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(54) **DISTRIBUTED RFID ANTENNA ARRAY UTILIZING CIRCULAR POLARIZED HELICAL ANTENNAS**

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(60) Provisional application No. 60/625,273, filed on Nov. 5, 2004.

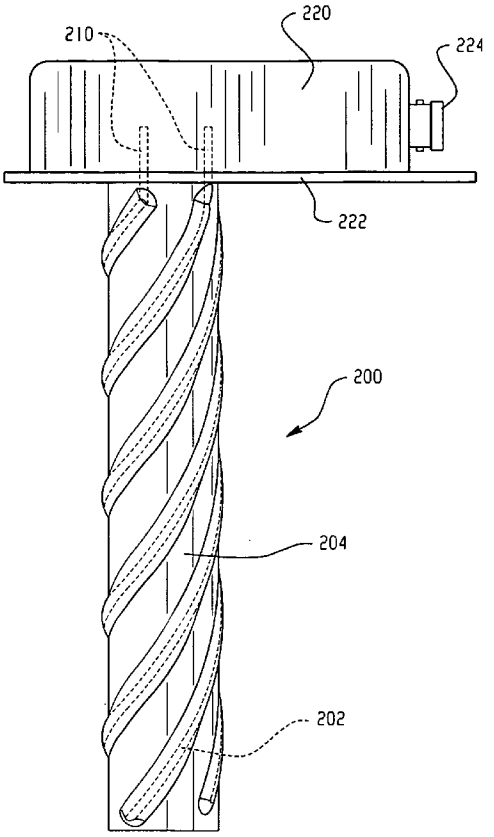
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(57) **ABSTRACT**

In accordance with the teachings described herein, RFID systems are provided that include a distributed RFID antenna array utilizing one or more circular polarized helical antennas. A plurality of RFID tags may be used, with each RFID tag including a linear polarized antenna for communicating RFID tag signals. One or more receiver antennas may be used for receiving the RFID tag signals from the RFID tags. An RFID tag signal reader may be used to process RFID tag signals received by the receiver antennas. In one example, the receiver antennas may include a circular polarized helical antenna element. One or more transmitter antennas may be used for transmitting an RF signal to the plurality of RFID tags, the transmitter antennas including a circular polarized helical antenna element. A transmitter may be used to generate the RF signal for transmission by the transmitter antennas. In one example, the RFID tag signal reader and the transmitter may be included in a single reader/transmitter unit.



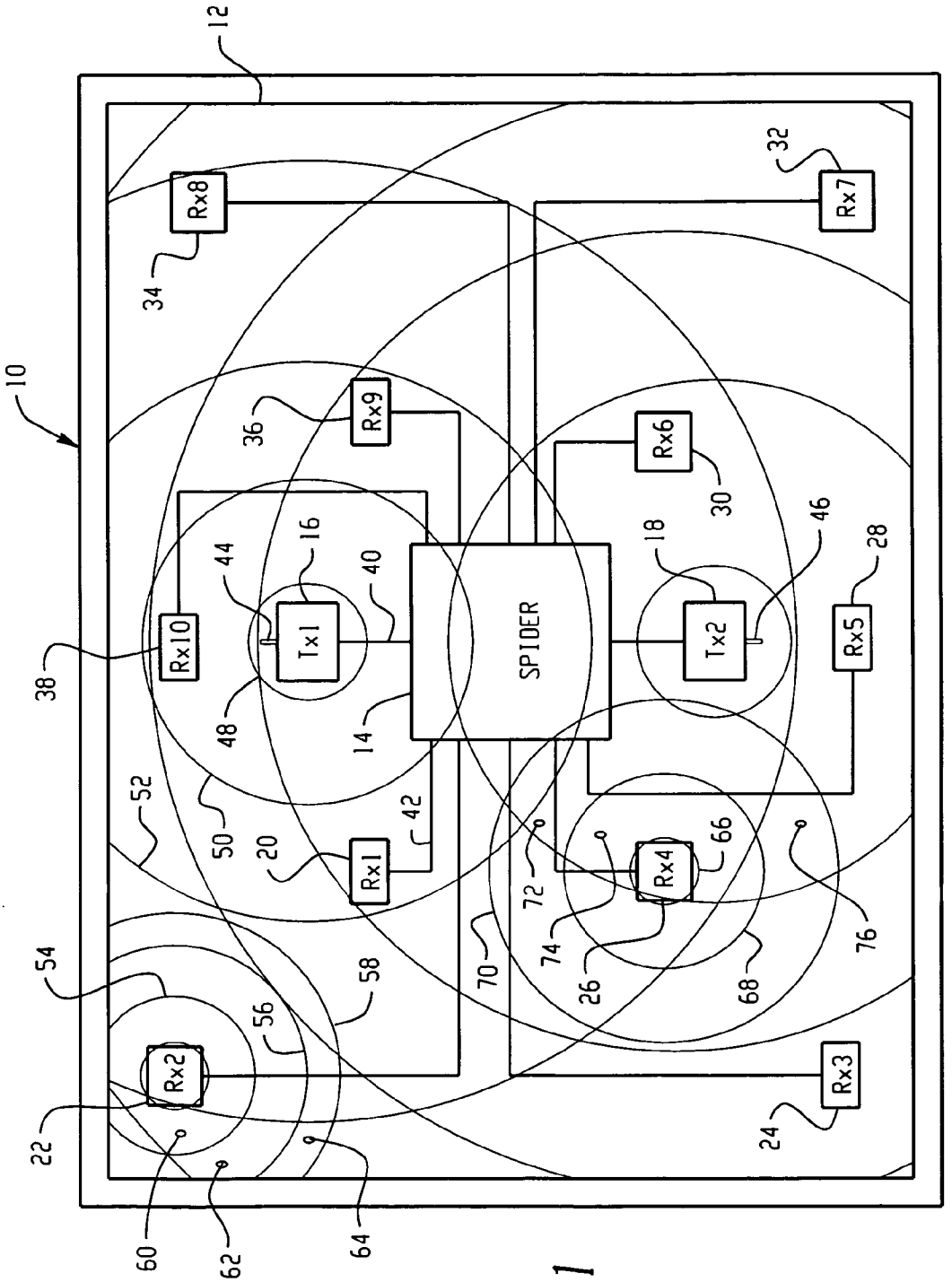

12
10
Rx8
34
32
Rx7
36
Rx9
Rx6
30
16
44
40
18
46
28
Rx10
Tx1
SPIDER
Tx2
Rx5
38
48
14
52
50
42
20
Rx1
66
Rx4
72
74
76
54
58
70
26
68
56
Rx2
Rx3
22
24
60
62
64

