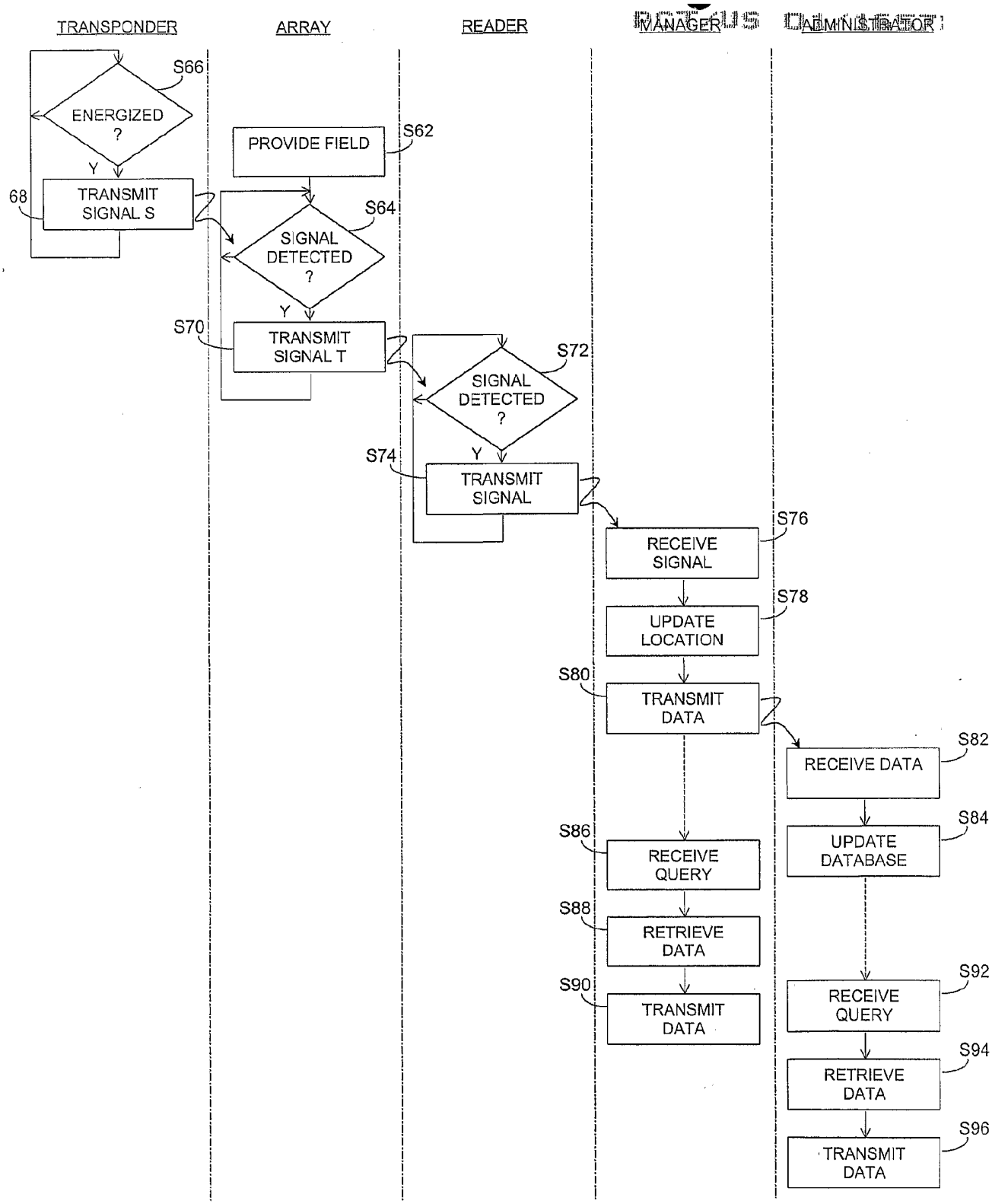

TRANSPONDER
ARRAY
READER
MANAGER
ADMINISTRATOR
S66
ENERGIZED ?
Y
68
TRANSMIT SIGNAL S
PROVIDE FIELD
S62
S64
SIGNAL DETECTED ?
Y
S70
TRANSMIT SIGNAL T
S72
SIGNAL DETECTED ?
Y
S74
TRANSMIT SIGNAL
S76
RECEIVE SIGNAL
S78
UPDATE LOCATION
S80
TRANSMIT DATA
S82
RECEIVE DATA
S84
UPDATE DATABASE
S86
RECEIVE QUERY
S88
RETRIEVE DATA
S90
TRANSMIT DATA
S92
RECEIVE QUERY
S94
RETRIEVE DATA
S96
TRANSMIT DATA

FIG. 17