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## Electric movable body


### Abstract

An electric movable body includes a plurality of motors and a plurality of batteries, among which the motors and the batteries are connected such that each of the batteries supplies electric power to a motor set driving separate output shafts. When an abnormal motor that has been determined as abnormal is in a drive state, by switching the abnormal motor to a stop state, and switching one of the motors driving the output shaft driven by the abnormal motor and in the stop state to the drive state, the electric movable body assigns the drive state or the stop state to a motor set including the abnormal motor and to a motor set including the switched motor, for driving each of the output shafts by at least one motor and for supplying electric power from each of the batteries to at least one motor.



**Inventors:** **Kawazu; Shinsuke (Kariya, JP), Nakai; Yasuhiro (Kariya, JP)**

**Applicant:** **DENSO CORPORATION** (Kariya, JP)



**Family ID:** **1000008762535**

**Assignee:** **DENSO CORPORATION (Kariya, JP)**

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*Primary Examiner:* Dhakal; Bickey

*Attorney, Agent or Firm:* Oliff PLC

## Background/Summary

CROSS REFERENCE TO RELATED APPLICATION (1) The present application is a continuation application of International Patent Application No. PCT/JP2021/035029 filed on Sep. 24, 2021, which designated the U.S. and claims the benefit of priority from Japanese Patent Application No. 2020-164036 filed on Sep. 29, 2020. The entire disclosures of all of the above applications are incorporated herein by reference.

TECHNICAL FIELD
(1) The present disclosure relates to an electric movable body.
BACKGROUND
(2) Conventionally, an electric aircraft includes a plurality of motors that drive one propeller and power supply devices that supply electric power to those motors.
SUMMARY
(3) According to an aspect of the present disclosure, an electric movable body includes a plurality of output shafts; a plurality of motors each driving an output shaft; and a plurality of batteries. The plurality of motors and the plurality of batteries are connected so that each battery supplies electric power to a motor set each driving one of the plurality of separate output shafts.

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## Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) The above and other objects, features and advantages of the present disclosure will become more apparent from the following detailed description made with reference to the accompanying drawings. In the drawings:
(2) FIG. **1** is a schematic diagram of an electric aircraft according to a first embodiment;
(3) FIG. **2** is a block diagram of the electric aircraft of the first embodiment;
(4) FIG. **3** is an electrical circuit diagram showing a mechanism for electrically disconnecting between a motor and a battery;
(5) FIG. **4** is a flowchart showing a processing procedure for abnormality determination during a first control;
(6) FIG. **5** is a time chart showing a mode of abnormality determination during the first control;
(7) FIG. **6** is a flowchart showing a processing procedure for abnormality determination during a third control;
(8) FIG. **7** is a time chart showing a mode of abnormality determination during the third control;
(9) FIG. **8** is a schematic diagram of an electric aircraft according to a second embodiment;
(10) FIG. **9** is a schematic diagram of an electric aircraft according to a third embodiment;
(11) FIG. **10** is a schematic diagram showing a modification of the electric aircraft of the third embodiment;
(12) FIG. **11** is a schematic diagram showing another modification of the electric aircraft of the third embodiment;
(13) FIG. **12** is a schematic diagram showing a modification of the electric aircraft;
(14) FIG. **13** is a schematic diagram showing another modification of the electric aircraft;
(15) FIG. **14** is a schematic diagram showing yet another modification of the electric aircraft;
(16) FIG. **15** is a schematic diagram showing still yet another modification of the electric aircraft;
(17) FIG. **16** is a schematic diagram showing still yet another modification of the electric aircraft; and
(18) FIG. **17** is a schematic diagram showing still yet another modification of the electric aircraft.
DETAILED DESCRIPTION

(19) Hereinafter, examples of the present disclosure will be described.
(20) According to an example of the present disclosure, an electric aircraft includes a plurality of motors that drive one propeller and power supply devices that supply electric power to those motors. In this electric aircraft, the safety of the electric aircraft is improved by electrically and mechanically isolating the motor in which an abnormality has occurred (hereinafter referred to as “abnormal motor”).
(21) By the way, in the electric aircraft (electric movable body), when the abnormal motor is electrically and mechanically disconnected or isolated, only the amount of electric power supplied from the power supply device (e.g., battery) that supplies electric power to the abnormal motor may be decreased. Therefore, the amount of electric power supplied from the respective power supply devices may become uneven.
(22) A first example to address the above-mentioned issue includes, in an electric movable body: a plurality of output shafts; a plurality of motors each driving an output shaft; and a plurality of batteries. The plurality of motors and the plurality of batteries are connected so that each battery supplies electric power to a motor set each driving one of the plurality of separate output shafts. The electric movable body comprises: a first control unit that performs a first control assigning either a drive state or a stop state to the motors, for driving each of the output shafts by at least one motor and for supplying electric power from each of the batteries to at least one motor; an abnormality determination unit that determines an abnormality of the plurality of motors; a switching unit that performs a switching control in which the abnormal motor is switched to the stop state, when the abnormal motor determined by the abnormality determination unit is in the drive state, and one of a plurality of switched motors in the stop state and switchable to drive the output shaft being driven by the abnormal motor is switched to the drive state; and a second control unit that performs, when the switching control is performed by the switching unit, a second control assigning either the drive state or the stop state to the motors constituting the motor set including the abnormal motor, and to the motors constituting the motor set including the switched motor, for driving each of the output shafts by at least one motor and for supplying electric power from each of the batteries to at least one motor.
(23) According to the above configuration, the electric movable body includes a plurality of output shafts, a plurality of motors respectively driving the output shaft, and a plurality of batteries. Therefore, even when an abnormality occurs in one of the plurality of motors respectively driving the output shaft, the output shaft can still be driven by the other motor that drives the same output shaft having been driven by the motor in which the abnormality has occurred.
(24) The plurality of motors and the plurality of batteries are connected so that each battery supplies electric power to each of plural motor sets each driving one of the separately-provided plurality of output shafts. Therefore, even when an abnormality occurs in one battery that supplies electric power to one motor set, by supplying electric power from the other battery to the other motor set, the plurality of output shafts are still drivable by those motors. Then, the first control unit performs the first control assigning either a drive state or a stop state to the motors for a drive of each of the output shafts, for driving each of the output shafts by at least one motor and for supplying electric power from each of the batteries to at least one motor. Therefore, while each of the output shafts is driven by at least one motor, it is possible to suppress unevenness in the supply amounts of electric power supplied from each of the batteries.
(25) The abnormality determination unit determines an abnormality of the plurality of motors. The switching unit switches the abnormal motor to the stop state when the abnormal motor, which is a motor determined as abnormal by the abnormality determination unit, is in the drive state. Therefore, when the abnormal motor is in the drive state, the abnormal motor is switchable to the stop state, thereby making it possible to suppress the movement of the electric movable body from becoming unstable. Further, the switching unit performs the switching control to switch, to the drive state, the switched motor, which is one of the motors in the stop state among the motors that

drive the output shaft driven by the abnormal motor. Therefore, even when the abnormal motor is switched from the drive state to the stop state, it is possible to suppress the decrease in the number of motors that drive the output shaft having been driven by the abnormal motor.

(26) Here, when the abnormal motor is switched to the stop state and the switched motor is switched to the drive state, the number of motors powered by a battery that supplies electric power to a motor set including the abnormal motor and the number of motors powered by another battery that supplies electric power to another motor set including the switched motor respectively change. Therefore, a difference in the numbers of motors powered by the respective batteries becomes large, and there is a risk that the supply amounts of electric power from each of the batteries may become uneven. In this regard, when the switching control is performed by the switching unit, the second control unit performs the second control that assigns either the drive state or the stop state to the motors constituting the motor set including the abnormal motor, and to the motors constituting the motor set including the switched motor, for driving each of the output shafts by at least one of the motors and for supplying electric power from each of the batteries to at least one of the motors. Therefore, even when an abnormality occurs in the motor, it is possible to suppress unevenness in the supply amounts of electric power supplied from each of the batteries.

(27) In a second example, when performing the first control, the first control unit assigns the drive state or the stop state to each of the motors driving the output shafts, for driving each of the output shafts by a same number of motors and for supplying electric power from each of the batteries to a same number of motors, and, when performing the second control, the second control unit assigns the drive state or the stop state to the each of the motors, in the motor set including the abnormal motor, and in the motor set including the switched motor, for driving each of the output shafts by the same number of motors and for supplying electric power from each of the batteries to the same number of motors.

(28) According to the above-described configuration, when performing the first control, the first control unit assigns the drive state or the stop state to each of the plurality of motors each driving the output shaft, for driving each of the output shafts by the same number of motors and for supplying electric power from each of the batteries to the same number of motors. Therefore, while driving each of the output shafts by the same number of motors, it is possible to suppress unevenness in the supply amount of electric power supplied from each of the batteries.

(29) When performing the second control, in which the switching control is performed by the switching unit, the second control unit assigns the drive state or the stop state to each of the motors, in the motor set including the abnormal motor, and in the motor set including the switched motor, for driving each of the output shafts by the same number of motors and for supplying electric power from each of the batteries to the same number of motors. Therefore, even when an abnormality occurs in the motor, it is possible to suppress unevenness in the supply amount of electric power supplied from each of the batteries.

(30) In a third example, when the first control is being performed by the first control unit, the abnormality determination unit determines an abnormality of a drive motor, which is a motor to which the drive state is being assigned, based on a predetermined state quantity correlated with the drive state of the drive motor. For example, the abnormality determination unit can determine that the drive motor is abnormal when a rotation speed of the drive motor (i.e., predetermined state quantity correlated with the drive state of the drive motor) rises above or falls below a threshold range. According to such a configuration, when the first control is being performed, which assigns the drive state or the stop state to the plurality of motors respectively driving the output shaft, it is possible to determine whether the drive motor is abnormal, thereby increasing a determination frequency for determining the abnormality.

(31) In a fourth example, a third control unit is provided for performing a third control, which assigns the drive state to the plurality of motors for driving the output shaft, and, when the third control unit performs the third control, and it is determined that any one of the drive motors is

abnormal based on the predetermined state quantity, the first control unit performs the first control, and, the abnormality determination unit identifies, when the first control is being performed by the first control, an abnormal drive motor having an abnormality based on the predetermined state quantity.
(32) According to the above-described configuration, the third control unit performs the third control for assigning the drive state to the plurality of motors that respectively drive the output shaft. Therefore, by performing the third control, it is possible to guarantee an output performance of the electric movable body. Note that, when the third control is performed by the third control unit, by assigning the drive state to all the motors that drive the output shafts, the maximum output performance of the electric movable body is guaranteeable.
(33) Here, when the third control is being performed, even when it is determined that one of the drive motors is abnormal based on the predetermined state quantity, the abnormal drive motor cannot be identified in case that the predetermined state quantity of the plurality of drive motors is all the same. For example, when the plurality of motors are directly connected to one output shaft, the rotation speed (i.e., the predetermined state quantity) is all the same among the plurality of motors.
(34) In this regard, when the third control is being performed by the third control unit and it is determined that one of the drive motors is abnormal based on the predetermined state quantity, the electric movable body controls the first control unit to perform the first control. Then, the abnormality determination unit identifies an abnormal drive motor based on the predetermined state quantity when the first control is being performed by the first control unit. That is, in other words, by assigning the drive state or the stop state to the plurality of motors each driving the output shaft by performing the first control, it becomes possible to determine whether or not a drive motor is abnormal based on the predetermined state quantity, thereby enabling identification of an abnormal drive motor.
(35) In a fifth example, a clutch is further provided, for switching between a first state in which a torque is transmittable from the motor to the output shaft and a second state in which a torque is not transmittable, and the abnormality determination unit determines, when the first control is being performed by the first control unit, an abnormality of a stopped motor to which the stop state is assigned based on a predetermined state quantity correlated with the drive state of the stopped motor, by changing the stopped motor to the drive state after switching the clutch to the second state for not transmitting the torque from the motor to the output shaft.
(36) According to the above-described configuration, the electric movable body includes a clutch that switches between a first state in which a torque is transmittable from the motor to the output shaft and a second state in which a torque is not transmittable from the motor to the output shaft. Therefore, by switching the clutch to the second state in which the torque is not transmittable from the stopped motor to which the stop state is assigned to the output shaft, it is possible to suppress transmission of a braking torque or the like from the motor in the stop state to the output shaft.
(37) Further, when the first control is being performed by the first control unit, the abnormality determination unit determines an abnormality of the stopped motor to which the stop state is assigned based on a predetermined state quantity correlated with the drive state of the stopped motor, by changing the stopped motor to the drive state after switching the clutch to the second state for not transmitting the torque from the motor to the output shaft. In such manner, by switching the clutch to the second state in which a torque is not transmittable from the stopped motor to the output shaft, it is possible to determine an abnormality of the stopped motor at an arbitrary timing without changing an output of the output shaft. Therefore, it is possible to quickly determine an abnormality of not only the drive motor but also the stopped motor.
(38) In a sixth example, the clutch is a one-way clutch that permits transmission of a torque from the motor to the output shaft and prohibits transmission of a torque from the output shaft to the motor, and the abnormality determination unit determines, when the first control is being

performed by the first control unit, an abnormality of the stopped motor based on the predetermined state quantity of the stopped motor, by changing the stopped motor to the drive state to rotate in an opposite direction, which is an opposite direction opposite to a rotation direction of the drive motor to which the drive state is assigned.

