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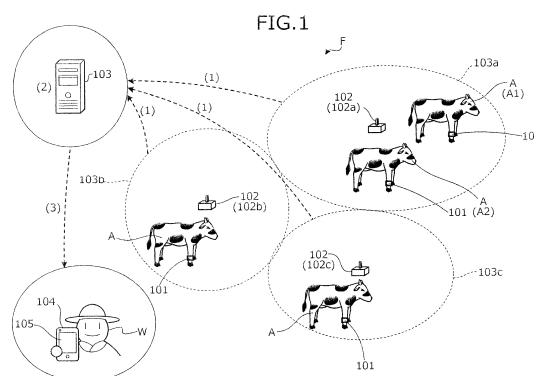
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(54) **ESTRUS NOTIFICATION METHOD, ESTRUS NOTIFICATION DEVICE AND ESTRUS NOTIFICATION PROGRAM**

(57) An estrus notifying apparatus (104) receives, via a relay device (102) and from communications devices (101) respectively attached to livestock animals (A) raised on a farm (F), measurement result information indicating measurement results of step counts for the livestock animals (A). The estrus notifying apparatus (104), based on measurement result information, respectively determines whether each of the livestock animals (A) is in estrus. If among the livestock animals (A), a given livestock (A1) is determined to be in estrus, the estrus notifying apparatus (104) determines whether the current time is included in the working hours of a worker (W). If the current time is included in the working hours, the estrus notifying apparatus (104) determines whether other livestock animals (A) near the given livestock animal (A1) have a possibility of being in estrus. If a livestock animal (A2) having a possibility of being in estrus is present, the estrus notifying apparatus (104) notifies the worker W of identification information for the given livestock animal (A1) and for other livestock animals (A2) near the given livestock animal (A1) and having the possibility of being

in estrus.



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Description

TECHNICAL FIELD

[0001] The present invention is related to an estrus notifying method, an estrus notifying apparatus, and an estrus notifying program.

BACKGROUND ART

[0002] A technique of attaching a pedometer to livestock such as grazing cattle and measuring the number of steps walked to detect changes in the state of the animal, such as the onset of estrus or illness is known. Based on the detection of a change in the state of the animal via the pedometer, a worker makes a determination such as whether to mate the animal, administer medical treatment, etc.

[0003]

Patent Document 1: Japanese Laid-Open Patent Publication No. 2003-343901

Patent Document 2: Japanese Laid-Open Patent Publication No. 2005-092595

DISCLOSURE OF INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0004] Nonetheless, with the conventional techniques, even if state changes are detected from the number of steps walked by the animal, the information is often inaccurate and the worker has to actually go and see whether the animal is in estrus. Further, when a state change in an animal is detected, the worker may be on a break or involved with other work and therefore, cannot immediately respond, even if notification of the state change is received.

[0005] To solve the problems of the conventional techniques above, one object of the present invention is to provide an estrus notifying method, an estrus notifying apparatus, and an estrus notifying program that can effectively identify livestock animals indicating estrus.

MEANS FOR SOLVING PROBLEM

[0006] To solve the problems above and achieve an object, according to one aspect of the present embodiment, an estrus notifying method, an estrus notifying apparatus, and an estrus notifying program that give notification of estrus based on step count measurement results from a step counting device attached to livestock animals are proposed. The estrus notifying method, the estrus notifying apparatus, and the estrus notifying program collect step a count measurement result for each livestock animal and position information of each livestock animal, and based on the step count measurement results and a first condition, determine whether each of

the livestock animals is in estrus. If a given livestock animal is determined to be in estrus, the estrus notifying method, the estrus notifying apparatus, and the estrus notifying program refer to a memory unit that retains the working hours of a worker, and determine whether the current time is included in the working hours. If the current time is included in the working hours, the estrus notifying method, the estrus notifying apparatus, and the estrus notifying program determine whether livestock animals near the given livestock animal indicate estrus, based on the step count measurement results and a second condition that is more lax than the first condition; and output the identification information of the given livestock animal determined to be in estrus and the identification information of the livestock animals determined to indicate estrus.

EFFECT OF THE INVENTION

[0007] According to one aspect of the present invention, livestock animals indicating estrus can be effectively identified.

BRIEF DESCRIPTION OF DRAWINGS

[0008]

FIG. 1 is a diagram depicting an example of an estrus notifying method according to an embodiment;
 FIG. 2 is a diagram depicting an example of system configuration of an estrus notifying system 200;
 FIG. 3 is a block diagram depicting a hardware configuration example of a communications device of the present embodiment;
 FIG. 4 is a block diagram depicting a hardware configuration example of a relay device 102;
 FIG. 5 is a block diagram depicting a hardware configuration example of an estrus notifying apparatus 104, etc.;
 FIG. 6 is a diagram depicting an example of the contents of a measurement result information table 201;
 FIG. 7 is a diagram depicting an example of the contents of a step count DB 202;
 FIG. 8 is a diagram depicting an example of the contents of a transmission source DB 203;
 FIG. 9 is a diagram depicting an example of the contents of a relay device DB 204;
 FIG. 10 is a diagram depicting an example of the contents of a threshold DB 205;
 FIG. 11 is a diagram depicting an example of the contents of a step count cumulation table 1100;
 FIG. 12 is a diagram depicting an example of the contents of a working hours DB 206;
 FIG. 13 is a block diagram depicting a functional configuration example of the estrus notifying apparatus 104;
 FIG. 14 is a diagram depicting an example of display by a client apparatus 105;

FIG. 15 is a flowchart depicting an example of a process procedure of a communications device 101;
 FIG. 16 is a flowchart (part 1) depicting an example of a process procedure of the estrus notifying apparatus 104;
 FIG. 17 is a flowchart (part 2) depicting an example of the process procedure of the estrus notifying apparatus 104;
 FIG. 18 is a flowchart (part 3) depicting an example of the process procedure of the estrus notifying apparatus 104; and
 FIG. 19 is a flowchart (part 4) depicting an example of the process procedure of the estrus notifying apparatus 104.

BEST MODE(S) FOR CARRYING OUT THE INVENTION

[0009] Embodiments of an estrus notifying method, an estrus notifying apparatus, and an estrus notifying program will be described in detail with reference to the accompanying drawings.

[0010] FIG. 1 is a diagram depicting an example of the estrus notifying method according to the present embodiment. In FIG. 1, livestock animals A are raised within the premises of a farm F managed by a worker W. Here, the worker W is one who is engaged in the livestock industry. The farm F is a facility that has a pasture area for pasturing the livestock animals A. A livestock animal A is an animal that can move within the premises of the farm F, for example, within the pasture area of the farm F. For example, a livestock animal A is an animal that moves by ambulation, such as a cow, pig, horse, etc.

[0011] A communications device 101 is attached to each livestock animal A. Here, the communications device 101 is a portable computer that measures a step count of the livestock animal A. For example, when the livestock animal A walks, the livestock animal A steps with the right-front leg, sending the leg out toward the ground in the direction of travel. Upon planting the right-front leg on the ground, next, the livestock animal A steps with the left-front leg, sending the leg out toward the ground in the direction of travel. Upon planting the left-front leg on the ground, again, the livestock animal A steps with the right-front leg, and repeats this series of actions. In other words, the step count of the livestock animal A can be the number of times that the livestock animal A steps with the right-front leg or the left-front leg, sending the leg out toward the ground in the direction of travel.

[0012] For example, when the state of the livestock animal becomes an abnormal state, which differs from a normal state, consequent to a state change of the livestock animal A, such as the onset of estrus or illness, giving birth, the appearance of a natural predator, etc., the step count per unit time of the livestock animal A increases or decreases compared to that for the normal state. Here, estrus is an excited state accompanying re-

productive activity of the livestock animal A. Illness is a state in which the physical or emotional state of the livestock animal A is poor or unfavorable.

[0013] When an abnormal state of the livestock animal A arises, the change in the step count of the livestock animal A is used to measure the step count of the livestock animal A, whereby the worker W can know that a change has occurred with the livestock animal A from the step count measurement result.

[0014] The communications device 101 is capable of communicating with multiple relay devices 102 installed within the premises of the farm F. Here, a relay device 102 is a computer that is capable of communicating with the communications device 101 and an estrus notifying apparatus 104 described hereinafter. Each of the relay devices 102 is installed at a different position in the farm F. The communications device 101, via a communicable relay device 102, transmits measurement result information that indicates measurement results to the estrus notifying apparatus 104.

[0015] For example, if the communications device 101 is located in a communications area 103a of a relay device 102a indicated as an example in FIG. 1 by reference numeral 102a, the communications device 101 can communicate with the relay device 102a. Further, if the communications device 101 is located in a communications area 103b of a relay device 102b indicated as an example in FIG. 1 by reference numeral 102b, the communications device 101 can communicate with the relay device 102b. If the communications device 101 is located in a communications area 103c of a relay device 102c indicated as an example in FIG. 1 by reference numeral 102c, the communications device 101 can communicate with the relay device 102c. A communications area, for example, is a 150-meter radius around the relay device 102. The relay device 102, upon receiving measurement result information from the communications device 101, transmits the received measurement result information to the estrus notifying apparatus 104. When transmitting the measurement result information to the estrus notifying apparatus 104, the relay device 102 also transmits relay device identification information thereof.

[0016] The estrus notifying apparatus 104 is a computer that is connected to the relay devices 102, and via the relay devices 102, is able to receive measurement result information of the communications devices 101. Further, for example, the estrus notifying apparatus 104 can be communicably connected to the client apparatus 105, via a given line.

[0017] The client apparatus 105 is a portable computer having a display 106 and capable of communicating with the estrus notifying apparatus 104. The client apparatus 105, upon receiving information from the estrus notifying apparatus 104, displays images based on the received information, on the display 106.

[0018] Here, as a technique of finding an abnormal state of a pastured livestock animal A, for example, an example will be given describing a technique of finding

an estrus state of a female cow. For example, the worker W periodically goes out to the pasture area, and actually visually confirms whether a female cow in estrus is present. Since the worker W has to make search rounds in the farm F, which is extremely large covering several 100 meters to several kilometers on a side, this technique, for example, not only takes time, but also is a burden to the worker W and ultimately, has a high personnel cost. Therefore, although mating implemented by the worker W during pasturing may be foregone, no mating of a female cow in estrus, i.e., not implementing mating when the potential of fertilization is high is a financial loss.

[0019] Further, when pasturing female cows, the worker W may also pasture stud bulls for natural mating to occur. However, natural mating by a stud bull is not desirable from the viewpoint of current livestock management ideals of producing better offspring. Furthermore, since bulls are aggressive, only an experienced worker W can handle the bulls and thus, is not an effective technique.

[0020] Further, a system is present that uses the property that the step count increases for a female cow in estrus, and attaches to a female cow, a pedometer that measures step count. In this system, the pedometer attached to the female cow transmits measurement results to a server, at given transmission intervals, via a relay device installed in the pasture area. Thus, by notifying the worker W of the relay device that relayed the measurement results, the worker W can surmise the position of the female cow in estrus.

[0021] Nonetheless, with the above system, the object of the system itself is to detect female cow estrus. Therefore, the pedometer, for example, is set to transmit measurement results at one-hour intervals. On the other hand, the worker W may be involved with other work such as cleaning the cattle shed and thus, cannot immediately go to the vicinity of the relay device (i.e., cow in estrus). In such a case, when the worker W goes to the vicinity of the relay device, the cow in estrus, which moves moment to moment, may have moved from the vicinity of the relay device and in the end, the worker W has to search the pasture area, which a burden on the worker W.

[0022] Further, to know the position of a female cow in estrus, although a technique of attaching a communications apparatus having a GPS function to each female cow may be considered, to attach a communications apparatus having a GPS function to each female cow requires a large cost. Further, the GPS function continuously emits an electronic signal and therefore, the consumption of the battery, which is the driving source, is fast, requiring frequent replacement of the battery or replacement of the communications apparatus itself. Consequently, this technique not only has a high initial cost but also places a burden on the worker W in terms of battery or apparatus replacement and therefore, is not suitable for actual implementation.

[0023] Thus, in the estrus notifying method of the present embodiment, even if a livestock animal is in es-

trus, in cases where the worker cannot go to the livestock animal immediately such as during hours outside of working hours, the minimally required information is notified to prevent, as much as possible, adverse effects consequent to misjudgment, to suppress the burden placed on the worker W, and to prevent the worker W from becoming exhausted. Further, in the estrus notifying method of the present embodiment, in cases when during the working hours of the worker, the worker can go to a female cow in estrus, the worker is prompted to check the livestock animal in estrus as well as other livestock animals that can be checked on.

[0024] Hereinafter, an example of the estrus notifying method according to the present embodiment will be described. In the embodiment, estrus will be taken as one example of an abnormal state of the livestock animal A. Further, in the present embodiment, the livestock animal A will be described as a female cow. Female cows have a characteristic in that the when in estrus, the female cow has a step count that increases per unit time compared to periods when not in estrus and this characteristic of female cows is used.

(1) The communications device 101 measures the step count of the livestock animal A and at given transmission intervals, transmits to the estrus notifying apparatus 104, via a relay device 102, measurement result information indicating measurement results of the step count for the livestock animal A. For example, here, the given transmission interval is a one-hour interval. The relay device 102, upon receiving the measurement result information from the communications device 101, transmits the received measurement result information and the relay device identification information thereof to the estrus notifying apparatus 104. Here, the relay device identification information is information that can identify one relay device 102 from among plural relay devices 102. For example, the relay device identification information is information representing a relay device ID specific to each of the relay devices 102.

(2) The estrus notifying apparatus 104, upon receiving the measurement result information via the relay device 102, determines whether the step count of the livestock animal A satisfies a given condition (first determination condition), based on the received measurement result information. For example, the estrus notifying apparatus 104 is assumed to determine that the livestock animal A indicated by reference numeral A1 in FIG. 1 has a step count that satisfies the first determination condition.

[0025] The estrus notifying apparatus 104 determines whether the current time is within the working hours of the worker W. Here, the working hours are a period of time preliminarily determined as a period of time during which the worker W is engaged in work. For example, the estrus notifying apparatus 104 stores information rep-

representing the working hours in a working hours DB 206 described hereinafter.

[0026] If the estrus notifying apparatus 104 determines that the current time is within the working hours, the estrus notifying apparatus 104 further determines whether among the other livestock animals A near the livestock animal A1 for which the step count satisfies the first determination condition, a livestock animal is present that satisfies a second determination condition that is more lax than the first determination condition above. For example, the estrus notifying apparatus 104 is assumed to determine that the livestock animal A indicated by reference numeral A2 in FIG. 1 and located in the communications area 103a of the same relay device 102a as the livestock animal A1, has a step count that satisfies the second determination condition.

[0027] In this case, the estrus notifying apparatus 104 notifies the worker W of the livestock animal A1 satisfying the first determination condition and the livestock animal A2 satisfying the second determination condition and located near the livestock animal A1 (FIG. 1 (3)). On the other hand, if the estrus notifying apparatus 104 determines that the current time is not within the working hours, the estrus notifying apparatus 104 notifies the worker W of only the livestock animal A1 satisfying the first determination condition. Furthermore, configuration may be such that if the estrus notifying apparatus 104 determines that the current time is not within the working hours, the estrus notifying apparatus 104 gives no notification concerning the livestock animal A1 satisfying the first determination condition to the worker W.

[0028] As described, in cases where even if a livestock animal A is in estrus, but the worker W cannot immediately go to the livestock animal A in estrus and the current time is outside the working hours, the estrus notifying apparatus 104 notifies the worker W of the minimally required information, to prevent as far as possible, adverse effects consequent to misjudgment, to suppress the burden placed on the worker W, and to prevent the worker W from becoming exhausted. On the other hand, in cases where the worker W can go immediately to the livestock animal A in estrus and the current time is during the working hours of the worker W, the estrus notifying apparatus 104 prompts the worker W to check the livestock animal A in estrus as well as other livestock animals A that can be checked on, whereby the worker W can be caused to recognize signs of estrus of other livestock animals A sooner.

(Example of system configuration of estrus notifying system)

[0029] An example of system configuration of an estrus notifying system of the present embodiment will be described. FIG. 2 is a diagram depicting an example of system configuration of an estrus notifying system 200. In FIG. 2, the estrus notifying system 200 includes one or more of the communications devices 101, the relay de-

vice 102 in plural, and the estrus notifying apparatus 104.

[0030] As depicted in FIG. 2, in the case of an estrus notifying system having the communications device 101 in plural, each of the communications devices 101, when transmitting measurement result information, further transmits communications device identification information thereof. Here, the communications device identification information is information that can identify one communications device 101 from among plural communications devices 101. For example, the communications device identification information is information representing a communications device ID specific to each of the communications devices 101.

