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(54) SYSTEM AND METHOD FOR RADIO FREQUENCY TAG GROUP SELECT

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(57) **ABSTRACT**

A system and method is disclosed for selecting certain subgroups of radio frequency (RF) tags for querying, communicating, and/or identifying by a base station. The base station sends commands to a group tags within a RF field of the base station. The tags use control logic to determine whether or not they meet certain criteria sent out by the commands. This may cause the tags to change state which either prevents or allows a given tag to participate in an identification process. In this way, a given subgroups of tags meeting certain criteria can be selected for querying, communicating, and/or identifying.

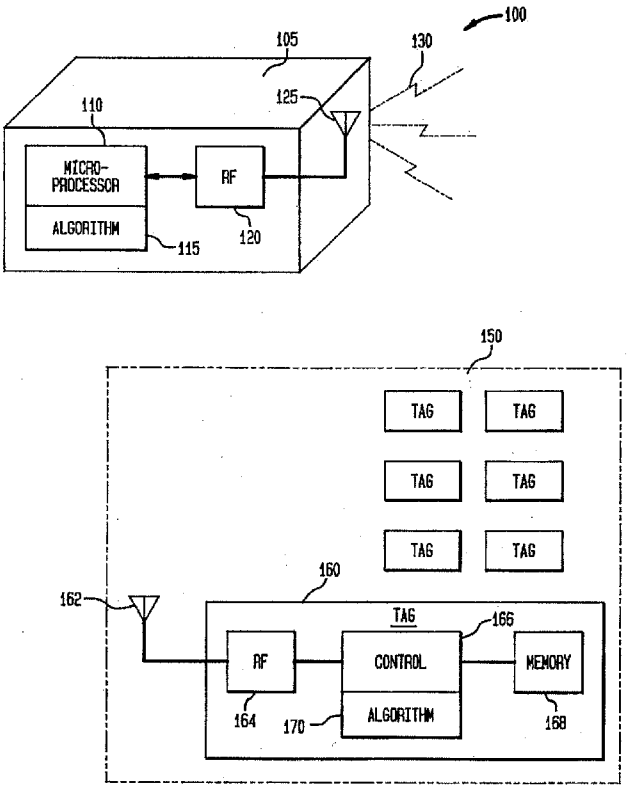


FIG. 1

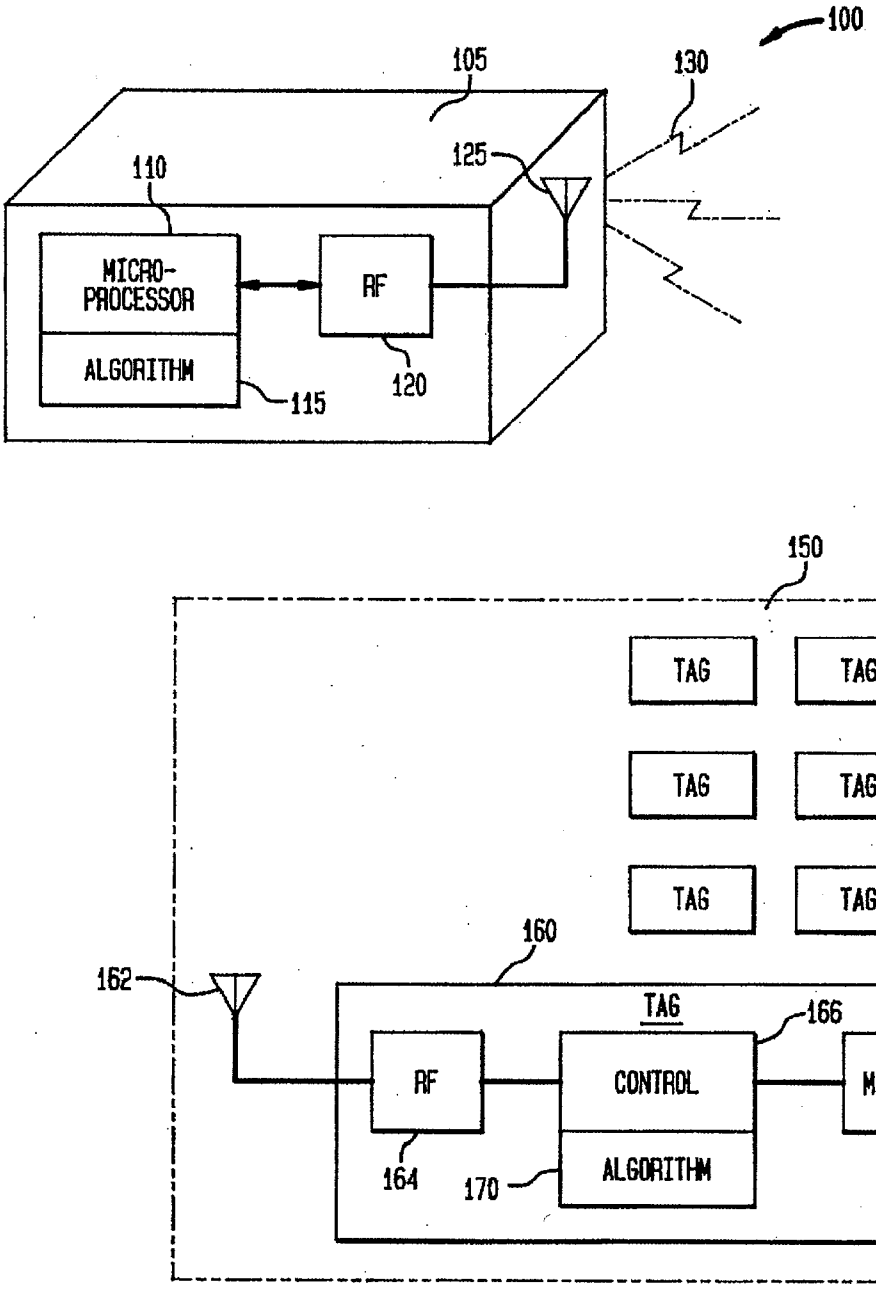

100
105
130
110
125
MICRO-
PROCESSOR
RF
ALGORITHM
115
120
150
TAG
TAG
TAG
TAG
TAG
TAG
160
162
TAG
166
RF
CONTROL
MEMORY
164
170
ALGORITHM
168

