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(54) **LABOR ASSISTANCE SYSTEM, MANAGEMENT METHOD FOR LABOR ASSISTANCE SYSTEM, AND MANAGEMENT PROGRAM FOR LABOR ASSISTANCE SYSTEM**

(57) The present invention appropriately manages a battery by driving a sensor by using the power of the battery, and by transmitting the results of measurement by the sensor by data communication using wireless communication. Detection devices 11A, 11B, 11C, 11D that operate on battery power are retained at moving parts 3, 4, 5, 6 of an operation machine 2; posture information of the moving parts 3, 4, 5, 6 is detected by sensors provided to the detection devices 11A, 11B, 11C, 11D and is transmitted from the detection devices 11A, 11B, 11C, 11D by data communication using wireless communication; assistance information for assisting operations by an operator is generated on the basis of the posture information transmitted from the detection devices 11A, 11B, 11C, 11D and is notified to the operator; remaining battery power information is acquired by the detection devices 11A, 11B, 11C, 11D; and on the basis of the remaining battery power information and an operation plan of the operation machine, battery replacement timing is projected and is notified to the operator of the operation machine 2.

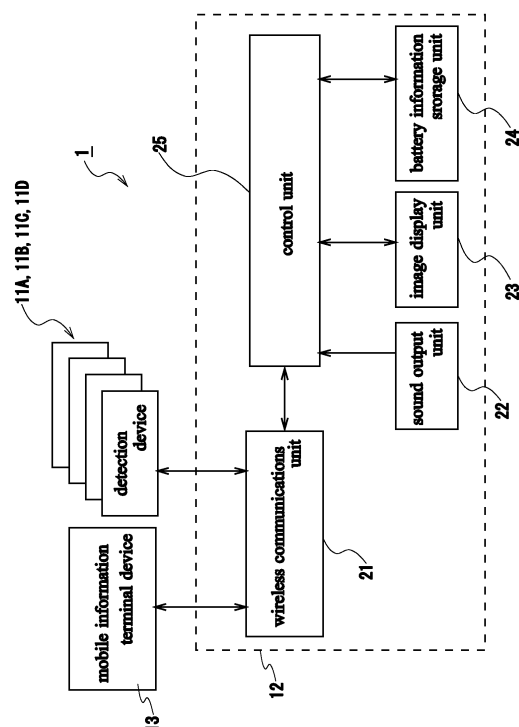


FIG. 2

Description**TECHNICAL FIELD**

5 **[0001]** The present invention relates to a work (labor) assistance system, a management method for a work assistance system, and a management program for a work assistance system and is applicable to a working machine such as a hydraulic shovel.

BACKGROUND ART

10 **[0002]** Previously, a working machine that a machine guidance function is incorporated in (a working machine that a work assistance system is applied to, namely, so-called ICT (information and communications technology) construction machine) has been provided. Machine guidance is a technology using a measurement technology, such as total station (TS) and GNSS (global navigation satellite system), to assist in an operation of a working machine. According to the
15 machine guidance, an operator is appropriately assisted in the operation so as to improve the work efficiency, the safety, and the work accuracy.

[0003] The ICT construction machine as above detects a posture of a movable part of the working machine with a sensor arranged on the movable part so as to prepare information (hereinafter appropriately referred to as assistance information) for assisting the operator in the operation (Patent Document 1, for instance).
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PRIOR ART DOCUMENT**PATENT DOCUMENT**

25 **[0004]** Patent Document 1: JP 2015-14147 A

SUMMARY OF THE INVENTION**PROBLEMS TO BE SOLVED BY THE INVENTION**

30 **[0005]** It is conceivable that, in the working machine provided with the machine guidance function, the sensor is driven by electric power of a battery so as to omit a cable for feeding electric power to the sensor. It is also conceivable that the result of measurement by the sensor is transmitted by data communications through wireless communications so as to omit a cable for data communications. Such measures simplify the configuration of the work assistance system and facilitate introduction of the machine guidance function into the working machine.
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[0006] If a battery is used, it is expected that the battery may need to be replaced in the course of a work, and, in that case, the work efficiency is deteriorated due to the interruption of the work during the replacement of the battery. For this reason, an appropriate management of the battery is required.

40 **[0007]** The present invention has been made taking the above points into account, and is aimed at proposing a work assistance system, a management method for a work assistance system, and a management program for a work assistance system that drive a sensor by electric power of a battery and, moreover, transmit the result of measurement by the sensor by data communications through wireless communications so as to allow an appropriate management of the battery.

SOLUTION TO PROBLEM

45 **[0008]** In order to solve the above problems, the invention of claim 1 is a labor assistance system that holds a detection device to operate by electric power of a battery, in a movable part of a working machine so as to detect posture information on the movable part with a sensor provided on the detection device and send the posture information from the detection device by data communications through wireless communications, generates, based on the posture information sent
50 from the detection device, assistance information for assisting an operator of the working machine in an operation so as to notify the operator of the assistance information, and acquires residual life information on the battery from the detection device so as to estimate time for replacement of the battery based on the residual life information on the battery and information concerning a work scheme of the working machine and notify the operator of the time for replacement
55 of the battery.

[0009] According to a configuration recited in claim 1, the time for replacement of the battery is estimated and reported based on the residual life information on the battery and the information concerning the work scheme of the working machine and, in consequence, the time for replacement is estimated and reported so that the work may not be interrupted.

As a result, in the configuration where the electric power of the battery is used to drive the sensor and, moreover, the result of measurement by the sensor is transmitted through wireless communications, the battery is appropriately managed and the deterioration of the work efficiency such as the interruption of the work for the replacement of the battery is prevented.

[0010] In the configuration in claim 1, the invention of claim 2 acquires the information concerning the work scheme of the working machine from an external information appliance.

[0011] According to a configuration recited in claim 2, the information concerning the work scheme of the working machine is acquired from the external information appliance, which makes it possible to acquire the information concerning the work scheme from a management device for managing multiple working machines, so as to appropriately manage batteries in multiple work assistance systems.

[0012] In the configuration in claim 1 or 2, the invention of claim 3 notifies the operator of the working machine of the time for replacement of the battery through a mobile information terminal device.

[0013] According to a configuration recited in claim 3, the time for replacement is reported even if the operator is not on the working machine.

[0014] The invention of claim 4 is a management method for a labor assistance system, the labor assistance system: holding a detection device to operate by electric power of a battery, in a movable part of a working machine so as to detect posture information on the movable part with a sensor provided on the detection device and send the posture information from the detection device by data communications through wireless communications; and generating, based on the posture information sent from the detection device, assistance information for assisting an operator of the working machine in an operation so as to notify the operator of the assistance information, the management method including: acquiring residual life information on the battery from the detection device; estimating time for replacement of the battery based on the residual life information on the battery and information concerning a work scheme of the working machine; and notifying the operator of the time for replacement of the battery.