Fig. 1

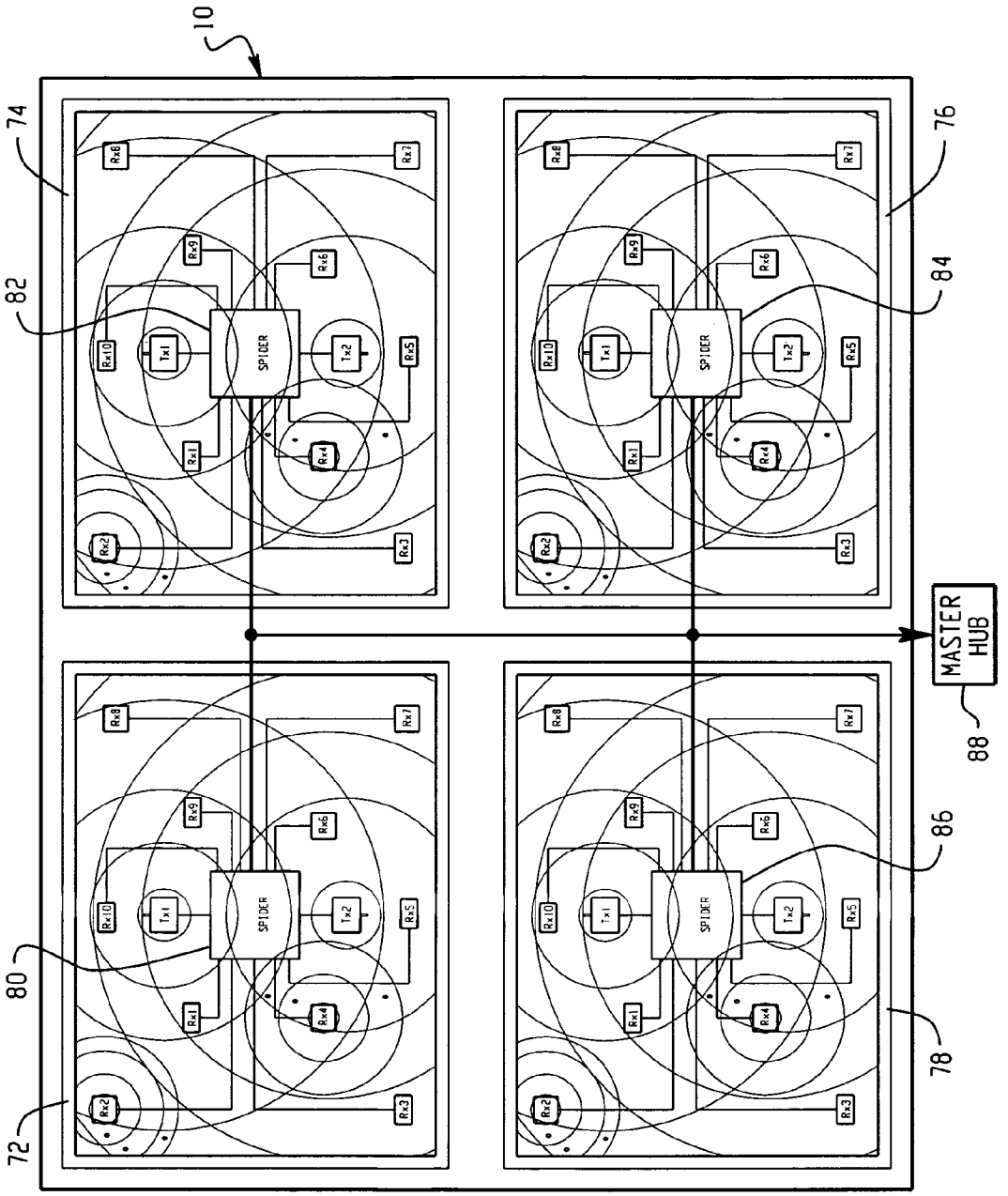

10
74
76
82
84
80
86
72
78
88
MASTER HUB
SPIDER
Rx1
Rx2
Rx3
Rx4
Rx5
Rx6
Rx7
Rx8
Rx9
Rx10
Tx1
Tx2