FIG. 2

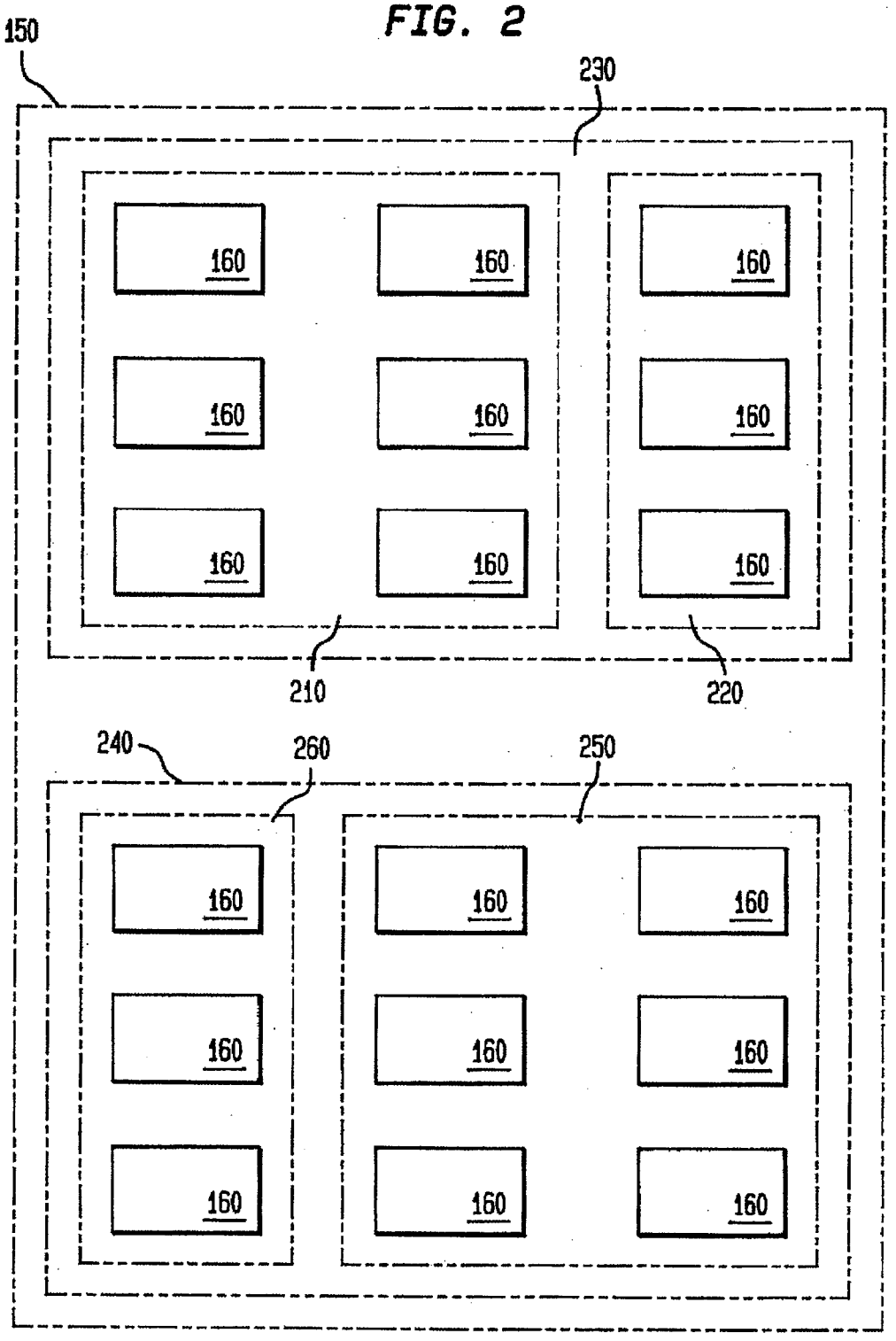

150
230
160
160
160
160
160
160
160
160
160
160
160
160
210
220
240
260
250
160
160
160
160
160
160
160
160
160
160
160
160

FIG. 3

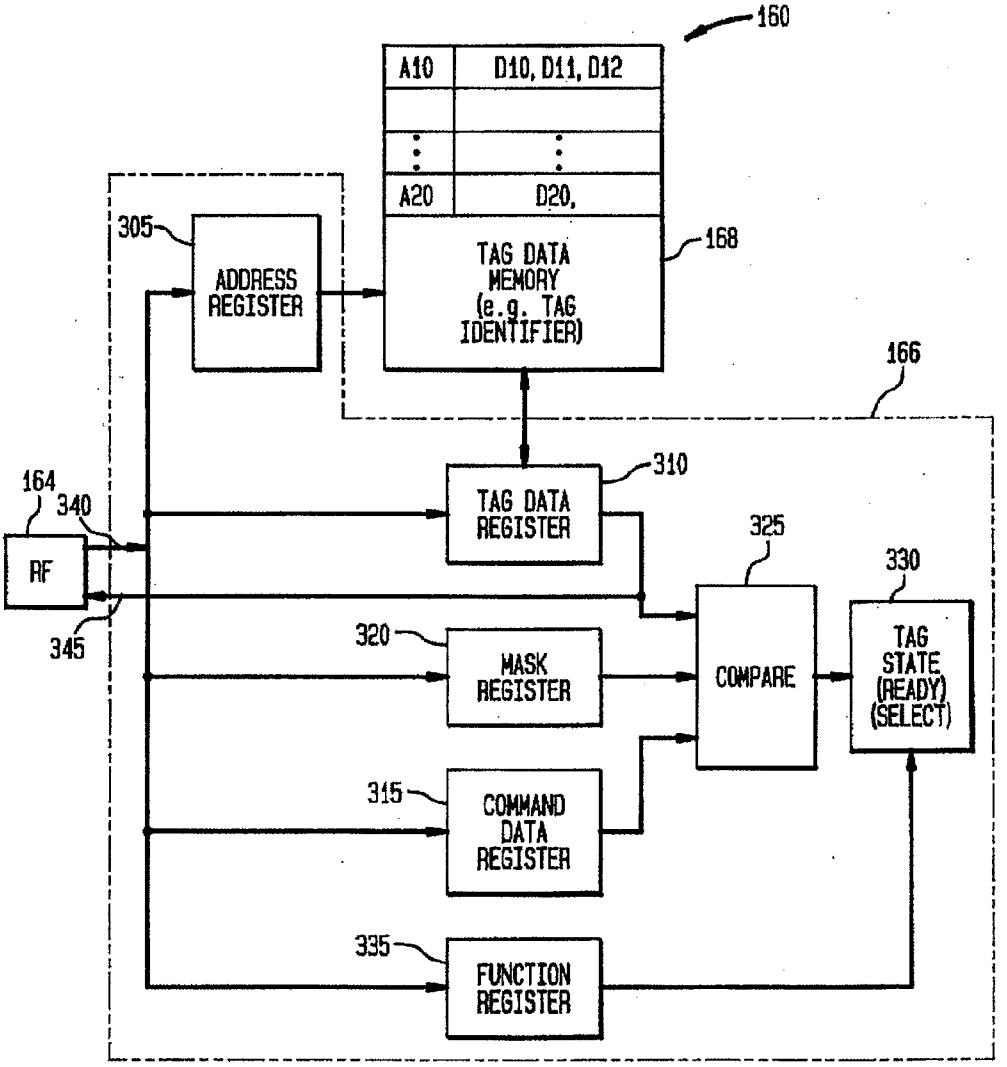

160
A10
D10, D11, D12
A20
D20,
168
TAG DATA MEMORY (e.g. TAG IDENTIFIER)
305
ADDRESS REGISTER
166
310
TAG DATA REGISTER
164
340
RF
345
325
330
320
MASK REGISTER
COMPARE
TAG STATE (READY) (SELECT)
315
COMMAND DATA REGISTER
335
FUNCTION REGISTER