(39) According to the above-described configuration, the clutch is a one-way clutch that permits transmission of a torque from the motor to the output shaft and prohibits transmission of a torque from the output shaft to the motor. Therefore, when the motor is in the drive state, the one-way clutch switches to a state in which a torque is transmitted from the motor to the output shaft. In addition, when the motor is in the stop state or in the drive state to rotate in the opposite direction, the one-way clutch switches to a state in which a torque is not transmitted from the output shaft to the motor i.e., switches to a state in which a negative torque is not transmitted from the motor to the output shaft. Therefore, without controlling the clutch, the one-way clutch is capable of switching to a state in which a torque is not transmitted from the motor to which the stop state is assigned to the output shaft, thereby suppressing transmission of a braking torque or the like from the motor in the stop state to the output shaft.

(40) Further, when the first control is being performed by the first control unit, the abnormality determination unit determines an abnormality of the stopped motor based on the predetermined state quantity, by changing the stopped motor to the drive state to rotate in an opposite direction, which is an opposite direction opposite to the rotation direction of the drive motor to which the drive state is assigned. Therefore, by changing the stopped motor to the drive state to rotate in the opposite direction, which the rotation direction opposite to the that of the drive motor, the one-way clutch switches to a state in which the braking torque or the like is not transmitted from the stopped motor to the output shaft, thereby enabling abnormality determination of the stopped motor at any timing without changing the output of the output shaft.

(41) In a seventh example, an electric disconnection mechanism electrically disconnecting between the motor and the battery is provided, and, when the first control is being performed by the first control unit, the stopped motor to which the stop state is assigned and the battery corresponding to the stopped motor are electrically disconnected by the electric disconnection mechanism.

(42) According to the above-described configuration, the electric movable body includes an electric disconnection mechanism that electrically disconnects between the motors and the batteries. Therefore, by electrically disconnecting the motor to which the stop state is assigned (i.e., the stopped motor) from the battery by using the electric disconnection mechanism, it is possible to suppress transmission of a braking torque or the like from the stopped motor to the output shaft. Therefore, even when the electric movable body does not have a clutch that switches between a first state in which a torque is transmittable from the motor to the output shaft and a second state in which a torque is not transmittable, transmission of the braking torque or the like from the stopped motor to the output shaft is suppressible. Further, when the electric movable body has a clutch, the clutch and the electric disconnecting mechanism can doubly suppress transmission of the braking torque or the like from the stopped motor to the output shaft.

(43) Furthermore, when the first control is being performed by the first control unit, the stopped motor to which the stop state is assigned and the battery corresponding to the stopped motor are electrically disconnected by using the electric disconnection mechanism. Therefore, when the first control is being performed, it is possible to suppress transmission of the braking torque or the like from the stopped motor to the output shaft by the electrically disconnecting between the stopped motor and the battery by using the electric disconnection mechanism.

(44) In an eighth example, when the first control is being performed by the first control unit, a stopped motor to which the stop state is assigned among the plurality of motors that drive a same output shaft is driven with a constant torque that is smaller than an output torque of the drive motor, to which the drive state is assigned.

(45) According to the above-described configuration, when the first control is being performed, by

driving the stopped motor with a constant torque smaller than the output torque of the drive motor, it is possible to prevent the braking torque from being transmitted from the stopped motor to the output shaft. Therefore, even when the electric movable body does not have a clutch that switches between a first state in which a torque is transmittable from the motor to the output shaft and a second state in which a torque is not transmittable, transmission of the braking torque from the stopped motor to the output shaft is suppressible.
(46) When temperature of a magnet of the motor is lower than a predetermined temperature (e.g., −20° C.), the output of the motor may be lower than a reference output.
(47) In this regard, in a ninth example, when, from among the plurality of motors that drive the same output shaft, the stopped motor, to which the stop state is assigned, is not determined as abnormal, and temperature of a magnet of the stopped motor is lower than a predetermined temperature, the stopped motor is driven with a constant torque smaller than the output torque of the drive motor, which is the motor to which the drive state is assigned. In such manner, by increasing the temperature of the magnet of the stopped motor compared to a case where the stopped motor is kept in the stop state, it is possible to suppress a drop of the output of the stopped motor below the reference output when driving the stopped motor.
(48) In a tenth example, a plurality of cooling devices are provided, and the plurality of motors and the plurality of cooling devices are connected, correspondingly to the connection of the plurality of motors and the plurality of batteries, for supplying coolant from each of the cooling devices to a motor set each driving one of the separate output shafts, and the first control unit assigns, in the first control, the drive state or the stop state to each of the motors, for driving each of the output shafts by at least one motor and for the cooling of an at least one motor in the drive state by each of the cooling devices, and the second control unit assigns, when the switching control is performed by the switching unit in the second control, the drive state or the stop state to each of the motors, in the motor set including the abnormal motor and in the motor set including the switched motor, for driving each of the output shafts by at least one motor and for the cooling of an at least one motor in the drive state by each of the cooling devices.
(49) In an eleventh example, an electric movable body includes a plurality of output shafts, a plurality of motors each driving an output shaft, and a plurality of cooling devices. The plurality of motors and the plurality of cooling devices are connected so that each cooling device supplies coolant to a motor set each driving one of the plurality of separate output shafts. The electric movable body comprises: a first control unit that performs a first control assigning either a drive state or a stop state to the motors, for driving each of the output shafts by at least one motor and for the cooling of an at least one motor in the drive state by each of the cooling devices; an abnormality determination unit that determines an abnormality of the plurality of motors; a switching unit that performs a switching control in which the abnormal motor is switched to the stop state, when the abnormal motor determined by the abnormality determination unit is in the drive state, and one of a plurality of switched motors in the stop state and switchable to drive the output shaft being driven by the abnormal motor is switched to the drive state; and a second control unit that performs, when the switching control is performed by the switching unit, a second control assigning either the drive state or the stop state to the motors constituting the motor set including the abnormal motor, and to the motors constituting the motor set including the switched motor, for driving each of the output shafts by at least one motor and for the cooling of an at least one motor in the drive state by each of the cooling devices.
(50) According to the above-described configuration, the electric movable body includes a plurality of output shafts, a plurality of motors respectively driving the output shaft, and a plurality of cooling devices. Therefore, even when an abnormality occurs in one of the plurality of motors respectively driving the output shaft, the output shaft can still be driven by the other motor that drives the same output shaft having been driven by the motor in which the abnormality has occurred.

(51) The plurality of motors and the plurality of cooling devices are connected so that coolant is supplied from each of the cooling devices to each of plural motor sets each driving one of the separate output shafts. Therefore, even when an abnormality occurs in one cooling device that supplies coolant to one motor set, by driving the other motor set by a supply of coolant from the other cooling device, the plurality of output shafts are still drivable by those motors cooled by the supply of coolant therefrom. Then, the first control unit performs the first control assigning either the drive state or the stop state to the motors for a drive of each of the output shafts, for driving each of the output shafts by at least one motor and for the cooling of an at least one of the motors in the drive state by each of the cooling devices. Therefore, while each of the output shafts is driven by at least one motor, it is possible to prevent a cooling load to be unevenly distributed among the cooling devices.
(52) The abnormality determination unit determines an abnormality of the plurality of motors. The switching unit switches the abnormal motor to the stop state when the abnormal motor, which is a motor determined as abnormal by the abnormality determination unit, is in the drive state. Therefore, when the abnormal motor is in the drive state, the abnormal motor is switchable to the stop state, thereby making it possible to suppress the movement of the electric movable body from becoming unstable. Further, the switching unit performs the switching control to switch, to the drive state, the switched motor, which is one of the motors in the stop state among the motors that drive the output shaft driven by the abnormal motor. Therefore, even when the abnormal motor is switched from the drive state to the stop state, it is possible to suppress the decrease in the number of motors that drive the output shaft having been driven by the abnormal motor.
(53) Here, when the abnormal motor is switched to the stop state and the switched motor is switched to the drive state, the cooling device that supplies coolant to the motor set including the abnormal motor and the cooling device that supplies coolant to the motor set including the switched motor respectively have a change in the number of motors in the drive state. Therefore, in such a situation, the number of motors in the drive state and cooled by one cooling device may become far greater than the number of motors in the drive state and cooled by the other cooling device, thereby causing an unevenly-distributed cooling load among those cooling devices. In this regard, the second control unit performs, when the switching control is performed by the switching unit, the second control assigning either the drive state or the stop state to the motor set including the abnormal motor, and to the motor set including the switched motor, for driving each of the output shafts by at least one motor, and for the cooling of an at least one of the motors in the drive state by each of the cooling devices. Therefore, even when an abnormality occurs in the motor, it is possible to prevent a cooling load to be unevenly distributed among the cooling devices.
(54) In a twelfth example, the first control unit assigns, in the first control, the drive state or the stop state to each of the plurality of motors driving the output shaft, for driving each of the output shafts by the same number of motors, and for the cooling of the same number of motors in the drive state by each of the cooling devices, and the second control unit assigns, when the switching control is performed by the switching unit in the second control, the drive state or the stop state to the motor set including the abnormal motor and to the motor set including the switched motor, for driving each of the output shafts by the same number of motors, and for the cooling of the same number of motors in the drive state by each of the cooling device.
(55) According to the above-described configuration, the first control unit assigns, in the first control, a drive state or a stop state to each of the plurality of motors, for driving each of the output shafts by the same number of motors, and for the cooling of the same number of motors in the drive state by each of the cooling devices. Therefore, while driving each of the output shafts by the same number of motors, it is possible to prevent a cooling load to be unevenly distributed among the cooling devices.
(56) The second control unit assigns, when the switching control is performed by the switching unit in the second control, the drive state or the stop state to each of the motor set including the