Fig. 2

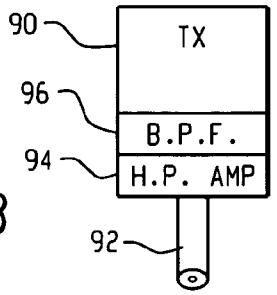


Fig. 3

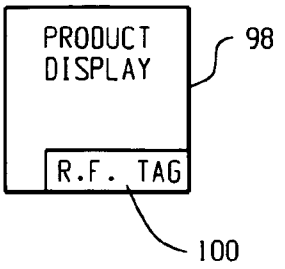


Fig. 4

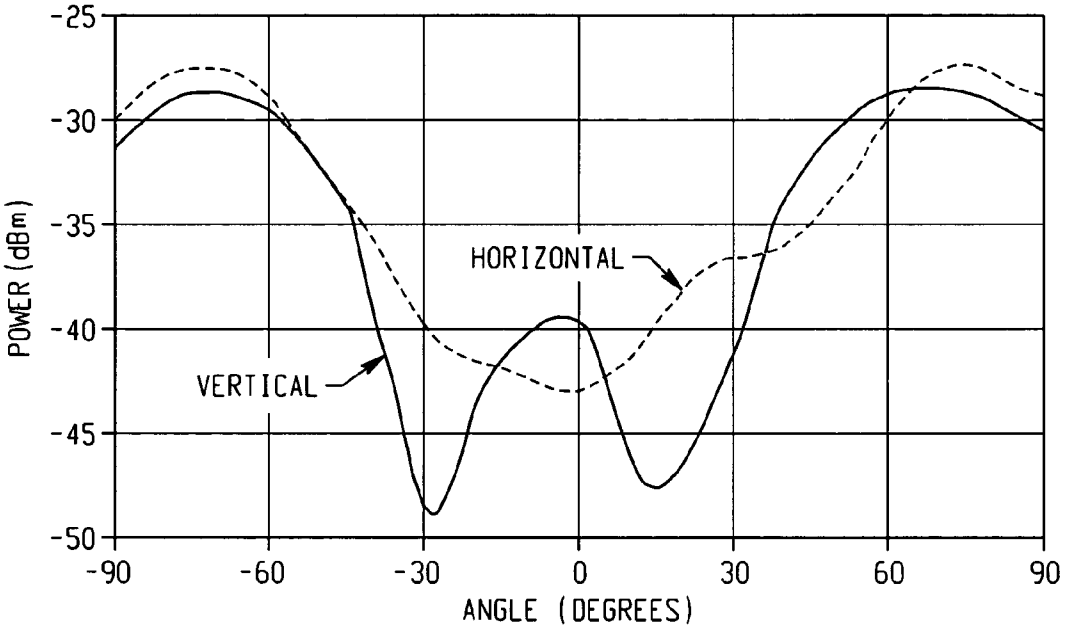


Fig. 5

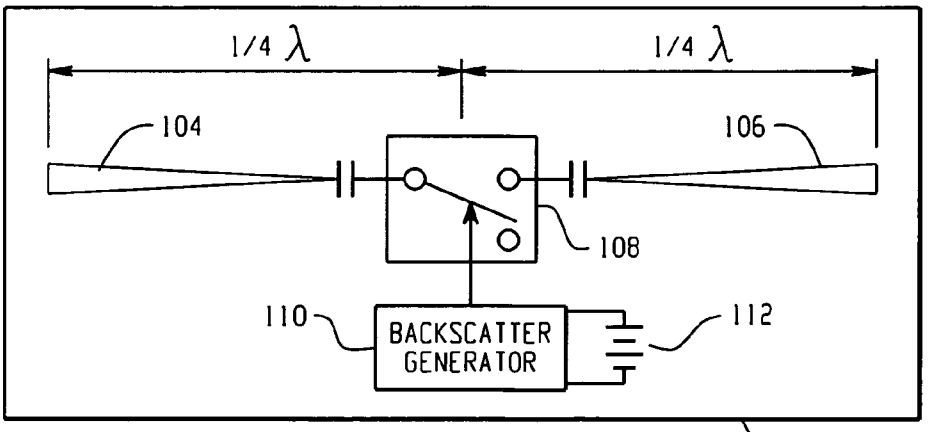


Fig. 6

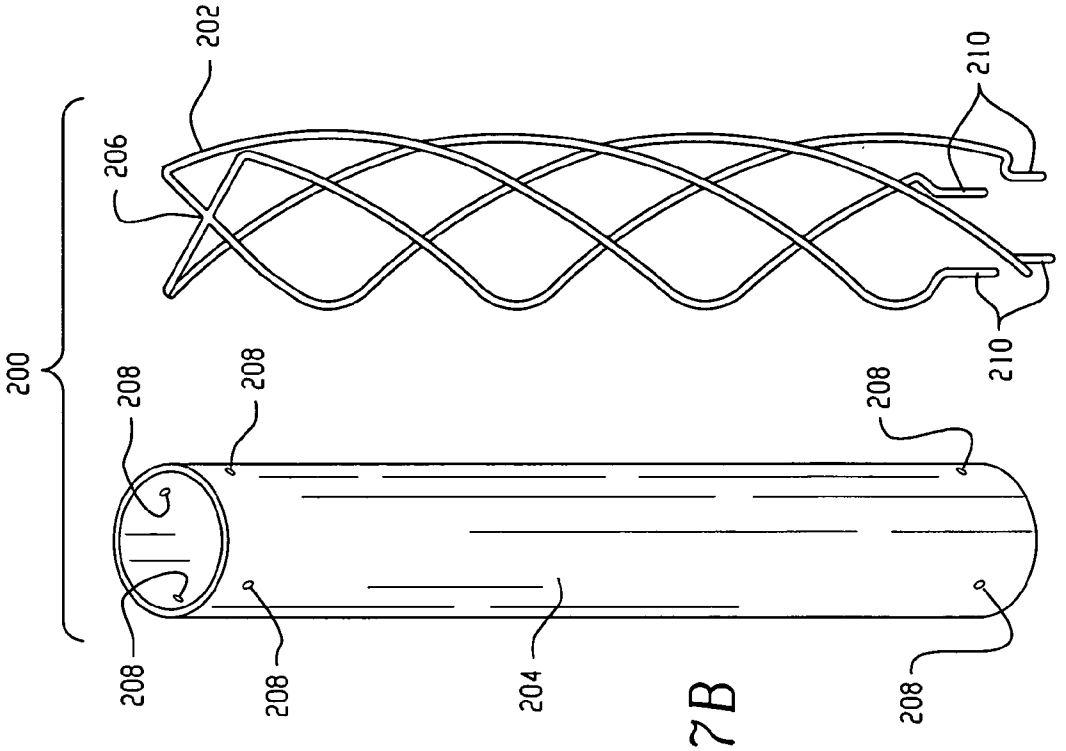

202
206
210
210
200
208
208
208
208
208
204
208

Fig. 7B

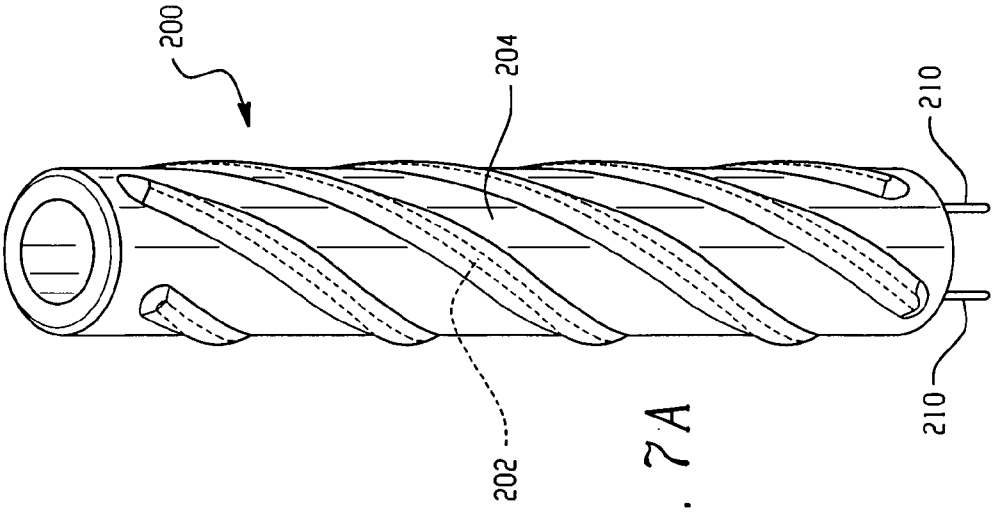

200
204
210
210
202

Fig. 7A

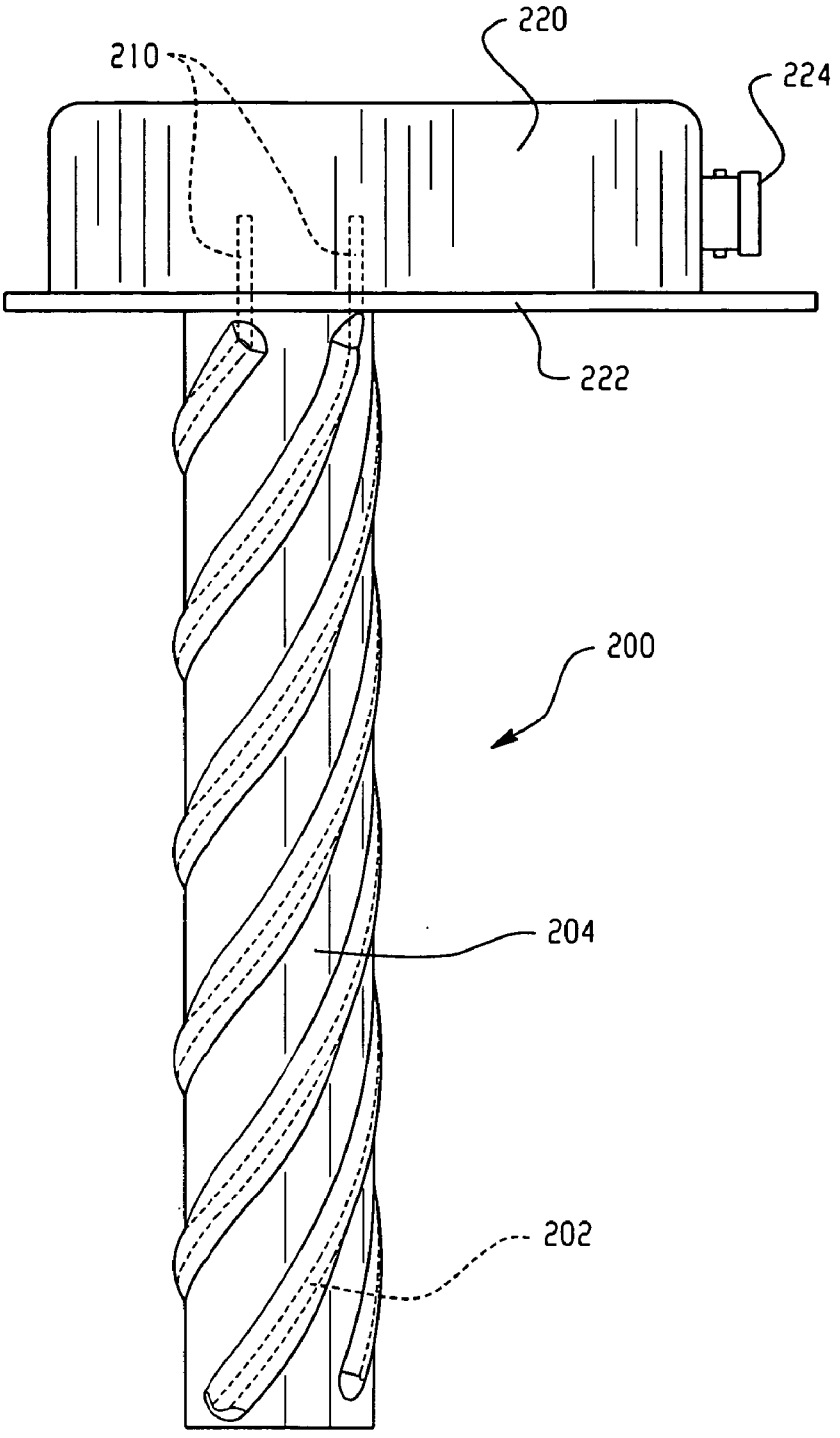