[0015] According to a configuration recited in claim 4, the time for replacement of the battery is estimated and reported based on the residual life information on the battery and the information concerning the work scheme of the working machine and, in consequence, the time for replacement is estimated and reported so that the work may not be interrupted. As a result, in the configuration where the electric power of the battery is used to drive the sensor and, moreover, the result of measurement by the sensor is transmitted through wireless communications, the battery is appropriately managed and the deterioration of the work efficiency such as the interruption of the work for the replacement of the battery is prevented.

[0016] The invention of claim 5 is a management program for a labor assistance system that is executed by an arithmetic processing circuit so as to perform a processing procedure specified, the labor assistance system: holding a detection device to operate by electric power of a battery, in a movable part of a working machine so as to detect posture information on the movable part with a sensor provided on the detection device and send the posture information from the detection device by data communications through wireless communications; and generating, based on the posture information sent from the detection device, assistance information for assisting an operator of the working machine in an operation so as to notify the operator of the assistance information, the processing procedure including: acquiring residual life information on the battery from the detection device; estimating time for replacement of the battery based on the residual life information on the battery and information concerning a work scheme of the working machine; and notifying the operator of the time for replacement of the battery.

[0017] According to a configuration recited in claim 5, the time for replacement of the battery is estimated and reported based on the residual life information on the battery and the information concerning the work scheme of the working machine and, in consequence, the time for replacement is estimated and reported so that the work may not be interrupted. As a result, in the configuration where the electric power of the battery is used to drive the sensor and, moreover, the result of measurement by the sensor is transmitted through wireless communications, the battery is appropriately managed and the deterioration of the work efficiency such as the interruption of the work for the replacement of the battery is prevented.

EFFECT OF THE INVENTION

[0018] According to the present invention, the electric power of the battery is used to drive the sensor and, moreover, the result of measurement by the sensor is transmitted by data communications through wireless communications, so as to allow an appropriate management of the battery.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

Fig. 1 is a diagram illustrating a work (labor) assistance system according to a first embodiment of the present invention.

Fig. 2 is a block diagram of the work assistance system in Fig. 1.

Fig. 3 is a flowchart illustrating a processing procedure according to a management program for the work assistance system.

Fig. 4 is a table for explaining residual life information on a battery.

Fig. 5 is a diagram for explaining information concerning a work scheme.

Fig. 6 is a diagram used for setting time for replacement.

Fig. 7 is a diagram illustrating an exemplary display of a notice of the time for replacement.

Fig. 8 is a diagram illustrating another exemplary display of the notice of the time for replacement.

MODE FOR CARRYING OUT THE INVENTION

[First Embodiment]

[0020] Fig. 1 is a diagram illustrating a work (labor) assistance system 1 according to a first embodiment of the present invention, and Fig. 2 is a block diagram.

[0021] The work assistance system 1 is applied to a hydraulic shovel 2 as a working machine so as to assist, according to a machine guidance function, an operator in operating the hydraulic shovel 2.

[0022] The hydraulic shovel 2 includes a body 3 that is self-propelled with a caterpillar and that a boom 4, an arm 5, and a bucket 6 are sequentially provided on. The work assistance system 1 is not limitedly applied to a hydraulic shovel but widely applied to various working machines used for civil engineering and construction works, including a working machine used for ground reinforcement.

[0023] The work assistance system 1 includes detection devices 11A, 11B, 11C, and 11D, a body device 12, and a mobile information terminal device 13, and the detection devices 11A, 11B, 11C, and 11D are arranged on the body 3, the boom 4, the arm 5, and the bucket 6 as movable parts of the hydraulic shovel 2, respectively. The detection devices 11A, 11B, 11C, and 11D may only be provided on some of the body 3, the boom 4, the arm 5, and the bucket 6, that is to say, can be provided on various parts as required.

[0024] The detection devices 11A, 11B, 11C, and 11D are each activated by a battery as a power source, and each acquire three-dimensional acceleration information and angular velocity information with a sensor that the relevant detection device holds. In addition, the detection devices 11A, 11B, 11C, and 11D each process the information as acquired with the sensor, so as to acquire posture information designating a posture of the movable part, in which the relevant detection device is held, and send the posture information by data communications through wireless communications.

[0025] To the posture information, an angle of the movable part to a reference direction is applied, for instance. The reference direction refers to a front and rear direction of a ground face of the hydraulic shovel 2, for instance.

[0026] To the sensors of the detection devices 11A, 11B, 11C, and 11D, an IMU (inertial measurement unit) sensor is applied. The sensors, however, are not limited to the IMU sensor, that is to say, a sensor other than a triaxial sensor may be applied and a wide variety of structures capable of detecting the posture information are applicable. The sensors are not limited to a structure capable of acquiring information for directly detecting the posture of the movable part, and extensive structures capable of indirectly detecting the posture of the movable part, such as a ranging sensor for measuring a distance to a land surface, are applicable.

[0027] While Bluetooth (registered trademark) is applied to the data communications through wireless communications on the detection devices 11A, 11B, 11C, and 11D, extensive wireless communications capable of data communications are applicable.

[0028] While a dry cell battery is applied to a battery relating to the power sources for the detection devices 11A, 11B, 11C, and 11D, a wide variety of primary batteries and secondary batteries are applicable.

[0029] The detection devices 11A, 11B, 11C, and 11D each detect residual life information on the battery in response to a request from the body device 12 so as to notify the body device 12 of the residual life information on the battery. To the detection of residual life of the battery, a wide variety of detection methods are applicable on diverse occasions including the occasion when the detection is based on a terminal voltage and the occasion when the detection is based on an internal resistance.

[0030] The mobile information terminal device 13 is a so-called smartphone or a tablet terminal that the operator carries, and uses an internal arithmetic processing circuit to execute an application program relating to the work assistance system, so as to boot the detection devices 11A, 11B, 11C, and 11D through the body device 12 and start the machine guidance function. Thus, the mobile information terminal device 13 acquires the posture information from the detection devices 11A, 11B, 11C, and 11D through the body device 12, generates assistance information based on the posture information, and sends the assistance information to the body device 12. The mobile information terminal device 13

constitutes an interface relating to the work assistance system 1, so as to accept various operations by the operator and notify the operator of various pieces of image information and sound information.

[0031] To the assistance information, information on a distance from a tip position of the bucket 6 to a construction target is applied, for instance.

[0032] In addition, the mobile information terminal device 13 records and holds information concerning a work scheme of the hydraulic shovel 2 and sends the held information concerning the work scheme to the body device 12 in response to a request from the body device 12.

[0033] The information concerning the work scheme is acquired by the download from a management computer for managing the work scheme, for instance, or directly input to the mobile information terminal device 13 and formed.

[0034] The information concerning the work scheme is information on a schedule for the hydraulic shovel 2, and is formed of a planned time to start a work by the hydraulic shovel 2, a planned time to terminate the work, a planned time to stop the work for lunch or the like, and a planned time to restart the work that are to be planned daily.