abnormal motor and to each of the motor set including the switched motor, for driving each of the output shafts by the same number of motors, and for the cooling of the same number of motors by each of the cooling devices. Therefore, even when an abnormality occurs in the motor, it is possible to prevent a cooling load to be unevenly distributed among the cooling devices.
First Embodiment
(57) The first embodiment embodied in an electric aircraft having a plurality of motors and a plurality of batteries is described below with reference to the drawings.
(58) As shown in FIG. **1**, an electric aircraft **10** includes batteries **21** and **22**, propulsion units **51** and **52**, output shafts **31** and **32**, propellers **41** and **42**, and the like. The electric aircraft **10** has a plurality of sets of these configurations, but here, one set shown in FIG. **1** is described.
(59) The batteries **21** and **22** are chargeable and dischargeable secondary batteries, and have the same rated voltage and rated capacity.
(60) The propulsion units **51** and **52** receive power supply from both of the batteries **21** and **22** and output driving force for propulsion.
(61) The propulsion unit **51** includes inverter (INV) units **61** and **62** and motors **71** and **72**. The INV units **61** and **62** convert Direct Current (DC) power supplied from the batteries **21** and **22**, respectively, into Alternative Current (AC) power, and supply the AC power to the motors **71** and **72**, respectively. The battery **21** is connected to the INV unit **61** and the battery **22** is not connected thereto. The battery **22** is connected to the INV unit **62** and the battery **21** is not connected thereto. That is, separate batteries **21** and **22** are respectively connected to the INV units **61** and **62** of the propulsion unit **51**. The INV unit and the motor to which the INV unit supplies electric power are collectively referred to as a system. For example, the INV unit **61** and the motor **71** constitute a system.
(62) The motors **71** and **72** are, for example, three-phase Alternative Current motors (i.e., AC motors), and rotate their own rotating shafts with AC power supplied from the INV units **61** and **62**, respectively. The rotating shafts of the motors **71** and **72** are directly connected to, or coupled with, the output shaft **31**. Therefore, a rotation speed of the motor **71**, a rotation speed of the motor **72**, and a rotation speed of the output shaft **31** become equal. The output shaft **31** is directly connected to, or coupled with, the propeller **41**. Note that the rotating shafts of the motors **71** and **72** may be coupled with the output shaft **31** via a speed reducer (e.g., transmission).
(63) The propulsion unit **52** has a configuration similar to that of the propulsion unit **51**. That is, the propulsion unit **52** includes INV units **63**, **64** and motors **73**, **74** corresponding to the INV units **61**, **62** and motors **71**, **72** of the propulsion unit **51**. The INV units **63**, **64** convert DC power supplied from the batteries **21**, **22**, respectively, into AC power, and supply the AC power to the motors **71**, **72**, respectively. The battery **21** is connected to the INV unit **63** and the battery **22** is not connected thereto. The battery **22** is connected to the INV unit **64** and the battery **21** is not connected thereto. That is, separate batteries **21** and **22** are respectively connected to the INV units **63** and **64** of the propulsion unit **52**.
(64) The rotating shafts of the motors **73** and **74** are directly connected to, or coupled with, the output shaft **32**. Therefore, the rotation speed of the motor **73**, the rotation speed of the motor **74**, and the rotation speed of the output shaft **32** are equal. The output shaft **32** is directly connected to, or coupled with, the propeller **42**.
(65) The motors **71** and **73** form a first motor set that drives separate output shafts **31** and **32**, respectively. The motors **72** and **74** form a second motor set that drives separate output shafts **31** and **32**, respectively. That is, the motors **71** to **74** (a plurality of motors) and the batteries **21** and **22** (a plurality of batteries) are connected to supply electric power from each of the batteries **21** and **22** (each battery) to both of the first motor set and the second motor set including the motors respectively driving output shafts **31**, **32** (separate output shafts).
(66) FIG. **2** is a block diagram of the electric aircraft **10**.
(67) The INV unit **61** includes an INV control unit **61**_a_, an INV circuit **61**_b_, a speed monitoring unit

**61***c*, and the like. The INV circuit **61***b* is a well-known three-phase full bridge circuit (see FIG. **3**). The INV control unit **61***a* controls each of switching elements of the INV circuit **61***b* based on an instruction from an integration ECU **80**. The INV unit **62** includes an INV control unit **62***a*, an INV circuit **62***b*, and a speed monitoring unit **62***c*. The INV unit **63** includes an INV control unit **63***a*, an INV circuit **63***b*, and a speed monitoring unit **63***c*. The INV unit **64** includes an INV control unit **64***a*, an INV circuit **64***b*, and a speed monitoring unit **64***c*.

(68) The motor **71** includes a magnet **71***a* that generates a magnetic field, a rotation sensor **71***b* that detects a rotation speed of its own rotating shaft, and the like. When temperature of the magnet **71***a* drops below, for example, −20° C. (i.e., predetermined temperature), the magnetic field generated by the magnet **71***a* becomes weaker than a reference magnetic field. As a result, an output of the motor **71** becomes lower than a reference output. The rotation sensor **71***b* detects a rotation speed of the rotating shaft of the motor **71** (hereinafter referred to as a rotation speed of the motor **71**) and outputs a detected rotation speed to the speed monitoring unit **61***c*.

(69) The speed monitoring unit **61***c* monitors whether or not the rotation speed of the motor **71** input from the rotation sensor **71***b* is out of a predetermined threshold range. The predetermined threshold range is a range from an upper limit value to a lower limit value including a speed instruction for instructing the rotation speed of the motor **71**. The speed monitoring unit **61***c* detects that the rotation speed of the motor **71** is abnormal (i.e., speed abnormality) when a state in which the rotation speed of the motor **71** is out of the predetermined threshold range continues for more than a predetermined time Te, and transmits to the integration ECU **80** that the speed abnormality has been detected. It should be noted that the fact that the rotation speed of the motor **71** is abnormal (i.e., speed abnormality) includes a case where the motor **71** is abnormal and a case where the INV unit **61** is abnormal. Further, the speed monitoring unit **61***c* detects that the rotation speed of the motor **71** is normal (i.e., speed normality) when a state in which the rotation speed of the motor **71** is within the predetermined threshold range continues for more than the predetermined time Te, transmits to the integration ECU **80** that the speed normality has been detected.

(70) The INV unit **62** has a configuration similar to that of the INV unit **61**. The motor **72** has a configuration similar to that of the motor **71**. The propulsion unit **52** has a configuration similar to that of the propulsion unit **51**.

(71) The integration ECU **80** includes a first control unit **81**, a second control unit **82**, a third control unit **83**, an abnormality determination unit **84**, a switching unit **85**, a single drive control unit **86**, and the like.

(72) The first control unit **81** performs a first control, which assigns active or standby to each of the motors **71** to **74** driving either the output shaft **31** or the output shaft **32**, so that each of the output shafts **31**, **32** is driven by the same number of motors, and each of the batteries **21**, **22** supplies electric power to the same number of motors. As the first control, for example, a first pattern and a second pattern are switched periodically. The first pattern is a pattern in which the motors **71** and **74** are active (i.e., drive state) and the motors **72** and **73** are on standby (i.e., stop state). The second pattern is a pattern in which the motors **72** and **73** are active and the motors **71** and **74** are standby. This makes it possible to reduce a difference in the degree of wear of the INV units **61** to **64** and a difference in the degree of wear of the motors **71** to **74**. That is, in the first control, the first control unit **81** assigns active or standby to the motors **71** to **74**, so that each of the output shafts **31** and **32** is driven by at least one of the motors **71** to **74**, and each of the batteries **21** and **22** supplies electric power to at least one of the motors **71** to **74**.

(73) In the first pattern, the first control unit **81** transmits a drive permission instruction and a speed instruction to the INV control units **61***a* and **64***a* corresponding to the motors **71** and **74** to which active is assigned. The INV control units **61***a* and **64***a* control the switching elements of the INV circuits **61***b* and **64***b* so that the rotation speeds of the motors **71** and **74** match the speed instructions. The first control unit **81** transmits a stop instruction (i.e., a speed instruction of speed

zero, in other words) to the INV control units **62***a* and **63***a* corresponding to the motors **72** and **73** to which standby is assigned. The INV control units **61***a* and **64***a* control the switching elements of the INV circuits **62***b* and **63***b* to stop the motors **72** and **73** (i.e., rotation speed=0). The same applies to the second pattern.
(74) When performing the first control, the integration ECU **80** electrically disconnects between the standby motor (i.e., stopped motor), which is the motor to which standby is assigned, and the battery corresponding to the standby motor by using a first switch unit **91** (i.e., electric disconnection mechanism), as shown in FIG. **3**. The first switch unit **91** includes switches **91***a* and **91***b*, a fuse **91***c*, and the like. The switches **91***a* and **91***b* disconnect and connect the battery **21** and the INV circuit **61***b*. A standby motor and an INV unit that supplies electric power to the standby motor are collectively referred to as a standby system.
(75) Note that the integration ECU **80** may electrically disconnect between the standby motor and the battery corresponding to the standby motor by using the second switch unit **92** (i.e., electric disconnection mechanism) when performing the first control. The second switch unit **92** includes switches **92***a* to **92***c* and the like. The switches **92***a* to **92***c* disconnect and connect between the INV circuit **61***b* and the motor **71**. Further, the integration ECU **80** may short-circuit the three-phase wiring of the motor **71** by the third switch unit **93** when performing the first control. That is, the standby motor and the battery corresponding to the standby motor may be substantially electrically disconnected by using the third switch unit **93** (i.e., electric disconnection mechanism). The third switch unit **93** is composed of a lower arm switch of the INV circuit **61***b*.
(76) When the first control unit **81** is performing the first control, the abnormality determination unit **84** determines abnormality of the active motor based on the rotation speed (i.e., a predetermined state quantity correlated with the drive state) of the active motor (i.e., drive motor), which is a motor to which active is assigned. Specifically, the abnormality determination unit **84** determines abnormality of the active motor based on the speed abnormality detection result from the speed monitoring unit **61***c*. For example, when a speed abnormality of the motor **71** is received from the speed monitoring unit **61***c*, it is determined that the motor **71** is abnormal. Since the abnormality of the motor **71** is determined based on the speed abnormality detection result from the speed monitoring unit **61***c*, when it is determined that the active motor is abnormal, such a situation includes a case where the motor **71** is abnormal and a case where the INV unit **61** is abnormal. An active motor and an INV unit that supplies electric power to the active motor are collectively referred to as an “active system.”
(77) The switching unit **85** performs a switching control, in which an abnormal motor is switched to standby when the abnormal motor that is determined as abnormal by the abnormality determination unit **84** is active, and a switched motor, which is one of the standby motors that drives the same output shaft driven by the abnormal motor, is switched to active. The switching unit **85** transmits a drive permission instruction and a speed instruction to an INV control unit corresponding to the switched motor, and transmits a stop instruction to an INV control unit corresponding to the abnormal motor.
(78) When the switching control has been performed by the switching unit **85**, the second control unit **82** performs a second control, which assigns active or standby to each of the motors constituting a motor set including the abnormal motor, and a motor set including the switched motor, so that each output shaft is driven by the same number of motors, and each battery supplies electric power to the same number of motors. That is, in the second control, when the switching control has been performed by the switching unit **85**, the second control unit **82** assigns active or standby to each of the motors constituting a motor set including the abnormal motor, and a motor set including the switched motor, so that each output shaft is driven by at least one of the motors **71** to **74** and each of the batteries **21**, **22** supplies electric power to the at least one of the motors **71** to **74**. The third control unit **83** and the single drive control unit **86** are described later.
(79) FIG. **4** is a flowchart showing a processing procedure for abnormality determination during