FIG. 4B

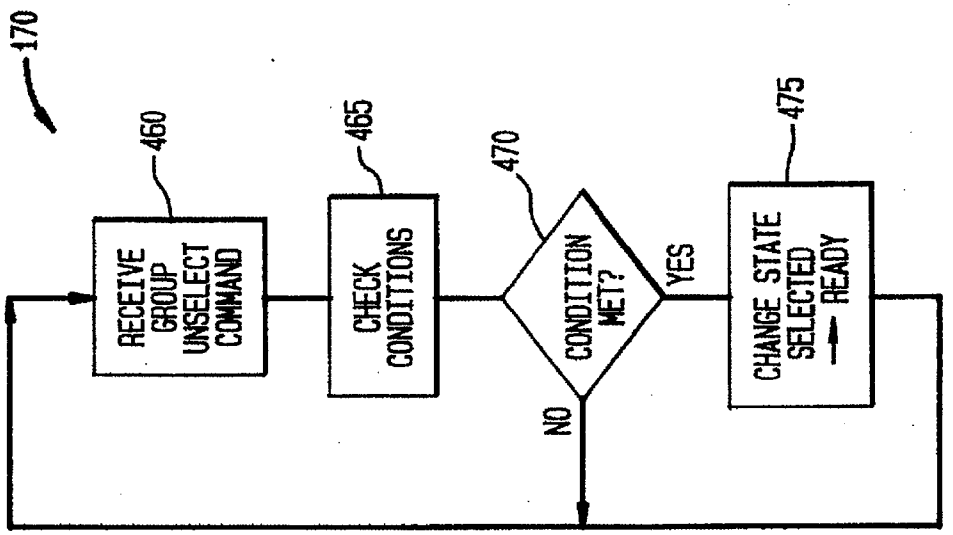

170
460
RECEIVE GROUP UNSELECT COMMAND
465
CHECK CONDITIONS
470
CONDITION MET?
YES
NO
475
CHANGE STATE SELECTED → READY

FIG. 4A

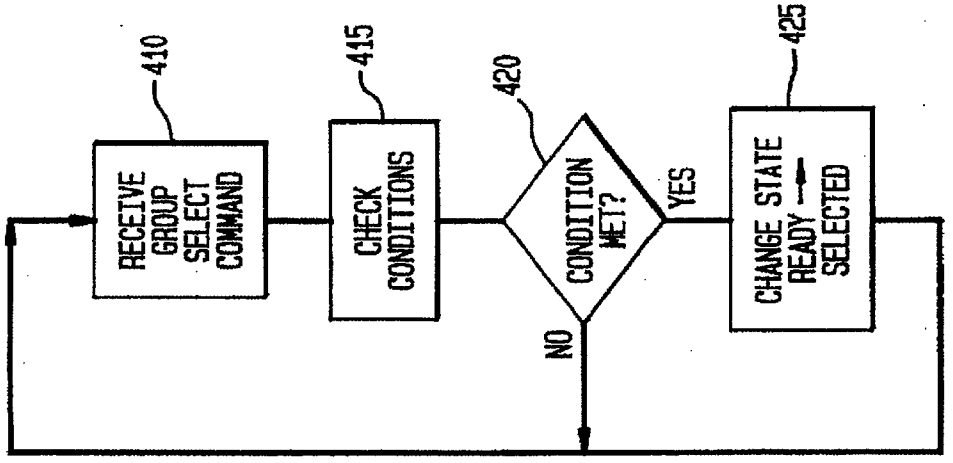

410
RECEIVE GROUP SELECT COMMAND
415
CHECK CONDITIONS
420
CONDITION MET?
YES
NO
425
CHANGE STATE READY → SELECTED

FIG. 5A

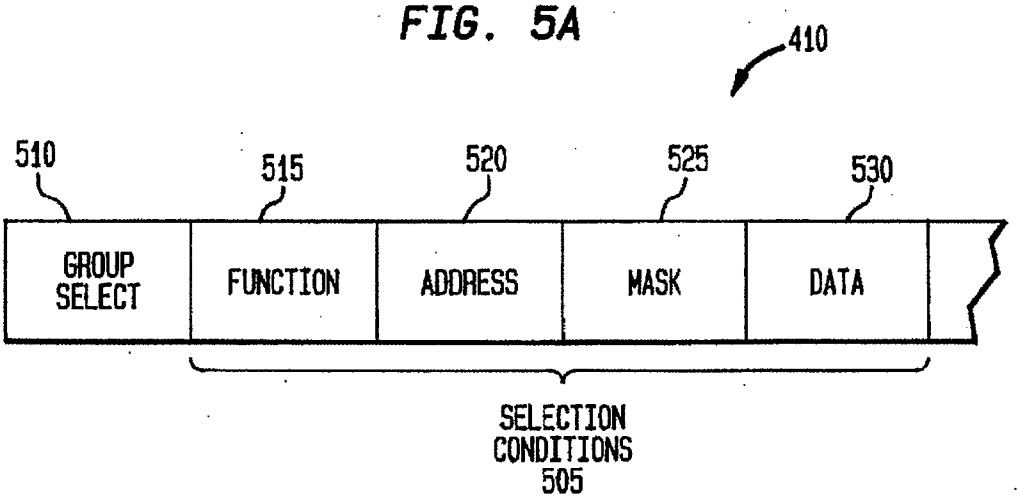

410
510
515
520
525
530
GROUP SELECT
FUNCTION
ADDRESS
MASK
DATA
SELECTION CONDITIONS 505

FIG. 5B

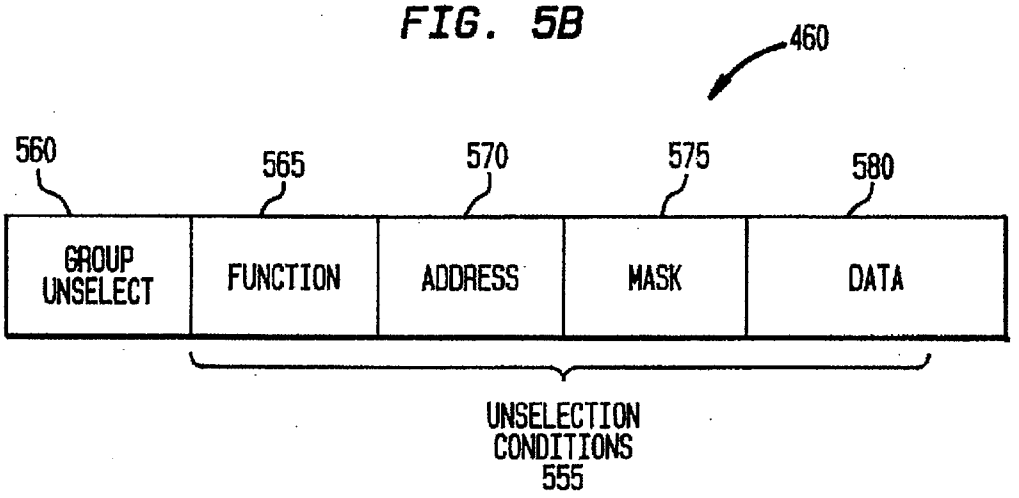
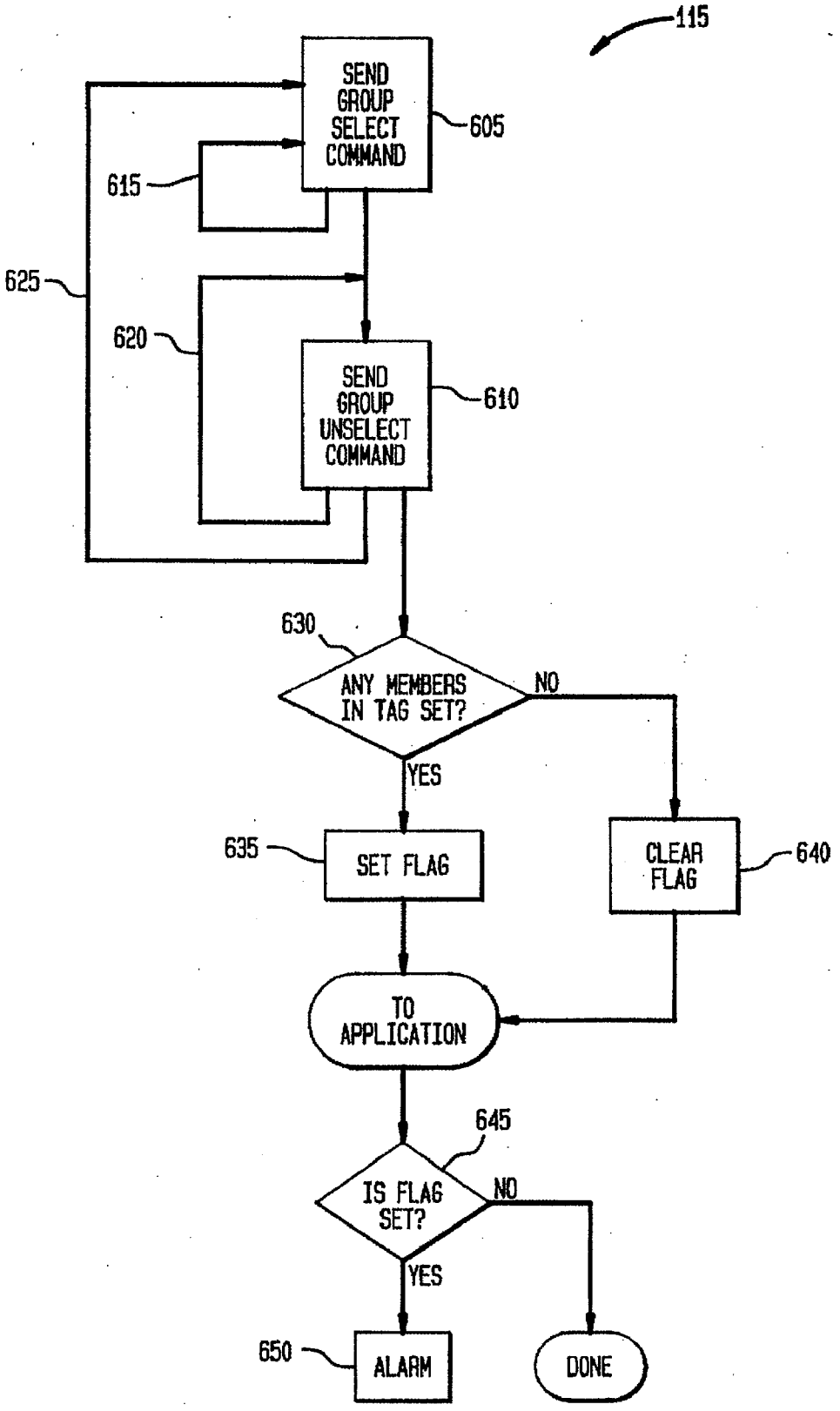

460
560
565
570
575
580
GROUP UNSELECT
FUNCTION
ADDRESS
MASK
DATA
UNSELECTION CONDITIONS 555

FIG. 6


115
SEND GROUP SELECT COMMAND
605
615
625
620
SEND GROUP UNSELECT COMMAND
610
630
ANY MEMBERS IN TAG SET?
NO
YES
635
SET FLAG
CLEAR FLAG
640
TO APPLICATION
645
IS FLAG SET?
NO
YES
650
ALARM
DONE

# SYSTEM AND METHOD FOR RADIO FREQUENCY TAG GROUP SELECT

## CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a division of application Ser. No. 10/979,866 filed Nov. 2, 2004, which is a continuation of application Ser. No. 09/179,481 filed Oct. 27, 1998, now U.S. Pat. No. 6,812,852 issued Nov. 2, 2004, which is a continuation of application Ser. No. 08/646,539 filed May 8, 1996, now U.S. Pat. No. 5,828,318 issued Oct. 27, 1998. Said application Ser. No. 09/179,481 is a continuation-in-part of application Ser. No. 08/694,606 filed Aug. 9, 1996, now U.S. Pat. No. 5,942,987 issued Aug. 24, 1999, which in turn is a continuation-in-part