[0035] The body device 12 is provided on the body 3 of the hydraulic shovel 2, and includes a wireless communications unit 21, a sound output unit 22, an image display unit 23, a battery information storage unit 24, and a control unit 25.

[0036] The wireless communications unit 21 transmits and receives various pieces of data to and from the detection devices 11A, 11B, 11C, and 11D and the mobile information terminal device 13 by data communications through wireless communications controlled by the control unit 25, and acquires information on a water temperature and the like from the hydraulic shovel 2.

[0037] The sound output unit 22 outputs various warning sounds and a synthesized voice from a speaker under the control by the control unit 25.

[0038] The image display unit 23 is constituted of a liquid crystal display panel, for instance, and notifies the operator, who is on the body 3, of various pieces of image information.

[0039] The battery information storage unit 24 stores and holds information on a battery decrease per unit time, a residual battery life, and a remaining time for battery availability for each of the detection devices 11A, 11B, 11C, and 11D and updates the held information under the control by the control unit 25.

[0040] The control unit 25 is a microcomputer including an arithmetic processing circuit, a ROM (read-only memory), and a RAM (random access memory), and starts operating and causes the detection devices 11A, 11B, 11C, and 11D to start operating under instructions from the mobile information terminal device 13 that are obtained through the wireless communications unit 21. As a result, the control unit 25 receives the posture information, which is sent from the detection devices 11A, 11B, 11C, and 11D, through the wireless communications unit 21, and sends the received posture information to the mobile information terminal device 13 through the wireless communications unit 21. The assistance information sent from the mobile information terminal device 13 based on the posture information is received through the wireless communications unit 21, and the image display unit 23 and the sound output unit 22 are controlled based on the assistance information so as to provide the operator with the assistance information.

[0041] The assistance information is provided by a bar graph-like segmental indication up to the construction target, for instance, while various methods including numerical indication of a distance to a working target are applicable. The assistance information is also provided in an aurally perceivable manner by generating a warning sound so that the pitch may change as the tip of the bucket 6 approaches the construction target.

[0042] The assistance information may be provided by the mobile information terminal device 13.

[0043] The control unit 25 executes a management program for this work assistance system with the arithmetic processing circuit so that the assistance information may be provided as above, so as to perform a specified processing procedure and manage the batteries of the detection devices 11A, 11B, 11C, and 11D.

[0044] Fig. 3 is a flowchart illustrating a processing procedure relating to the management of the batteries.

[0045] If an ignition key as a starting switch is operated (IG-ON) and the hydraulic shovel 2 starts moving, the control unit 25 starts the processing procedure and acquires the residual life information on the batteries from the detection devices (sensor devices) 11A, 11B, 11C, and 11D (residual life information acquisition step: SP2).

[0046] The control unit 25 updates a record in the battery information storage unit 24 based on the acquired residual life information (SP3).

[0047] Fig. 4 is a table illustrating an update process performed by the control unit 25 on the battery information storage unit 24. In Fig. 4, the detection devices 11A, 11B, 11C, and 11D are represented by sensors 1, 2, 3, and 4, respectively.

[0048] The control unit 25 executes the management program so as to acquire the residual life information at certain time intervals (intervals of an hour, for instance) and hold the residual life information in the battery information storage unit 24, and updates the residual life information as recorded and held with the residual life information acquired in step SP2. In the example in Fig. 4, residual battery lives in the detection devices 11A, 11B, 11C, and 11D are 40%, 30%, 46%, and 40%, respectively.

[0049] The control unit 25 calculates a residual life reduction rate per unit time from the residual life information as recorded and held in the battery information storage unit 24 and the residual life information acquired in step SP2, so as to update the record in the battery information storage unit 24. In the example in Fig. 4, residual life reduction rates

per unit time in the detection devices 11A, 11B, 11C, and 11D are 4%/h, 2%/h, 2%/h, and 4%/h, respectively. The control unit 25 divides the residual battery life by the residual life reduction rate per unit time so as to calculate and update the remaining time for battery availability. In the example in Fig. 4, remaining times for battery availability in the detection devices 11A, 11B, 11C, and 11D are 10 hours, 15 hours, 23 hours, and 10 hours, respectively.

[0050] Next, the control unit 25 acquires information concerning a work scheme of the working machine from the mobile information terminal device 13. The acquired information concerning the work scheme is processed so as to calculate a work suspension time period allowing battery replacement, a time period when use of machine guidance (MG) is assumed, and a total length of time periods when the use of machine guidance is assumed (SP4).

[0051] Fig. 5 is a diagram for explaining the above process performed by the control unit 25. The control unit 25 detects a time period when the hydraulic shovel 2 successively works from the planned time to start the work, the planned time to terminate the work, the planned time to stop the work, and the planned time to restart the work, all set in the information concerning the work scheme, and sets the detected time period as the time period when the use of machine guidance is assumed. The time period when the use of machine guidance is assumed is daily totalized so as to calculate the total length of time periods when the use of machine guidance is assumed.

[0052] The work suspension time period allowing battery replacement is set based on time required for the battery replacement at a time period that is equal to or longer than the time required for the battery replacement and that the work by the hydraulic shovel 2 is not planned in. The information concerning the work scheme of the working machine may be acquired from an external information appliance such as a management computer for managing work schemes of multiple working machines. In that case, it is possible to acquire the information concerning the work scheme from a management device for managing multiple working machines, so as to appropriately manage batteries in multiple work assistance systems.

[0053] In the example in Fig. 5, on August 17, 2020, a time period extending from 0800 hours as a time to begin work to 0900 hours is set as the work suspension time period allowing battery replacement, and a time period extending from 0900 hours to 1200 hours and a time period extending from 1300 hours to 1700 hours are each set as the time period when the use of machine guidance is assumed. On the following day, the 18th, the time period extending from 0800 hours as the time to begin work to 0900 hours is set as the work suspension time period allowing battery replacement, and the time period extending from 0900 hours to 1200 hours and a time period extending from 1300 hours to 1600 hours are each set as the time period when the use of machine guidance is assumed. On the following day, the 19th, a time period extending from 0800 hours to 1400 hours is set as the time period when the use of machine guidance is assumed, and a time period extending from 1600 hours to 1700 hours is set as the work suspension time period allowing battery replacement. On the 20th, a time period extending from 1300 hours to 1700 hours is set as the time period when the use of machine guidance is assumed, and a time period extending from 1700 hours to 1800 hours is set as the work suspension time period allowing battery replacement.

[0054] The total length of time periods when the use of machine guidance is assumed (MG total time) is 7 hours on the 17th, 6 hours on the 18th, 6 hours on the 19th, and 4 hours on the 20th.

[0055] Next, the control unit 25 estimates a battery replacement time (SP5). Specifically, the control unit 25 compares the total length of time periods when the use of machine guidance is assumed with the remaining time for battery availability for each of the detection devices 11A, 11B, 11C, and 11D so as to detect the work suspension time period allowing battery replacement, which exists before the remaining time for battery availability becomes zero. The detected work suspension time period allowing battery replacement is set as the battery replacement time.