[0031] In the estrus notifying system 200, the communications device 101 and the relay device 102 are connected through a wireless communications network 210. The communications device 101 and the relay device 102 each have a given range around the device 101, 102 (e.g., a range of a 150-meter radius around the device 101, 102), as a communications area in which communication through the wireless communications network 210 is possible. When having a positional relation enabling communication, the communications device 101 and the relay device 102 are connected by the wireless communications network 210. For example, near field communication such as radio frequency identification (RFID) is applicable as the wireless communications network 210.

[0032] Further, the relay device 102, the estrus notifying apparatus 104, and the client apparatus 105 are connected via a network 220. For example, the network 220 is the Internet, a local area network (LAN), a wide area network (WAN), etc.

[0033] The communications device 101 has a measurement result information table 201 and is a portable computer attached to each livestock animal A raised on the farm F. The communications device 101 has a function of measuring the step count of the livestock animal A to which the communications device 101 is attached and a communications function through the wireless communications network 210. For example, a pedometer with an additional function of communication via the wireless communications network 210 is applicable as the communications device 101. Contents of the measurement result information table 201 will be described with reference to FIG. 6.

[0034] The relay device 102 is installed within the premises of the farm F and is a computer having a communications function via the wireless communications network 210 and communications function via the network 220. The relay devices 102 are respectively installed at a different installation site.

[0035] The estrus notifying apparatus 104 has a step count DB 202, a transmission source DB 203, a relay device DB 204, a threshold DB 205 and is a computer having a communications function via the network 220. For example, a server included in a cloud computing system, a personal computer (PC), note PC, etc. used by a

manager of the farm F or the worker W are applicable as the estrus notifying apparatus 104. Contents of the step count DB 202, the transmission source DB 203, the relay device DB 204, and the threshold DB 205 will be described with reference to FIGs. 7 to 10.

[0036] The client apparatus 105 is a computer having the display 106 that displays images based on various types of information, and a communications function via the network 220. For example, a PC or note PC, mobile telephone, smartphone, and the like used by the worker W of the farm F are applicable as the client apparatus 105.

(Hardware configuration example of communications device)

[0037] A hardware configuration example of the communications device 101 will be described. FIG. 3 is a block diagram depicting a hardware configuration example of the communications device of the present embodiment. In FIG. 3, the communications device 101 includes a central processing unit (CPU) 301, memory 302, an interface (I/F) 303, a sensor 304, and a timer 305, respectively connected by a bus 300.

[0038] Here, the CPU 301 governs overall control of the communications device 101. The memory 302 includes read-only memory (ROM), random access memory (RAM), and flash ROM. The ROM and the flash ROM, for example, store various types of programs such as a boot program. The RAM is used as a work area of the CPU 301.

[0039] The I/F 303 is connected to the wireless communications network 210 through a communications line and is connected to other apparatuses such as the relay devices 102, via the wireless communications network 210. The I/F 303 administers an internal interface with the wireless communications network 210 and controls the input and output of data from external apparatuses.

[0040] The sensor 304 outputs information for detecting behavior of the communications device 101. For example, when the sensor 304 is implemented by a gyroscope or a triaxial accelerometer and the communications device 101 accelerates, the sensor 304 outputs information according to the acceleration. The timer 305 has a function of measuring time. For example, the timer 305 is implemented by a real time clock (RTC) and measures the actual time. Further, the timer 305 may measure the time that elapses from a given time point. Configuration may be such that the timer 305 is disposed external to the communications device 101 and the communications device 101 obtains the measurement results of the timer 305 through the wireless communications network 210.

(Hardware configuration example of relay device)

[0041] A hardware configuration example of the relay device 102 will be described. FIG. 4 is a block diagram depicting a hardware configuration example of the relay

device 102. In FIG. 4, the relay device 102 includes a CPU 401, memory 402, and an I/F 403, respectively connected by a bus 400.

[0042] Here, the CPU 401 governs overall control of the relay device 102. The memory 402 includes ROM, RAM, and flash ROM. The ROM and flash ROM, for example, store various types of programs such as a boot program. The RAM is used as a work area of the CPU 401.

[0043] The I/F 403 is connected to the wireless communications network 210 through a communications line and is connected to other apparatuses such as the communications device 101, via the wireless communications network 210. The I/F 403 is further connected to the network 220 through a communications line and through the network 220, is connected to other apparatuses such as the estrus notifying apparatus 104. The I/F 403 administers an internal interface with the wireless communications network 210 and the network 220; and controls the input and output of data from external apparatuses.

(Hardware configuration example of estrus notifying apparatus and client apparatus)

[0044] A hardware configuration example of the estrus notifying apparatus 104 and the client apparatus 105 will be described. Here, the estrus notifying apparatus 104 and the client apparatus 105 will be indicated as simply "the estrus notifying apparatus 104, etc."

[0045] FIG. 5 is a block diagram depicting a hardware configuration example of the estrus notifying apparatus 104, etc. In FIG. 4, the estrus notifying apparatus 104, etc. include a CPU 501, ROM 502, RAM 503, a magnetic disk drive 504, a magnetic disk 505, an optical disk drive 506, an optical disk 507, a display 508, an I/F 509, a keyboard 510, a mouse 511, a scanner 512, and a printer 513, respectively connected by a bus 500.

[0046] Here, the CPU 501 governs overall control of the estrus notifying apparatus 104, etc. The ROM 502 stores programs such as a boot program. The RAM 503 is used as a work area of the CPU 501. The magnetic disk drive 504, under the control of the CPU 501, controls the reading and writing of data with respect to the magnetic disk 505. The magnetic disk 505 stores data written thereto under the control of the magnetic disk drive 504.

[0047] The optical disk drive 506, under the control of the CPU 501, controls the reading and writing of data with respect to the optical disk 507. The optical disk 507 stores data written thereto under the control of the optical disk drive 506, the data being read out by a computer.

[0048] The display 508 displays documents, images, and functional information in addition to a cursor, icons, and toolboxes. A CRT, TFT liquid crystal display, plasma display, and the like may be employed as the display 508.

[0049] The I/F 509 is connected to the network 220 through a communications line, and is connected to other apparatuses such as the relay device 102 and the client

apparatus 105, via the network 220. The I/F 509 administers an internal interface with the network 220, and controls the input and output of data from external apparatuses. A modem, LAN adapter, etc. may be employed as the I/F 509.

[0050] The keyboard 510 has keys for inputting text, numerals, various instructions, etc. and inputs data. The keyboard 510 may be a touch panel input pad, a numeric pad, etc. The mouse 511 is used to move the cursor, select a range, move or change the size of a window, etc. As long as functions identical to a pointing device are provided, a trackball, a joy stick, and the like may be employed.

[0051] The scanner 512 optically reads images and takes in image data into the estrus notifying apparatus 104. The scanner 512 may have an optical character reader (OCR) function. The printer 513 prints image data and document data. A laser printer or ink jet printer may be employed as the printer 513.

[0052] Further, for example, among the components described above, the estrus notifying apparatus 104 may be configured to omit the optical disk drive 506, the optical disk 507, the display 508, the mouse 511, the scanner 512, and the printer 513. The client apparatus 105 may be configured to omit the optical disk drive 506, the optical disk 507, the mouse 511, the scanner 512, and the printer 513.

(Example of information stored by communications device)

[0053] An example of the information stored by the communications device 101 will be described. As described above, the communications device 101 stores the measurement result information table 201. For example, the measurement result information table 201 is implemented by the memory 302 of the communications device 101.

<Example of contents of measurement result information table>

[0054] FIG. 6 is a diagram depicting an example of the contents of the measurement result information table 201. In FIG. 6, the measurement result information table 201 has fields for dates and times of measurement, and measurement values. By setting information into these fields, measurement result information for each combination of a measurement value and the date and time of the measurement is stored as a record in the measurement result information table 201. For instance, in the example depicted in FIG. 6, records of measurement result information 600-1 to 600-6 are stored in the measurement result information table 201.

[0055] Here, the date and time of measurement represents the date and time of past transmissions of measurement result information. In the case of the present embodiment, as one example, the date and time of meas-

urement indicates the date and time of the most recent six transmissions of the measurement result information. The measurement value represents a past measurement value of the step count of the livestock animal A at the time of transmission of the measurement result information. In the case of the present embodiment, as one example, the measurement values of the step counts of the livestock animal A at the time of the most recent six transmissions of the measurement result information are indicated.

[0056] For example, the communications device 101 cumulates, as the current measurement value, the step count of the livestock animal A from the time when the measurement value is set to "0" until the current time. With each step that the livestock animal A takes, the communications device 101 instantaneously accelerates. Upon detecting this acceleration via the sensor 304, the communications device 101 increments the current measurement value by "+1".

[0057] When the transmission time for the measurement result information arrives according to the measurement result of the timer 305, the communications device 101 stores measurement result information in which the current measurement value is correlated with the date and time of measurement for this transmission time. If the transmission time for the measurement result information is a one-hour interval, for example, transmission occurs every hour, on the hour.

[0058] For example, in FIG. 6, the measurement result information 600-1 indicates that the measurement value at 2:00 on 2012/02/20 is "C6". Here, "C6" is a positive integer. Upon storing the measurement result information to the measurement result information table 201, the communications device 101 transmits to the estrus notifying apparatus 104, via the relay device 102, each record of measurement result information stored in the measurement result information table 201. In the example depicted in FIG. 6, the communications device 101 transmits the measurement result information 600-1 to 600-6.

[0059] As a result, the communications device 101 is able to transmit measurement result information multiple times. For example, the measurement result information 600-1 is transmitted six times, at one-hour intervals from 21:00 on 2012/02/19 until 2:00 on 2012/02/20. Therefore, even if the communications device 101 cannot communicate with any of the relay devices at the current transmission time for the measurement result information and the transmission of the measurement result information fails, the communications device 101 can transmit at a subsequent transmission time, the measurement result information for which transmission failed.

[0060] In this example, although an example is described where the communications device 101 stores measurement result information for the six most recent measurements, configuration is not limited hereto. Configuration may be such that the communications device 101 does not store past measurement result information. For example, in this case, when the transmission time

for the measurement result information arrives, the communications device 101 may transmit the current measurement value as the measurement result information and delete the measurement result information. With such a configuration, in terms of storage of the measurement result information, the volume of data that the communications device 101 has to store can be reduced.

[0061] Although the communications device 101 is described to transmit each record of measurement result information stored in the measurement result information table 201, configuration is not limited hereto. For example, configuration may be such that the communications device 101 transmits only the one most recent record of measurement result information. More specifically, in the case of the example depicted in FIG. 6, the communications device 101 may be configured to transmit only the measurement result information 600-1. In this case, in terms of the transmission of the measurement result information, the volume of data that the communications device 101 has to transmit can be reduced.

[0062] Furthermore, configuration may be such that when the communications device 101 transmits the one most recent record of measurement result information, the communications device 101 also transmits the measurement result information for which transmission failed at a past transmission time. For example, in this case, upon receiving measurement result information from the communications device 101, the relay device 102 transmits to the communications device 101, successful reception information indicating that measurement result information has been received. If the communications device 101 does not receive the successful reception information within a given period from the transmission of the measurement result information, the communications device 101 determines that this transmission of the measurement result information has failed.

[0063] In this case, the communications device 101 correlates and stores the measurement result information for which transmission failed and information indicating that the transmission failed. Thereafter, when the transmission time for the measurement result information arrives, the communications device 101 transmits the one most recent record of the measurement result information and the measurement result information for which transmission failed. With such a configuration, in terms of transmission of the measurement result information, the volume of data that the communications device 101 has to transmit can be reduced while assuredly transmitting measurement result information to the relay device 102.

(Example of information stored by estrus notifying apparatus)

[0064] An example of information stored by the estrus notifying apparatus 104 will be described. First, examples of the contents of the various DBs 202, 203, 204, and 205 stored by the estrus notifying apparatus 104 will be

described. For example, the various DBs, 202, 203, 204, and 205 described hereinafter are implemented by a memory apparatus such as the ROM 502, the RAM 503, the magnetic disk 505, and the optical disk 507 of the estrus notifying apparatus 104.

<Example of contents of step count DB>

[0065] FIG. 7 is a diagram depicting an example of the contents of the step count DB 202. In FIG. 7, the step count DB 202 has fields for dates, step counts, estrus predictor flags, and estrus indication flags. By setting information into these fields, step count information for each combination of a date, step count, estrus predictor flag, and estrus indication flag is stored as a record in the step count DB 202. In the example depicted in FIG. 7, records of step count information 700-1 to 700-3 are stored in the step count DB 202.

[0066] Here, the date is the date that the step count was measured and is indicated as YEAR/MONTH/DAY, for example. The step count indicates the step count of the livestock animal A, based on count result information. The step count field includes, for example, time slot fields such as "0:00-1:00", "1:00-2:00", "2:00-3:00", ..., "22:00-23:00", and "23:00-24:00". Each of the time slot fields stores information indicating the step count of the livestock animal A for the respective time slot. For example, the estrus notifying apparatus 104 stores into each time slot field, as the step count of the livestock animal A, the difference of the measurement value at the last time less the measurement value at the head time.

[0067] More specifically, for example, assuming that the measurement value at 2:00 on 2012/02/20 is "C6" and the measurement value at 1:00 on 2012/02/20 is "C5". As described above, "C6" and "C5" are positive integers. In this case, as the step count of the livestock animal A, the estrus notifying apparatus 104 stores into the "1:00-2:00" time slot field for the date "2012/02/20", "N302(N302=C6-C5)", which is the difference of "C6" less "C5".

[0068] The estrus predictor flags and the estrus indication flags include an ON/OFF field that indicates whether the flag is "ON" or "OFF". In the case of the present embodiment, as one example, if a flag is ON, "1" is set in the ON/OFF field. If a flag is "OFF", "0" is set in the ON/OFF field. The estrus predictor flags and the estrus indication flags further include, for example, a flag ON date/time field storing the date and time when the flag was set to "ON".

[0069] For example, when a given condition is satisfied, the estrus notifying apparatus 104 stores "1" into the ON/OFF field of an estrus predictor flag or an estrus indication flag. On the other hand, when "1" is not stored in the ON/OFF field, the estrus notifying apparatus 104 stores "0". The setting of the estrus predictor flags and the estrus indication flags will be described with reference to FIGs. 15 and 16 hereinafter.

[0070] In the step count DB 202, each of the above

fields is set for each of the communications devices 101. For example, in FIG. 6, fields of the step count DB 202, for the communications device 101 of the communications device ID "G01" are depicted. In the step count DB 202, the estrus notifying apparatus 104 stores step count information for each of the communications devices 101 and based on the stored step count information, determines whether the step count satisfies a given condition.

[0071] More specifically, for example, the communications device 101 transmits the communications device identification information thereof when transmitting measurement result information. The estrus notifying apparatus 104 receives the measurement result information and the communications device identification information. Each of the communications devices 101 have a communications device ID, and from the received communications device identification information, the estrus notifying apparatus 104 identifies the communications device 101 that transmitted the measurement result information. The estrus notifying apparatus 104 calculates and stores into the fields of the step count DB 202, for the identified communications device ID, the step count based on the identified communications device ID received together with the measurement result information. The estrus notifying apparatus 104 determines whether the stored step count satisfies a given condition.

[0072] Further, as depicted in FIG. 7, the communications device ID and a livestock animal ID, which is identification information for each livestock animal A, may be correlated and stored into the step count DB 202.

<Example of contents of transmission source DB>

[0073] An example of the contents of the transmission source DB 203 will be described. FIG. 8 is a diagram depicting an example of the contents of the transmission source DB 203. In FIG. 8, the transmission source DB 203 has fields for communications device IDs and transmission source relay device IDs. By setting information into these fields, transmission source relay device information for each combination of communications device ID and transmission source relay device ID is stored as records in the transmission source DB 203. For instance, in the example depicted in FIG. 8, records of transmission source relay device information 800-1 to 800-m are stored in the transmission source DB 203.

[0074] A communications device ID is an identifier of a communications device 101. A transmission source relay device ID is an identifier of a transmission source relay device 102 that transmitted to the estrus notifying apparatus 104, the measurement result information just transmitted by the communications device 101. For example, in FIG. 8, transmission source relay device information 800-1 indicates that the measurement result information just transmitted by the communications device 101 of the communications device ID "G01" has been transmitted to the estrus notifying apparatus 104, via the relay device 102 of the relay device ID "B1".

[0075] In the case of the present embodiment, the estrus notifying apparatus 104 stores by the transmission source DB 203, information indicating the relay device 102 through which the measurement result information just transmitted by a communications device 101 is received. Thus, for example, when the worker W requests the output of transmission source relay device information for a given communications device 101, the estrus notifying apparatus 104 can output this transmission source relay device information to the client apparatus 105, etc. As a result, when a desired communications device 101 transmits recent measurement result information, the worker W can know in which relay device 102 communications area, the desired communications device 101 is located.