of application Ser. No. 08/303,965 filed Sep. 9, 1994, now U.S. Pat. No. 5,673,037 issued Sep. 30, 1997. Reference is also made to U.S. Pat. No. 5,550,547 which is commonly owned with the aforementioned applications. Said U.S. Pat. Nos. 5,550,547, 5,673,037 and 5,828,318 are hereby incorporated herein by reference in their entireties, including material incorporated in said U.S. Pat. No. 5,550,547, 5,673,037 and 5,828,318 by reference. application Ser. No. 10/979,866 filed Nov. 2, 2004, is hereby incorporated herein by reference in its entirety including material incorporated in said application Ser. No. 10/979,866 by reference.

## FIELD

[0002] This invention relates to the field of radio frequency tagging. More specifically, the invention relates to communication with and/or identification of subsets of a group of radio frequency tags.

## BACKGROUND

[0003] A radio frequency (RF) identification system consists of an RF base station and a plurality of RF tags.

[0004] In a typical configuration, the base station has a computer section which issues commands to an RF transmitter and receives commands from the RF receiver. The commands serve to identify tags present in the RF field of the base station. In some implementations, commands exist to gather information from the tags. In more advanced systems, commands exist which output information to the tags. This output information may be held temporarily on the tag, it may remain until over written, or it may remain permanently on the tag.