the first control. This series of processes is performed by the integration ECU **80**.
(80) First, it is determined whether or not it is received from the speed monitoring unit of any of the INV units that a motor rotation speed abnormality (i.e., speed abnormality) has been detected (S**10**). In such determination, if it is determined that the detection of the speed abnormality has not been received from the speed monitoring unit of any of the INV units (S**10**: NO), the process of S**10** is performed again.
(81) On the other hand, if it is determined that a speed abnormality has been detected from the speed monitoring unit of any of the INV units (S**10**: YES), it is determined whether or not a standby system that drives the same output shaft driven by an abnormal system, which is a system in which the speed abnormality has been detected, is normal (S**11**). For example, it is determinable that the standby system is normal if the speed monitoring unit of the standby system has not detected a speed abnormality, during a time when the standby system was lastly switched to the active system, and it is determinable that the standby system is not normal if the speed monitoring unit of the standby system has detected a speed abnormality, during the above-described time. It should be noted that other methods may also be used to determine whether the standby system is normal.
(82) When it is determined in S**11** that the standby system that drives the output shaft driven by the abnormal system is normal (S**11**: YES), the active/standby pattern is switched (S**12**). For example, if the first pattern is being performed when it is determined that a speed abnormality has been detected from the speed monitoring unit of any INV unit, the first pattern is aborted and the second pattern is performed. That is, when the abnormal system is active, the abnormal system is switched to standby, and the standby system that drives the output shaft driven by the abnormal system is switched to active. Then, active or standby is assigned to the motors, or the systems, i.e., to the motor set constituting the abnormal system and to the motor set constituting the standby system, so that each output shaft is driven by the same number of systems (i.e., at least one system is driving each output shaft), and each battery supplies electric power to the same number of systems (i.e., each battery is supplying electric power to at least one of the systems). Subsequently, the series of processes is terminated (END).
(83) On the other hand, when it is determined in S**11** that the standby system that drives the output shaft driven by the abnormal system is not normal (S**11**: NO), the propulsion unit including the abnormal system is stopped (S**13**). Note that, even when the propulsion unit including the abnormal system is stopped, the electric aircraft **10** can maintain the attitude of the airframe by using other propulsion units. Subsequently, the series of processes is terminated (END).
(84) Note that the process of S**10** corresponds to a process of the abnormality determination unit **84**, and the process of S**12** corresponds to a process of the switching unit **85** and the second control unit **82**.
(85) FIG. **5** is a time chart showing how an abnormality is determined during the first control. Here, an example is described in which it is detected that the rotation speed of the motor **71** is abnormal (i.e., speed abnormality) while the first pattern is being performed. Although FIG. **5** shows the speed instruction, the rotation speed, the speed deviation, and the speed abnormality only for the motor **71**, the speed instruction, the rotation speed, the speed deviation, and the speed abnormality are also acquired for each of the motors **72** to **74**.
(86) At time t**11**, an abnormality occurs in the system composed of the INV unit **61** and the motor **71**, and the rotation speed of the motor **71** starts to increase despite the speed instruction of the motor **71**. Along with the above, a speed deviation of the motor **71**, which is a value obtained by subtracting the speed instruction for the motor **71** from a rotation speed of the motor **71**, starts to increase.
(87) At time t**12**, the speed deviation of the motor **71** exceeds a threshold value N**1**, that is, the rotation speed of the motor **71** is out of a predetermined threshold range.
(88) At time t**13**, a duration of a state in which the rotation speed of the motor **71** is out of the

predetermined threshold range exceeds a predetermined time Te. Therefore, it is detected that the rotation speed of the motor **71** is abnormal (i.e., speed abnormality). Then, the first pattern in which the motors **71** and **74** are active and the motors **72** and **73** are on standby is switched to the second pattern in which the motors **72** and **73** are active and the motors **71** and **74** are standby.

(89) At time t**14**, the duration of the state in which the rotation speed of the motor **71** is within the predetermined threshold range exceeds the predetermined time Te. Therefore, it is detected that the rotation speed of the motor **71** is normal (i.e., speed normality).

(90) The present embodiment described above in detail has the following advantages.

(91) The electric aircraft **10** includes the output shafts **31** and **32**, the motors **71** and **72** and the motors **73** and **74** that drive the output shafts **31** and **32**, and the batteries **21** and **22**. Therefore, even when an abnormality occurs in any of the motors **71** to **74** that drive the output shafts **31** and **32**, the other motors that drive the output shafts driven by the motor in which the abnormality has occurred are capable of driving the output shafts.

(92) The motors **71** to **74** and the batteries **21** and **22** are connected to supply electric power from each of the batteries **21** and **22** to both of the first motor set and the second motor set driving the output shafts **31**, **32**. Therefore, even when an abnormality occurs in the battery that supplies electric power to one motor set, the output shafts **31** and **32** can still be driven by the other motor by supplying electric power to the other motor set from the other battery. Further, the first control unit **81** performs the first control, which assigns active (i.e., drive state) or standby (i.e., stop state) to each of the motors **71**, **72**, **73** and **74** driving either the output shaft **31** or the output shaft **32**, so that each of the output shafts **31**, **32** is driven by the same number of motors (i.e., each of the output shafts **31**, **32** is driven by at least one of the motors **71** to **74**), and each of the batteries **21**, **22** supplies electric power to the same number of motors (each of the batteries **21**, **22** supplies electric power to at least one of the motors **71** to **74**). Therefore, while each of the output shafts **31** and **32** is driven by the same number of motors (i.e., while driving the output shafts **31** and **32** by at least one motor), unevenness in the amount of electric power supplied from each of the batteries is suppressible.

(93) The abnormality determination unit **84** determines abnormality of the motors **71** to **74**. The switching unit **85** switches the abnormal motor to the stop state when the abnormal motor determined by the abnormality determination unit **84** as abnormal is in the drive state. Therefore, when the abnormal motor is in the drive state, the abnormal motor is switchable to the stop state, thereby making it possible to prevent the movement of the electric aircraft **10** from becoming unstable. Further, the switching unit **85** performs the switching control to switch the switched motor, which is one of the stopped motors among the motors that drive the output shaft driven by the abnormal motor, to the drive state. Therefore, even when the abnormal motor is switched from the drive state to the stop state, it is possible to suppress the decrease in the number of motors that drive the output shaft driven by the abnormal motor.

(94) When the abnormal motor is switched to the stop state and the switched motor is switched to the drive state, the number of motors constituting a motor set including the abnormal motor and the number of motors constituting a motor set including the switched motor change, in terms of receiving supply of electric power from one of two batteries. Therefore, the numbers of motors receiving supply of electric power from the batteries **21** and **22** become different (i.e., the difference in the number of motors receiving supply of electric power from the batteries **21** and **22** becomes large), and the amount of electric power supplied from each of the batteries may become uneven. In this respect, when the switching unit **85** performs the second control, which assigns either the drive state or the stop state to the motors constituting the motor set including the abnormal motor and to the motors constituting the motor set including the switched motor, so that each of the output shafts **31** and **32** is driven by the same number of motors (i.e., the output shafts **31** and **32** are driven by at least one of the motors **71** to **74**), and each of the batteries **21**, **22** supplies electric power to the same number of motors (i.e., each of the batteries **21**, **22** supplies

electric power to at least one of the motors **71** to **74**). Therefore, even when an abnormality occurs in the motor, it is possible to suppress unevenness in the amount of electric power supplied from each battery.
(95) When the first control is being performed by the first control unit **81**, the abnormality determination unit **84** determines the abnormality of the drive motor based on the predetermined state amount (i.e., rotation speed). According to such a configuration, when the first control is being performed, which assigns the drive state or the stop state to the motors **71**, **72** and the motors **73**, **74** that drive the output shafts **31**, **32**, abnormality of the drive motor is determinable, thereby increasing the frequency of such determination.
(96) The electric aircraft **10** includes an electric disconnection mechanism (i.e., the first switch unit **91**, the second switch unit **92**, and the third switch unit **93**) that electrically disconnects between the motors **71** to **74** and the batteries **21**, **22**. Therefore, by electrically disconnecting the motor to which the stop state is assigned (i.e., stopped motor) from the battery by the electric disconnection mechanism, transmission of braking torque and the like from the stopped motor (i.e., standby motor) to the output shaft is suppressible. Therefore, even when the electric aircraft **10** does not have a clutch that switches between a state in which a torque is transmitted from the motors **71** to **74** to the output shafts **31** and **32** and a state in which a torque is not transmitted, transmission of the braking torque and the like from the stopped motor to the output shafts is suppressible.
(97) When the first control is being performed by the first control unit **81**, the electric disconnection mechanism electrically disconnects between the stopped motor, to which the stop state is assigned, and the battery corresponding to the stopped motor. Therefore, when the first control is being performed, the electric disconnection mechanism electrically disconnects between the stopped motor and the battery, thereby suppressing transmission of the braking torque or the like from the stopped motor to the output shaft.
(98) It should be noted that the first embodiment can also be implemented with the following changes. Parts that are the same as the first embodiment are denoted by the same reference numerals, and descriptions thereof are omitted.
(99) The processing of S**11** and S**13** in FIG. **4** can be omitted. Even in such case, it is rare that an abnormality occurs in the active system and the standby system at the same time. Therefore, it is possible to switch the standby system to active to drive the output shaft, and to prevent the movement of the electric aircraft **10** from becoming unstable. Further, even when an abnormality occurs in any of the motors **71** to **74** that drive the output shafts **31** and **32**, the number of motors that drive the output shafts driven by the abnormal motor is prevented from decreasing. In addition, unevenness in the supply amounts of electric power among the batteries is suppressible.
(100) The third control unit **83** (i.e., a double drive control unit) performs a third control (i.e., a double drive control) that assigns the drive state (active) to the plurality of motors **71** and **72** and to the plurality of motors **73** and **74** that drive the output shafts **31** and **32**.
(101) Here, when the third control is being performed, even in case that it is determined that one of the drive motors is abnormal based on the rotation speed (i.e., the predetermined state quantity), if the rotation speeds of the plurality of drive motors are the same, an abnormal drive motor is not identifiable. In the above embodiment, since the motors **71**, **72** (**73**, **74**) are directly connected to the output shaft **31** (**32**), the rotation speeds of the motors **71**, **72** (**73**, **74**) are the same.
(102) Therefore, the integration ECU **80** performs an abnormality determination shown in FIG. **6** during the third control.
(103) The processing of S**20** is the same as the processing of S**10** in FIG. **4**.
(104) When it is determined that detection of a speed abnormality has been received from the speed monitoring unit of any of the INV units (S**20**: YES), the control is switched from the third control to the first control (S**21**).
(105) Subsequently, it is determined whether or not the abnormal system has been identified (S**22**). Specifically, when a speed abnormality is detected in one of the propulsion units after switching to

the first control, a system to which active is assigned in an abnormal propulsion unit, which is the propulsion unit in which the speed abnormality has been detected in the first control, is identified as an abnormal system, thereby determining that an abnormal system has been identified. When no speed abnormality is detected in the abnormal propulsion unit after switching to the first control, it is determined that the abnormal system could not be identified. In such determination, when it is determined that the abnormal system could not be identified (S**22**: NO), the active/standby pattern is switched (S**23**). The processing of S**23** is the same as the processing of S**12** in FIG. **4**.
(106) Subsequently, it is determined whether or not the abnormal system has been identified (S**24**). Specifically, when a speed anomaly is detected in an abnormal propulsion unit after switching the active/standby pattern, a system being active in the abnormal propulsion unit is identified as the abnormal system, thereby determining that the abnormal system has been identified. When no speed abnormality is detected in the abnormal propulsion unit after switching the active/standby pattern, it is determined that the abnormal system could not be identified. In such determination, when it is determined that the abnormal system has been identified (S**24**: YES), the process proceeds to S**25**. Further, when it is determined in the determination of S**22** that the abnormal system has been identified (S**22**: YES), the process also proceeds to S**25**.
(107) In S**25**, it is determined whether or not there is a normal system. Specifically, when it is determined that the abnormal system could not be identified in the determination of S**22** (S**22**: NO), it is determined that the abnormal propulsion unit has a normal system. Further, when it is determined in S**22** that an abnormal system has been identified (S**22**: YES), it is determined whether or not there is a normal system as follows. That is, when the standby system was lastly switched to the active system during switching to the first control, if the speed monitoring unit of the standby system has not detected a speed abnormality, it is determined that the standby system is normal (i.e., there is a normal system), and if the speed monitoring unit of the standby system has detected a speed abnormality, it is determined that the standby system is not normal (there is no normal system). Note that, if it is determined in S**22** that the abnormal system has been identified (S**22**: YES), it can be determined that the abnormal propulsion unit does not have a normal system.
(108) When it is determined in S**25** that the abnormal propulsion unit has a normal system (S**25**: YES), the abnormal system is stopped in the abnormal propulsion unit and the normal system is driven (S**26**). That is, when the abnormal system is active, the abnormal system is switched to standby, and the standby system that drives the output shaft driven by the abnormal system is switched to active (i.e., switching control). Then, to the motors (system) forming the motor set including the motor of the abnormal system and to the motors (system) forming the motor set including the motor of the normal system, active or standby is assigned, so that each output shaft is driven by the same number of systems, and each battery supplies electric power to the same number of systems (i.e., second control). That is, in the second control, active or standby is assigned to the motors (system) constituting the motor set including the motor of the abnormal system and to the motors (system) constituting the motor set including the motor of the normal system, so that each output shaft is driven by at least one system and each battery supplies electric power to at least one system. Subsequently, the series of processes is terminated (END).
(109) Further, when it is determined that the abnormal system could not be identified in the determination of S**24** (S**24**: NO), when it is determined that the abnormal propulsion unit does not have a normal system in the determination of S**25** (S**25**: NO), the abnormal propulsion unit is stopped (S**27**). Subsequently, the series of processes is terminated (END).
(110) Note that the processing of S**20**, S**22**, and S**24** corresponds to the processing of the abnormality determination unit **84**, the processing of S**23** and S**26** corresponds to the processing of the switching unit **85**, and the processing of S**26** corresponds to the processing of the second control unit **82**.
(111) FIG. **7** is a time chart showing how an abnormality is determined during the third control. Here, a case in which the propulsion unit **51** detects that the rotation speed of the motor **71** is