<Contents of relay device DB>

[0076] An example of the contents of the relay device DB 204 will be described. FIG. 9 is a diagram depicting an example of the contents of the relay device DB 204. In FIG. 9, the relay device DB 204 has fields for relay device IDs and installation positions. By setting information into these fields, installation position information for each combination of a relay device ID and an installation position is stored as a record in the relay device DB 204. For instance, in the example depicted in FIG. 9, records of installation position information 900-1 to 900-n are stored in the relay device DB 204.

[0077] Here, a relay device ID is an identifier of a relay device 102. An installation position is installation position information indicating the installation position of a relay device 102. Installation position information is information that can specify one geographical point on a map and, for example, is information representing latitude and longitude, information representing coordinates, and the like. For example, in FIG. 9, installation position information 900-1 indicates that the relay device 102 of the relay device ID "B1" is installed at a geographical point indicated by a "north latitude of x1 degrees and longitude of y1 degrees".

<Contents of threshold DB>

[0078] An example of the contents of the threshold DB 205 will be described. FIG. 10 is a diagram depicting an example of the contents of the threshold DB 205. In FIG. 10, the threshold DB 205 has fields for time slots and thresholds. By setting information into these fields, threshold information for each combination of a time slot and a threshold is stored as a record in the threshold DB 205. For instance, in the example depicted in FIG. 10, records of threshold information 1000-1 to 1000-24 are stored in the threshold DB 205.

[0079] A time slot is information for specifying whether a threshold for a step count stored in a time slot field of the step count DB 202 is to be used. The time slots are provided corresponding to the time slot fields of the step

count DB 202. A threshold represents a threshold for determining whether the livestock animal A to which the communications device 101 is attached is in estrus. For example, the estrus notifying apparatus 104 determines if the step count stored in the time slot field "0:00-1:00" in the step count DB 202 is greater than or equal to a threshold "Th1" for a case where the time slot is "0:00-1:00".

[0080] Each of the thresholds Th1 to Th24 may be a different value or may be the same value. For example, if the thresholds Th1 to Th24 that take into consideration the biology of the livestock animal A are defined, the effects of the biology of the livestock animal A can be reduced and the accuracy in detecting estrus of the livestock animal A can be increased. More specifically, for example, if the livestock animal A is a nocturnal animal, the threshold for 22:00 to 3:00 is set to be higher than the thresholds for other time slots.

[0081] Further, the thresholds Th1 to Th24 may be values that differ according to the livestock animal A or may be a common value for each livestock animal A. For example, by setting for each livestock animal A, the thresholds Th1 to Th24 based on a history of step counts obtained in the past, the effects of individual differences of the livestock animals A can be reduced and the accuracy in detecting estrus of the livestock animals A can be increased. More specifically, for example, the threshold for a livestock animal A that actively walks on a regular basis can be set higher than the thresholds for other livestock animals A.

[0082] As described, in the case of the present embodiment, the thresholds Th1 to Th24 of the threshold DB 205 are defined for hourly step counts. Thus, if measurement result information is transmitted to the estrus notifying apparatus 104 at 10-minute intervals, the estrus notifying apparatus 104 sums six of the 10-minute step counts to calculate an hourly step count and compares the calculated hourly step count and the threshold in the threshold DB 205.

<Example of contents of step count cumulation table>

[0083] FIG. 11 is a diagram depicting an example of the contents of a step count cumulation table 1100. The estrus notifying apparatus 104 stores the step count cumulation table 1100 depicted in FIG. 11. For example, the step count cumulation table 1100 is stored in a memory apparatus such as the RAM 503, the magnetic disk 505, and the optical disk 507 of the estrus notifying apparatus 104.

[0084] In FIG. 11, a step count cumulation table 1100 has fields for dates and times of measurement, measurement values, and step counts for cumulation. By setting information into these fields, step-count-for-cumulation information for each combination of a date and time of measurement, a measurement value, and a step count for cumulation is stored as a record in the step count cumulation table 1100. In the example depicted in FIG.

11, records of step-count-for-cumulation information 1100-1 to 1100-6 are stored.

[0085] Here, a date and time of measurement represents a date and time indicated by received measurement result information. A measurement value represents a measurement value indicated by the received measurement result information. A step count for cumulation represents a 10-minute step count of a livestock animal A. The step count for cumulation can be obtained by subtracting a previous measurement value among two consecutive measurement values in the step count cumulation table 1100 from the subsequent measurement value among the two consecutive measurement values.

[0086] For example, as depicted in FIG. 11, the estrus notifying apparatus 104 is assumed to receive measurement result information for dates and times of measurement including "1:10", "1:20", ..., "1:50", and "2:00". In this example, the dates of the measurement result information are the same date. In the example depicted in FIG. 11, the date is "2012/02/20". Further, measurement values indicated by the measurement result information are "C11", "C12", ..., "C15", and "C16".

[0087] In this case, for example, the step count for cumulation for the date and time of measurement "2:00" is "H6", which is the difference of "C16" less the measurement value "C15" of the previous date and time of measurement "1:50", or more specifically, $H6=C16-C15$. The step count for cumulation for the date and time of measurement "1:50" is "H5", which is the difference of "C15" less the measurement value "C14" of the previous date and time of measurement "1:40", or more specifically, $H5=C15-C14$.

[0088] The estrus notifying apparatus 104 stores to the time slot field "1:00-2:00" for the date "2012/02/20" the value obtained by integrating H1 to H6. In the example depicted in FIG. 7, "N302" is stored in the time slot field "1:00-2:00" for the date "2012/02/20". For example, the value of "N302" in FIG. 7 is the sum of "H1 to H6" in FIG. 11.

<Example of contents of working hours DB>

[0089] FIG. 12 is a diagram depicting an example of the contents of the working hours DB 206. In FIG. 12, the working hours DB 206 has fields for attributes and working hours. By setting information into these fields, working-hours information for each combination of an attribute and working hours is stored as a record in the working hours DB 206. For instance, in the example depicted in FIG. 12, records of working-hours information 1200-1 and 1200-2 are stored in the working hours DB 206.

[0090] In the working hours DB 206, an attribute is information for specifying a work day. For example, as depicted in FIG. 12, the day of the week can be used as an attribute. The attribute of the working-hours information 1200-1 is "Monday to Friday", indicating that the working-hours information 1200-1 is the working-hours informa-

tion when the work day is "Monday to Friday". The attribute of the working-hours information 1200-2 is "Saturday to Sunday", indicating that the working-hours information 1200-2 is working-hours information when the work day is "Saturday to Sunday". An attribute is not limited to a day of the week and may be, for example, a national holiday, a date, etc.

[0091] Information indicating the working hours during the correlated work day is stored in the working hours field. For example, the working-hours information 1200-1 having the attribute "Monday to Friday" indicates that the working hours of the worker W are "5:00 to 7:00", "8:00 to 12:00", "13:00 to 15:00", "16:00 to 18:00", and "19:00 to 21:00". Further, for example, the working-hours information 1200-2 having the attribute "Saturday to Sunday" indicates that the working hours of the worker W are "5:00 to 7:00", "8:00 to 12:00", "13:00 to 15:00", and "16:00 to 18:00".

[0092] When the estrus notifying apparatus 104 determines whether the current time is included in the working hours of the worker W, the estrus notifying apparatus 104 obtains the current date and time, and the day of the week. If the obtained day of the week is "Monday to Friday", the estrus notifying apparatus 104 determines whether the current time is included in the working hours, based on information stored in the work time slot field of the working-hours information 1200-1 and the current date and time obtained.

[0093] Information indicating whether there is downtime during the working hours is stored in the working hours field. In the example depicted in FIG. 12, there is no downtime during the working hours "5:00 to 7:00" for "Monday to Friday", but there is downtime during the working hours "8:00 to 12:00". For example, with respect to working hours for which the volume of work is relatively low, the worker W preliminarily sets indication that there is downtime. With respect to working hours for which the volume of work is relatively high, the worker W preliminarily sets indication that there is no downtime.

[0094] Working-hours information for each worker W may be stored in the working hours DB 206, for multiple workers W. For example, the workers W respectively manage a different livestock animal A. Thus, by correlating and storing in the working hours DB 206, a communications device ID and a worker ID, which is an identifier of the worker W, the estrus notifying apparatus 104 can determine whether the current times is included in the working hours of each worker W managing a communications device 101.

[0095] More specifically, for example, in the example depicted in FIG. 12, the working-hours information of the worker W who manages the livestock animal A to which the communications device 101 of the communications device ID "G01" is attached is depicted. For example, upon receiving measurement result information and communications device identification information, the estrus notifying apparatus 104 identifies from the received communications device identification information, the

communications device 101 attached to the livestock animal A managed by a worker W and from which the measurement result information is. Next, based on the identified the communications device 101, the estrus notifying apparatus 104 obtains working-hours information from the working hours DB 206 of the worker W managing the communications device 101.

[0096] Thus, for workers W whose working hours differ, the estrus notifying apparatus 104 can shorten the transmission interval for the measurement result information of the communications devices 101 managed by the workers W and can prevent the transmission interval from being shortened. Therefore, for each of the workers W, the estrus notifying apparatus 104 can support the tracking of the livestock animal A and suppress battery consumption of the communications device 101.

(Functional configuration example of estrus notifying apparatus)

[0097] FIG. 13 is a block diagram depicting a functional configuration example of the estrus notifying apparatus 104. In FIG. 13, the estrus notifying apparatus 104 is configured to include an obtaining unit 1301, a first determining unit 1302, a second determining unit 1303, a third determining unit 1304, and an output unit 1305. These functions forming a control unit, i.e., the obtaining unit 1301 to the output unit 1305, are implemented by executing on the CPU 501, a program stored in the magnetic disk 505, etc. depicted FIG. 5, or by the I/F 509, the magnetic disk 505, etc. Process results of the functional units are stored to the RAM 503, for example.

[0098] The obtaining unit 1301 has a function of obtaining measurement results for the step count of each livestock animal A and position information for each livestock animal A. For example, the obtaining unit 1301 receives, via the network 220, measurement result information from the communications device 101 attached to each livestock animal A and thereby, obtains the measurement results for the step count of each livestock animal A. Further, when receiving the measurement result information, the obtaining unit 1301 receives the relay device identification information of the relay device 102 that relayed the measurement result information and obtains the received relay device identification information as position information of a livestock animal A.

[0099] The first determining unit 1302 has a function of determining with respect to each livestock animal A, whether the livestock animal A is in estrus, based on the measurement results of the step count obtained by the obtaining unit 1301 and a first condition. For example, if the determination is made based on the first determination condition, the first determining unit 1302 determines if the three most recently measured, consecutive hourly step counts stored in the step count DB 202 are greater than or equal to a threshold defined in the threshold DB 205 and if the three consecutive step counts are greater than or equal to the threshold, the first determining unit

1302 determines that the livestock animal A is in estrus.

[0100] The second determining unit 1303 has a function of referring to a memory unit retaining the working hours of the worker W and determining whether the current time is within the working hours, if estrus is determined by the first determining unit 1302. For example, when estrus is determined by the first determining unit 1302, the second determining unit 1303 obtains the current date and time and by using the obtained current date and time and the working hours DB 206, determines whether the current time is within the working hours.

[0101] The third determining unit 1304 has a function of determining with respect to other livestock animals A located near a specific livestock animal A determined to be in estrus by the first determining unit 1302, whether estrus is indicated based on the second determination condition, when the current time is determined to be included in the working hours by the second determining unit 1303. For example, the third determining unit 1304 identifies, as a livestock animal A of the same herd, each livestock animal A having a communications device 101 from which measurement result information is received via the same relay device 102. The third determining unit 1304 refers to the step count DB 202, obtains step count information for each livestock animal A in the herd, and determines whether the obtained step count information satisfies a given condition.

[0102] The third determining unit 1304 determines whether a livestock animal A indicates estrus by a more lax determination criterion than that of the first determining unit 1302. For example, the third determining unit 1304 determines with respect to the other livestock animals A, if the two most recently measured, consecutive hourly step counts stored in the step count DB 202 are greater than or equal to a threshold defined in the threshold DB 205 and if the two consecutive steps counts are greater than or equal to the threshold, the third determining unit 1304 determines estrus to be indicated. Further, for example, with respect to the other livestock animals A, the third determining unit 1304 may use a threshold defined to be lower than the threshold used by the first determining unit 1302 to determine whether a livestock animal A indicates estrus.

[0103] The output unit 1305 has a function of outputting the identification information of the livestock animal A determined to be in estrus by the first determining unit 1302, and the identification information of the livestock animals A determined to indicate estrus by the third determining unit 1304. For example, the output unit 1305 uses the network 220 to transmit to the client apparatus 105, the communications device identification information of the communications device 101 attached to the livestock animal A determined to be in estrus by the first determining unit 1302, and the communications device identification information of the communications device 101 attached to the livestock animal A determined to indicate estrus by the third determining unit 1304. Further, if the current time is determined by the second determining

unit 1303 to be outside the working hours, the output unit 1305 may output to the client apparatus 105, only the communications device identification information of the communications device 101 attached to the livestock animal A determined to be in estrus by the first determining unit 1305.

(Display example of client apparatus)

[0104] An example of display by the client apparatus 105 will be described. In the display example described hereinafter, for example, when the client apparatus 105 receives from the estrus notifying apparatus 104, communications device identification information, relay device identification information, and/or installation position information, the received information is displayed on the display 106.

[0105] FIG. 14 is a diagram depicting an example of display by the client apparatus 105. In FIG. 14, for example, on the display 106, a message 1401 notifying the worker W that the livestock animal A for which the communications device identification information has been received from the estrus notifying apparatus 104 is in estrus. Further, the message 1401 includes information notifying the worker W that the relay device 102 corresponding to the received relay device identification information is the relay device 102 located near the livestock animal A in estrus. For example, the communications device ID of the communications device 101 attached to the livestock animal A determined to be in estrus is assumed to be "G01" and the relay device ID of the relay device 102 that relayed the measurement result information most recently received from the communications device 101 is assumed to be "B1". In this case, as depicted in FIG. 14, the client apparatus 105 displays the message 1401, "The livestock animal having the communications device 'G01' near the relay device having the relay device ID 'B1' is in estrus" on the display 106.

[0106] From the message 1401, the worker W can surmise the location of the livestock animal A in estrus. Therefore, the worker W can narrow down the range to be searched for the livestock animal A in estrus, enabling reductions in the work load and time consumed to search for the livestock animal A in estrus.

[0107] The estrus notifying apparatus 104 further transmits to the client apparatus 105, the communications device identification information of the communications devices 101 attached to other livestock animals A that indicate estrus and are near the livestock animal A in estrus. The client apparatus 105, upon receiving the communications device identification information of the communications devices 101 attached to the other livestock animals A indicating estrus, may display the message 1401 including information pointing to this communications device identification information. For example, a livestock animal A indicating estrus and having the communications device 101 with the communications device ID "G03" is assumed to be near the livestock animal A

in estrus having the communications device 101 with the communications device ID "G01". In this case, the client apparatus 105 displays the message 1401, "The livestock animal having the communications device "G03" near the relay device with the relay device ID "B1" may also be in estrus" on the display 106. Thus, this livestock animal can be checked together with the livestock animal A in estrus and the worker W can be prompted to check other livestock animals possibly in estrus.

[0108] The display 106 displays an installation position image 1402 notifying the worker W of the geographical point specified by the installation position information. Here, for example, the installation position image 1402 has a map image Mp and a geographical point image P. The map image Mp is an image that represents a given map range that includes the geographical point specified by the installation position information. The geographical point image P is an image that represents on the map image Mp, the geographical point specified by the installation position information. As depicted in FIG. 14, the installation position image 1402 is an image in which the geographical point image P is displayed superimposed on the map image Mp.

[0109] The client apparatus 105 may further display a communications area image E that represents the communications area of the relay device 102. Here, for example, the communications area image E is an image that represents a given range that includes the geographical point specified by the installation position information. The communications area image E does not strictly have to represent the communications area of the relay device 102. For example, the communications area image E may be an image that represents a 150-meter radius around the geographical point specified by the installation position information.

[0110] For example, if the client apparatus 105 stores map data, the client apparatus 105 generates based on the stored map data and the received installation information, image data for displaying the installation position image 1402. Further, if the estrus notifying apparatus 104 stores map data, the estrus notifying apparatus 104 may generate based on the stored map data and the installation position information, an image for displaying the installation position image 1402 and may transmit the generated image data to the client apparatus 105.

[0111] From the installation position image 1402, even an inexperienced worker W unable to determine the position of a relay device from the relay device ID can surmise the location of the livestock animal A having the traced communications device 101. Therefore, the worker W can narrow down the range to be searched for the livestock animal A having the traced communications device 101, enabling reductions in the work load and time consumed in searching for the livestock animal A.