[0005] The RF transmitter of the base station encodes the command from the computer section, modulates it from a base band to the radio frequency, amplifies it, and passes it to the RF antenna. The RF receiver gathers the return signal from the antenna, demodulates it from the RF frequency to the base band, decodes it, and passes it back to the computer section for processing. The base station antenna sends RF signals to and receives RF signals from one or more tags within the RF signal range.

[0006] Two useful functions of the system are:

[0007] 1.) determining if any tags meeting certain criteria are in the field (the range of the RF signal transmitted and/or received by the the base station) of the base station; and

[0008] 2.) identifying tags meeting certain criteria for subsequent processing.

## STATEMENT OF PROBLEMS WITH THE PRIOR ART

[0009] The prior art requires that all tags in the RF field be identified and that data be read from them in order to determine if any of the tags met the criteria specified by the tagging application. This process is slow to the point where certain tagging applications are precluded.

[0010] For example, a security application might have a number of tags passing through a base station RF field in a short time. It is important that tags meeting certain alarm criteria be detected during this short time (also called real time). The requirement may be to identify and read all tags to determine alarm status during the real time that the tags are passing through the base station field. If there are a large number of tags passing through the RF field and/or the tags are passing through very rapidly, the prior art may fail to identify and read all the tags in the RF field before they pass out of the field.

[0011] As another example, a transit application might have a large number of tagged items in a tagged container. To log the movement of a container, all the tags must be identified in the container as well as the container itself. Using prior art techniques, the container might be required to pause in the field to allow enough time to identify and read all of the tags in the field. This pause may cause an undesirable delay in the movement of the container.

## GENERAL DISCUSSION OF THE DISCLOSURES INCORPORATED HEREIN BY REFERENCE

[0012] Because the master often does not know ahead of time the number of slaves present and because that number may be very large and possibly unwieldy, it is advantageous for the master to be able to select a subset of the slaves with which to communicate further. Such a selection must of course be done by a conditional. Those slaves that meet the condition are thus considered selected, while those that do not meet the condition are considered not selected. The selection is performed by broadcasting to all slaves the condition that must be met. This is akin to asking those among a large crowd of people whose last name is Lowell to raise their hand. Each slave is defined as having at least the capability to listen to the master's broadcasts, to receive the broadcast condition and to self-test so as to determine whether it meets the condition. See U.S. patent application Ser. No. 08/303,965, to Cesar et al. filed on Sep. 9, 1994, now U.S. Pat. 5,673,037 issued Sep. 30, 1997, which is herein incorporated by reference in its entirety. U.S. Pat. No. 5,673,037 in turn incorporates U.S. Pat. No. 5,550,547 by reference in its entirety, and accordingly, U.S. Pat. No. 5,550,547 is hereby incorporated herein by reference in its entirety. U.S. Pat. No. 5,550,547 discloses a base station with a base memory (**220**, the second figure of U.S. Pat. No. 5,550,547) which stores a special command structure that is used to communicate with the RFID tags. In a preferred embodiment, the base memory includes a novel command structure for tag group selection also. U.S. Pat. No. 5,550,547 states that group select structures are described in the U.S. patent application Ser. No. 08/303,965 entitled "SYS-

TEM AND METHOD FOR RADIO FREQUENCY TAG GROUP SELECT" to C. Cesar et al. filed Sep. 9, 1994 (now U.S. Pat. No. **5,673,037**), which is incorporated by reference in its entirety in U.S. Pat. No. 5,550,547. The fifth figure of the incorporated U.S. Pat. No. 5,550,547 shows an algorithm being executed by each of a plurality of RF tags which includes processing of an identification command which in a preferred embodiment is the group select command.

## OBJECTS

[**0013**] An object of this invention is an improved system and method to rapidly determine which tags of a group of tags meet a certain criteria.

[**0014**] Another object of this invention is an improved system and method to rapidly identify and/or select tags meeting certain criteria for subsequent processing.

## SUMMARY

[**0015**] The present invention enables rapid querying, selecting, and identifying of a large number of radio frequency (RF) tags. This is done by implementing an efficient state machine on each tag. The tags power up in a default state (READY) where they do not transmit or participate in an identification algorithm. A subset of the tags in the field can be moved into a second state (SELECTED) by a signal from the base station. In the SELECTED state the tags transmit their unique identifier to the base station in an attempt to identify themselves.

[**0016**] The process of moving the tags to the second state, SELECTED, is based on the data in the tag data memory. With a comparison unit and two tag commands, any arbitrarily complex selection criteria can be realized to move a given tag into the SELECT state (or back to the READY state).

[**0017**] Determining if any tags meeting certain criteria are in the field is performed very efficiently since the invention does not require individual tag identification. This is accomplished by each tag processing one or more "group select" and/or "group unselect" commands in sequence using control logic located on the tag. This tag control logic determines whether the respective tag meets the selection criteria.

[**0018**] Tags meeting the selection criteria participate in the identification process. This identification process may be limited to determining whether one or more tags are participating, but not uniquely identifying individual tags.

[**0019**] The invention also simplifies the identification of tags in a large group of tags. This is done by using one or more "group select" and/or "group unselect" commands to select only the relevant tags for identification. This allows the system to process only tags which are of interest, i.e., meet the selection criteria. This feature improves the speed at which the system can process tags and allows the system to select subgroups of tags for processing from very large numbers of tags.

[**0020**] Other protocols may be used with the present invention. In one preferred embodiment, more than one tag simultaneously communicating with the base station can be identified by using the protocol described in U.S. patent application to S. Chan et al. entitled "MULTIPLE ITEM RADIO FREQUENCY TAG IDENTIFICATION PROTOCOL", now U.S. Pat. No. 5,550,547, which is herein incorporated by reference in its entirety.

## BRIEF DESCRIPTION OF THE DRAWINGS

[**0021**] FIG. **1** is a block diagram of the present system showing a base station and a plurality of novel tags.

[**0022**] FIG. **2** is a drawing showing the concept of tag groups and subgroups.

[**0023**] FIG. **3** is a block diagram of a preferred embodiment of the novel tag of the present invention.

[**0024**] FIG. **4** comprises FIG. **4**A which is a flow chart showing the steps of an OR function performed in the tag and FIG. **4**B is a flow chart showing the steps of an AND function performed in the tag.

[**0025**] FIG. **5** comprises FIG. **5**A which is a block diagram showing the format of a preferred embodiment of a "group select" command and FIG. **5**B which is a block diagram showing the format of a preferred embodiment of a "group unselect" command sent out by the base station.

[**0026**] FIG. **6** is a flow chart showing the steps performed by one preferred embodiment of a novel base station algorithm.

## DESCRIPTION

[**0027**] The system **100** is comprised of two types of hardware, a base station **105** and a plurality of tags **150**.