abnormal (i.e., speed abnormality) is described as an example. Although FIG. **7** shows the speed instruction, the rotation speed, the speed deviation, and the speed abnormality only for the motor **71**, the speed instruction, the rotation speed, the speed deviation, and the speed abnormality are also acquired for each of the motors **72** to **74**.
(112) At time t**21**, an abnormality occurs in the system composed of the INV unit **61** and the motor **71**, and the rotation speed of the motor **71** starts to increase despite the speed instruction of the motor **71**. Along with the above, the speed deviation of the motor **71** starts to increase.
(113) At time t**22**, the speed deviation of the motor **71** exceeds the threshold value N**1**, that is, the rotation speed of the motor **71** is out of the predetermined threshold range.
(114) At time t**23**, a duration of a state in which the rotation speed of the motor **71** is out of the predetermined threshold range exceeds the predetermined time Te. Therefore, it is detected that the rotation speed of the motor **71** is abnormal (i.e., speed abnormality). Then, in the propulsion unit **51**, the third control is switched to the first control. Here, in the first control, the first pattern in which the motors **71** and **74** are active and the motors **72** and **73** are on standby is performed.
(115) At time t**24**, a duration of a state in which the rotation speed of the motor **71** is out of the predetermined threshold range exceeds the predetermined time Te. Therefore, it is detected that the rotation speed of the motor **71** is abnormal (i.e., speed abnormality), and the system including the motor **71** is identified as the abnormal system. Here, it is assumed that a normal system has been identified. Then, in the abnormal propulsion unit, the abnormal system including the motor **71** is put on standby, and the normal system including the motor **72** is made active. Further, the motor **73** is set to active and the motor **74** is put on standby, so that each output shaft is driven by the same number of systems (i.e., at least one of the systems drives each output shaft), and each battery supplies electric power to the same number of systems (i.e., each battery supplies electric power to at least one of the systems).
(116) At time t**25**, a duration of a state in which the rotation speed of the motor **71** is within the predetermined threshold range exceeds the predetermined time Te. Therefore, it is detected that the rotation speed of the motor **71** is normal (i.e., speed normality). Note that, even when the speed of the motor **71** is detected as normal, there is a possibility that the system including the motor **71** is actually abnormal.
(117) According to the above-described configuration, the electric aircraft **10** causes the first control unit **81** to perform the first control, when the third control (i.e., the double drive control) is performed by the third control unit **83** (i.e., the double drive control unit), and the drive motor (i.e., active motor) is determined as abnormal based on the predetermined state quantity (i.e., rotation speed). Then, when the first control is being performed by the first control unit **81**, the abnormality determination unit **84** identifies the abnormal drive motor based on the predetermined state quantity. That is, in other words, by assigning the drive state (active) or the stop state (standby) to the motors **71** and **72** that drive the output shaft **31** by performing the first control, whether or not the drive motor is abnormal is determinable based on the predetermined state quantity.
Second Embodiment
(118) The second embodiment is described below with reference to the drawings mainly in terms of differences from the first embodiment. In the present embodiment, each propulsion unit has three systems and is powered by three batteries.
(119) As shown in FIG. **8**, an electric aircraft **110** includes batteries **121** to **123**, propulsion units **151** to **153**, output shafts **131** to **133**, propellers **141** to **143**, and the like. The electric aircraft **110** has a plurality of sets of these components (for example, the propellers **144** to **146** are shown), but the one set shown in the drawing is described here.
(120) The batteries **121** to **123** are chargeable/dischargeable secondary batteries, and have the same rated voltage and same rated capacity.
(121) The propulsion units **151** to **153** each receive power supply from all of the batteries **121** to **123** and output driving force for propulsion.

(122) The propulsion unit **151** includes inverter (INV) units **161** to **163** and motors **171** to **173**. The INV units **161** to **163** convert the DC power supplied from the batteries **121** to **123**, respectively, into AC power, and supply the AC power to the motors **171** to **173**, respectively. The battery **121** is connected to the INV unit **161**, and the batteries **122** and **123** are not connected thereto (i.e., not connected to the INV unit **161**). The battery **122** is connected to the INV unit **162**, and the batteries **121** and **123** are not connected thereto. The battery **123** is connected to the INV unit **163**, and the batteries **121** and **122** are not connected thereto. That is, in other words, separate batteries **121** to **123** are connected to the INV units **161** to **163** of the propulsion unit **151**, respectively.
(123) The motors **171** to **173** are, for example, three-phase Alternate Current motors (i.e., AC motors), and rotate their own rotating shafts with AC power supplied from the INV units **161** to **163**, respectively. The rotating shafts of the motors **171** to **173** are directly connected to, or coupled with, the output shaft **131**. Therefore, the rotation speed of the motor **171**, the rotation speed of the motor **172**, the rotation speed of the motor **173**, and the rotation speed of the output shaft **131** are equal. The output shaft **131** is directly connected to, or coupled with, the propeller **141**. Note that the rotating shafts of the motors **171** to **173** may be coupled with the output shaft **131** via a reduction gear (e.g., transmission).
(124) The propulsion unit **152** has a configuration similar to that of the propulsion unit **151**. That is, the propulsion unit **152** includes INV units **164** to **166** and motors **174** to **175** corresponding to the INV units **161** to **163** and motors **171** to **173** of the propulsion unit **151**. The battery **121** is connected to the INV unit **164**, and the batteries **122** and **123** are not connected thereto. The battery **122** is connected to the INV unit **165**, and the batteries **121** and **123** are not connected thereto. The battery **123** is connected to the INV unit **166**, and the batteries **121** and **122** are not connected thereto.
(125) The rotating shafts of the motors **174** to **175** are directly connected to, or coupled with, the output shaft **132**. Therefore, the rotation speed of the motor **174**, the rotation speed of the motor **175**, the rotation speed of the motor **176**, and the rotation speed of the output shaft **132** are equal. The output shaft **132** is directly connected to, or coupled with, the propeller **142**. The propulsion unit **153** is also similar to the above.
(126) The motors **171**, **174** and **177** constitute a first motor set that drive separate output shafts **131**, **132** and **133**, respectively. The motors **172**, **175** and **178** constitute a second motor set that drive separate output shafts **131**, **132** and **133**, respectively. The motors **173**, **176** and **179** constitute a third motor set that drive separate output shafts **131**, **132** and **133**, respectively. That is, the motors **171** to **179** (a plurality of motors) and the batteries **121** to **123** (a plurality of batteries) are connected so that each of the first motor set (may also be mentioned hereafter as a first motor set), the second motor set, and the third motor set (may also be mentioned as a second and third motor set) composed of motors that respectively drive the output shafts **131** to **133** (separate output shafts) are powered from the batteries **121** to **123** (from each of the batteries).
(127) The first control unit **81** performs the first control, which assigns the drive state or the stop state to each of the motors **171** to **179** that drive the output shafts **131** to **133**, so that each of the output shafts **131** to **133** is driven by the same number of motors and each of the batteries **121** to **123** powers the same number of motors. As the first control, for example, the first pattern, the second pattern, and a third pattern are switched periodically or intermittently. The first pattern is a pattern in which the motors **171**, **172**, **174**, **176**, **178** and **179** are active (drive state) and the motors **173**, **175** and **177** are on standby (stop state). The second pattern is a pattern in which the motors **171**, **173**, **175**, **176**, **177** and **178** are active and motors **172**, **174** and **179** are on standby. The third pattern is a pattern in which the motors **172**, **173**, **174**, **175**, **177** and **179** are active and the motors **171**, **176** and **178** are on standby. In such manner, a difference in a degree of wear of the INV units **161** to **169** and a difference in a degree of wear of the motors **171** to **179** are reducible. That is, in the first control, the first control unit **81** assigns the drive state or the stop state to each of the motors **171** to **179**, so that each of the output shafts **131** to **133** is driven by at least one of the

motors **171** to **179**, and each of the batteries **121** to **123** powers at least one of the motors **171** to **179**. Note that other pattern(s) different from the above can also be performed based on a discharge current of each of the batteries **121** to **123**, a predicted value of the voltage, and the like.
(128) In each pattern, the processing performed by each INV controller (not shown) of each of the INV units **161** to **169** is the same as in the first embodiment. Further, when performing the first control, the integration ECU **80** disconnects, by using the electric disconnection mechanism, between the standby motor (i.e., stopped motor), which is a motor to which the standby is assigned, and the battery corresponding to the standby motor as in the first embodiment.
(129) As in the first embodiment, when the first control is being performed by the first control unit **81**, the abnormality determination unit **84** determines abnormality of the active motor (i.e., drive motor) to which active is assigned based on the rotation speed (i.e., the predetermined state quantity correlated with the drive state). In the first control of the present embodiment, since each propulsion unit has two active motors, when an abnormality occurs in one of the two active motors of each propulsion unit, it is determined that both of the two active motors are abnormal (i.e., an abnormal motor is not identified at this point).
(130) Therefore, the single drive control unit **86** (see FIG. **2**) performs a single drive control which assigns, when the first control (i.e., the double drive control) is performed by the first control unit **81** (i.e., the double drive control unit), and it is determined that one of the plurality of motors is abnormal, the drive state to one of the plurality of motors and the stop state to the other motors. When performing single drive control, the integration ECU **80** disconnects, by using electric disconnection mechanism, between the standby motor (stopped motor), which is a motor to which standby is assigned, and the battery corresponding to the standby motor as in the first embodiment.
(131) The switching unit **85** performs the switching control, in which an abnormal motor is switched to standby when the abnormal motor that is determined as abnormal by the abnormality determination unit **84** is active, and a switched motor, which is one of the standby motors that drives the same output shaft driven by the abnormal motor, is switched to active. The switching unit **85** transmits the drive permission instruction and the speed instruction to an INV control unit corresponding to the switched motor, and transmits the stop instruction to an INV control unit corresponding to the abnormal motor.
(132) When the switching control has been performed by the switching unit **85**, the second control unit **82** performs the second control, which assigns active or standby to each of the motors constituting a motor set including the abnormal motor, and a motor set including the switched motor, so that each output shaft is driven by the same number of motors and each battery supplies electric power to the same number of motors. That is, in the second control, when switching control is performed by the switching unit **85**, the second control unit **82** assigns active or standby to the motor set including the abnormal motor and to the motor set including the switched motor, so that each output shaft is driven by at least one of the motors **171** to **179** and each battery power is supplied to at least one of the motors **171** to **179**.
(133) Then, after the single drive control is performed by the single drive control unit **86**, the integration ECU **80** performs an abnormality determination with the processing procedure according to the flowchart of FIG. **4**.
(134) Here, when it is determined that the standby system that drives the output shaft driven by the abnormal system is normal (S**11**: YES), the active/standby pattern is switched (S**12**). Specifically, a pattern is switched to the one in which the abnormal system is put on standby. For example, when the motor **171** is identified as an abnormal motor, the pattern is switched to the third pattern in which the motor **171** is on standby. That is, when the abnormal system is active, the abnormal system is switched to standby, and the standby system that drives the output shaft driven by the abnormal system is switched to active. Then, active or standby is assigned to the motors, or systems, i.e., to the motor set constituting the abnormal system and to the motor set constituting the standby system, so that each output shaft is driven by the same number of systems (i.e., at least one