[0056] In the example in Fig. 5, processes relating to the processing procedure are to be performed during the beginning of work on the 17th, the total length of time periods when the use of machine guidance is assumed is 7 hours on the 17th and 6 hours on the 18th, and the remaining time for battery availability is 10 hours (Fig. 4), so that the work suspension time period allowing battery replacement immediately after the beginning of work on the 18th is detected and set as the battery replacement time for the detection devices 11A, 11B, and 11D (sensors 1, 2, and 4), as illustrated in Fig. 6. With respect to the detection device 11C, the total length of time periods when the use of machine guidance is assumed is 6 hours on the 19th and 4 hours on the 20th, and the remaining time for battery availability is 23 hours, so that the work suspension time period allowing battery replacement on the 19th is set as the battery replacement time.

[0057] Consequently, in the processing procedure in Fig. 3, processes in steps SP4 and SP5 constitute an estimation step of estimating the time for replacement of the battery based on the residual life information on the battery and the information concerning the work scheme of the working machine.

[0058] The control unit 25, which has thus estimated the battery replacement time, determines whether time to give notice of the battery replacement time has come, and, if the time to give notice has not come yet, returns to step SP2 after a lapse of certain time (an hour, for instance) so as to acquire the residual life information on the batteries anew from the detection devices 11A, 11B, 11C, and 11D and repeat processes in steps SP3 through SP6.

[0059] If the time to give notice has come, the battery replacement time is reported through the image display unit 23 and the sound output unit 22 or through the mobile information terminal device 13 (notification step: SP7).

[0060] The time to give notice is a point of time preceding the battery replacement time by a length of the time for

notification as set in advance, and time set in advance by the operator is applied to the time to give notice, for instance.

[0061] Fig. 7 is a diagram illustrating an exemplary notification of the battery replacement time through the image display unit 23. In Fig. 7, information concerning a movement state of the hydraulic shovel 2 is displayed in an upper portion of a display screen in the image display unit 23. Such display is carried out by displaying an indication 31 of a temperature of fuel in a fuel tank, an indication 32 of a temperature of a cooling water, and an indication 33 of a remaining amount of the fuel.

[0062] In a lower portion of the display screen, a message stating the notification of the battery replacement time is displayed. In such display, a title "notice of battery replacement time" indicating that the notification of the battery replacement time is made, then a phrase "perform battery replacement", a phrase "on sensor 1, sensor 2, and sensor 4" specifying the detection devices, on which the battery replacement is to be performed, and a phrase "between 8:00 and 9:00 on 18/08/2020" stating the corresponding time for replacement are displayed.

[0063] In the sound output unit 22, on the other hand, a message reporting the battery replacement time is output by voice synthesis, for instance.

[0064] Fig. 8 is a diagram illustrating an exemplary notification of the battery replacement time through the mobile information terminal device 13. In Fig. 8, a message identical to the message stating the notification of the battery replacement time on the display screen in the image display unit 23 is displayed so as to report the battery replacement.

[0065] Also in the mobile information terminal device 13, the battery replacement may be reported by voice.

[0066] If the time for replacement of the battery is reported through the mobile information terminal device as described above, the time for replacement is reported even if the operator is not on the working machine.

[0067] The control unit 25 returns to step SP2 after a lapse of certain time so as to acquire the residual life information on the batteries anew from the detection devices 11A, 11B, 11C, and 11D and repeat the processes in steps SP3 through SP6 even if the time for replacement of the battery has been reported. If an engine of the hydraulic shovel 2 is stopped by operating the ignition key, the control unit 25 terminates the processing procedure in Fig. 3.

[0068] According to the configurations as described above, the time for replacement of the battery is estimated and reported based on the residual life information on the battery and the information concerning the work scheme of the working machine and, in consequence, the time for replacement is estimated and reported so that the work may not be interrupted. As a result, in the configuration where the electric power of the battery is used to drive the sensor and, moreover, the result of measurement by the sensor is transmitted through wireless communications, the battery is appropriately managed and the deterioration of the work efficiency such as the interruption of the work for the replacement of the battery is prevented.

[0069] If the information concerning the work scheme of the working machine is acquired from an external information appliance, it is possible to acquire the information concerning the work scheme from a management device for managing multiple working machines, so as to appropriately manage the batteries.

[0070] If the time for replacement of the battery is reported through the mobile information terminal device, the time for replacement is reported even if the operator is not on the working machine.

[Other Embodiments]

[0071] Specific configurations suitable for the implementation of the present invention have been detailed above, while the configurations of the above embodiment of the present invention can variously be changed without departing from the gist of the present invention.

[0072] To be specific: In the above embodiment, a management program relating to the batteries is executed on the body device's side, while the present invention is not limited to such configuration and the management program may be executed on the mobile information terminal device's side. Furthermore, in the above embodiment, the assistance information is generated in the mobile information terminal device, while the present invention is not limited to such configuration and the assistance information may be generated on the body device's side.

DESCRIPTION OF REFERENCE NUMERALS

[0073]

1	work assistance system
2	hydraulic shovel
3	body
4	boom
5	arm
6	bucket
11A, 11B, 11C, 11D	detection device

12	body device
13	mobile information terminal device
21	wireless communications unit
22	sound output unit
5 23	image display unit
24	battery information storage unit
25	control unit

10 Claims

1. A labor assistance system that:

holds a detection device to operate by electric power of a battery, in a movable part of a working machine so as to detect posture information on the movable part with a sensor provided on the detection device and send the posture information from the detection device by data communications through wireless communications; generates, based on the posture information sent from the detection device, assistance information for assisting an operator of the working machine in an operation so as to notify the operator of the assistance information; and acquires residual life information on the battery from the detection device so as to estimate time for replacement of the battery based on the residual life information on the battery and information concerning a work scheme of the working machine and notify the operator of the time for replacement of the battery.

2. The labor assistance system according to claim 1, which acquires the information concerning the work scheme of the working machine from an external information appliance.

3. The labor assistance system according to claim 1 or 2, which notifies the operator of the working machine of the time for replacement of the battery through a mobile information terminal device.

4. A management method for a labor assistance system,

the labor assistance system:

holding a detection device to operate by electric power of a battery, in a movable part of a working machine so as to detect posture information on the movable part with a sensor provided on the detection device and send the posture information from the detection device by data communications through wireless communications; and generating, based on the posture information sent from the detection device, assistance information for assisting an operator of the working machine in an operation so as to notify the operator of the assistance information, the management method comprising:
acquiring residual life information on the battery from the detection device;
estimating time for replacement of the battery based on the residual life information on the battery and information concerning a work scheme of the working machine; and
notifying the operator of the time for replacement of the battery.