[0112] The client apparatus 105 may further display on the display 106, a flag release button for setting the estrus indication flag of the livestock animal A to OFF. For ex-

ample, if the worker W presses the flag release button, the client apparatus 105 transmits to the estrus notifying apparatus 104, a flag release request to set the estrus indication flag of the livestock animal A to OFF. By receiving the flag release request, the estrus notifying apparatus 104 can determine that a flag release operation has been received and sets the estrus indication flag of the livestock animal A to OFF.

10 (Process procedure of communications device)

[0113] A process procedure of the communications device 101 will be described. FIG. 15 is a flowchart depicting an example of a process procedure of the communications device 101. In the flowchart depicted in FIG. 15, the communications device 101, via the sensor 304, determines whether acceleration of the communications device 101 has occurred that is greater than or equal to a given value (step S1501). If acceleration greater than or equal to a given value has not occurred (step S1501: NO), the communications device 101 transitions to the operation at step S1503.

[0114] If acceleration greater than or equal to a given value has occurred (step S1501: YES), the communications device 101 increments the current measurement value by "+1" (step S1502). Thus, each time acceleration of the communications device 101 occurs consequent to the livestock animal A walking, the communications device 101 can cumulate the current measurement value by +1. The communications device 101 determines whether the transmission time for the measurement result information has arrived (step S1503). For example, as described above, when the time measured by the timer 305 becomes a given time, the communications device 101 determines that the transmission time for the measurement result information has arrived.

[0115] At step S1503, the communications device 101 uses a different condition for each set transmission interval to determine the transmission time for the measurement result information. More specifically, if the transmission interval is set to a one-hour interval, the communications device 101 determines that the transmission time has arrived at given times of one-hour intervals, such as when the time measured by the timer 305 becomes "0:00", "1:00", ...

[0116] On the other hand, if the transmission interval is set to be a 10-minute interval, the communications device 101 determines that the transmission time for the measurement result information has arrived at given times of 10-minute intervals, such as when the time measured by the timer 305 becomes "0:10", "0:20", ... Further, if the transmission interval is set to be a one-minute interval, the communications device 101 determines that the transmission time for the measurement result information has arrived at given times of one-minute intervals, such as when the time measured by the timer 305 becomes "0:01", "0:02",

[0117] If the transmission time for the measurement

result information has arrived (step S1503: YES), the communications device 101 stores to the measurement result information table 201, measurement result information in which the date and time of the current transmission time for the measurement result information and the current measurement value are correlated (step S1504). Thus, each time the transmission time arrives for measurement result information, the communications device 101 can store the measurement value for the corresponding time.

[0118] The communications device 101 transmits to the relay device 102, all measurement result information stored in the measurement result information table 201 and the communications device identification information thereof (step S1505), and transitions to the operation at step S1506. Thus, the communications device 101 can transmit measurement result information at a given transmission interval.

[0119] As described above, upon receiving measurement result information and communications device identification information from the communications device 101, the relay device 102 transmits to the estrus notifying apparatus 104, via the network 220, the received measurement result information and communications device identification information as well as the relay device identification information thereof.

[0120] At step S1503, if the transmission time has not arrived (step S1503: NO), the communications device 101 transitions to step S1506. The communications device 101 determines whether an instruction to change the transmission interval for the measurement result information has been received from the relay device 102 (step S1506). If no instruction to change the transmission interval has been received (step S1506: NO), the communications device 101 ends the series of operations according to the present flowchart.

[0121] If an instruction to change the transmission interval has been received (step S1506: YES), the communications device 101 sets the transmission interval according to the received instruction (step S1507), and ends the series of operations according to the present flowchart. Thus, the communications device 101 can change the transmission interval according to a received change instruction.

[0122] The communications device 101 may further reset the measurement value to "0" at a given timing. For example, when a given time has arrived (e.g., "0:00", every day), the communications device 101 resets the measurement value to "0". Further, the communications device 101 may reset the measurement value "0", if an instruction to reset the measurement value to "0" is received from the estrus notifying apparatus 104, via the relay device 102.

(Process procedure of estrus notifying apparatus)

[0123] A process procedure of the estrus notifying apparatus 104 will be described. FIG. 16 is a flowchart (part

1) depicting an example of a process procedure of the estrus notifying apparatus 104. For example, the estrus notifying apparatus 104 performs the operations in the flowchart depicted in FIG. 16, if in the step count DB 202, no estrus predictor flag and no estrus indication flag is set to "1", i.e., ON.

[0124] In the flowchart depicted in FIG. 16, the estrus notifying apparatus 104 determines whether measurement result information, communications device identification information, and relay device identification information have been received from the relay device 102 (step S1601). The estrus notifying apparatus 104 stands by until measurement result information, communications device identification information, and relay device identification information are received (step S1601: NO).

[0125] Upon receiving measurement result information, communications device identification information, and relay device identification information (step S1601: YES), the estrus notifying apparatus 104 updates the stored contents of the transmission source DB 203, based on the received communications device identification information and relay device identification information (step S1602). For example, at step S1602, the estrus notifying apparatus 104 stores to the transmission source DB 203, transmission source relay device information in which the communications device ID indicated by the received communications device identification information and the relay device ID indicated by the received relay device identification information are correlated.

[0126] The estrus notifying apparatus 104 calculates the step count of the livestock animal A, based on the communications device identification information and the measurement result information received at step S1601 and stores the calculated step count to the step count DB 202 (step S1603). As described above, at step S1603, the estrus notifying apparatus 104 calculates a step count for each communications device 101, based on the received communications device identification information and measurement result information, and stores the calculated step counts. Calculation of the livestock animal A step counts, based on the received measurement result information has been described with reference to FIG. 6, etc. and therefore, description thereof will be omitted hereinafter.

[0127] The estrus notifying apparatus 104 determines whether among the step counts stored in the step count DB 202 for the communications device identification information received at step S1601, the step counts for the two most recently measured time slots are respectively greater than or equal to a threshold defined in the threshold DB 205 (step S1604).

[0128] If the step counts for the two most recently measured time slots are respectively greater than or equal to a threshold defined in the threshold DB 205 (step S1604: YES), the estrus notifying apparatus 104 obtains the current date, time, and day of the week (step S1605). For example, the estrus notifying apparatus 104 may ob-

tain the current date, time, and day of the week by a timer function of the estrus notifying apparatus 104, or may obtain the current date, time, and day of the week via the network 220, for example, according to Network Time Protocol (NTP). The estrus notifying apparatus 104 may obtain, as the current date and time, the last date and time of measurement among the dates and times of measurement included in the received measurement result information.

[0129] Upon obtaining the current date, time, and day of the week, the estrus notifying apparatus 104 obtains from the working hours DB 206, the working-hours information identified by the obtained day of the week (step S1606). Further, as described above, when identifying the working-hours information to be obtained, the estrus notifying apparatus 104 may use the received communications device identification information. Thus, for each communications device 101, the estrus notifying apparatus 104 can obtain the working-hours information for the worker W managing the communications device 101.

[0130] The estrus notifying apparatus 104 determines from the obtained current date and time, and the working-hours information, whether the current time is included in the working hours (step S1607). Further, as described above, the estrus notifying apparatus 104 may determine based on the communications device identification information received at step S1601, whether the current time is the working hours of the worker W who transmitted the current measurement result information. If the current time is not during the working hours (step S1607: NO), the estrus notifying apparatus 104 ends the series of operations according to the present flowchart.

[0131] On the other hand, if the current time is during the working hours (step S1607: YES), the estrus notifying apparatus 104 sets the estrus predictor flag to "1", and stores the flag ON date/time for the estrus predictor flag (step S1608). For example, the estrus notifying apparatus 104 stores, as the flag ON date/time, the date and time of measurement that is currently the most recent among the received measurement result information. For example, the estrus notifying apparatus 104 may obtain the current date and time, and store the obtained current date and time, as the flag ON date/time.

[0132] The estrus notifying apparatus 104 transmits to the relay device 102, a change instruction to change the one-hour interval to a 10-minute interval (step S1609), and ends the series of operations according to the present flowchart. At step S1604, if the step counts are not greater than or equal to the threshold (step S1604: NO), the estrus notifying apparatus 104 ends the series of operations according to the present flowchart.

[0133] FIG. 17 is a flowchart (part 2) depicting an example of the process procedure of the estrus notifying apparatus 104. For example, the estrus notifying apparatus 104 performs the operations in the flowchart depicted in FIG. 17, if in the step count DB 202, an estrus predictor flag is set to "1", i.e. ON.

[0134] In the flowchart depicted in FIG. 17, the estrus

notifying apparatus 104 determines whether measurement result information, communications device identification information, and relay device identification information have been received from the relay device 102 (step S1701). The estrus notifying apparatus 104 stands by until measurement result information, communications device identification information, and relay device identification information are received (step S1701: NO).

[0135] Upon receiving measurement result information, communications device identification information, and relay device identification information (step S1701: YES), the estrus notifying apparatus 104, similar to step S1602, updates the stored contents of the transmission source DB 203, based on the received communications device identification information and relay device identification information (step S1702).

[0136] The estrus notifying apparatus 104 obtains based on the received relay device identification information and the relay device DB 204, the installation position information of the relay device 102 that transmitted the currently received measurement result information (step S1703). At step S1703, the estrus notifying apparatus 104 obtains from the relay device DB 204, the installation position information to which the relay device ID in the received relay device identification information is correlated.

[0137] The estrus notifying apparatus 104 transmits to the client apparatus 105, the relay device identification information received at step S1701 and the installation position information obtained at step S1703 (step S1704). The estrus notifying apparatus 104 calculates based on the received measurement result information, the step count of the livestock animal A having the communications device 101 that transmitted the measurement result information, and stores the calculated step count to the step count cumulation table 1100 (step S1705).

[0138] The estrus notifying apparatus 104 determines whether an hourly step count can be calculated based on measurement result information transmitted at 10-minute intervals (step S1706). For example, at step S1706, the estrus notifying apparatus 104 determines whether six step counts for cumulation are stored in step count cumulation table 1100. If six step counts for cumulation are stored, the estrus notifying apparatus 104 determines that an hourly step count can be calculated. If an hourly step count cannot be calculated (step S1706: NO), the estrus notifying apparatus 104 transitions to the operation at step S1701.

[0139] If an hourly step count can be calculated (step S1706: YES), the estrus notifying apparatus 104 sums six step counts for cumulation stored in the step count cumulation table 1100 to calculate an hourly step count, and stores the calculated step count into the step count DB 202 (step S1707). Thus, the estrus notifying apparatus 104 can calculate an hourly step count from measurement result information transmitted at 10-minute transmission intervals and can store the step count into

the step count DB 202.

[0140] The estrus notifying apparatus 104 determines if the hourly step count calculated at step S1607 is greater than or equal to a threshold defined in the threshold DB 205 (step S1708). If the hourly step count is greater than or equal to the threshold (step S1708: YES), the estrus notifying apparatus 104 sets the estrus indication flag to "1", i.e., ON, and stores the flag ON date/time (step S1709). The estrus notifying apparatus 104 transmits to the communications device 101, via the relay device 102, a change instruction instructing the transmission interval to be changed from a 10-minute interval to a one-minute interval (step S1710), and ends the series of operations according to the present flowchart.

[0141] On the other hand, if the hourly step count calculated at step S1707 is not greater than or equal to the threshold (step S1708: NO), the estrus notifying apparatus 104 sets the estrus predictor flag to "0", i.e., OFF (step S1711). The estrus notifying apparatus 104 transmits to the communications device 101, via the relay device 102, a change instruction instructing the transmission interval to be changed from a 10-minute interval to a one-hour interval (step S1712), and ends the series of operations according to the present flowchart. For example, upon setting the estrus predictor flag to OFF at step S1711, the estrus notifying apparatus 104 clears the stored contents of the step count cumulation table 1100.

[0142] FIG. 18 is a flowchart (part 3) depicting an example of the process procedure of the estrus notifying apparatus 104. For example, the estrus notifying apparatus 104 performs the operations in the flowchart depicted in FIG. 18, if in the step count DB 202, an estrus indication flag is set to "1", i.e., ON.

[0143] In the flowchart depicted in FIG. 18, the estrus notifying apparatus 104 determines whether measurement result information, communications device identification information, and relay device identification information have been received from the relay device 102 (step S1801). The estrus notifying apparatus 104 stands by until measurement result information, communications device identification information, and relay device identification information are received (step S1801: NO).

[0144] Upon receiving measurement result information, communications device identification information, and relay device identification information (step S1801: YES), the estrus notifying apparatus 104, similar to step S1605, obtains the current date, time, and day of the week, and determines whether downtime has been set for the current date and time in the working hours DB 206 (step S1802).

[0145] If downtime has not been set for the current date and time (step S1802: NO), the estrus notifying apparatus 104 updates the stored contents of the transmission source DB 203, based on the received communications device identification information and relay device identification information, similar to step S1702 (step S1803). The estrus notifying apparatus 104, similar to step S1703, obtains based on the received relay device iden-

tification information and the relay device DB 204, the installation position information of the relay device 102 that transmitted the currently received measurement result information (step S1804).

[0146] The estrus notifying apparatus 104 transmits to the client apparatus 105, via the network 220, the communications device identification information and relay device identification information received at step S1801, and the installation position information obtained at step S1804 (step S1805). At step S1805, the estrus notifying apparatus 104 may refer to the step count DB 202, identify the livestock animal ID from the communications device ID in the communications device identification information, and transmit the livestock animal ID to the worker W.

[0147] The estrus notifying apparatus 104 determines whether a flag release operation for setting the estrus indication flag to OFF has been received from the worker W (step S1806). If no flag release operation has been received (step S1806: NO), the estrus notifying apparatus 104 transitions to the operation at step S1801 and repeats the operations at each of the above steps.

[0148] If a flag release operation has been received (step S1806: YES), the estrus notifying apparatus 104 sets the estrus indication flag, which is ON, to OFF (step S1807), transmits to the communications device 101, via the relay device 102, a change instruction instructing the transmission interval to be changed from a one-minute interval to a one-hour interval (step S1808), and ends the series of operations according to the present flowchart. Thus, the estrus notifying apparatus 104 can return the transmission interval of the communications device 101 to a one-hour interval according to an operation of the worker W, enabling battery consumption of the communications device 101 to be suppressed.

[0149] Similar to step S1707, the estrus notifying apparatus 104 may calculate an hourly step count based on measurement result information transmitted at one-minute intervals, and store the hourly step count to the step count DB 202. Thus, similar to a case where the communications device 101 transmits measurement result information at 10-minute intervals, in a case where the measurement result information is transmitted at one-minute intervals, the estrus notifying apparatus 104 can calculate the step count and store the step count to the step count DB 202.

[0150] On the other hand, if the current date and time is a time slot for which downtime is set (step S1802: YES), the estrus notifying apparatus 104 determines whether among the livestock animals A in the same herd as the livestock animal A for which the estrus indication flag is set to ON, other livestock animals A are present for which the estrus predictor flag is ON (step S1809). For example, at step S1809, the estrus notifying apparatus 104 refers to the transmission source DB 203, and identifies the communications device ID to which the same relay device ID as the relay device ID indicated by the relay device identification information received at step S1801 is cor-

related, as the transmission source relay device ID. After identifying the communications device ID, the estrus notifying apparatus 104 refers to the step count DB 202, and determines whether the estrus predictor flag for the identified communications device IDs is set to ON. By the operation at step S1809, the estrus notifying apparatus 104 can determine whether other livestock animals A near the livestock animal A for which the estrus indication flag is ON, i.e., the livestock animal A for which estrus has been determined, are present who have the possibility of entering estrus soon. If no other such livestock animals A are present (step S1809: NO), estrus notifying apparatus 104 transitions to the operation at step S1803.

[0151] If other such livestock animals A are present (step S1809: YES), similar to step S1803, the estrus notifying apparatus 104 updates the stored contents of the transmission source DB 203, based on the received communications device identification information and relay device identification information (step S1810). Similar to step S1804, the estrus notifying apparatus 104 obtains based on the received livestock number, relay device identification information, and the relay device DB 204, the installation position information of the relay device 102 that transmitted the measurement result information currently received (step S1811).

[0152] The estrus notifying apparatus 104 transmits to the client apparatus 105, via the network 220, the communications device identification information and relay device identification information received at step S1801, and the installation position information obtained at S1811 (step S1812), and transitions to the operation at step S1806. At step S1812, the estrus notifying apparatus 104 further transmits to the client apparatus 105, the communications device identification information of the communications devices 101 attached to the other livestock animals A identified at step S1809. By the operation at step S1812, the estrus notifying apparatus 104, during downtime, can notify the worker W of the livestock animal A in estrus and livestock animals A that are near the livestock animal A in estrus and have the possibility of entering estrus soon.