[**0028**] The base station **105** includes a microprocessor **110** running a novel base station algorithm **115**. The microprocessor has a duplex connection to a radio frequency (RF) front end **120**, which in turn connects to an RF antenna **125**. The resulting RF signal **130** is broadcast to the tags. Base stations **105** of this type (without the novel algorithm **115**) are well known.

[**0029**] Each tag (typically **160**) in the group **150** of tags contains a tag antenna **162** which couples the RF signal **130** to the RF front end **164**. This in turn connects to the tag control circuit **166**. The control circuit implements an algorithm **170**, and interfaces to the tag memory **168**.

[**0030**] FIG. **2** shows the concept of tag groups **150** and subgroups (**210**, **220**, **230**, **240**, **250**, and **260**).

[**0031**] The plurality of tags **150** in the RF field **130** of the base station **105** is represented by the 18 tags shown. A base station **105** is able to communicate with a tag (typically **160**) in the RF field **130** of the base station **105** using the RF field **130** or signal **130**. Tags in the RF field **130** are said to be in the tag group **150**.

[**0032**] A group select command can be used to select the subgroup (for example, **210**) from the tag group **150** and move it to a SELECTED state using the algorithm **115** on the base station, algorithm **170** on the tag, and the tag control logic **166** processing the commands **410** and **460**. See FIG. **4**.

[**0033**] Note that several different subgroups can be moved from a READY state to a SELECTED state by sending a signal **130** from the base station **105**. The subgroups moved, i.e., the subgroups that have tags that change state, are determined by criteria sent out by the base station.

[0034] In essence, tags meeting any one of the selection criteria of the group select commands are placed in the SELECTED state. In the example above, tags meeting the first OR the second criteria (i.e., tags in subgroups **210** and **220** of group **150**) are selected, forming the subgroup **230**.

[0035] To illustrate, suppose that the plurality of tags **150** identify and/or are attached to clothing items. Further, suppose that it is desired to determine whether there are any socks or shirts in the RF field **130**. Finally, suppose that the tag memory **168** has an address A**10**, with data D**10** for socks and D**11** for shirts.

[0036] Socks or shirts are selected, like subgroup **230**, of group **150** above by running the base station algorithm **115**. Refer to FIGS. **4** and **6**. The first step **605** would be to send a group select command **410** (received by the tags) with the following fields:

[0037] command **510**—group select

[0038] function **515**—equals

[0039] address **520**—including A**10**

[0040] mask **525**—mask only A**10**

[0041] data **530**—D**10**

which would cause the subgroup **210** of socks to move from the READY state to the SELECTED state.

[0042] The next step would be to send a group select command **410** (received by the tags) with the following fields:

[0043] command **510**—group select

[0044] function **515**—equals

[0045] address **520**—including A**10**

[0046] mask **525**—mask only A**10**

[0047] data **530**—D**11**

which would cause the subgroup **220**, of tags associated with shirts to move from the READY state to the SELECTED state. Therefore, the subgroup **230**, comprising subgroups **210** (socks) and **220** (shirts) is the logical OR (or union) of the two subgroups **210** of socks and **220** of shirts, and is now in the SELECTED state.

[0048] A group unselect command can move a subgroup back to the READY state. The group unselect command performs a logical AND (or intersection) function.

[0049] For example, suppose that it is desired to determine whether there are any pale green pants in the RF field **130**. Further, suppose that the tag memory **168** has an address A**10**, with data D**12** for pants and an address A**20**, with data D**21** for pale green colors.

[0050] The first step would be to send a group select command **410** (received by the tags) with the following fields:

[0051] command **510**—group select

[0052] function **515**—equals

[0053] address **520**—including A**10**

[0054] mask **525**—mask only A**10**

[0055] data **530**—D**12**

which would cause the subgroup **240** of pants to move from the READY state to the SELECTED state.

[0056] The next step would be to send a group unselect command **460** (received by the tags) with the following fields:

[0057] command **560**—group select

[0058] function **565**—not equals

[0059] address **570**—including A**20**

[0060] mask **575**—mask only A**20**

[0061] data **580**—D**21**

which would cause the subgroup **250** of pants whose color is not pale green to move from the SELECTED state to the READY state. The subgroup **260**, which is the logical AND of the two subgroups **240** of pants and not **250** of not pale green, is now in the SELECTED state.

[0062] FIG. **3** is a block diagram of one typical preferred embodiment of a tag **160** and further illustrates how the tag moves between states.

[0063] Data enters and leaves the control block **166** through the RF block **164**.

[0064] Within the control block **166**, the appropriate fields (see description of FIG. **5** below) of the command sent from the base station **105** are routed to an address register **305**, a mask register **320**, a function register **335**, and a command data register **315**. More specifically, the value in the command field (**510**, **560**) and function field (**515**, **565**) of the base station **105** signal **130** is placed in the function register **335**, the value in the data field (**530**,**580**) of the signal **130** is placed in the command data register **315**. The value in the mask field (**525**, **575** in FIG. **5**) of the command signal **130** is placed in the mask register **320**, and the value in the address field (**520**, **570**) of the signal **130** is placed in the tag address register **305**.

[0065] In one preferred implementation, the data emanating from the RF block **164** is serial digital data, and the registers (**305**,**320**,**315**,**335**) are shift registers which are loaded in turn. The registers could also be parallel loadable registers, with a field of data being assembled before being loaded into a register. The determination of where the data fields are loaded is determined by the command field (**510**, **560**).

[0066] After the fields of the signal **130** are stored in the tag registers, a group select or group unselect operation begins by reading data from the tag data memory **168** into the tag data register **310**. The data read is determined by the value previously loaded into the address register **305**.

[0067] In one preferred implementation, the tag memory **168** holds byte wide (8 bit) data, and the tag data register **310** is a parallel in/serial out shift register. The memory could also be bit wide, with the tag data register being a simple one bit storage device. In a preferred embodiment, the mask indicates whether or not the data should be acted upon. If it is to be acted upon, the tag data **310** and command data **315** are compared in the compare block **325**. In another preferred embodiment, the mask could be more complex. For example, it could modify the type of function to be performed rather than simply enabling a function.

[0068] In one preferred embodiment, the command data field (**530**,**580**) is 8 bytes, the tag data memory **168** is one byte wide, and the mask contains a logic 1 for each byte which should participate in the comparison and a 0 for each byte which should be ignored. As each byte in turn is read from the tag data memory **168** to the tag data register **310** and routed to the compare unit **325**, one bit of the mask register **320** is used to determine whether the data should be used or ignored.

[0069] Note that in a preferred embodiment, a mask of all zeros says that all data is ignored. The result is a useful select all tags or unselect all tags function.

[0070] The compare unit determines the results (greater than, greater than or equal, equal, less than, less than or equal) as data is received. The compare unit **325** computes the results for each masked data item using standard digital arithmetic and passes the results to the tag state machine **330**. Once the compare operation is complete, the tag state **330** is updated.