5. A management program for a labor assistance system that is executed by an arithmetic processing circuit so as to perform a processing procedure specified,

the labor assistance system:

holding a detection device to operate by electric power of a battery, in a movable part of a working machine so as to detect posture information on the movable part with a sensor provided on the detection device and send the posture information from the detection device by data communications through wireless communications; and generating, based on the posture information sent from the detection device, assistance information for assisting an operator of the working machine in an operation so as to notify the operator of the assistance information, the processing procedure including:
acquiring residual life information on the battery from the detection device;
estimating time for replacement of the battery based on the residual life information on the battery and information concerning a work scheme of the working machine; and
notifying the operator of the time for replacement of the battery.

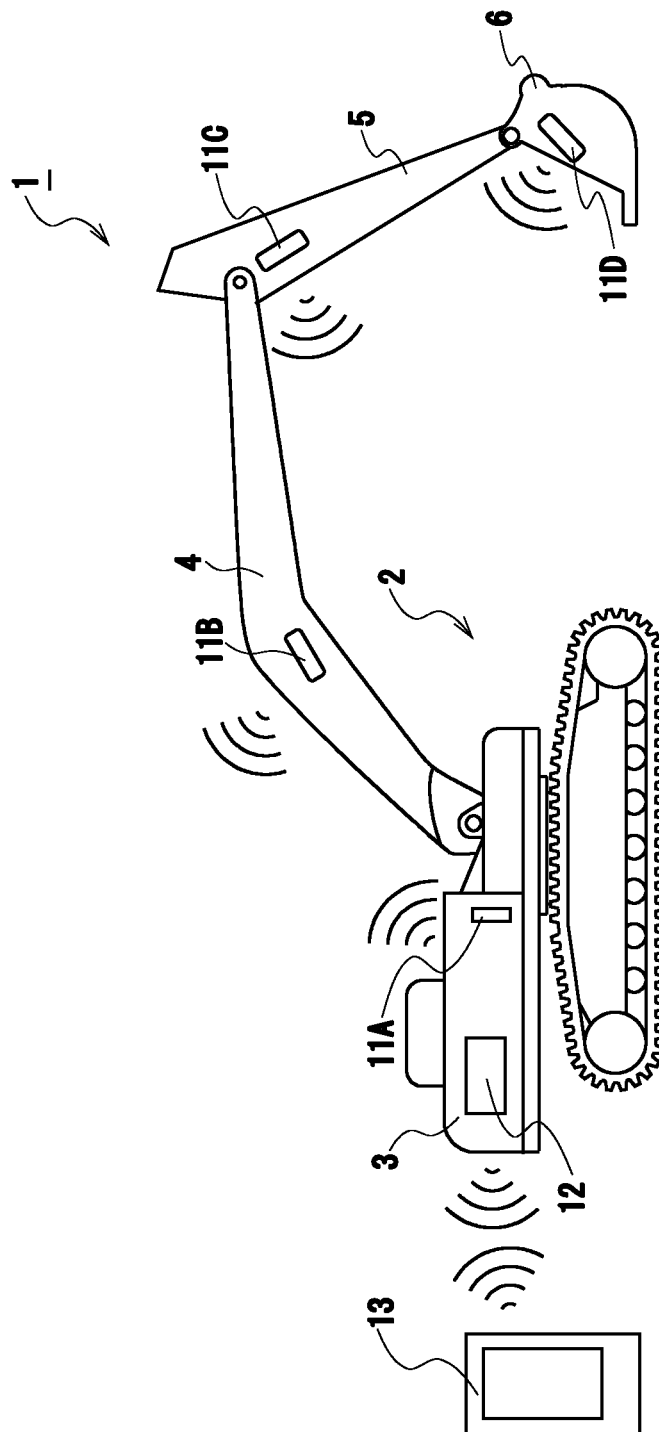


FIG. 1

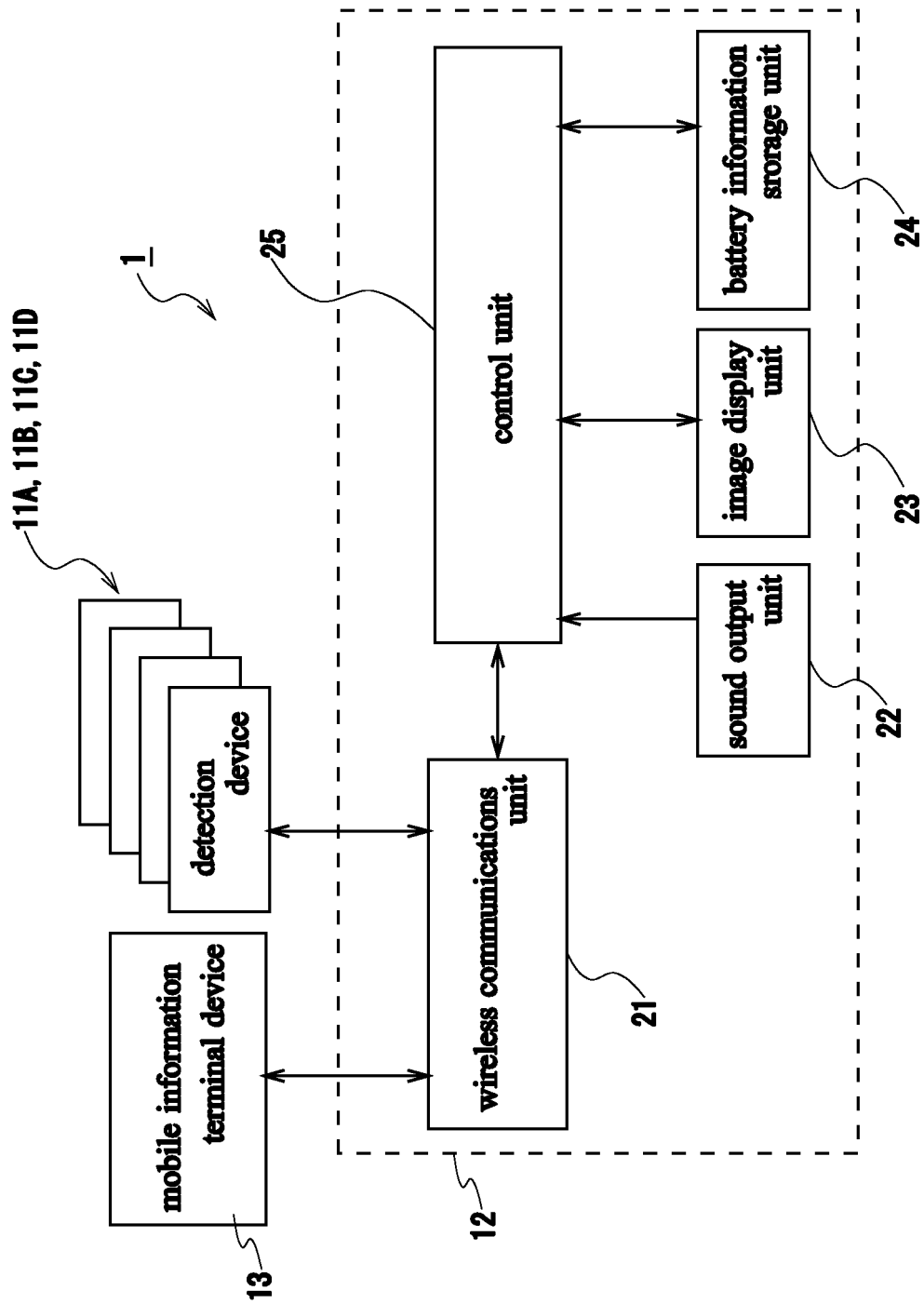


FIG. 2

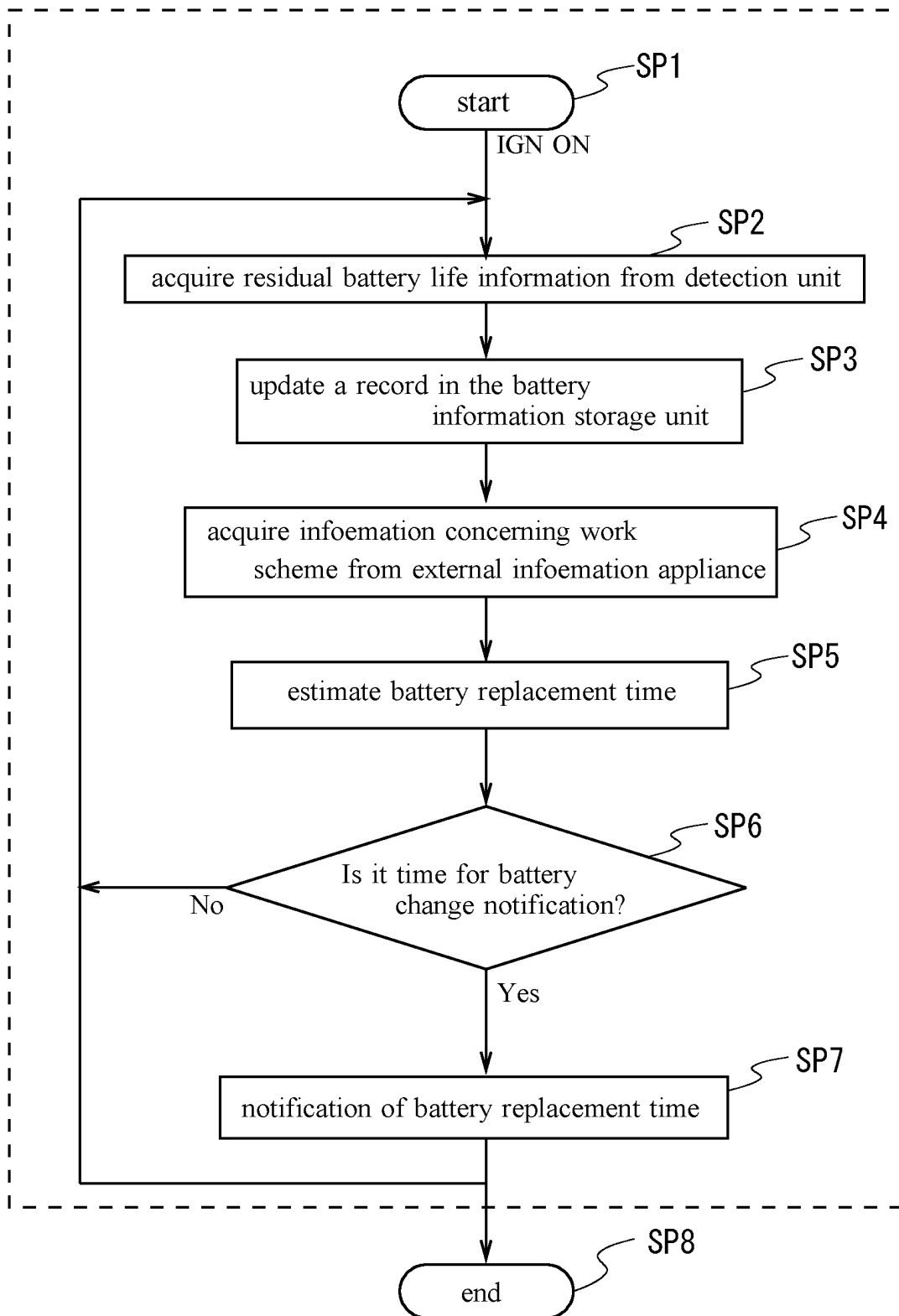


FIG. 3

	sensor 1	sensor 2	sensor 3	sensor 4
battery decrease	4%/h	2%/h	2%/h	4%/h
residual battery life	40%	30%	46%	40%
remaining time for battery availability	10h	15h	23h	10h