[0153] At step S1812, similar to step S1805, the estrus notifying apparatus 104 may refer to the step count DB 202, identify a livestock animal ID from each communications device ID, and transmit each livestock animal ID to the worker W.

[0154] Further, in the example described above, although the estrus notifying apparatus 104 is described to set the estrus predictor flag and the estrus indication flag to OFF and transmit a change instruction instructing the transmission interval to be changed to a one-hour interval if the step count of the livestock animal A does not satisfy a given condition or if a flag release operation has been received, configuration is not limited hereto. For example, the estrus notifying apparatus 104 may perform the operation in the flowchart depicted in FIG. 19 if the estrus predictor flag and/or the estrus indication flag

is set to ON.

[0155] FIG. 19 is a flowchart (part 4) depicting an example of the process procedure of the estrus notifying apparatus 104. In the flowchart depicted in FIG. 19, the estrus notifying apparatus 104 determines whether the estrus predictor flag or the estrus indication flag is ON (step S1901). The estrus notifying apparatus 104 stands by until the estrus predictor flag or the estrus indication flag becomes ON (step S1901: NO).

[0156] When the estrus predictor flag or the estrus indication flag becomes ON (step S1901: YES), the estrus notifying apparatus 104 obtains the current date, time, and day of the week (step S1902). The estrus notifying apparatus 104 obtains from the working hours DB 206, the working-hours information indicated by the obtained day of the week (step S1903).

[0157] The estrus notifying apparatus 104 determines from the obtained current date and time, and working-hours information, whether the current time is included in the working hours (step S1904). If the current time is included in the working hours (step S1904: YES), the estrus notifying apparatus 104 ends the series of operations according to the present flowchart. If the current time is outside the working hours (step S1904: NO), the estrus notifying apparatus 104 sets the estrus predictor flag and the estrus indication flag to OFF (step S1905).

[0158] The estrus notifying apparatus 104 transmits to the communications device 101, via the relay device 102, a change instruction instructing the transmission interval to be changed to a one-minute interval (step S1906), and ends the series of operations according to the present flowchart. For example, at step S1906, the estrus notifying apparatus 104 transmits the change instruction to all of the communications devices 101. Further, at step S1906, the estrus notifying apparatus 104 may identify from the step count DB 202, the communications device 101 for which the estrus predictor flag or the estrus indication flag is set to ON, and transmit the change instruction to the identified the communications device 101.

[0159] Thus, when shortening the transmission interval of the communications device 101, if the current time is during the working hours and thereafter, becomes outside the working hours of the worker W while the transmission interval has been shortened, the estrus notifying apparatus 104 can return the transmission interval of the communications device 101 to a one-hour interval. Therefore, the estrus notifying apparatus 104 can suppress battery consumption of the communications device 101. For example, the operations depicted in FIG. 19 are particularly effective when the current time is at night and the worker W cannot engage in work for some time. Therefore, for example, the estrus notifying apparatus 104 may perform the operation in the flowchart depicted in FIG. 19 when the last working hours for one day ends.

[0160] Further, in the operations depicted by the flowchart of FIG. 19, the estrus notifying apparatus 104 may backup in the RAM 503, the magnetic disk 505, etc., the current settings of the estrus predictor flag and estrus

indication flag, before setting the estrus predictor flag and the estrus indication flag to OFF. The estrus notifying apparatus 104 may set the estrus predictor flag and the estrus indication flag to ON, based on the backed up information and when the current time returns to be during the working hours, and transmit a change instruction for the flags to the communications device 101. Thus, when the current time is again during the working hours, the estrus notifying apparatus 104 can support the tracking of the livestock animal A by the worker W, enabling the work load of the worker W to be reduced.

[0161] As described above, upon detecting a livestock animal A in estrus, the estrus notifying apparatus 104 according to the present invention determines whether other livestock animals A near the livestock animal A in estrus are present that have the possibility of entering estrus soon. If other livestock animals near the livestock animal A in estrus and having the possibility of entering estrus soon are present, the estrus notifying apparatus 104 notifies the worker W of the livestock animal A in estrus and the identification information of the other livestock animals A having the possibility of entering estrus soon.

[0162] Thus, according to the estrus notifying apparatus 104, even if a livestock animal A has entered estrus and the current time is outside the working hours, if the worker W cannot immediately go to the livestock animal A in estrus, notification of the minimally required information is given, enabling adverse effects consequent to errant judgment to be prevented as much as possible. The estrus notifying apparatus 104 can suppress the burden placed on the worker W and prevent the worker W from becoming exhausted.

[0163] Further, if the current time is during the working hours of the worker W and the worker W can immediately go to the livestock animal A in estrus, the estrus notifying apparatus 104 can also prompt the worker to check other livestock animals A when checking the livestock animal A in estrus. Thus, the worker W can be caused to check not only the livestock animal A in estrus, but other livestock animals possibly in estrus, enabling other livestock animal A indicating estrus to be recognized.

[0164] According to the estrus notifying apparatus 104, if an abnormal state of a livestock animal A and the current time is included in the working hours, the transmission interval for the measurement result information of the communications device 101 can be shortened. Further, according to the estrus notifying apparatus 104, each time measurement result information is received at the shortened transmission interval, the worker W can be notified of the relay device ID of the relay device 102 that relayed the received measurement result information.

[0165] Thus, if no abnormal state of a livestock animal A is detected and/or the current time is outside the working hours, the estrus notifying apparatus 104 can reduce the transmission frequency of the measurement result information of the communications device 101, enabling

battery consumption of the communications device 101 to be suppressed and reduction of the work load of the worker W.

[0166] Further, if an abnormal state of a livestock animal A is detected and the current time is included in the working hours, the estrus notifying apparatus 104 can shorten the interval at which the worker W is notified of relay device identification information, which is an indication of the position of the livestock animal A. Thus, the estrus notifying apparatus 104 can support the tracking of a livestock animal A in an abnormal state by the worker W and reduce the work load of the worker W.

[0167] According to the estrus notifying apparatus 104, if estrus of a livestock animal A is detected and the current time is included in the working hours of the worker W, the transmission interval for measurement result information of the communications device 101 can be shortened. Further, according to the estrus notifying apparatus 104, each time measurement result information is received at the shortened transmission interval, the worker W can be notified of the relay device ID of the relay device 102 that relayed the received measurement result information. Thus, the estrus notifying apparatus 104 can suppress battery consumption of the communications device 101 and support the tracking of a livestock animal A in estrus by the worker W.

[0168] According to the estrus notifying apparatus 104, based on the step count for each differing time slot sequentially measured, whether a livestock animal A is in estrus can be determined. Thus, the estrus notifying apparatus 104 can increase the accuracy in detecting estrus of a livestock animal A and reduce the work load placed on the worker W consequent to errant judgment.

[0169] According to the estrus notifying apparatus 104, if a livestock animal A is detected to be in estrus, the transmission interval for the measurement result information of the communications device 101 can be further shortened. Thus, the estrus notifying apparatus 104 can reduce the distance that the livestock animal A can travel during the transmission interval for the measurement result information and support the tracking of the livestock animal A in estrus by the worker W.

[0170] According to the estrus notifying apparatus 104, if estrus of the livestock animal A has been determined to be errantly judged, the transmission interval of the communications device 101 can be returned to the usual transmission interval from the shortened transmission interval. Thus, the estrus notifying apparatus 104 can suppress battery consumption of the communications device 101 and reduce the work load of the worker W.

[0171] According to the estrus notifying apparatus 104, the worker W can be notified of the installation position information indicating the installation position of the relay device 102. Thus, the estrus notifying apparatus 104 can simplify the task of grasping the position of the livestock animal A by the worker W and facilitate support of the tracking of the livestock animal A.

[0172] The estrus notifying method described in the

present embodiment may be implemented by executing a prepared program on a computer such as a personal computer and a workstation. The program is stored on a computer-readable recording medium such as a hard disk, a flexible disk, a CD-ROM, an MO, and a DVD, read out from the computer-readable medium, and executed by the computer. The program may be distributed through a network such as the Internet.

EXPLANATIONS OF LETTERS OR NUMERALS

[0173]

- 101 communications device
- 102 relay device
- 104 estrus notifying apparatus
- 105 client apparatus

Claims

1. An estrus notifying method of giving notification of estrus, based on a step count measurement result from a step counting device attached to each livestock animal among a plurality of livestock animals, the estrus notifying method being executed by a computer and comprising:

collecting the step count measurement result for each livestock animal and position information for each livestock animal;
determining with respect to each livestock animal and based on the step count measurement result and a first condition, whether the livestock animal is in estrus;
referring to a memory unit retaining working hours of a worker and determining whether the current time is included in the working hours, if a given livestock animal has been determined to be in estrus;
determining with respect to the plurality of livestock animals near the given livestock animal, whether a livestock animal indicates estrus, the determining being based on the step count measurement result and a second condition that is more lax than the first condition, and being performed when the current time is included in the working hours; and
outputting, identification information of the given livestock animal determined to be in estrus and identification information of each livestock animal determined to indicate estrus.

2. The estrus notifying method according to claim 1, wherein the determining whether a livestock animal indicates estrus includes referring to the memory unit retaining herd information of the plurality of livestock animals,

and determining with respect to the plurality of livestock animals belonging to the same herd as the given livestock, whether a livestock animal indicates estrus.

3. An estrus notifying apparatus that gives notification of estrus, based on a step count measurement result from a step counting device attached to each livestock animal among a plurality of livestock animals, the estrus notifying apparatus comprising:

an obtaining unit that collects the step count measurement result for each livestock animal and position information for each livestock animal;
a memory unit retaining working hours of a worker;
a first determining unit that determines with respect to each livestock animal and based on the step count measurement result and a first condition, whether the livestock animal is in estrus;
a second determining unit that if a given livestock animal is determined to be in estrus by the first determining unit, determines whether the current time is included in the working hours and if the current time is included in the working hours, determines with respect to the plurality of livestock animals near the given livestock animal and determines based on a second condition that is more lax than the first condition, whether a livestock animal indicates estrus; and
an output unit that outputs identification information of the given livestock animal determined to be in estrus by first determining unit and identification information of each livestock animal determined to indicate estrus by the second determining unit.

4. The estrus notifying apparatus according to claim 3, wherein the second determining unit has herd information of the plurality of livestock animals and determines with respect to the plurality of livestock animals belonging to the same herd as the given livestock, whether a livestock animal indicates estrus.

5. An estrus notifying program causing a computer to give notification of estrus, based on a step count measurement result from a step counting device attached to each livestock animal among a plurality of livestock animals, the estrus notifying program causing the computer to execute:

collecting the step count measurement result for each livestock animal and position information for each livestock animal;
determining with respect to each livestock animal and based on the step count measurement

result and a first condition, whether the livestock animal is in estrus;
 referring to a memory unit retaining working hours of a worker and determining whether the current time is included in the working hours, if a given livestock animal has been determined to be in estrus;
 determining with respect to the plurality of livestock animals near the given livestock animal, whether a livestock animal indicates estrus, the determining being based on the step count measurement result and a second condition that is more lax than the first condition, and being performed when the current time is included in the working hours; and
 outputting, identification information of the given livestock animal determined to be in estrus and identification information of each livestock animal determined to indicate estrus.

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6. The estrus notifying program according to claim 5, wherein the determining whether a livestock animal indicates estrus includes referring to the memory unit retaining herd information of the plurality of livestock animals, and determining with respect to the plurality of livestock animals belonging to the same herd as the given livestock, whether a livestock animal indicates estrus.

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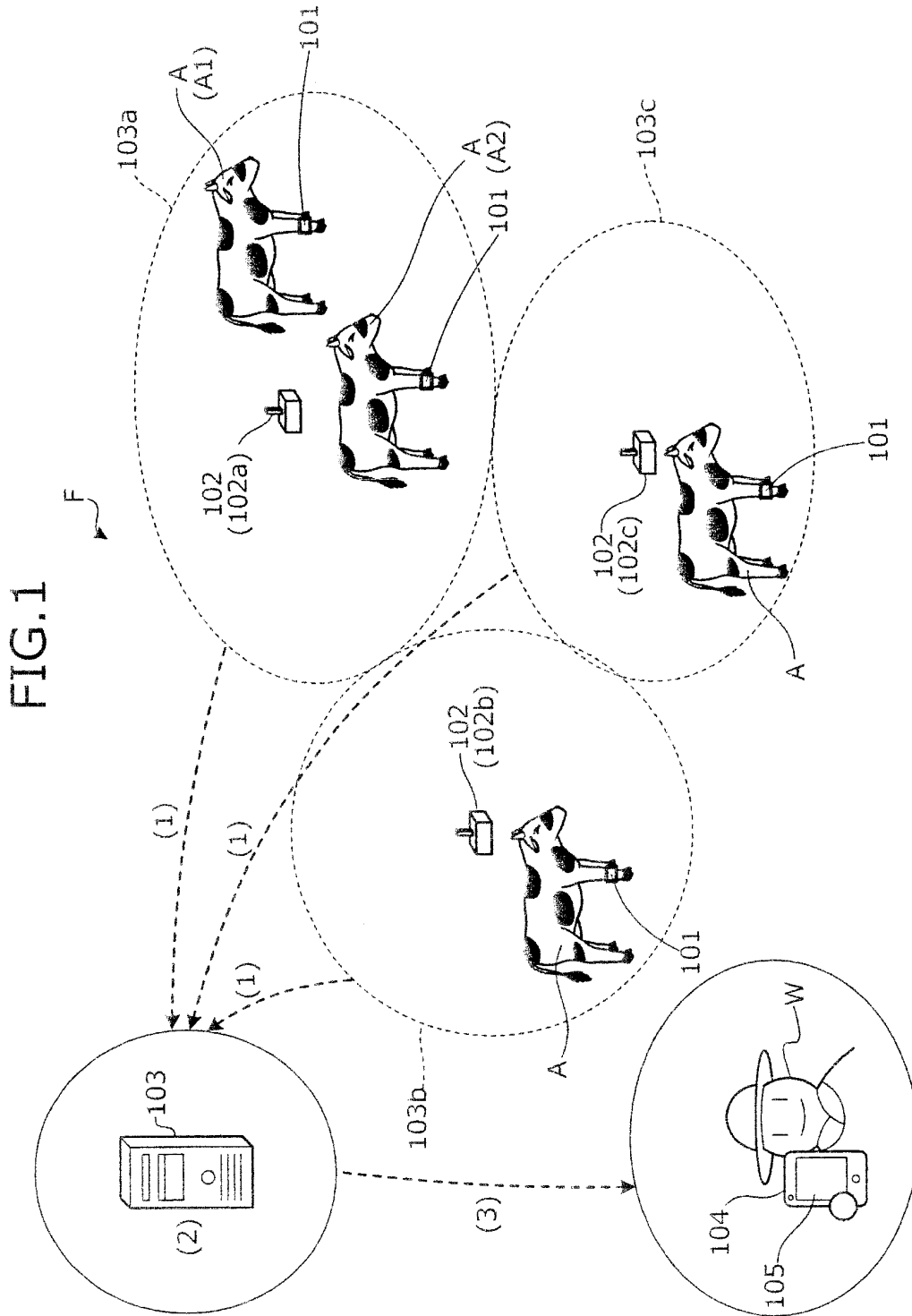