[0071] If required, the compare operation can be repeated multiple times as data is received in the command data register and data is read from the tag data memory to the tag data register.

[0072] For example, suppose that the address A1 reads 8 bytes and the first three bytes (here these first three bytes might be the address A**10** described above) contain data D**10** describing the item as socks. To group select all socks, the command data field **410** would have the following fields

[0073] command **510**—group select

[0074] function **515**—equals

[0075] address **520**—A1

[0076] mask **525**—11100000

[0077] data **530**—D**10**

[0078] Once the compare operation is complete, the tag state **330** is updated. In this example, an 8 byte compare with mask is performed. Alternatively, a different number of bits could be used, or the mask could be bit wide.

[0079] The tag states in the tag state machine **330** are READY (the tag is in the set of unselected tags) and SELECTED (the tag is in the set of selected tags). A preferred state machine is a one bit register. In one preferred embodiment, that tag might have other states (for example, shut down, identified, error states, etc.) with a correspondingly more complex state machine **330**.

[0080] An additional path connects the tag data register back to the RF section. This read data path can be used to identify and classify individual tags in the base station. In a typical implementation, the connection between the RF block **164** and the control block **166** contains a transmit path **340** and a receive path **345**.

[0081] Alternatively, there could be one bidirectional path.

[0082] FIG. **4**A shows the tag **160** selection algorithm **170** in more detail.

[0083] In step **410** the group select command is received by the tag control logic.

[0084] In step **415**, the conditions of the command are checked as described in FIG. **3** using the tag data memory **168**, the tag data register **310**, the mask register **320**, the command data register **315**, and the compare block **325**.

[0085] In step **420**, the control logic decides whether the conditions were met, using the compare block **325** and the function register **335**.

[0086] If the conditions (i.e. the compare conditions) were not met, the tag state **330** does not change and the tag waits for the next command.

[0087] If the conditions are met, step **425** changes the tag state **330** from READY to SELECTED. That is, the tag moves from the set of unselected tags to the set of selected tags.

[0088] For example, to select all tags which indicate socks, the group select command **410** would indicate a group select on equals, with the address pointing to the potential socks data, the mask selecting only the potential socks field within the address, and the data indicating socks.

[0089] FIG. **4**B shows the tag **160** unselection algorithm **170** in more detail.

[0090] In step **460**, the group unselect command is received by the tag control logic.

[0091] In step **465**, the conditions of the command are checked as described in FIG. **3** using the tag data memory **168**, the tag data register **310**, the mask register **320**, the command data register **315**, and the compare block **325**.

[0092] In step **470**, the control logic decides whether the conditions (i.e., the compare conditions) were met, using the compare block **325** and the function register **335**.

[0093] If the conditions were not met, the tag state **330** does not change and the tag waits for the next command.

[0094] If the conditions are met, step **475** changes the tag state **330** from SELECTED to READY. That is, the tag moves from the set of selected tags to the set of unselected tags.

[0095] For example, to unselect all tags which indicate colors other than pale green, the group unselect command **460** would indicate a group unselect on not equals, with the address pointing to the color data, the mask selecting only the color field within the address, and the data indicating pale green.

[0096] FIG. **5** shows preferred formats for a group select or group unselect command received from the tag RF block **164** through the path **340** (FIG. **3**) initially sent from the base station **105**.

[0097] The first field, **510** or **560**, indicates the type of command, select or unselect, field **510** for select commands and field **560** for unselect commands. In a preferred embodiment, the tag implements other commands, (e.g. read, write, etc.) and the field contains multiple bits which describe the command. In a typical implementation, the bits could be either coded or contain one bit per command.

[0098] The next field, **515** (select) or **565** (unselect), indicates the type of command function. In a typical implementation, the functions includes equal, not equal, greater than, less than, greater than or equal, or less than or equal.

A more complex tag could implement additional functions or combinations of functions in the function register **335**, the mask register **320**, and the compare block **325**.

[**0099**] The next field, **520** (select) or **570** (unselect), contains the tag memory address. Its exact format depends on the configuration of the tag data memory. In a preferred embodiment, the address would access 8 bytes of tag data memory, with individual bytes selected via the mask field. In an alternative implementation, a one byte address or a bit address could be used.

[**0100**] The next field, **525** (select) or **575** (unselect), holds the mask. Its format also depends upon the tag data memory format and the mask granularity desired. For example, the mask could be on a bit by bit basis, or it could mask 8 bit bytes. In a typical implementation, the mask enables or inhibits the compare block **325**, but more complex masking is also possible.

[**0101**] The final field, **530** (select) or **580** (unselect), holds the command data. This is the data with which the tag data is compared. Again, the format is dependent on the tag data memory configuration and the application. A typical size could be one bit, an 8 bit byte, or a number of bytes.

[**0102**] In a preferred embodiment, the format of the command selection conditions **505** and **555** would be identical. In this way, the tag control logic acts on the commands in the same manner, with only the final state change dependent upon the actual command.

[**0103**] For example, the command to select pale green items would be:

[**0104**] command **510**—group select

[**0105**] function **515**—equals

[**0106**] address **520**—address including the color field in tag data memory

[**0107**] mask **525**—mask of the actual color bytes in tag data memory

[**0108**] data **530**—code indicating pale green

[**0109**] Similarly, the command to unselect pale green items would be:

[**0110**] command **560**—group unselect

[**0111**] function **565**—equals

[**0112**] address **570**—address including the color field in tag data memory

[**0113**] mask **575**—mask of the actual color bytes in tag data memory

[**0114**] data **580**—code indicating pale green

[**0115**] FIG. **6** describes the base station algorithm.

[**0116**] The first step, **605**, is a group select command. This moves a subset of tags from the READY state to the SELECTED state. This group select step **605** can be repeated any number of times as required, **615**, to move more tags from READY to SELECTED. This performs an OR function.

[**0117**] The next step, if required, is **610**. This group unselect command acts on the tags in the SELECTED state. A subset of them moves back to the READY state. This performs an AND function. This group unselect step **610** can be repeated any number of times as required, **620**, to move more tags from SELECTED to READY.

[**0118**] For example, to select socks and shirts, one group select command **605** selects socks. Through **615**, another group select command **605** selects shirts. The result is that items which are shirts OR socks are selected.

[**0119**] In another example, to select pale green pants, a group select command **605** selects pants. Then a group unselect command **610** unselects not pale green. The result is that items which are pants and pale green are selected.

[**0120**] After the tags now in the SELECTED state are accessed, the entire selection process can be repeated as required, indicated by the path **625**.

[**0121**] In a typical application, accessing the tag could consist of identifying individual items and reading a universal product code (UPC).

[**0122**] This flexibility allows tags to be selected using an arbitrarily complex logical equation.

[**0123**] For example, it would be possible to identify all pale green pants sizes 30 through 34 manufactured in Conn. or mens socks manufactured between January and March.