system is driving each output shaft), and each battery supplies electric power to the same number of systems (i.e., each battery is supplying electric power to at least one of the systems). Subsequently, the series of processes is terminated (END).
(135) The present embodiment described above in detail has the following advantages. Here, only advantages different from those of the first embodiment are described.
(136) The electric aircraft **110** includes the output shafts **131** to **133**, the motors **171** to **173**, the motors **174** to **176**, and the motors **177** to **179** that respectively drive the output shafts **131** to **133**, and the batteries **121** to **123**. Therefore, even when an abnormality occurs in any of the motors **171** to **179** that drive the output shafts **131** to **133**, the other motors that drive the output shaft driven by the abnormal motor in which the abnormality has occurred can still drive the relevant output shaft.
(137) The motors **171** to **179** and the batteries **121** to **123** are connected so that electric power is supplied from each of the batteries **121** to **123** to the first motor set, the second motor set, and the third motor set, which are respectively composed of the motors that drive separate output shafts. Therefore, even when an abnormality occurs in a battery that supplies electric power to one motor set, the output shafts **131** to **133** can still be driven by the motors by supplying electric power to the other motor sets from the other batteries. Further, the first control unit **81** performs the first control, which assigns the drive state (active) or the stop state (standby) to the motors **171** to **173**, the motors **174** to **176**, and the motors **177** to **179** for driving the output shafts **131** to **133**, so that each of the output shafts is driven by the same number of motors (each of the output shafts **131** to **133** is driven by at least one of the motors **171** to **179**), and each of the batteries powers the same number of motors (each of the batteries **121** to **123** powers at least one of the motors **171** to **179**). Therefore, while driving the respective output shafts **131** to **133** by the same number of motors (i.e., while driving each of the output shafts **131** to **133** by at least one motor), unevenness in the supply amount of electric power from each of the batteries is suppressible.
(138) The abnormality determination unit **84** determines abnormality of the motors **171** to **179**. The switching unit **85** switches the abnormal motor to the stop state when the abnormal motor determined by the abnormality determination unit **84** as abnormal is in the drive state. Therefore, when the abnormal motor is in the drive state, the abnormal motor can be switched to the stop state, and it is possible to prevent the movement of the electric aircraft **110** from becoming unstable. Further, the switching unit **85** performs the switching control to switch the switched motor, which is one of the stopped motors among the motors that drive the output shaft driven by the abnormal motor, to the drive state. Therefore, even when the abnormal motor is switched from the drive state to the stop state, it is possible to suppress the decrease in the number of motors that drive the output shaft driven by the abnormal motor.
(139) When the switching control has been performed by the switching unit **85**, the second control unit **82** performs the second control, which assigns the drive state or the stop state to the motor set including the abnormal motor and to the motor set including the switched motor, so that each of the output shafts **131** to **133** is driven by the same number of motors (i.e., each of the output shafts **131** to **133** is driven by at least one of the motors **171** to **179**), and each of the batteries **121** to **123** powers the same number of motors (i.e., each of the batteries **121** to **123** powers at least one of the motors **171** to **179**). Therefore, even when an abnormality occurs in the motor, it is possible to suppress unevenness in the supply amount of electric power from each of the batteries.
(140) It should be noted that the second embodiment may be modified as follows. Parts that are the same as in the second embodiment are denoted by the same reference numerals, and descriptions thereof are omitted.
(141) When the first control (i.e., the double drive control) is performed by the first control unit **81** (i.e., the double drive control unit) and it is determined that one of the plurality of motors is abnormal, the integration ECU **80** can identify the abnormal system by sequentially changing a combination of the motors among which the drive state is assigned to two motors and the stop state is assigned to one motor. For example, when two motors among the motors **171** to **173** are active

and one motor is standby, it is assumed that the normal and abnormal motors are determined as follows. That is, it is determined that the motors **171** and **172** are abnormal, the motors **172** and **173** are normal, and the motors **171** and **173** are abnormal. In such case, it can be identified that the motor **171** (i.e., a system including the motor **171**) is abnormal.
(142) In the single drive control, when a motor to which the drive state is assigned is normal and motors to which the stop state is assigned include an abnormal motor, the abnormality determination unit **84** cannot clearly identify an abnormal motor.
(143) Therefore, when the abnormality determination unit **84** cannot identify the abnormal drive motor, the single drive control unit **86** performs the single drive control again, in which the drive state is assigned to only one motor that is different from the motor to which the drive state had been assigned in the single drive control at the previous time or before, with other motors put in the stop state. According to such a configuration, even when the motor to which the drive state is assigned in the single drive control at the previous time or before is normal, only one other than the motor to which the drive state is assigned in the single drive control at the previous time or before is put in the drive state, for performing the single drive control and for repeating the identification of the abnormal motor by the abnormality determination unit **84**. Therefore, it is possible to make it easier to identify an abnormal motor.
(144) Further, when the abnormality determination unit **84** has identified an abnormal drive motor and the plurality of motors has included a normal motor, the electric aircraft **110** may switch, to the stop state, the drive motor having been identified as abnormal, and switch at least one of the normal motors to the drive state. According to such a configuration, after switching the drive motor identified as abnormal to the stop state, it is possible to continue driving the output shaft by the normal motor.
Third Embodiment
(145) The third embodiment is described in the following with reference to the drawings, focusing on differences from the first embodiment. Parts that are the same as the first embodiment are denoted by the same reference numerals, and descriptions thereof are omitted. In the present embodiment, two cooling devices are provided corresponding to the two motor sets.
(146) As shown in FIG. **9**, in an electric aircraft **210**, the propulsion units **51**, **52** are supplied with coolant from both of cooling devices **11**, **12**. The cooling devices **11** and **12** cool the INV units **61** to **64**, the motors **71** to **74**, and the like by circulating coolant such as water in the propulsion units **51** and **52** to exchange heat. In the drawing, a coolant supply route is indicated by a dashed line.
(147) The INV units **61** and **62** are supplied with coolant from the cooling devices **11** and **12**, respectively. The INV unit **61** is supplied with coolant from the cooling device **11** and is not supplied with coolant from the cooling device **12**. The INV unit **62** is supplied with coolant from the cooling device **12** and is not supplied with coolant from the cooling device **11**. That is, each of the INV units **61**, **62** of the propulsion unit **51** is supplied with coolant from separate cooling devices **11**, **12**, respectively.
(148) The INV units **63** and **64** are supplied with coolant from the cooling devices **11** and **12**, respectively. The INV unit **63** is supplied with coolant from the cooling device **11** and is not supplied with coolant from the cooling device **12**. The INV unit **64** is supplied with coolant from the cooling device **12** and is not supplied with coolant from the cooling device **11**. That is, each of the INV unit **63**, **64** of the propulsion unit **52** is supplied with coolant from separate cooling devices **11**, **12**, respectively.
(149) The motors **71** to **74** (i.e., a plurality of motors) and the cooling devices **11** and **12** (i.e., a plurality of cooling devices) are connected, so that the cooling devices **11**, **12** supply coolant to each of a first motor set and a second motor set (each motor set) driving separate output shafts **31**, **32** (separate output shafts), in a manner corresponding to the connections between the motors **71** to **74** and the batteries **21** and **22**.
(150) In the first control, the first control unit **81** assigns active or standby to the motors **71**, **72**, **73**,

**74** (a plurality of motors) driving the output shafts **31**, **32** so that each of the output shafts **31** and **32** is driven by the same number of motors, and each of the cooling devices **11** and **12** cools the same number of motors in the drive state. As the first control, similarly to the first embodiment, the first pattern and the second pattern are periodically switched. The first pattern is a pattern in which the motors **71** and **74** are active (i.e., drive state) and the motors **72** and **73** are on standby (i.e., stop state). The second pattern is a pattern in which the motors **72** and **73** are active and the motors **71** and **74** are standby. That is, in the first control, the first control unit **81** assigns active or standby to the motors **71**, **72** and the motors **73**, **74** driving the output shafts **31** and **32**, so that at least one of the motors **71** to **74** drives the output shafts **31**, **32**, and each of the cooling devices **11** and **12** cools at least one of the motors in the drive state.
(151) In the second control, when the switching control is performed by the switching unit **85**, the second control unit **82** assigns active or standby to a motor set including the abnormal motor and to a motor set including the switched motor, so that each of the output shafts is driven by the same number of motors, and each of the cooling devices **11** and **12** cools the same number of the motors in the drive state. That is, in the second control, when switching control is performed by the switching unit **85**, the second control unit **82** assigns active or standby to a motor set including the abnormal motor and to a motor set including the switched motor, so that each of the output shafts is driven by at least one of the motors **71** to **74**, and each of the cooling devices **11**, **12** cools at least one of the motors in the drive state.
(152) Also in the present embodiment, the integration ECU **80** performs the abnormality determination during the first control shown in FIG. **4** and the abnormality determination during the third control shown in FIG. **6**.
(153) The present embodiment described above in detail has the following advantages. Here, only advantages different from those of the first embodiment are described.
(154) The motors **71** to **74** and the cooling devices **11** and **12** are connected so that the cooling devices **11** and **12** supply coolant to each of the first motor set and the second motor set, respectively driving the separate output shafts. Therefore, even when an abnormality occurs in the cooling device that supplies coolant to one motor set, the coolant is supplied from the other cooling device to the other motor set to drive the motors to which the coolant is supplied, thereby the output shafts **31** and **32** can still be driven by the motors while cooling the plural motor sets. Then, the first control unit **81** performs the first control, which assigns the drive state or the stop state (standby) to each of the motors **71** to **74** driving the output shafts, so that each of the output shafts **31** and **32** is driven by the same number of motors (i.e., each of the output shafts **31** and **32** is driven by at least one of the motors **71** to **74**), and each of the cooling devices **11**, **12** cools the same number of motors in the drive state (active) (i.e., each of the cooling devices **11**, **12** cools at least one of the motors in the drive state). Therefore, while causing the same number of motors to drive the output shafts **31** and **32** (while driving each of the output shafts **31** and **32** by at least one motor), it is possible to prevent the cooling load to be unevenly distributed among the cooling devices.
(155) When the abnormal motor is switched to the stop state and the switched motor is switched to the drive state, the number of motors in the drive state which are cooled by the cooling device supplying coolant thereto changes in the motor set including the abnormal motor and in the motor set including the switched motor. Therefore, there is a possibility that the numbers of motors in the drive state that are cooled by the respective cooling devices **11** and **12** become different from each other, and the cooling load for the respective cooling devices may become uneven. In this respect, when the switching unit **85** performs the switching control, the second control unit **82** performs the second control, which assigns the drive state or the stop state to a motor set including the abnormal motor and to a motor set including the switched motor, so that each of the output shafts **31**, **32** is driven by the same number of motors (i.e., each of the output shafts **31**, **32** is driven by at least one of the motors **71** to **74**), and each of the cooling devices **11**, **12** cools the same number of motors in