FIG. 2

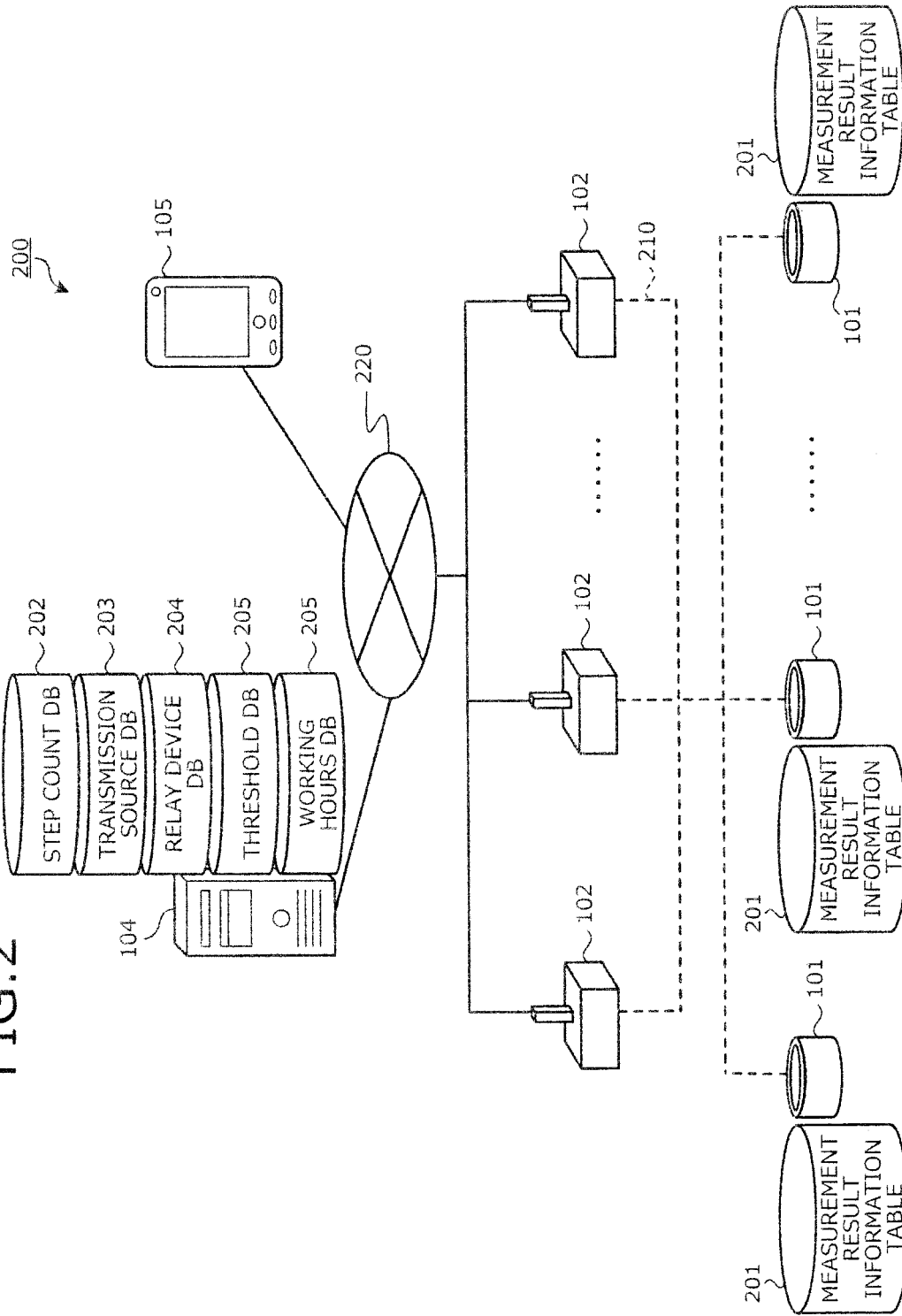


FIG.3

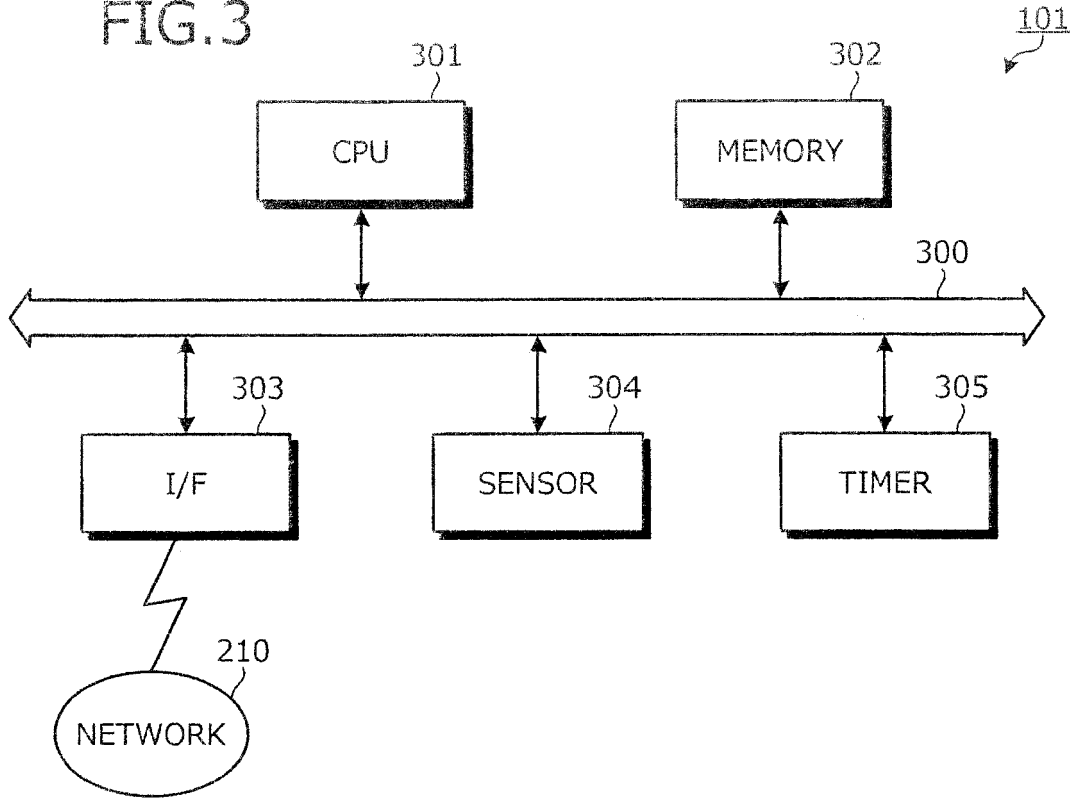


FIG.4

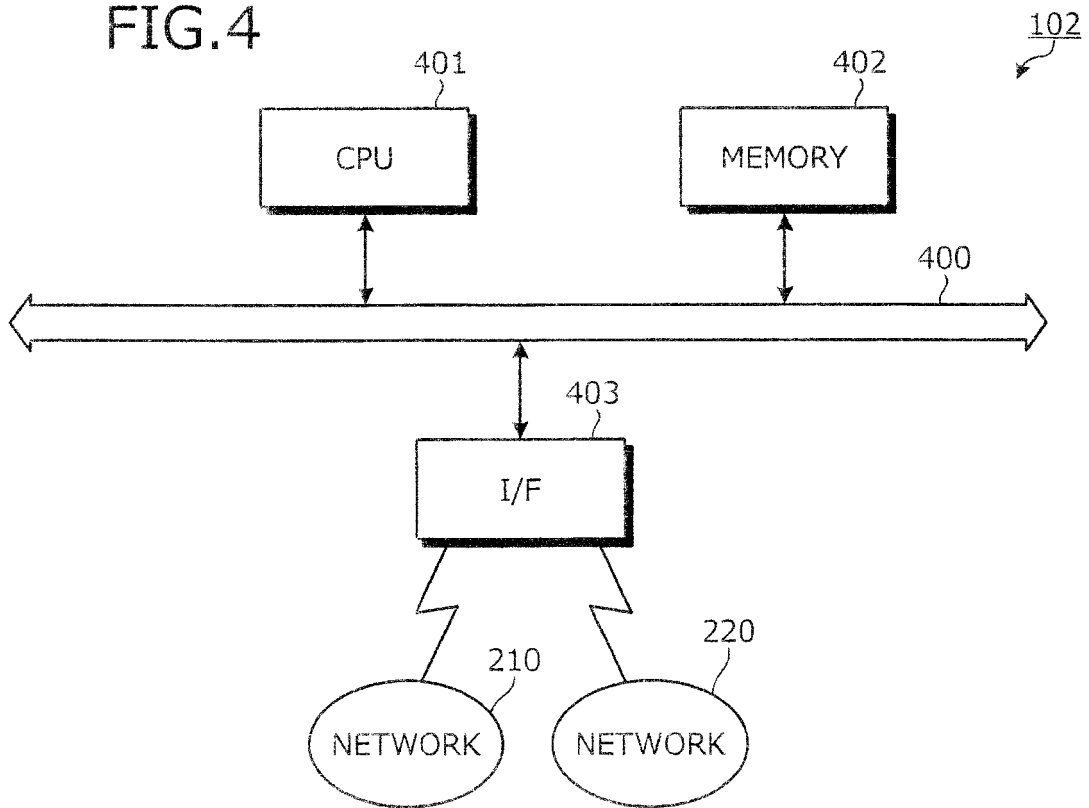


FIG.5

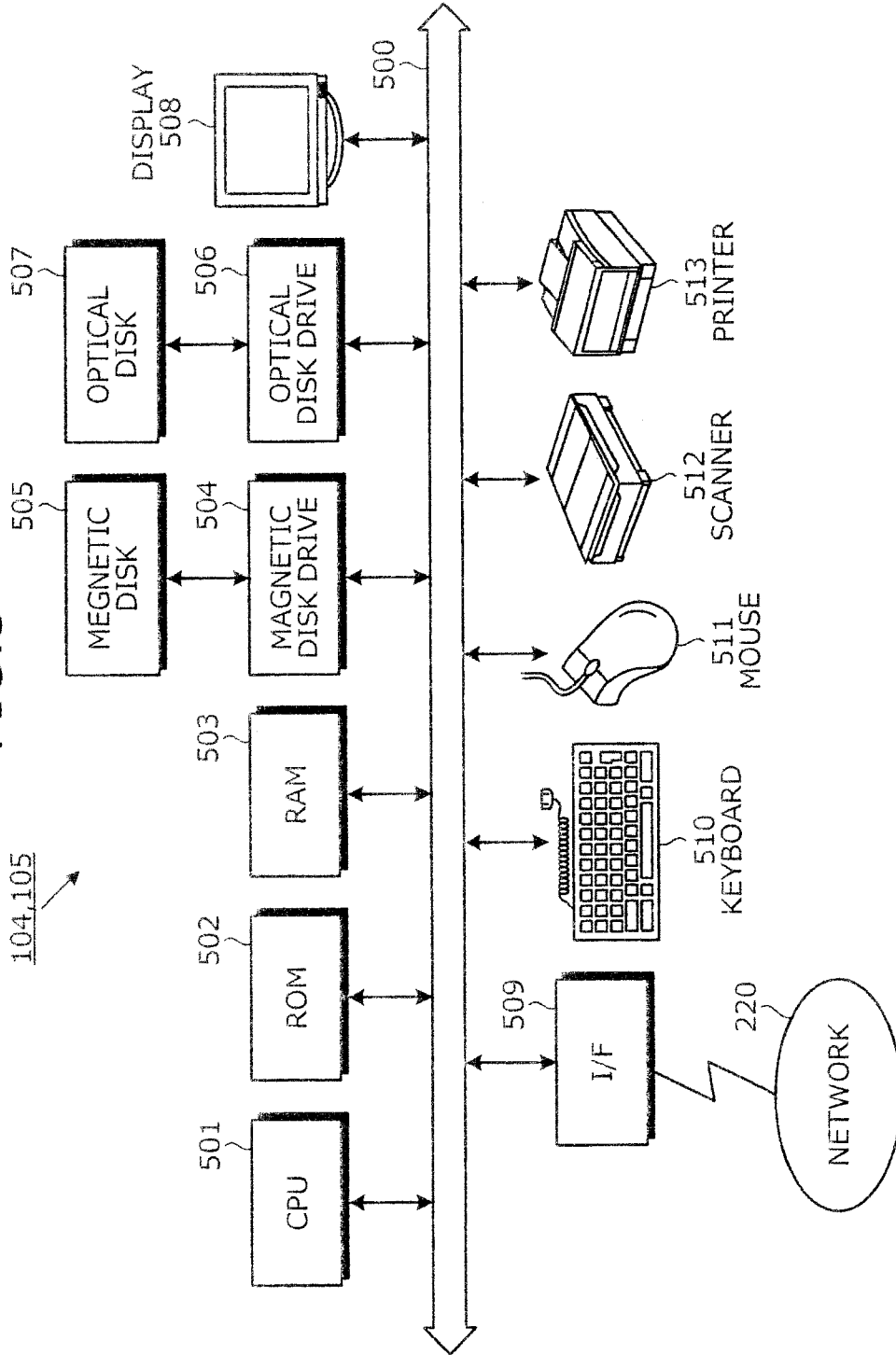


FIG.6

MEASUREMENT RESULT INFORMATION TABLE

	DATES AND TIMES OF MEASUREMENT	MEASUREMENT VALUES
600-1	2012/2/20, 2:00	C6
600-2	2012/2/20, 1:00	C5
600-3	2012/2/20, 0:00	C4
600-4	2012/2/19, 23:00	C3
600-5	2012/2/19, 22:00	C2
600-6	2012/2/19, 21:00	C1