FIG. 4

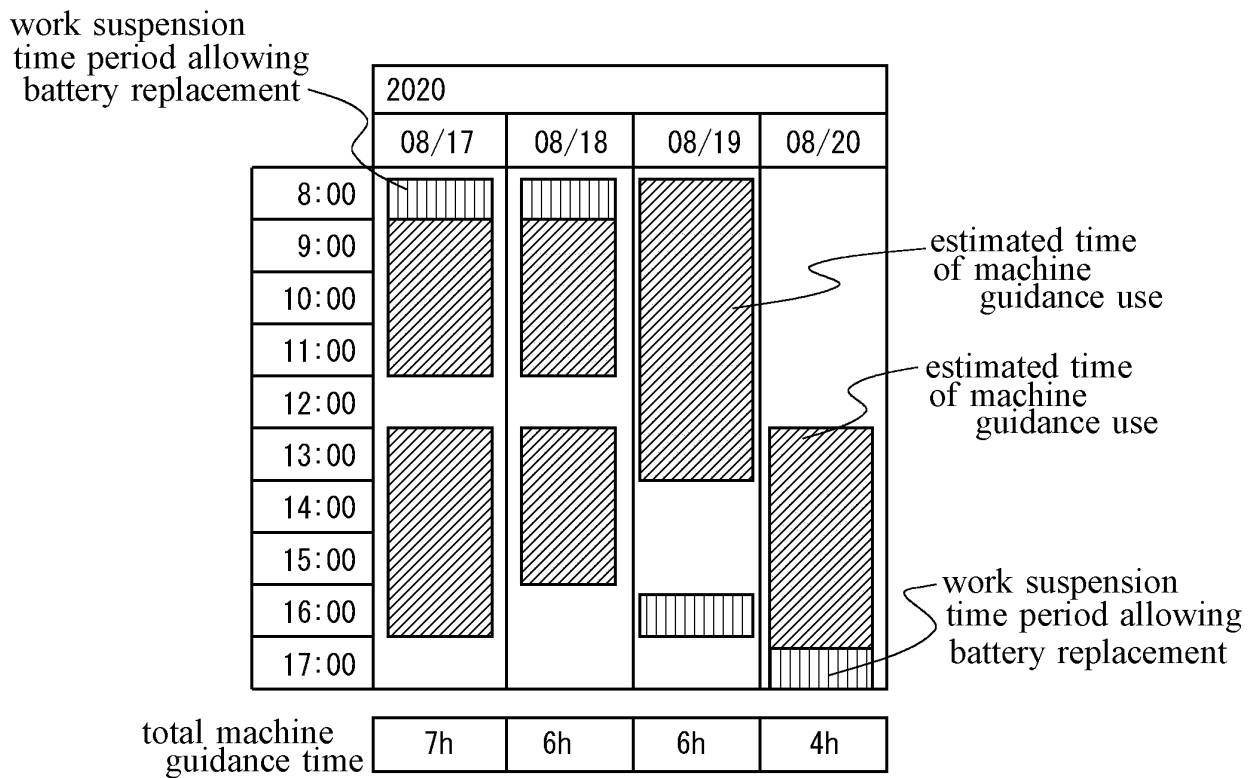


FIG. 5

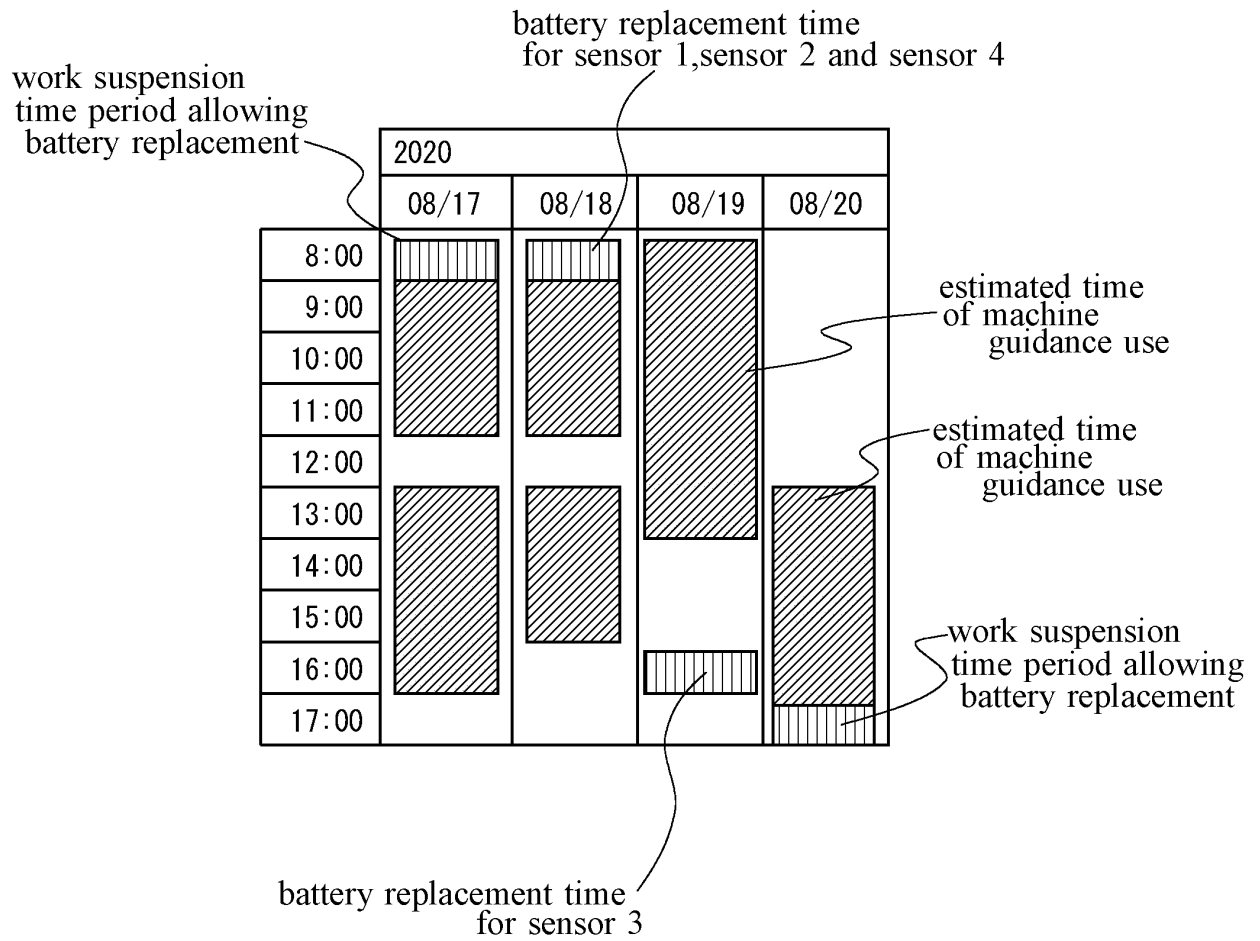


FIG. 6

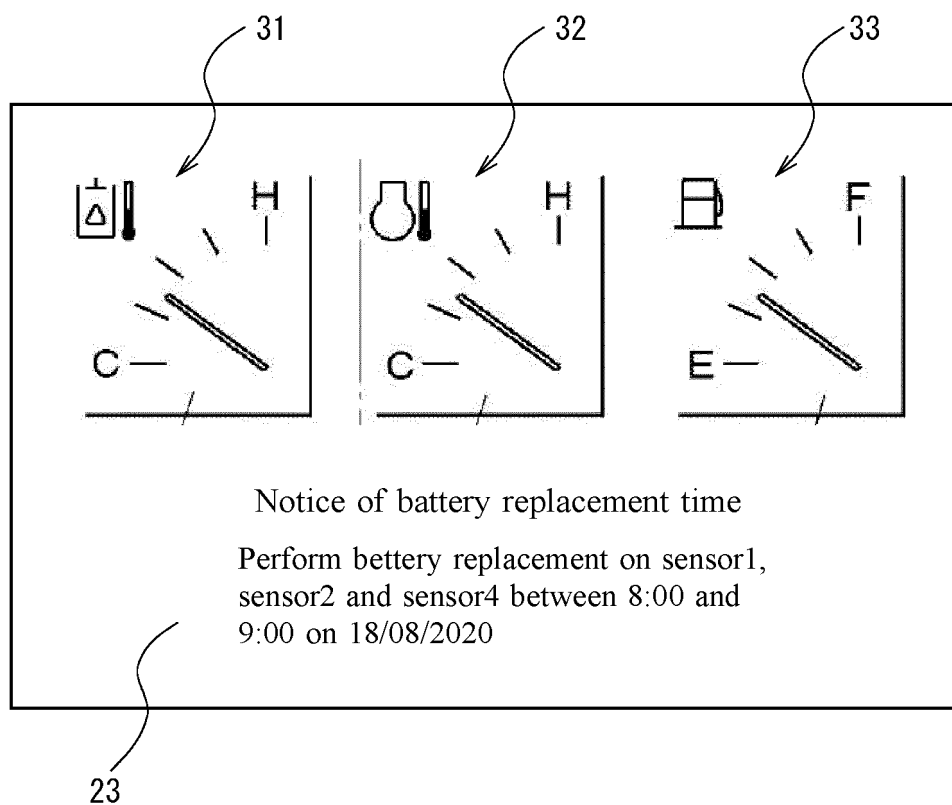


FIG. 7

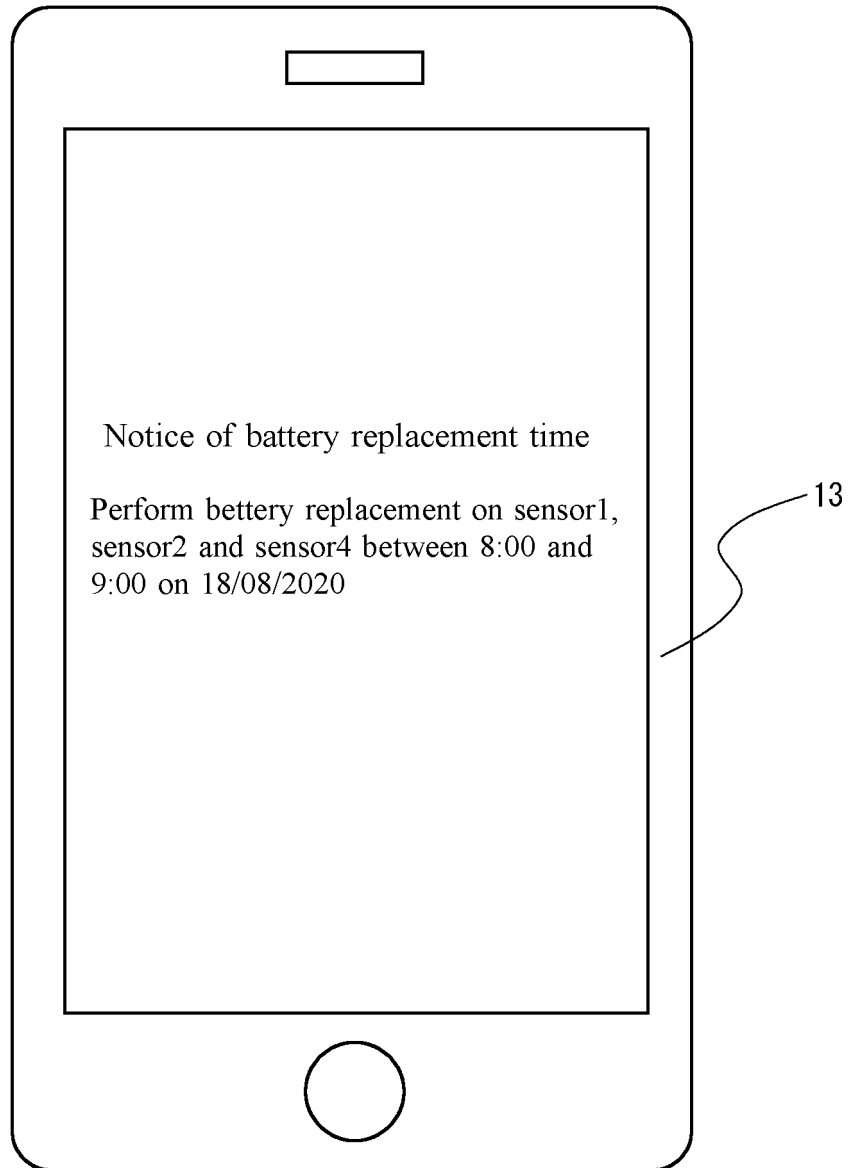


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2022/023721

A. CLASSIFICATION OF SUBJECT MATTER <i>E02F 9/20</i> (2006.01)i; <i>E02F 9/26</i> (2006.01)i FI: E02F9/20 M; E02F9/26 A According to International Patent Classification (IPC) or to both national classification and IPC	B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) E02F9/20-E02F9/22, E02F3/42-E02F3/43, E02F3/84-E02F3/85, E02F9/24, E02F9/26, H02J7/00-H02J7/12, H02J7/34-H02J7/36 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Published examined utility model applications of Japan 1922-1996 Published unexamined utility model applications of Japan 1971-2022 Registered utility model specifications of Japan 1996-2022 Published registered utility model applications of Japan 1994-2022 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)	
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2020-029766 A (BRIDGIN) 27 February 2020 (2020-02-27) paragraphs [0012]-[0056], fig. 1, 2	1-5
Y	JP 2020-525165 A (ETHICON LIMITED LIABILITY COMPANY) 27 August 2020 (2020-08-27) paragraph [0058]	1-5
Y	JP 2019-219700 A (BLUE INNOVATION COMPANY, LIMITED) 26 December 2019 (2019-12-26) paragraphs [0044]-[0058]	1-5
Y	WO 2020/111096 A1 (NILEWORKS INCORPORATED) 04 June 2020 (2020-06-04) paragraphs [0060]-[0065], [0078]-[0088], [0108]-[0118]	1-5
Y	JP 2016-084633 A (HITACHI CONSTR. MACH. COMPANY, LIMITED) 19 May 2016 (2016-05-19) paragraphs [0013]-[0106]	1-5