the drive state (i.e., each of the cooling devices **11**, **12** cools at least one motor in the drive state). Therefore, even when an abnormality occurs in the motor, it is possible to suppress unevenness in the cooling load of each cooling device.
(156) It should be noted that the third embodiment can also be implemented with the following modifications. Parts that are the same as in the third embodiment are denoted by the same reference numerals, and descriptions thereof are omitted.
(157) As shown in FIG. **10**, in an electric aircraft **310**, it is possible to change the connection between the plurality of batteries and the plurality of systems, and then to change the connection between the plurality of cooling devices and the plurality of systems according to such change. In FIG. **10**, a battery **321** is connected to the INV unit **61** and a battery **322** is not connected thereto. The battery **322** is connected to the INV unit **62** and the battery **321** is not connected thereto. That is, separate batteries **321** and **322** are connected to the INV units **61** and **62** of the propulsion unit **51**, respectively. Correspondingly, the cooling device **311** is connected to the INV unit **61** and the cooling device **312** is not connected thereto. The cooling device **312** is connected to the INV unit **62** and the cooling device **311** is not connected thereto. That is, separate cooling devices **311** and **312** are connected to the INV units **61** and **62** of the propulsion unit **51**, respectively.
(158) The battery **322** is connected to the INV unit **63** and the battery **321** is not connected thereto. The battery **321** is connected to the INV unit **64** and the battery **322** is not connected thereto. That is, separate batteries **322**, **321** are connected to the INV units **63**, **64** of the propulsion unit **52**, respectively. Correspondingly, the cooling device **312** is connected to the INV unit **63** and the cooling device **311** is not connected thereto. The cooling device **311** is connected to the INV unit **64** and the cooling device **312** is not connected thereto. That is, separate cooling devices **312** and **311** are connected to the INV units **63** and **64** of the propulsion unit **52**, respectively. Even with the above-described configuration, the same effects as those of the third embodiment are achievable.
(159) As shown in FIG. **11**, it is also possible to change the connections between the plurality of cooling devices and the plurality of systems irrespective of (independently from) the connections between the plurality of batteries and the plurality of systems. In FIG. **11**, a battery **421** is connected to the INV units **61** to **64**. That is, the same battery **421** is connected to each of the INV units **61** to **64**.
(160) The cooling device **11** is connected to the INV unit **61** and the cooling device **12** is not connected thereto. The cooling device **12** is connected to the INV unit **62** and the cooling device **11** is not connected thereto. That is, separate cooling devices **311** and **312** are connected to the INV units **61** and **62** of the propulsion unit **51**, respectively.
(161) The cooling device **11** is connected to the INV unit **63** and the cooling device **12** is not connected thereto. The cooling device **12** is connected to the INV unit **64** and the cooling device **11** is not connected thereto. That is, separate cooling devices **311** and **312** are connected to the INV units **63** and **64** of the propulsion unit **52**, respectively.
(162) The first control unit **81** performs the first control, which assigns active or standby to each of the motors **71**, **72** and the motors **73**, **74** (a plurality of motors) that drive the output shafts **31**, **32**, so that each of the output shafts **31** and **32** is driven by the same number of motors and each of the cooling devices **11** and **12** cools the same number of motors in the drive state. As the first control, similarly to the first embodiment, the first pattern and the second pattern are periodically switched. The first pattern is a pattern in which the motors **71** and **74** are active (i.e., drive state) and the motors **72** and **73** are on standby (i.e., stop state). The second pattern is a pattern in which the motors **72** and **73** are active and the motors **71** and **74** are standby. That is, in the first control, the first control unit **81** assigns active or standby to the motors **71**, **72** and the motors **73**, **74** driving the output shafts **31** and **32**, so that at least one of the motors **71** to **74** drives the output shafts **31**, **32**, and each of the cooling devices **11** and **12** cools at least one of the motors in the drive state.
(163) When the switching control is performed by the switching unit **85**, the second control unit **82** performs the second control, which assigns active or standby to each of the motor set including the

abnormal motor and to each of the motor set including the switched motor, so that each of the output shafts is driven by the same number of the motors and each of the cooling devices **11** and **12** cools the same number of motors in the drive state. That is, in the second control, when switching control is performed by the switching unit **85**, the second control unit **82** assigns active or standby to a motor set including the abnormal motor and to a motor set including the switched motor, so that each of the output shafts is driven by at least one of the motors **71** to **74**, and each of the cooling devices **11**, **12** cools at least one of the motors in the drive state.
(164) Then, the integration ECU **80** performs the abnormality determination during the first control shown in FIG. **4** and the abnormality determination during the third control shown in FIG. **6**, "by cooling the same number of motors in the drive state respectively by the cooling devices **11** and **12**" instead of "powering the same number of motors respectively by the batteries **21** and **22**." Even with the above-described configuration, when an abnormality occurs in the motor, it is possible to suppress unevenness in the cooling load of each of the cooling devices.
Fourth Embodiment
(165) Hereinafter, the fourth embodiment is described with reference to the drawings, focusing on the differences from the first embodiment. In the present embodiment, a battery is provided for each propulsion unit.
(166) As shown in FIG. **12**, an electric aircraft **510** includes batteries **521** and **522**, a propulsion unit **551**, an output shaft **531**, a propeller **541**, and the like. The electric aircraft **510** has a plurality of sets of these configurations, but here, one set shown in the drawing is described.
(167) The batteries **521** and **522** are chargeable/dischargeable secondary batteries, and have the same rated voltage and rated capacity.
(168) The propulsion unit **551** receives power supply from both of the batteries **521** and **522** and outputs driving force for propulsion.
(169) The propulsion unit **551** has a configuration similar to that of the propulsion unit **51**. The battery **521** is connected to the INV unit **561** and the battery **522** is not connected thereto. The battery **522** is connected to the INV unit **562** and the battery **521** is not connected thereto. That is, separate batteries **521** and **522** are connected to the INV units **561** and **562** of the propulsion unit **551**, respectively.
(170) The third control unit **83** (i.e., double drive control unit) performs the third control (i.e., double drive control) that assigns the drive state (active) to a plurality of (at least two) motors **571** and **572** that drive the output shaft **531**.
(171) As described above, when the third control is being performed, even when it is determined that one of the drive motors is abnormal based on the rotation speed (i.e., predetermined state quantity), the abnormal drive motor cannot be identified if the rotation speeds of the plurality of drive motors are the same.
(172) Therefore, when the third control (double drive control) is performed by the third control unit **83** (double drive control unit) and it is determined that one of the plurality of motors is abnormal, the single drive control unit **86** performs the single drive control in which the drive state is assigned to only one of the plurality of motors and the stop state is assigned to the other motors.
(173) The switching unit **85** performs the switching control, in which an abnormal motor is switched to standby when the abnormal motor that is determined as abnormal by the abnormality determination unit **84** is active, and a switched motor, which is one of the standby motors that drives the same output shaft driven by the abnormal motor, is switched to active. The switching unit **85** transmits a drive permission instruction and a speed instruction to an INV control unit corresponding to the switched motor, and transmits a stop instruction to an INV control unit corresponding to the abnormal motor.
(174) The abnormality determination unit **84** identifies an abnormal motor having an abnormality based on a predetermined state quantity correlated with the drive state of the drive motor, which is a motor to which the drive state is assigned, when the single drive control is being performed by

the single drive control unit **86**.

(175) The present embodiment has the following advantages. Here, only advantages different from those of the first embodiment are described.

(176) The double drive control unit (i.e., third control unit **83**) performs the double drive control that assigns the drive state to at least two of the plurality of motors **571** and **572**. Therefore, by performing double drive control, the output performance of the electric movable body is improvable more than when only one motor is assigned to the drive state. In particular, the double drive control unit assigns the drive state to all the motors **571** and **572** that drive the output shaft **531** in the double drive control. Therefore, the maximum output performance of the electric aircraft **510** is guaranteeable by performing the double drive control.

(177) The single drive control unit **86** performs the single drive control, which assigns the drive state to only one of the plurality of motors **571** and **572** and assigns the stop state to the other motors, when the dual drive control unit performs the dual drive control and one of the plurality of motors **571** and **572** is determined as abnormal. Then, the abnormality determination unit **84** identifies an abnormal motor having an abnormality based on the predetermined state quantity correlated with the drive state of the drive motor, when the single drive control unit **86** is performing the single drive control. Therefore, the state in which the drive states of the plurality of motors **571** and **572** affect the predetermined state quantity is changeable to the state in which the drive state of only one motor affects the predetermined state quantity. Therefore, in the electric aircraft **510** including the plurality of motors **571** and **572** that drive the output shaft **531**, identification of the abnormal motor is made easy even when the plurality of motors **571** and **572** are in the drive state.

(178) It should be noted that the fourth embodiment can also be implemented with the following modifications. Parts that are the same as the fourth embodiment are denoted by the same reference numerals, and descriptions thereof are omitted.

(179) As shown in FIG. **13**, an electric aircraft **610** may include a battery **621** instead of the batteries **521** and **522** shown in FIG. **12**. A propulsion unit **651** receives supply of electric power from the battery **621**, and outputs driving force for propulsion. The propulsion unit **651** has a configuration similar to that of the propulsion unit **51**. The battery **621** is connected to the INV units **661** and **662**. The same effects as those of the fourth embodiment are achievable with such a configuration as well.

Other Embodiments

(180) It should be noted that the first to fourth embodiments can be modified as follows. Parts that are the same as those in the first to fourth embodiments are denoted by the same reference numerals, and descriptions thereof are omitted.

(181) The single drive control unit **86** assigns the drive state or the stop state to the plurality of motors driving the output shafts, so that, in the single drive control, each of the output shafts is driven by the same number of motors and each of the batteries powers the same number of motors. According to such a configuration, while the number of motors driving the respective output shafts is made equal, it is possible to suppress unevenness in the supply amount of electric power from each of the batteries.

(182) Further, when the switching control is performed by the switching unit **85**, the second control unit **82** (i.e., reassignment control unit) performs the second control (i.e., reassignment control), which assigns the drive state or the stop state to each of the motor set including the abnormal motor and to each of the motor set including the switched motor, so that each output shaft is driven by the same number of motors and each battery supplies electric power to the same number of motors. Therefore, even when an abnormality occurs in the motor, it is possible to suppress unevenness in the amount of electric power supplied from each battery.