Fig. 8

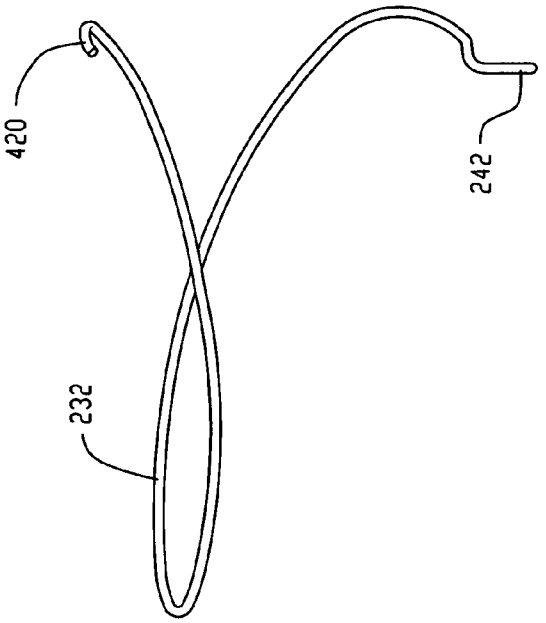


Fig. 9B

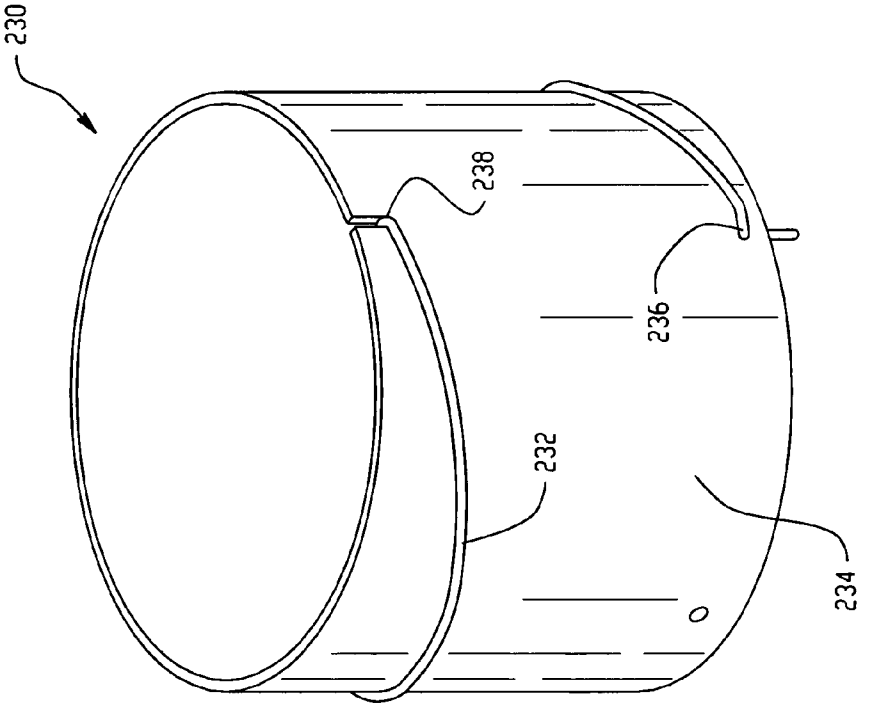


Fig. 9A

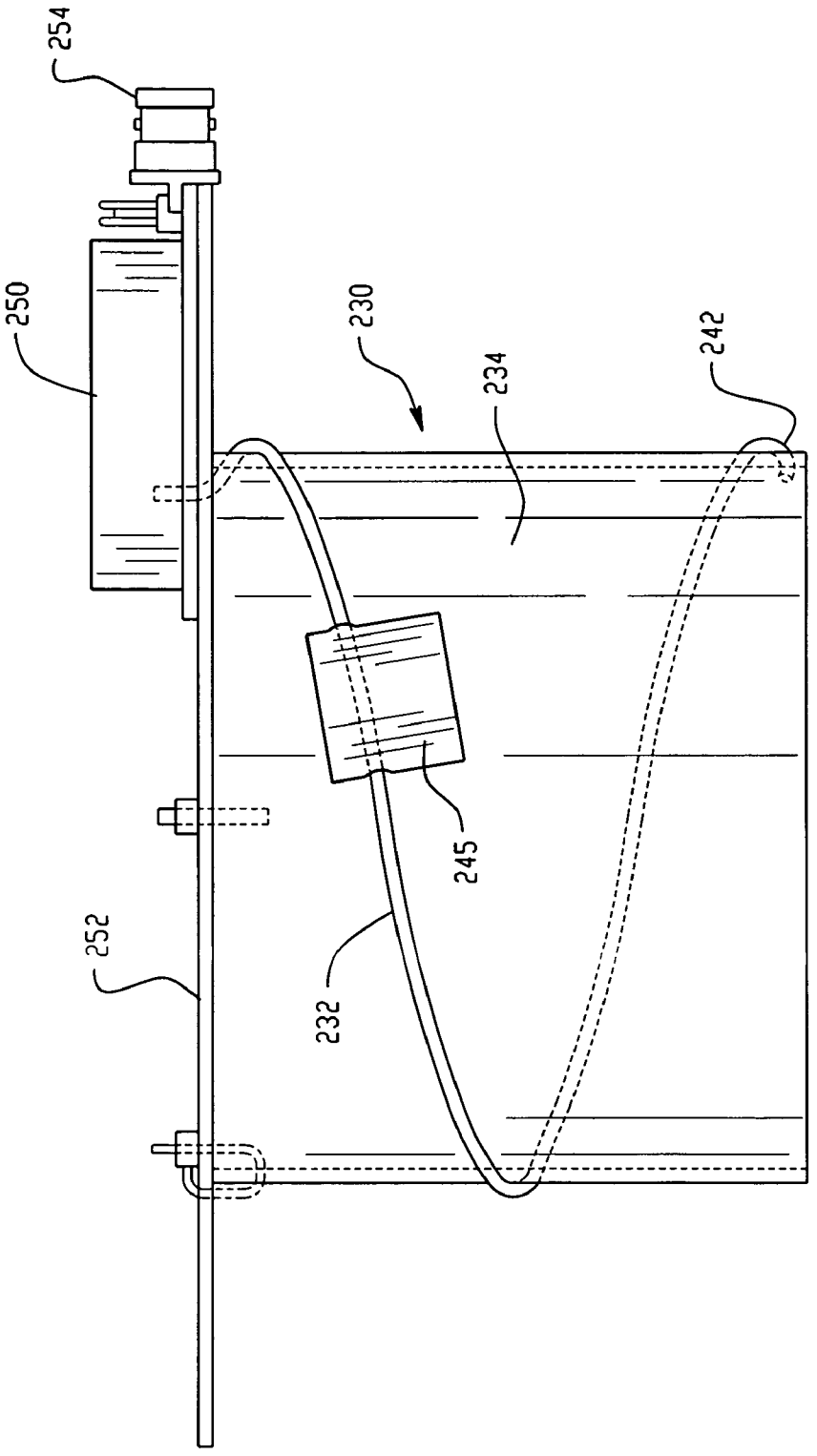


Fig. 10

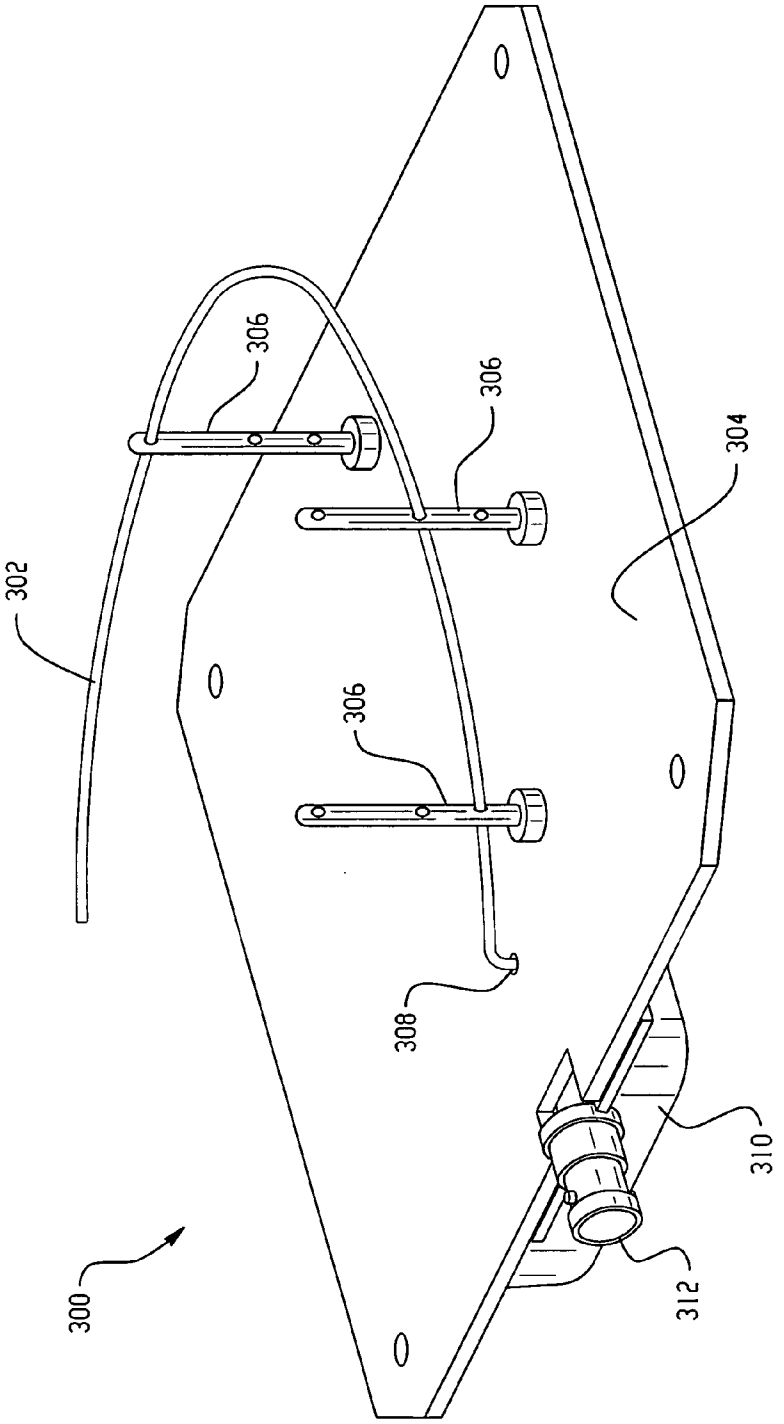


Fig. 11

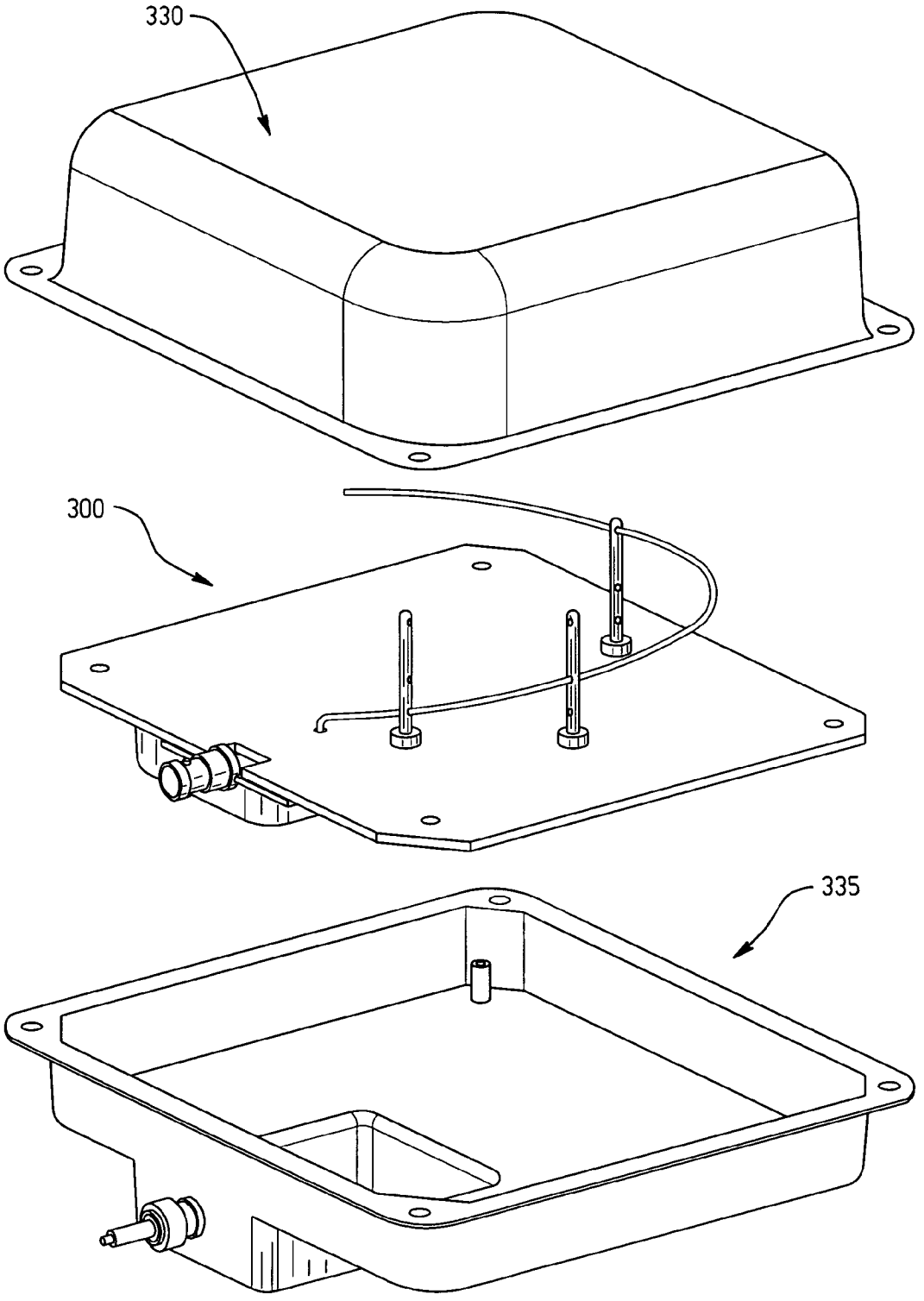


Fig. 12

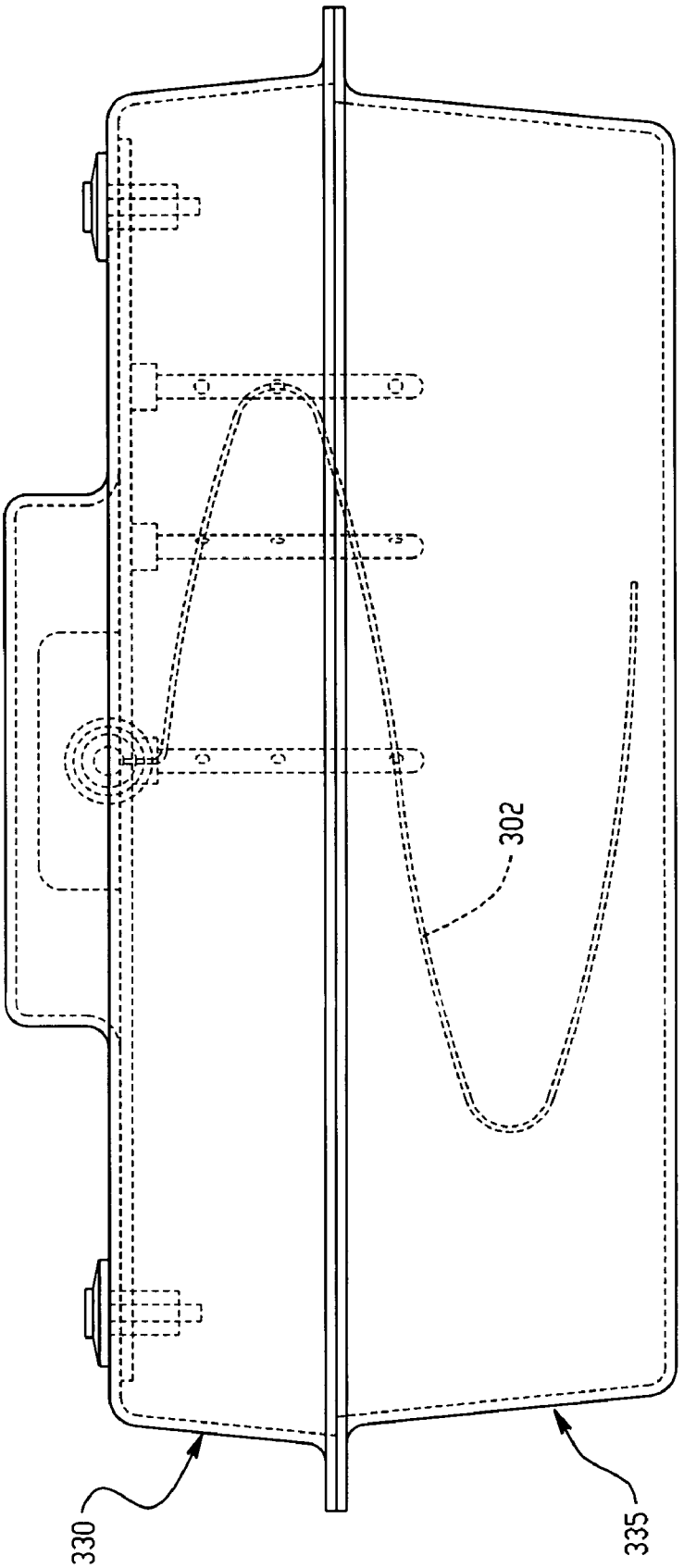


Fig. 13

DISTRIBUTED RFID ANTENNA ARRAY UTILIZING CIRCULAR POLARIZED HELICAL ANTENNAS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. patent application Ser. No. 11/417,768, filed on May 4, 2006, which is a continuation-in-part of International Patent Application No. PCT/US05/37138, filed on Oct. 18, 2005, which claims priority from U.S. Provisional Application No. 60/625,273, filed on Nov. 5, 2004. These prior applications are incorporated herein by reference in their entirety.