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex. * Special categories of cited documents: "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 "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		
Date of the actual completion of the international search 13 July 2022		Date of mailing of the international search report 09 August 2022
Name and mailing address of the ISA/JP Japan Patent Office (ISA/JP) 3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915 Japan		Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

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PCT/JP2022/023721

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2011-142704 A (MITSUBISHI HEAVY IND., LIMITED) 21 July 2011 (2011-07-21) paragraphs [0002]-[0003], [0008]-[0011], [0028]-[0041]	1-5
A	JP 2017-071915 A (KOMATSU LIMITED) 13 April 2017 (2017-04-13)	1-5
A	US 2015/0094953 A1 (DEERE & COMPANY) 02 April 2015 (2015-04-02)	1-5

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/JP2022/023721

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2020-029766 A	27 February 2020	EP 3613905 A1 paragraphs [0010]-[0056], fig. 1, 2	
		FR 3085048 A1	
JP 2020-525165 A	27 August 2020	US 2018/0368822 A1 paragraph [0074]	
		EP 3420966 A1	
JP 2019-219700 A	26 December 2019	(Family: none)	
WO 2020/111096 A1	04 June 2020	CN 113168777 A	
JP 2016-084633 A	19 May 2016	(Family: none)	
JP 2011-142704 A	21 July 2011	US 2012/0126754 A1 paragraphs [0003]-[0006], [0010]-[0014], [0047]-[0070]	
		WO 2011/083613 A1	
		EP 2509187 A1	
		CN 102474121 A	
JP 2017-071915 A	13 April 2017	US 2018/0245311 A1	
US 2015/0094953 A1	02 April 2015	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2015014147 A [0004]