FIG.7

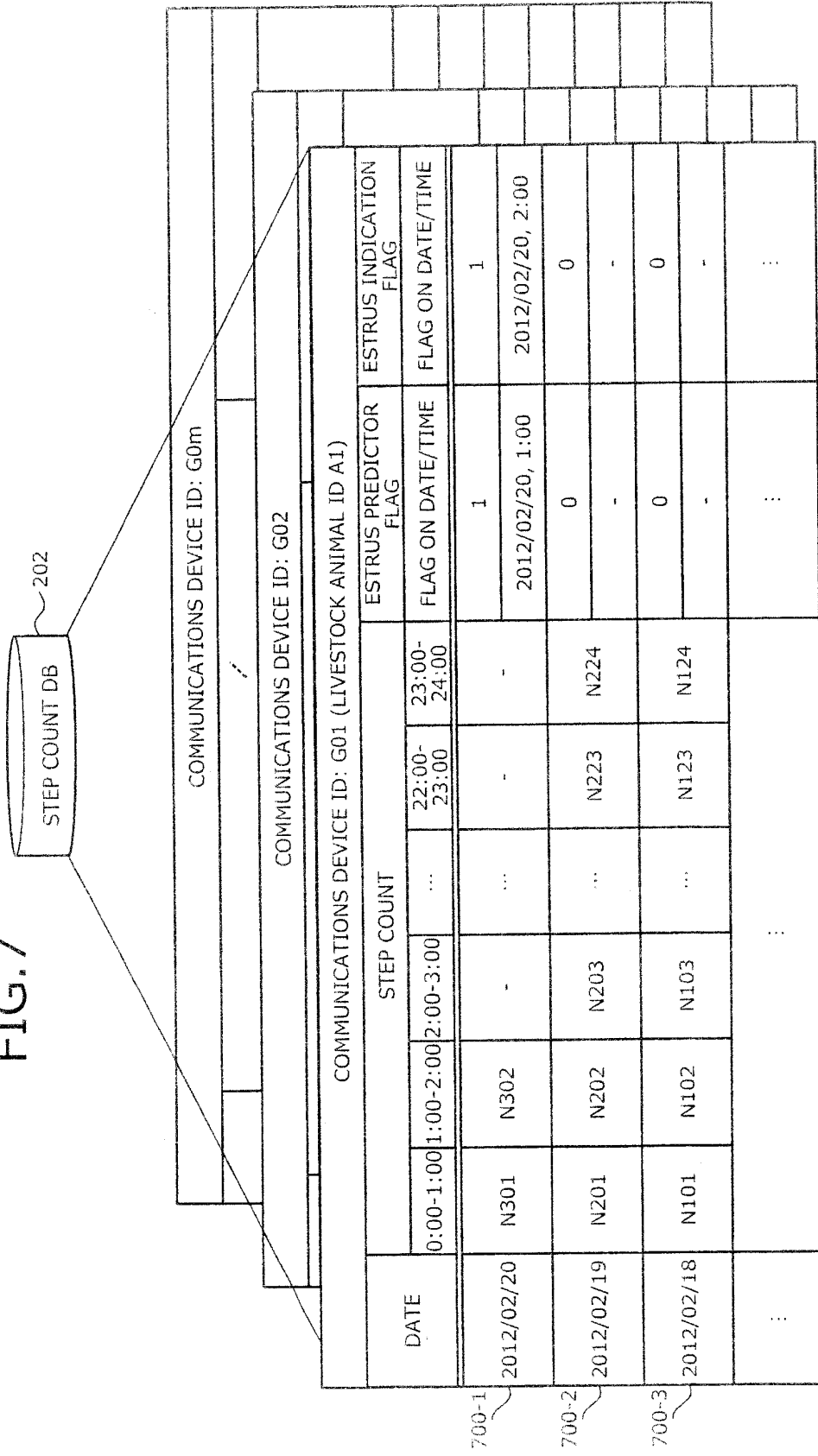


FIG.8

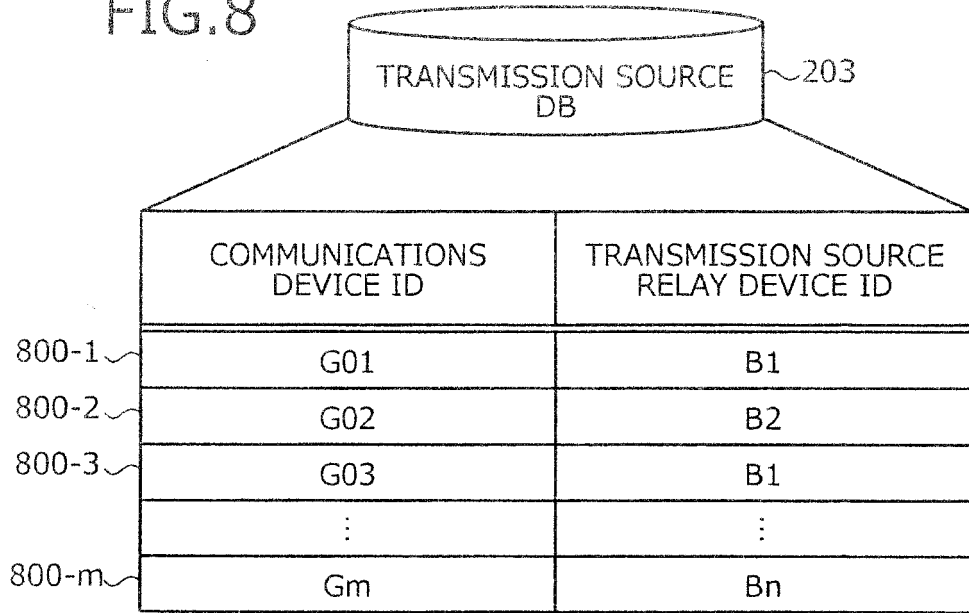


FIG.9

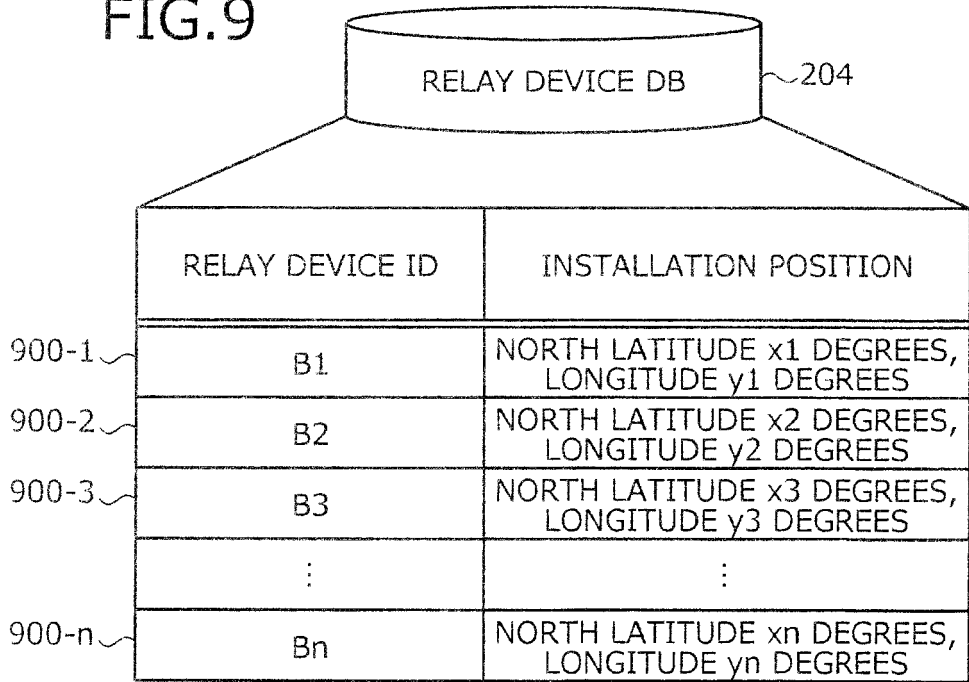


FIG. 10

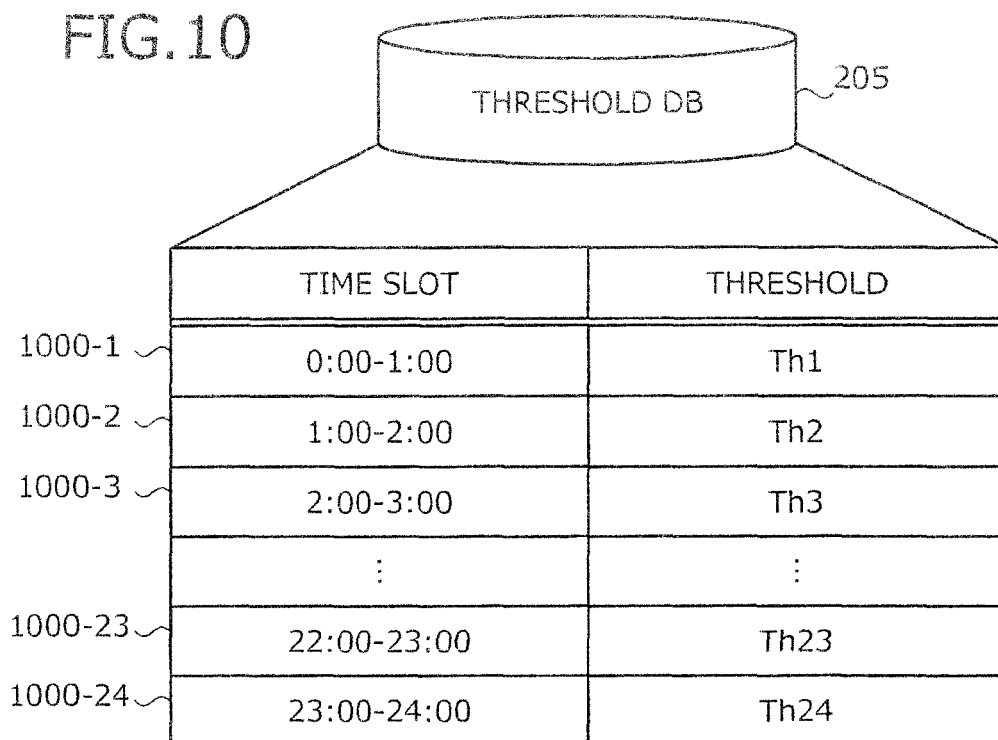
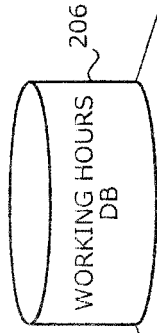


FIG. 11

1100

	DATES AND TIMES OF MEASUREMENT	MEASUREMENT VALUES	STEP COUNT FOR CUMULATION
1100-1	2012/2/20, 2:00	C16	H6
1100-2	2012/2/20, 1:50	C15	H5
1100-3	2012/2/20, 1:40	C14	H4
1100-4	2012/2/19, 1:30	C13	H3
1100-5	2012/2/19, 1:20	C12	H2
1100-6	2012/2/19, 1:10	C11	H1

FIG.12



WORKER ID: Z1 (ID OF MANAGED COMMUNICATIONS DEVICE: G01...)						
WORKING HOURS						
ATTRIBUTE						
1200-1	MONDAY-FRIDAY	5:00-7:00	8:00-12:00	13:00-15:00	16:00-18:00	19:00-21:00
	MONDAY-FRIDAY DOWNTIME YES/NO	NO	YES	YES	NO	YES
1200-2	SATURDAY-SUNDAY	5:00-7:00	8:00-12:00	13:00-15:00	16:00-18:00	-
	SATURDAY-SUNDAY DOWNTIME YES/NO	NO	YES	NO	NO	-