FIELD

[0002] The technology described in this patent document relates generally to radio frequency identification (RFID) systems. More particularly, the patent document describes a distributed RFID antenna array that utilizes one or more circular polarized helical antennas.

BACKGROUND

[0003] The RFID system described herein is related to the inventions described in commonly assigned U.S. Patent Application Pub. No. 2004/0056091, which is incorporated herein by reference in its entirety. In that patent application, it was pointed out that a need exists for an advertising compliance monitoring system that provides versatility and flexibility by providing an RFID tag, associated with a specific sign or product display, that communicates tag data to an external reader.

[0004] U.S. Patent Application Pub. No. 2004/0056091 describes an RFID system that may include RFID tags of various types (e.g., passive, semi-passive or active), backscatter reader transmitters (BRT), and hubs. Typically, each BRT is a fully self-contained, battery operated unit, and utilizes three antennas. Two medium-gain patch antennas are used to read the tags, and a whip antenna is used to report the received data over a wireless link to the hub. This system functions well and is capable of detecting and reporting tags in a variety of retail environments and at different frequencies. It is desirable, however, to provide an even more economical RFID system by centralizing some or all of the electronics that have been distributed across areas or subareas in a given facility, thereby reducing redundancy and cost. It is also desirable to increase the read range of tags by the system to reduce the number of antennas required and to increase the reliability of tags being read under marginal conditions.

SUMMARY

[0005] In accordance with the teachings described herein, RFID systems are provided that include a distributed RFID antenna array utilizing one or more circular polarized helical antennas. A plurality of RFID tags may be used, with each RFID tag including a linear polarized antenna for communicating RFID tag signals. One or more receiver antennas may be used for receiving the RFID tag signals from the RFID tags. An RFID tag signal reader may be used to process RFID tag signals received by the receiver antennas. In one example, the receiver antennas may include a circular polarized helical antenna element. One or more transmitter antennas may be used for transmitting an RF signal to the plurality of RFID tags, the transmitter antennas including a circular polarized helical antenna element. A transmitter may be used to generate the RF signal for transmission by the transmitter antennas. In one example, the RFID tag signal reader and the transmitter may be included in a single reader/transmitter unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** depicts an example RFID system that includes a BRT hub that covers a designated area such as an entire commercial sales facility.

[0007] FIG. **2** depicts an example RFID system that includes a plurality of BRT hubs that are used in a plurality of designated areas to cover a larger facility.

[0008] FIG. **3** depicts an example RF transmitter with a high power amplifier and a band-pass filter.

[0009] FIG. **4** depicts an object having an RFID tag associated therewith.

[0010] FIG. **5** is a graph illustrating example quadrifiler helix antenna gain patterns to show that the antenna has a low gain on the axis and a high gain on the sides.

[0011] FIG. **6** depicts an example switched backscatter tag (SBT) illustrating the manner in which the switch is opened and closed to accept or reject a BRT carrier signal.

[0012] FIGS. **7**A and **7**B depict an example transmitter antenna having a circular polarized quadrifiler helix antenna element.

[0013] FIG. **8** depicts the example quadrifiler helix antenna attached to an amplifier circuit.

[0014] FIGS. **9**A and **9**B depict an example receiver antenna having a single turn helix antenna element.

[0015] FIG. **10** depicts the example single turn helix antenna attached to an amplifier circuit.

[0016] FIGS. **11-13** depict another receiver antenna embodiment that includes a single turn helix antenna element.

DETAILED DESCRIPTION

[0017] FIG. **1** depicts an example RFID system that includes a backscatter reader/transmitter (BRT) hub (called a "Spider") that covers a designated area of a facility. The RFID system may, for example, be used to detect and report the presence and location of radio frequency (RF) tags across selected zones in a retail environment. The RFID system may also be used to centralize RF transmission and receiving functions to reduce the expense of recurring components. A single BRT hub ("Spider") may be used that includes antennas attached to multiple transmit and receive ports to cover a designated area of a facility. In small facilities, a single BRT hub may be used to cover the entire facility as the designated area. The Spider may, for example, be connected to AC power to eliminate the cost and maintenance of batteries, as well as allowing more read cycles, if desired. This also may permit higher wattage to be used in the transmit function, potentially increasing the size and reliability of detection zones.

[0018] In FIG. **1**, a small facility **10** is shown in which the designated area **12** to be covered by a BRT hub **14** includes the entire facility. The BRT hub **14** is coupled to a plurality of transmitters (TX **1**, **2**) **16-18** and a plurality of receivers (RX **1-10**) **20-38**, for example using coaxial cable. The plurality of receivers **20-38** are positioned to provide coverage of the entire designated area **12** (the entire facility **10**). Preferably, only one TX and one RX are active at a time. It will be noted that RX **22** is able to receive data from RFID tags **60**, **62**, and **64** at different distances in the sub-area covered by RX **22**, as illustrated by concentric circles **54**, **56**, and **58**. Also it will be noted that the transmitter TX **16** has concentric rings **48**, **50**, and **52** that illustrate the transmitter-to-tag zones covered by the range of transmitter TX **16**, thus showing that the transmitting antenna TX **16** is positioned to illuminate at least a portion of the RFID tags (in the RX zones covered by RX **20**, **22**, **26**, **30**, **34**, **36**, and **38**) in the designated area. In like manner, TX **18** shows corresponding concentric rings illustrating illumination coverage ranges and representing transmitter-to-tag zones covering at least a portion of the RFID tags. Between the two transmitters TX **16** and **18**, all of the RFID tags in the designated area (the facility **12**) are capable of illumination.

[0019] Each of the transmitters TX **16** and **18** is coupled to the BRT hub **14**, for example with coaxial cable. In like manner, each of the receiver antennas in each sub-area is coupled to the BRT hub **14**, for example using coaxial cable. Of course, wireless connections, or other well-known known types of connections could be used instead of coaxial cable.

[0020] When the transmitting antenna **16** illuminates RFID tags within its range, one of the RF signal receiving antennas, such as RX **22**, receives the modulated tag signals and conveys them to the BRT hub **14** over coaxial cable (such as **42**) for transmission to a remote server. A modulated RFID tag signal may be received by more than one RX antenna when read sequentially (for example RX **26** and RX **28**). In such cases, the BRT hub (Spider **14**) may forward both RX events to the server, and may ascertain a location within a store using closest zone readings, received signal strength indicator (RSSI) readings, antenna intersection, or other algorithms. One preferred method is disclosed in commonly assigned copending application Ser. No. 11/418,319, entitled "Systems and Methods for Approximating the Location of an RFID Tag," filed on even date herewith, the subject matter of which is incorporated herein in full.