[**0124**] In one application, querying, a flag is set if the selected subgroup has one or more members. In that application, tags remaining in the SELECTED state after processing a group select or group unselect command would transmit back to the base station.

[**0125**] The base station, in **630**, would detect the presence or absence of a return signal from one or more tags. If a signal is detected, a flag is set in **635**. If a signal is not detected, the flag is cleared in **640**. The flag state can be determined without identifying individual tags. In other words, the base station has queried the tag group to determine if any tags met certain conditions (or criteria) without ever identifying a tag.

[**0126**] For example, an application could scan a display of pale green pants for misshelved items, The application would first group select on not pants. A set flag indicates the presence of not pants tags, and the application knows that items are misshelved. If the flag is not set, the application next group selects pants and then group unselects pale green colors. A set flag now indicates the presence of pants which are not pale green. Again the application knows that items are misshelved.

[**0127**] In another application, the flag is an alarm. The selection conditions are arranged by the application so that the only tags remaining in the SELECTED state are those tags for which security is being breached. In that case, in step **645**, the application would check the flag. If the flag is set, the application implements its alarm procedure **650**.

[**0128**] For example, an application could group select all retail items, followed by a group unselect on items marked paid. A set flag indicates unpaid items passing through the field, which can be used by the application to trigger an alarm.

[**0129**] Given this disclosure, one skilled in the art could construct other embodiments that are equivalent to those disclosed here. These embodiments are within the contemplation of the inventors.

1. A method of selecting subgroups of a group of radio frequency tags comprising the steps of:

a. sending a group select radio signal command from a base station to a plurality of radio frequency tags, the command defining certain selection conditions, the tags each having a radio frequency communications component for receiving the command and a tag memory with tag fields;

b. changing a state of one or more tags in the group of tags, the state change being from a READY state to a SELECTED state, the tags changing state being a selected subgroup of tags from the group of tags, and the selected tags having data in their respective tag memory that meets the selection conditions.

2. The method of claim 1, where the selected tags send a tag identifier to the base station.

3. The method of claim 1, where the selected tags change data in one or more tag fields of their respective memory.

4. The method of claim 1, where steps a and b are repeated one or more times to create a ORed subgroup which includes the union of the tags of each of the subgroups.

5. The method of claim 2, where the tags are queried to indicate that the selected subgroup has one or more members.

6. The method of claim 5, where a flag is set if the selected subgroup has members, the flag being an alarm and the selection condition being that there was a security breach.

7. The method according to claim 1, wherein

in step a. the command defining certain logical selection conditions; and

in step b. the tags changing state being a first selected subgroup of tags from the group of tags;

the method further comprises the steps of:

c. sending a group unselect radio signal command from a base station to a plurality of radio frequency tags, the command defining certain logical unselection conditions; and

d. changing a state of one or more tags in the first selected subgroup of tags, the state change being from the SELECTED state to the READY state, the remaining tags in the SELECTED state being a second selected subgroup of tags, the tags in the second selected subgroup having data in their respective tag memories that meet both the selection and unselection conditions.

8. The method of claim 7, where steps c and d are repeated one or more times to create an ANDed subgroup which includes the tags in the intersection of each of the second selected subgroups.

9. The method of claim 7, where the selection conditions are one or more of the logical comparisons including greater than, less than, equal, not equal, greater than or equal, and less than or equal.

10. The method of claim 9, where the comparison is made between a data value sent from the base station and a tag value stored in the tag memory.

11. The method of claim 10, where the tag value is a value obtained by masking in the tag.

12. The method of claim 7, where the unselection conditions are one or more of the logical comparisons including greater than, less than, equal, not equal, greater than or equal, and less than or equal.

13. The method of claim 12, where the comparison is made between a data value sent from the base station and a tag value stored in the tag memory.

14. The method of claim 13, where the tag value is a value obtained by masking in the tag.

15. A system for selecting subgroups of radio frequency tags from a group of tags, comprising:

a. a base station for communicating radio frequency commands to the tags, the commands comprising command type, function, tag memory address value, and command data;

b. a plurality of tags having radio frequency component for receiving the radio frequency commands from the base station and sending radio frequency information to the base station, a tag memory with a tag memory address and tag memory data, tag control logic, a tag compare function, and a tag state, whereby the command type sent by the base station causes the tag control logic to perform the function sent by the base station in the tag compare function to compare tag memory data located in the tag memory address specified by the tag memory address value with the command data, and if comparison conditions are met, the tag control logic causing the tag state to change.

16. The system, as in claim 15, where the command type is a select command and the tag logic causes the tag to move from a READY state to a SELECTED state; or

where the command type is a unselect command and the tag logic causes the tag to move from a SELECTED state to a READY state.

17. The system, as in claim 15, where the tags identify clothing.

18. The system, as in claim 16, where the base station queries the tags in the SELECTED state.

19. The system, as in claim 18, where an security alarm is enabled if there are any tags in the SELECTED state.

20. A system for selecting a subset of slaves that satisfy a selection criterion, and causing the selected subset of slaves to participate in an identification and isolation process whereby slaves of the selected subset are successively identified and isolated from further participation in such identification and isolation process, said system comprising:

(a) a master unit for communicating a command containing a selection criterion to a plurality of slaves;

(b) each slave of said plurality of slaves being in one of three or more different possible conditions during the identification and isolation process;

(c) a memory in said each slave containing at least one information value for use in evaluation of a selection criterion;

(d) a receiving unit in said each slave for receiving the command containing the selection criterion from the master unit; and

(e) a processing unit in said each slave that processes the command containing the selection criterion from the master unit;

(f) the processing units of the slaves having a mode of operation such that a subgroup of slaves that have an information value that satisfies the selection criterion

are moved from a first condition to a second condition for participation in an identification and isolation process; and

(g) the processing units of the subgroup of slaves in the second condition having a mode of operation whereby individual slaves of said subgroup can progress to a third condition during the identification and isolation process, with slaves that have progressed to the third condition, and have been identified, being isolated from further participation in the identification and isolation process that continues so as to identify and isolate other of the slaves in the second condition.

**21**. A method for selecting a subset of slaves that satisfy at least one selection criterion during a selection process, and then identifying slaves of the selected subset, and causing identified slaves of the selected subset of slaves to be isolated from further participation in the identification process, said method comprising;

(a) storing at least one information value in each of a plurality of slaves for use in evaluating at least one selection criterion;

(b) representing at least one selection criterion in at least one selection criterion command;

(c) communicating the at least one selection criterion command to the plurality of slaves;

(d) processing the at least one selection criterion command at each of said plurality of slave and deeming certain of the slaves based on storage of the at least one information value to be selected as a result of the selection process;

(e) carrying out an identification process with respect to the certain slaves deemed selected as a result of the selection process; and

(f) causing slaves that are identified during the identification process of clause (e) to be isolated from responding further in the course of the identification process of clause (e).

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