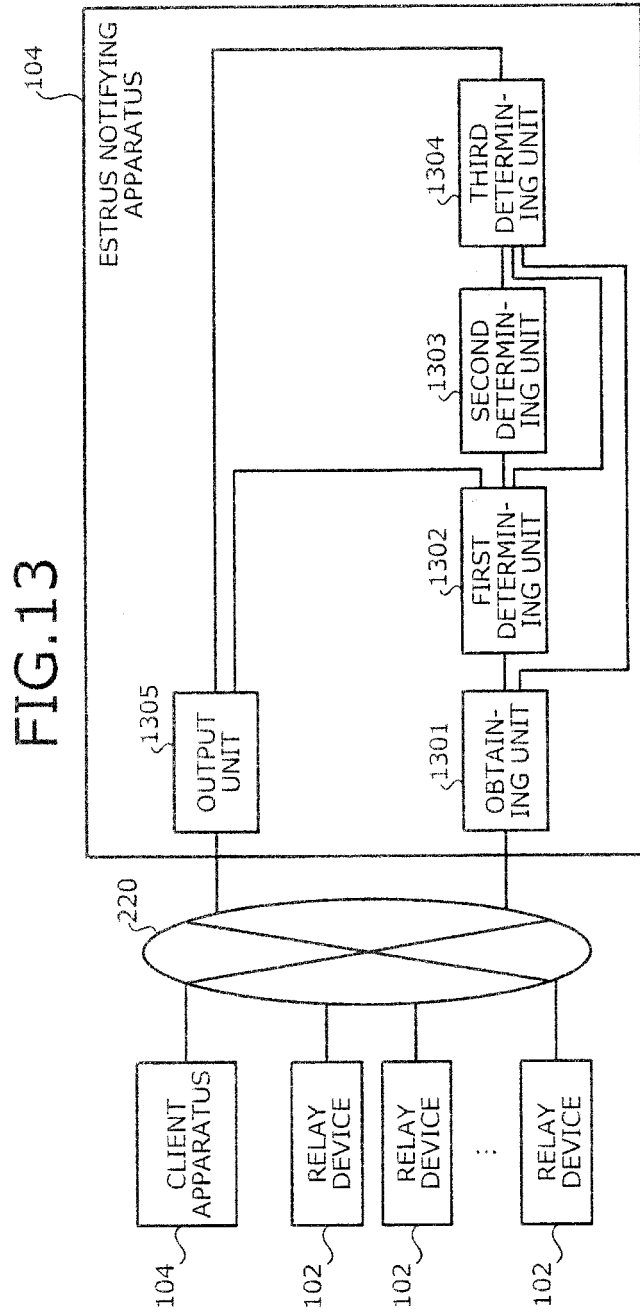


FIG. 14

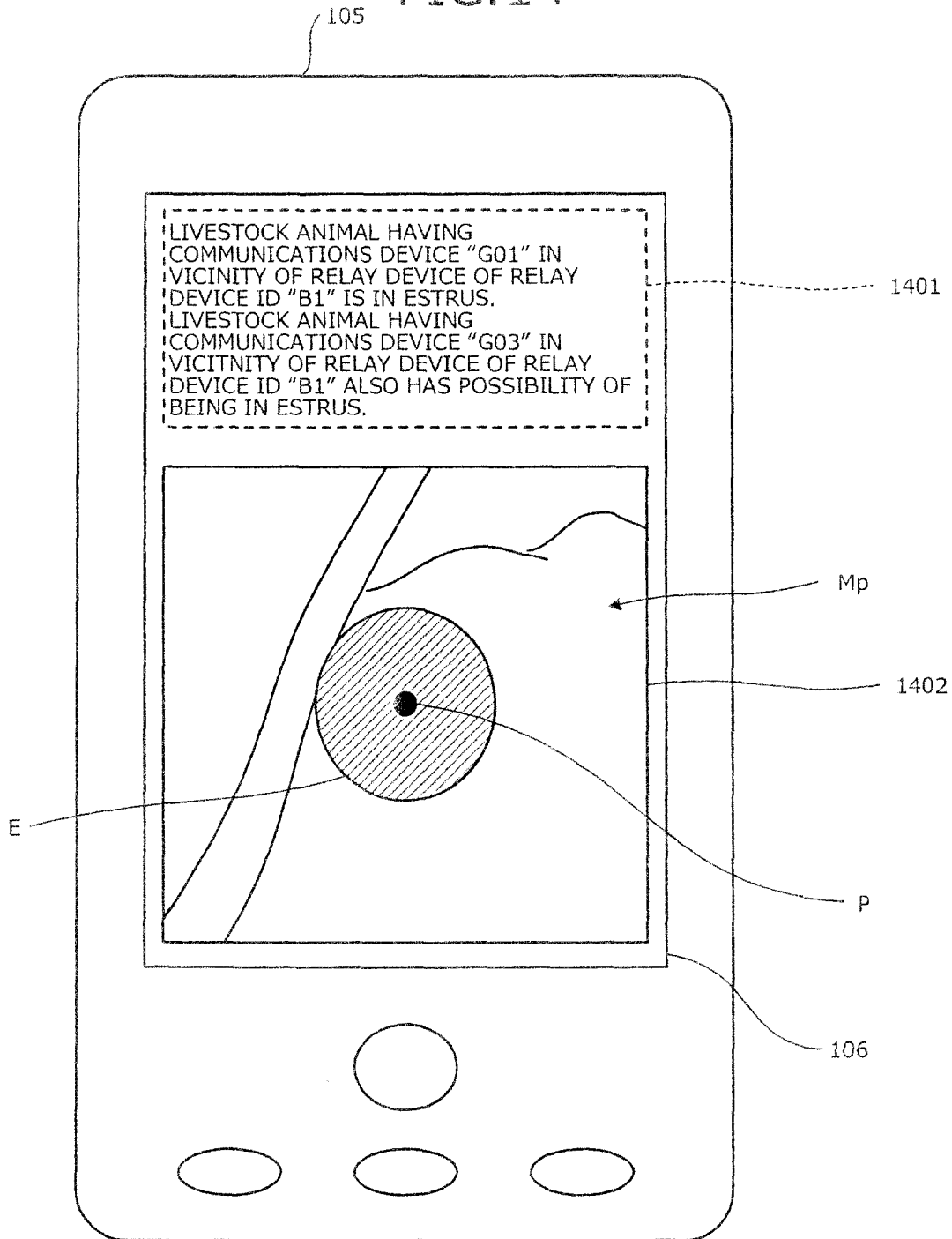


FIG.15

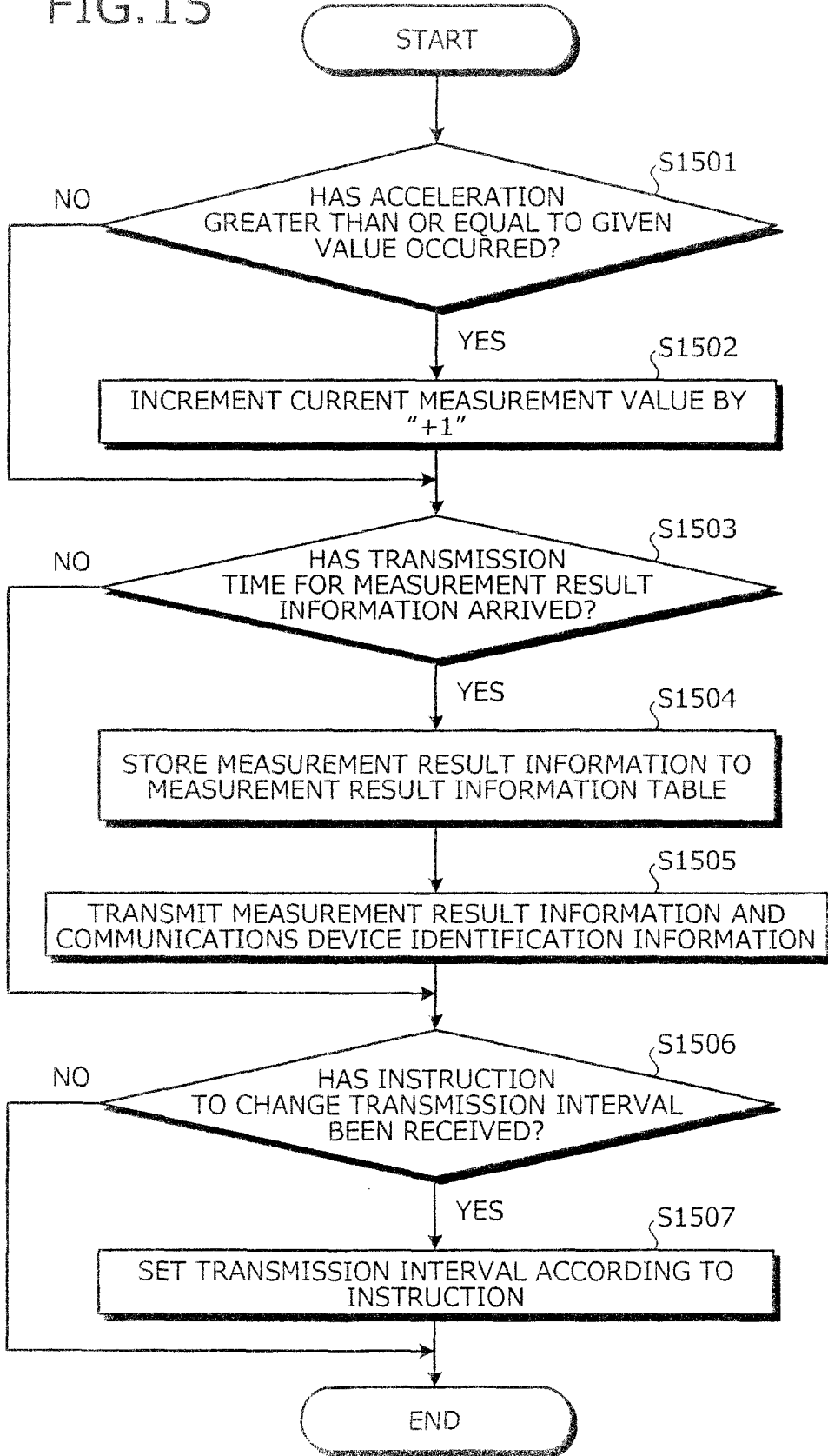


FIG. 16

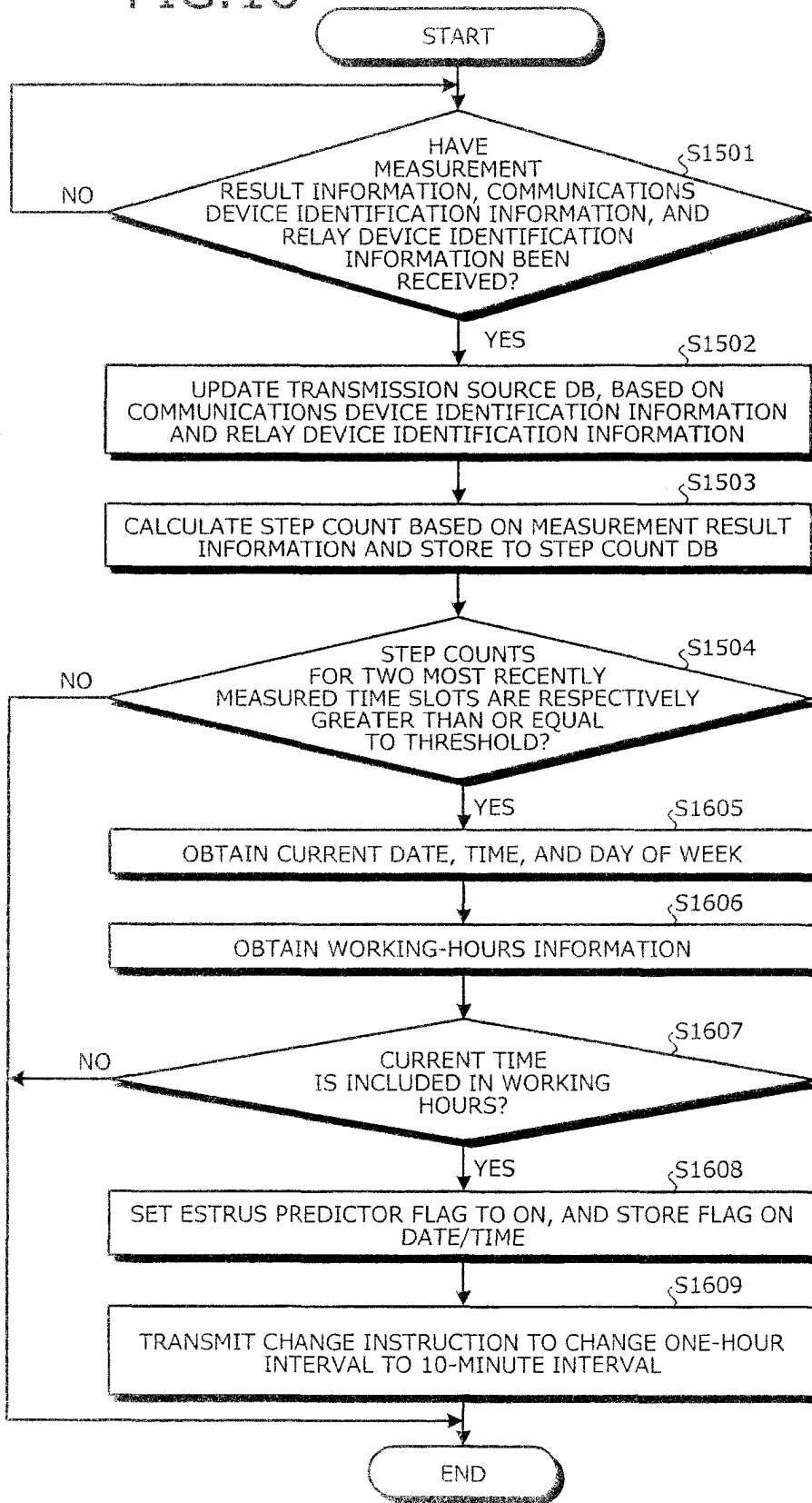


FIG. 17

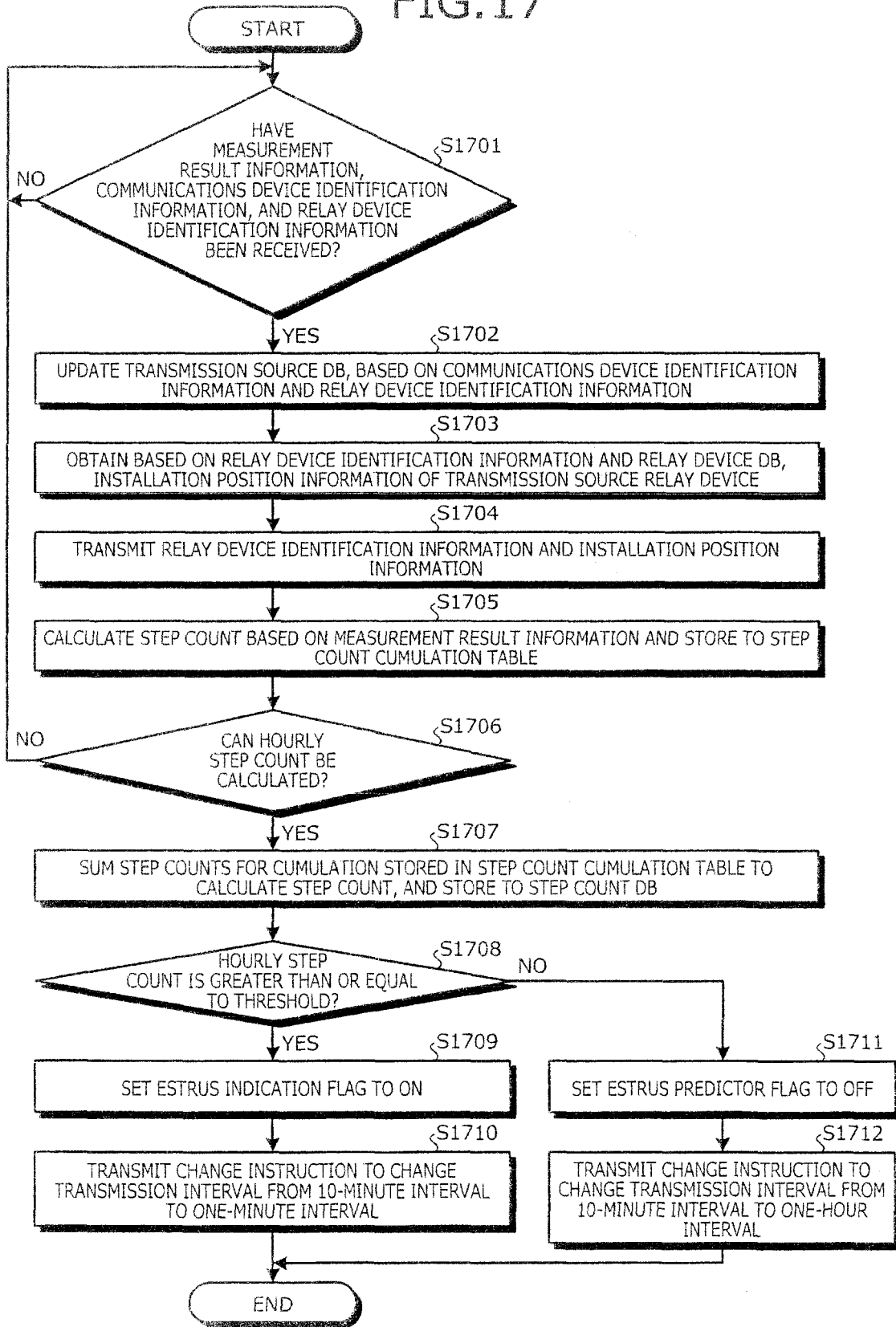


FIG.18

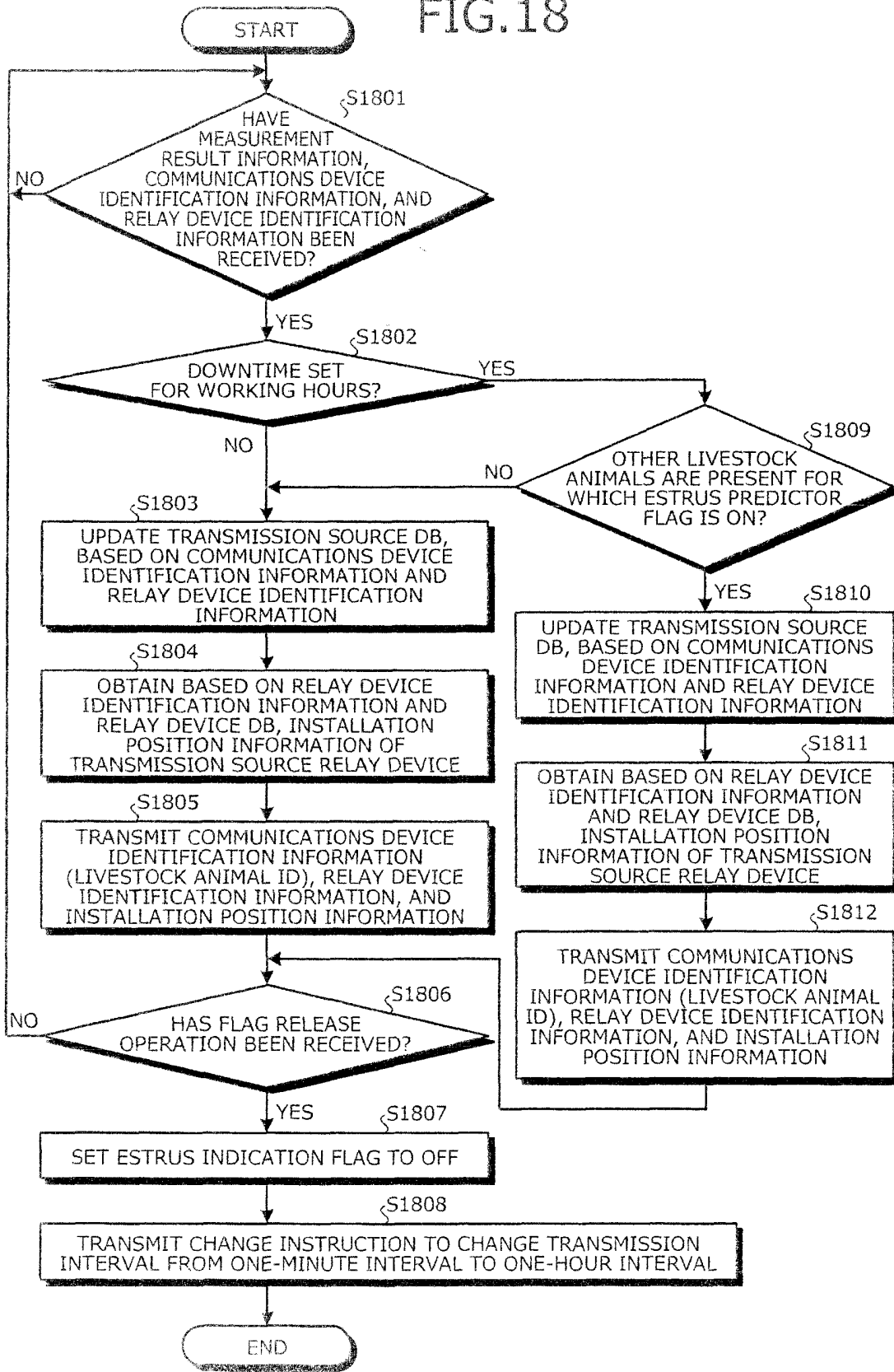
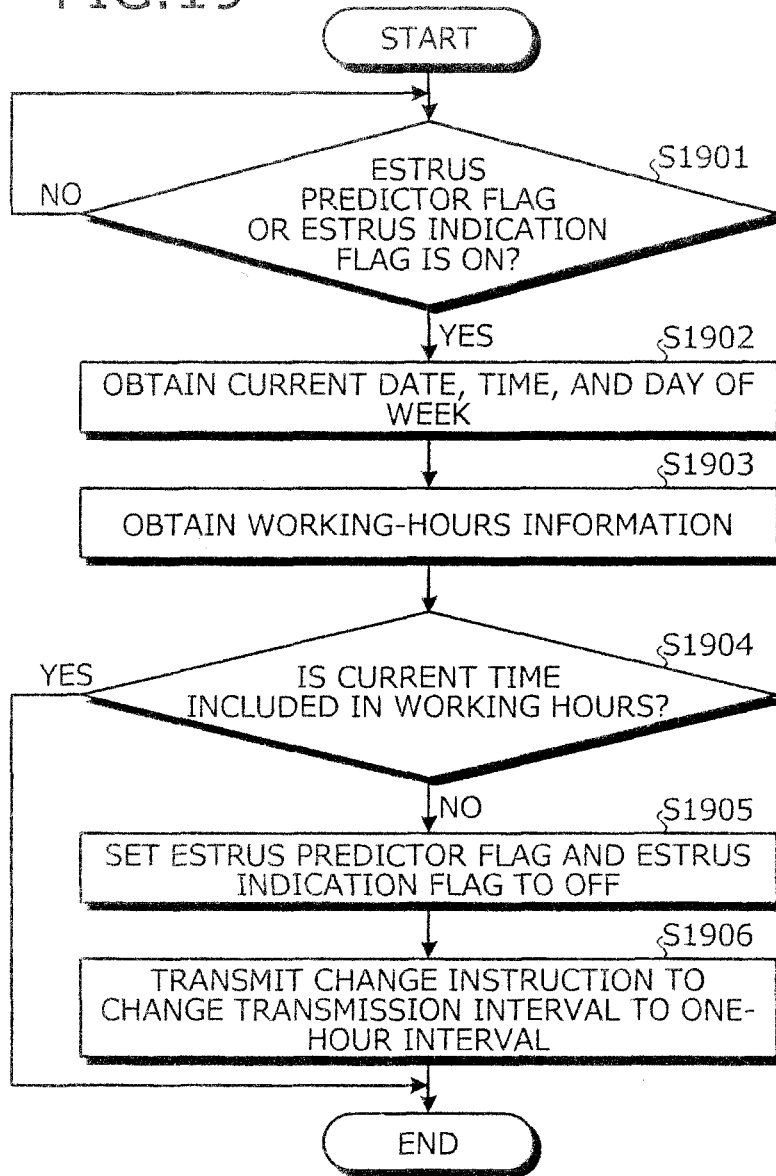


FIG.19



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/058760

5	A. CLASSIFICATION OF SUBJECT MATTER A01K29/00(2006.01)i, A01K67/00(2006.01)i, A61D1/08(2006.01)i, G06Q50/02(2012.01)i	
	According to International Patent Classification (IPC) or to both national classification and IPC	
10	B. FIELDS SEARCHED	
	Minimum documentation searched (classification system followed by classification symbols) A01K29/00, A01K67/00, A61D1/08, G06Q50/02	
15	Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012 Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012	
	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) JSTPlus/JST7580 (JDreamII)	
20	C. DOCUMENTS CONSIDERED TO BE RELEVANT	
	Category*	Citation of document, with indication, where appropriate, of the relevant passages
25	A	JP 11-128210 A (Matsushita Electric Works, Ltd.), 18 May 1999 (18.05.1999), entire text; all drawings (Family: none)
30	A	JP 2008-148569 A (Oki Electric Industry Co., Ltd.), 03 July 2008 (03.07.2008), entire text; all drawings & US 2008/0147458 A1
35	A	JP 2008-92878 A (Comtec Co., Ltd.), 24 April 2008 (24.04.2008), entire text; all drawings (Family: none)
40	<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.	
45	* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family
50	"A" document defining the general state of the art which is not considered to be of particular relevance	
	"E" earlier application or patent but published on or after the international filing date	
	"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	
	"O" document referring to an oral disclosure, use, exhibition or other means	
	"P" document published prior to the international filing date but later than the priority date claimed	
55	Date of the actual completion of the international search 19 June, 2012 (19.06.12)	Date of mailing of the international search report 26 June, 2012 (26.06.12)
	Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
	Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

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- JP 2003343901 A [0003]
- JP 2005092595 A [0003]