[0021] The transmitting antennas **44** and **46** associated with respective transmitters TX **16** and **18** should be omni-directional in order to illuminate tags over a large area. A shaped beam with low gain on axis and a high gain to the sides is ideal. For example, a quadrifiler helix antenna, as illustrated in FIGS. **7** and **8**, may be used for the transmitting antennas **44** and **46**. Quadrifiler helix antennas have been the choice in orbiting spacecraft communications for years. A quadrifiler helix antenna has circular polarization and a shaped beam for high gain when the spacecraft is farthest away on the earth's horizon, and low gain when the spacecraft is closest or overhead. Also, when used in an RFID system as described herein, the low profile of an quadrifiler antenna is equally advantageous. To a consumer or other observer in the facility, a quadrifiler helix antenna will typically look like a small white paper towel tube that hangs down a few inches vertically from the ceiling.

[0022] Typically, the transmit beam gain from TX **16** to RX **38** would be lower than the transmit beam gain from TX **16** to RX **22**. Quadrifiler helix antennas are range compensating. The gain of the antenna is higher for objects farther away, which compensates for free-space power loss due to distance. This is illustrated in FIG. **5** which shows power vs. antenna angle. Higher power levels (gain) at 70 degrees are offset by the bore sight of the antenna.

[0023] Further, quadrifiler helix antennas are typically inexpensive. The antennas **44** and **46** shown in FIG. **1**, for example, may be constructed of materials, such as PVC piping, #12 copper wire, and a small circuit card to maintain proper phasing between the elements. This type of antenna has been experimentally tested in a retail environment with very successful results.

[0024] Under FCC rules, part 15, a conducted RF output power of 1 Watt is allowed. The BRT's that are used in the system disclosed in commonly assigned U.S. Patent Application Publication No. 2004/0056091 are battery powered and have a maximum output power of 200 mW to conserve battery life while "illuminating" tags (e.g., reflect and receive backscatter modulated signals produced by the tags). Increasing conducted transmitter power will illuminate tags in a larger area and better illuminate tags marginally located in existing zones. The use of the quadrifiler helix antenna enables a gain of approximately 6 dbic translating into an effective isotropic radiated power (EIRP) of +36 dBm or 4 W. This is an increase of approximately 9 dB over the BRT patch antenna disclosed in the above identified published and commonly assigned co-pending patent application. This translates into an increase of 8 times the power.

[0025] The performance of an RF reader may be affected by transmitter power being coupled into the BRT receiver through the receiver antenna. The backscattered signal from the RFID tag is extremely small, and its detection can easily be overwhelmed by the backscatter transmitter carrier wave signal. Therefore, the separation of the TX antenna and the RX antenna, as shown in FIG. **1**, improves performance because the deployment system allows for excellent separation.

[0026] Also, the use of the switched backscatter RFID tag (SBT) **102** shown in FIG. **6** also improves the signal communications between the SBT and the BRT. In one example, the SBT **102** has an antenna in which each side **104** and **106** of the antenna is approximately ¼λ (i.e., ¼ wavelength). In the case of a 915 MHz tag, each side is about 3.2 inches long. For a 2.45 GHz tag, these lengths would be approximately 1.2 inches long. Thus, for different frequencies the antenna lengths also would be different. A backscatter generator **110** produces a sub-carrier frequency that contains data, such as a tag ID. This backscatter signal opens and closes the RF switch **108** that connects the resonant ¼λ antenna elements **104** and **106**. When the switch **108** is in the closed position, the antenna acts as a ½λ element, which is not a good receiver, and that reflects a higher percentage of the reader carrier frequency back to the reader.

[0027] When the switch **108** is in the open position, as shown, each antenna side is ¼ of the wavelength of the carrier frequency, which makes it a good receiver, and therefore absorbs more of the reader carrier frequency so it is not reflected back to the reader. This combination results in a substantial increase in the ratio of a "mark" (a 1 in

binary state monitoring) to "space" (a 0 in binary state monitoring) signal received by the BRT. The increased ratio results in a dramatic improvement in the reader's ability to track the modulated signal containing the tag data across much larger distances. It also allows tags to be read more easily under marginal conditions, such as when they are close to liquid or metal (conditions well known in the art to be quite challenging for tags in the UHF band). In one example, the tag has improved performance because the antenna is T-shaped, with the antenna elements across the top of the tag, pointing out and away from other circuitry on the printed circuit board. This increases the effectiveness of the available frequency aperture and reduces antenna detuning.

[0028] The clean switching between "on" and "off" of a resonant aperture increases the mark-to-space ratio of the backscatter data as received by the BRT. It is this increased ratio that improves the BRT's ability to detect tags in a specific area of the store area being monitored using a carrier frequency, thereby allowing tags with a cleanly-switched resonant aperture to be detected at a much greater distance than tags without a cleanly-switched resonant aperture.

[0029] The system shown in FIG. **1** is well-suited for a small commercial sales establishment, such as a drug store, but a single Spider would likely be insufficient for larger-format retailers, such as grocery or mass merchandiser outlets. In such cases, several Spiders, each with separate Webs, could be used to cover the establishment. Connectivity to phone lines and redundant external communication electronics across multiple Spiders in a store could be circumvented by centralizing those functions into one master Spider **84**. Such a system is shown in FIG. **2**.

[0030] Note in FIG. **2** that the selected location, or retail sales facility **10**, is too large for one Spider. Therefore, in this example, four designated areas **72**, **74**, **76**, and **78** are used to cover the entire facility **10**. Each of the systems in each of the designated areas **72-78** is identical to the system shown in FIG. **1** and operates in an identical manner as described above. However, each of the Spiders **80**, **82**, **84**, and **86** could be electronically coupled to a master hub **88** as shown.

[0031] Multiple Web antennae are connected to a single backscatter transmitter/receiver in the Spider, for example through coaxial cables. These coaxial cables pass through a switch matrix. This matrix and the long coaxial cables combine to create additional attenuation, thereby lowering the received signal level. To overcome this loss, a low noise amplifier (LNA) is positioned at each RX antenna. These amplifiers draw small amount of current (≈15 mA) through the coaxial cable using bias tees. Locations in retail environments that are difficult or expensive to monitor via coaxial cable, such as external fuel pump signage, could still be served by the previously-designed BRT's with distributed reader/transmitter electronics by forwarding their data wirelessly to the master Spider.

[0032] FIG. **3** is a block diagram of an example quadrifiler helix antenna **90**. The antenna **90** is coupled to the Spider through a coaxial cable **92** and has an associated high power amplifier **94** to recover coaxial cable signal attenuation. The antenna **90** also has an associated ISM (Industrial, Scientific, and Medical) band pass filter **96** to reduce noise or harmonics.

[0033] FIG. **4** depicts an example object **98** having an PFID tag **100** associated therewith. The object may be a permanent display, Point of Purchase (POP) temporary display, signage, advertising material, stock-alert sensors, merchandising material, category section marker, individual product, or other material desired to be monitored by retailers, manufacturers, or point-of-sale producers (collectively a "display"). The object may also be a consumer (or movable object) to which an RFID tag is associated so that the shopping (movement) pattern of the consumer can be monitored. In this manner, consumer exposure to a given display may be tracked. An RFID tag given to a consumer may, for example, be a small active transmitter tag (ATT) that uses the same frequency and protocol as the reflection from the semi-passive backscatter tags.

[0034] FIGS. **7-10** depict example circular polarized antenna configurations that may be used as transmitter and receiver antennas in an RFID system, as described herein. It has been determined that for both economic and performance reasons the optimal solution for the antennas in an RFID system is to use circular polarized antennas for the transmitters and receivers and to use linear polarized antennas for the RFID tags. The switched backscatter RFID tag (SBT), described herein, is one example of an RFID tag having a linear polarized antenna.

[0035] Using a linear polarized tag in an RFID system is typically more economical than using a tag with circular polarization. A linear polarized tag can typically be made smaller than a tag using circular polarization because a linear polarized antenna needs to operate in only one axis. However, from a system standpoint the radiation patterns of the antennas in the transmitter, receiver and tag should all be aligned or coplanar to achieve the most robust link and the best performance. This is most easily achieved in a retail environment using circular polarized antennas because maintaining coplanar antenna alignment between linear antennas in a retail environment is often impractical. A good compromise is the use of circular polarized antennas for the receivers and transmitters and linear polarized antennas for the RFID tags. In this manner, a high level of overall system performance may be maintained, while reducing the cost of the RFID tags.

[0036] FIGS. **7**A and **7**B depict an example transmitter antenna **200** that includes a quadrifiler helix antenna element **202**. FIG. **7**A is a side view of the antenna structure **200** and FIG. **7**B is an exploded view in which the antenna element **202** and dielectric core **204** are depicted separately. The dielectric core **204** is a cylindrical structure formed from a non-conducting material. The antenna element **202** includes four radiating arms that are joined at a common junction **206** and that extend from the common junction in a helical pattern. In one example, the antenna element **202** may be formed from two antenna wires that are joined at the common junction **206**, for instance by soldering, and that are shaped to form the four radiating arms of the quadrifiler helix structure. In another example, the two wires forming the antenna element may be in physical contact, but not mechanically joined, at the common junction **206**.

[0037] In the illustrated example, the antenna structure **202** is attached to the dielectric core **204** using a plurality of holes **208** in the dielectric core **204**. As illustrated in FIG. **7**A, the antenna structure **202** may be attached through the

holes **208** in the dielectric core **204**, such that the common junction **206** is within the cylinder of the core **204** and the spiral portions of the radiating arms extend through an upper set of holes **208** and along the outside of the dielectric core **204**. The four radiating arms may also extend through a lower set of holes **208** such that the four end portions **210** of the radiating arms extend from inside of the dielectric core **204**. In addition, the antenna element **202** may be further secured to the dielectric core **204**, as well as protected from environmental conditions, by covering the radiating arms on the outside of the core **204** with a protective material, such as a heat shrink, as shown in FIG. **7**A.

[**0038**] FIG. **8** depicts the example quadrifiler helix antenna **200** attached to an amplifier circuit **220**. As illustrated, the end portions **210** of the antenna element **202** may extend through a dielectric material **222**, such as a printed circuit board, to couple the antenna **202** to the amplifier circuit **220**. The dielectric material **222** may also incorporate an antenna backplane (e.g., a metallic surface) to shield the antenna **202** from the amplifier circuit **220** and to provide directivity to the circular polarized radiation pattern of the helical antenna element **202**.

[**0039**] The amplifier circuit **220** may, for example, be attached to the ceiling of a retail environment such that the antenna **200** extends downwardly from the ceiling. In addition, the amplifier circuit **220** may be coupled to other components in the RFID system via an external connector **224**, such as a coaxial cable connector. In one example, the amplifier circuit **220** may include two or more gain settings that may be used to tune the amplifier circuit **220** for use in different sized retail environments. For example, a higher gain setting for the amplifier **220** may be used for a larger retail environment.

[**0040**] FIGS. **9**A and **9**B depict an example receiver antenna **230** that includes a single turn helix antenna element **232**. FIG. **9**A is a prospective view of the antenna structure **230** showing both the antenna element **232** and the dielectric core **234**, and FIG. **9**B shows only the antenna element **232**. The dielectric core **234** is a cylindrical structure formed from a non-conducting material. In the illustrated example, the antenna element **232** is attached to the dielectric structure **234** using a hole **236** in a bottom portion of the dielectric core **234** and a slot **238** in an upper portion of the core **234**. As illustrated in FIG. **9**A, an upper end portion **240** of the antenna element **232** may extend trough the slot **238** and a lower end portion **242** of the antenna element **232** may extend through the hole **236**, such that the spiral portion of the antenna element extends along the outside of the dielectric core **234**.

[**0041**] FIG. **10** depicts the example single turn helix antenna **230** attached to an amplifier circuit **250**. As illustrated, the lower end portion **242** of the antenna element **232** may extend through a dielectric material **252**, such as a printed circuit board, to couple the antenna **232** to the amplifier circuit **250**. The dielectric material **252** may also incorporate an antenna backplane (e.g., a metallic surface) to shield the antenna **232** from the amplifier circuit **250** and to provide directivity to the circular polarized radiation pattern of the helical antenna structure **232**. FIG. **10** also illustrates a conductive patch **245** that may be included to tune the antenna and possibly to help adhere the antenna element **232** to the dielectric material **252**. The element **232** may be adhered to the outside of the patch **245**.

[**0042**] The amplifier circuit **250** may, for example, be located in the ceiling of a retail environment, for example above the ceiling tiles. In addition, the amplifier circuit **250** may be coupled to other components in the RFID system via an external connector **254**, such as a coaxial cable connector.

[**0043**] FIG. **11** depicts another preferred embodiment of receiver antenna **300** that includes a single turn helix antenna element **302**. In this example, the antenna element **302** is not supported by a dielectric core. Rather, the antenna element **302** is attached to a dielectric material **304**, such as a printed circuit board, using a plurality of support structures **306** made of a dielectric material, such as plastic. In addition, an end portion of the antenna element **302** is coupled to an amplifier circuit **310** through a hole **308** in the dielectric material **304**. The dielectric material **304** may also incorporate an antenna backplane (e.g., a metallic surface) to shield the antenna element **302** from the amplifier circuit **310** and to provide directivity to the circular polarized radiation pattern of the helical antenna structure **302**. Also illustrated is a connector **312**, such as a coaxial cable connector, for coupling the amplifier circuit **310** to other components in the RFID system. In one example, the antenna element **302** may be about 1λ in length with a pitch of about 0.2λ The openings **307** in the supports **306** serve to fix the pitch at the beginning portion of the element **302** at its critical beginning location.

[**0044**] FIG. **12** is an exploded view of an example enclosure **330**, **335** for housing the receiver antenna **300**. The antenna housing **330**, **335** may, for example, be secured in the ceiling of a retail environment, for example above the ceiling tiles. FIG. **13** shows how the antenna structure **302** fits within the housing portions **330**, **335**.

[**0045**] This written description uses examples to disclose the invention, including the best mode, and also to enable a person skilled in the art to make and use the invention. The patentable scope of the invention may include other examples that occur to those skilled in the art.

It is claimed:

1. A coreless helical antenna structure, comprising:

a dielectric base structure;

an antenna element extending away from the dielectric base structure in a spiral pattern and having a circular polarized radiation pattern; and

a plurality of support structures that attach the antenna element to the dielectric base structure.

2. The coreless helical antenna structure of claim 1, wherein the plurality of support structures are configured to maintain the spiral pattern of the antenna element.

3. The coreless helical antenna structure of claim 1, wherein the antenna element includes a single radiating arm that extends away from the dielectric base structure in the spiral pattern.

4. The coreless helical antenna structure of claim 3, wherein the single radiating arm of the antenna element forms a single turn helix antenna.

5. The coreless helical antenna structure of claim 3, wherein the single radiating arm is formed from a single antenna wire.

6. The coreless helical antenna structure of claim 1, further comprising:

a metallic antenna backplane that adds directivity to the circular polarized radiation pattern of the antenna element.

7. The coreless helical antenna structure of claim 6, wherein the metallic antenna backplane is integral to the dielectric base structure.

8. The coreless helical antenna structure of claim 1, wherein the plurality of support structures include openings and the antenna element is supported within the openings.

9. The coreless helical antenna structure of claim 3, wherein the plurality of support structures maintain a desired pitch of the antenna element with respect to the dielectric base structure.

10. The coreless helical antenna structure of claim 9, wherein the antenna element has a total length and the pitch is about equal to ⅕ the total length of the antenna element.

11. The coreless helical antenna structure of claim 1, wherein the plurality of support structures are made of a dielectric material.

12. The coreless helical antenna structure of claim 11, wherein the plurality of support structures are plastic.

13. The coreless helical antenna structure of claim 1, further comprising an amplifier circuit coupled to the antenna element and operable to amplify a signal received by the antenna element.

14. The coreless helical antenna structure of claim 1, wherein the coreless helical antenna structure is configured as a receiver antenna for an RFID system.

15. The coreless helical antenna structure of claim 1, wherein the coreless helical antenna structure is supported within an enclosure.

16. A coreless helical antenna structure, comprising:

a dielectric base structure;

an antenna element that includes a single radiating arm extending away from the dielectric base structure in a spiral pattern and having a circular polarized radiation pattern; and

a support structure that attaches the antenna element to the dielectric base structure and that is configured to maintain a desired pitch of the antenna element with respect to the dielectric base structure.

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