(183) Further, the single drive control unit **86** assigns the drive state or the stop state to each of the plurality of motors driving the output shafts, so that, in the single drive control, each of the output

shafts is driven by the same number of motors and each of the cooling devices cools the same number of motors in the drive state. According to such a configuration, while the number of motors driving the respective output shafts can be made equal to each other, unevenness of the cooling load among the cooling devices can be suppressed.
(184) Then, in the second control (i.e., reassignment control), the second control unit **82** (i.e., reassignment control unit) assigns, when the switching control is performed by the switching unit **85**, the drive state or the stop state to each of the motor set including the abnormal motor and to each of the motor set including the switched motor, so that each of the output shafts is driven by the same number of motors and each of the cooling devices cools the same number of motors in the drive state. Therefore, even when an abnormality occurs in the motor, it is possible to suppress unevenness in the cooling load of each cooling device.
(185) As shown in FIG. **14**, an electric aircraft **710** may include clutches **71***c* and **72***c* that switch between a state in which a torque is transmitted from the motors **71** and **72** to the output shaft **31** and a state in which a torque is not transmitted from the motors **71** and **72** to the output shaft **31**, and clutches **73***c* and **74***c* that switch between a state in which a torque is transmitted from the motors **73** and **74** to the output shaft **32** and a state in which a torque is not transmitted from the motors **73** and **74** to the output shaft **32**. The clutches **71***c* to **74***c* are known clutches for connecting and disconnecting between the motors **71** to **74** and the output shafts **31** and **32**, respectively.
(186) Further, when the first control (i.e., single drive control) is being performed by the first control unit **81** (i.e., by the single drive control unit **86**), the abnormality determination unit **84** determines an abnormality of the stopped motor, which is a motor to which the stop state is assigned, by changing the stopped motor to the drive state after switching the clutch from a torque transmission state to a torque non-transmission state and based on the predetermined state quantity (for example, rotation speed) correlated with the drive state of the stopped motor.
(187) According to the above-described configuration, by switching the clutches **71***c* to **74***c* to a state in which torque is not transmitted to the output shaft from the motor to which the stop state is assigned, transmission of braking torque or the like from the motor in the stop state to the output shaft is suppressible. Further, by switching the clutches **71***c* to **74***c* to a state in which torque is not transmitted to the output shaft from the stopped motor, it is possible to determine the abnormality of the stopped motor at any timing without changing the output of the output shaft. Therefore, it is possible to quickly determine the abnormality of the motor including not only the drive motor but also the stopped motor.
(188) Note that when changing the stopped motor to the drive state, a plurality of stopped motors may also be changed to the drive state at the same time. Further, when changing the stopped motor to the drive state, the stopped motor may either be rotated forward or backward.
(189) As shown in FIG. **15**, an electric aircraft **810** may have one-way clutches **71***d*, **72***d*, **73***d* and **74***d*, among which the one-way clutches **71***d*, **72***d* permit transmission of a torque from the motors **71**, **72** to the output shaft **31** and prohibit transmission of a torque from the output shaft **31** to the motors **71**, **72**, and the one-way clutches **73***d*, **74***d* permit transmission of a torque from the motors **73**, **74** to the output shaft **32** and prohibit transmission of a torque from the output shaft **32** to the motors **73**, **74**, respectively.
(190) Then, when the first control (i.e., single drive control) is being performed by the first control unit **81** (i.e., by the single drive control unit **86**), the abnormality determination unit **84** determines an abnormality of the stopped motor based on the predetermined state quantity (for example, rotation speed) of the stopped motor, by changing the stopped motor to be put in the drive state for rotating the stopped motor in an opposite direction opposite to a rotation direction of the drive motor to which the drive state is assigned.
(191) According to the above-described configuration, when the motors **71**, **72** and the motors **73**, **74** are in the drive state, the one-way clutches **71***d*, **72***d* and the one-way clutches **73***d*, **74***d* switch to a state in which a torque is transmissible from the motors **71**, **72** to the output shaft **31** and from

the motors **73**, **74** to the output shaft **32**. Further, when the motors **71**, **72** and the motors **73***m* **74** are in the stop state or in the drive state with an opposite rotation direction, the one-way clutches **71***d*, **72***d* and the one-way clutches **73***d*, **74***d* switch to a state which does not transmit a torque from the output shafts **31**, **32** to the motors **71**, **72** and the motors **73**, **74**, i.e., to a state which does not transmit a negative torque from the motors **71**, **72** and the motors **73**, **74** to the output shafts **31**, **32**. Therefore, even without controlling the clutches, the one-way clutches **71***d* to **74***d* can be switched to a state in which a torque is not transmitted from the motor to which the stop state is assigned to the output shaft, thereby preventing the braking torque and the like from being transmitted from the motor in the stop state to the output shaft.
(192) Further, when the first control (i.e., single drive control) is being performed by the first control unit **81** (i.e., by the single drive control unit **86**), the abnormality determination unit **84** determines an abnormality of the stopped motor based on the predetermined state quantity of the stopped motor, by changing the stopped motor to the drive state in which the stopped motor is driven in the opposite rotation direction opposite to the rotation direction of the drive motor to which the drive state is assigned. Therefore, when the stopped motor is changed to the drive state in which the rotation direction of the motor is opposite to that of the drive motor, the one-way clutch can switch to a state in which the braking torque or the like is not transmitted from the stopped motor to the output shaft, thereby abnormality of the stopped motor is determinable at any timing without changing the output of the output shaft Note that, when the stopped motor is changed to the opposite rotation direction in the drive state, a plurality of stopped motors may be changed to the opposite rotation direction in the drive state at the same time.
(193) Further, the electric disconnection mechanism (**91** to **93**) shown in FIG. **3** and the clutches **71***c* to **74***c* shown in FIG. **14** or the one-way clutches **71***d* to **74***d* shown in FIG. **15** may be provided in the electric aircraft. According to such a configuration, transmission of the braking torque from the stopped motor to the output shafts **31**, **32** can be doubly suppressed by the clutches **71***c* to **74***c* or the one-way clutches **71***d* to **74***d* and the electric disconnection mechanism.
(194) The time to change the stopped motor to the opposite rotation direction in the drive state and to determine the abnormality of the stopped motor may be set to a time when the electric aircraft is coasting or a time when the propeller is stopped before the electric aircraft takes off. That is, even when the speed instruction of speed zero is being used, it is possible to determine an abnormality of the stopped motor.
(195) As shown in FIG. **16**, an electric aircraft **910** may include a battery **923** that powers the INV units **61** to **64**. That is, electric power may be supplied from a plurality of batteries to one system. According to such a configuration, even when an abnormality occurs in one of the batteries **21** and **22**, electric power is suppliable from the battery **923** to the INV unit that has been powered by the battery in which the abnormality has occurred. Therefore, even when an abnormality occurs either in the battery **21** or **22**, the maximum output performance of the electric aircraft **910** is still guaranteeable.
(196) When the first control (i.e., single drive control) is being performed by the first control unit **81** (i.e., by the single drive control unit **86**), the stopped motor to which the stop state is assigned among the plurality of motors that drive the same output shaft may be driven with a constant torque smaller than the output torque of the drive motor, which is the motor to which the drive state is assigned. According to such a configuration, when the first control (i.e., single drive control) is being performed, by driving the stopped motor with a constant torque (e.g., a torque of 0 or more) smaller than the output torque of the drive motor, transmission of the braking torque from the stopped motor to the output shaft is suppressible. Therefore, even when the electric movable body does not have a clutch that switches between a first state in which a torque is transmitted from each motor to each output shaft and a second state in which a torque is not transmitted, transmission of the braking torque from the stopped motor to the output shaft is suppressible.
(197) When temperature of a magnet (e.g., the magnet **71***a*) of each motor (e.g., the motor **71**) is

lower than a predetermined temperature (e.g., −20° C.), the output of each motor may drop to be lower than the reference output. Therefore, among the plurality of motors that drive the same output shaft, when the stopped motor, which is a motor to which the stop state is assigned, is not determined as abnormal, and temperature of the magnet of the stopped motor is lower than a predetermined temperature, the stopped motor may be driven with a constant torque smaller than the output torque of the drive motor, which is a motor to which the drive state is assigned. According to such a configuration, temperature of the magnet of the stopped motor can be increased compared to a case where the stopped motor is maintained in the stop state, and the output of the stopped motor dropping to be lower than the reference output is preventable when the stopped motor is driven.
(198) The number of systems including the INV unit and the motor may be four or more for one output shaft. Moreover, the number of output shafts is also arbitrary.
(199) The rotation speed of the output shaft driven by the drive motor, the motor torque output by the drive motor, the output shaft torque output by the output shaft driven by the drive motor may be adoptable as the predetermined state quantity correlated with the drive state of the drive motor together with other quantity. In such case, instead of using the speed monitoring unit **61***c*, a predetermined state quantity monitoring unit may monitor whether the predetermined state quantity is out of a predetermined threshold range. Further, when a plurality of motors are directly connected to the output shaft, the rotation speed of the drive motor and the rotation speed of the stopped motor are the same, thereby the rotation speed of the stopped motor can be used as the predetermined state quantity.
(200) As shown in FIG. **17**, an electric aircraft **1010** may include an INV unit **65** and a motor **75** in addition to the electric aircraft **10** of FIG. **1**, and may include a battery **23** in place of the battery **21**. That is, the number of motors that drive the output shaft **31** and the number of motors that drive the output shaft **32** may be different, for example. The battery **23** is connected to the INV unit **65**, and the battery **22** is not connected thereto. The battery **23** is a chargeable/dischargeable secondary battery. The rated voltage of battery **23** and the rated voltage of battery **22** are equal, and the rated capacity of the battery **23** is greater than the rated capacity of the battery **22**.
(201) The first control unit **81** performs the first control which assigns active or standby to the motors **71** to **75** that drive the output shafts **31** and **32**, so that each of the output shafts **31**, **32** is driven by at least one of the motors **71** to **75**, and each of the batteries **23** and **22** supplies electric power to at least one of the motors **71** to **75**. As the first control, for example, the first pattern and the second pattern are switched periodically. The first pattern is a pattern in which the motors **71**, **75** and **74** are active (drive state) and the motors **72** and **73** are on standby (stop state). The second pattern is a pattern in which the motors **72** and **73** are active and the motors **71**, **75** and **74** are on standby.
(202) Further, when the switching control is performed by the switching unit **85**, the second control unit **82** performs the second control, which assigns the drive state or the stop state to a motor set including the abnormal motor and to a motor set including the switched motor, so that each of the output shafts **31**, **32** is driven by at least one of the motors **71** to **75**, and each of the batteries **23** and **22** supplies electric power to at least one of the motors **71** to **75**. For example, when it is detected that the rotation speed of the motor **71** is abnormal (i.e., speed abnormality), the motors **72**, **73** are switched from the first pattern in which the motors **71**, **75**, **74** are active and the motors **72**, **73** are on standby to the second pattern in which the motors **72**, **73** are active and the motors **71**, **75**, **74** are on standby. Therefore, even when an abnormality occurs in the motor, it is possible to suppress unevenness in the supply amount of electric power from each of the batteries.
(203) The INV control unit (i.e., INV unit) may be provided with the first control unit **81** to the third control unit **83**, the abnormality determination unit **84**, the switching unit **85**, and the single drive control unit **86** instead of the integrated ECU **80**.
(204) As each of the motors, not only an AC motor but also a DC motor is adoptable. In such case,

instead of using the INV unit, a current control unit or the like that controls an electric current flowing through the DC motor is adoptable.
(205) Each of the motors can be changed to a motor generator capable of driving and generating electric power. Further, the control in each of the first to fourth embodiments can be performed by replacing the driving of each of the motors with an electric power generation by each of the motors. According to such a configuration, even when an abnormality occurs in the motor generator, it is possible to suppress unevenness in a received power amount (i.e., charge amount) for each of the batteries.
(206) Each of the above-described embodiments can be applied not only to an electric aircraft, but also to electrically-driven train (i.e., electric movable body) and electric watercraft (i.e., electric movable body). In such case, the electric movable body may be provided with driving wheels instead of the propeller, and the electric watercraft may be provided with a screw instead of the propeller.
(207) Although the present disclosure has been described in accordance with the embodiments, it is understood that the present disclosure is not limited to the above embodiments or structures. The present disclosure incorporates various modifications and variations within the scope of equivalents. In addition, the present disclosure also includes various combinations and configurations, as well as other combinations and configurations that include only one element added thereto or subtracted therefrom, within the scope and spirit of the present disclosure.

## Claims

1. An electric movable body comprising: a plurality of output shafts; a plurality of motors each configured to drive an output shaft of the output shafts; a plurality of batteries, the motors and the batteries being connected to each other, such that each of the batteries is configured to supply electric power to a motor set each configured to drive one of the output shafts; a first control unit configured to perform a first control to assign either a drive state or a stop state to each of the motors, such that the output shaft is driven by at least one of the motors, and such that each of the batteries supplies electric power to at least one of the motors; an abnormality determination unit configured to determine an abnormality of the motors; a switching unit configured to, when an abnormal motor determined by the abnormality determination unit is in the drive state, perform a switching control to switch the abnormal motor into the stop state and to switch an other one of the plurality of motors, which is in the stop state and configured to drive the same output shaft as the abnormal motor, into the drive state; and a second control unit configured to, when the switching unit performs the switching control, perform a second control to assign either the drive state or the stop state to one of the motors, which constitutes the motor set including the abnormal motor, and to one of the motors, which constitutes the motor set including the other motor, such that each of the output shafts is driven by at least one of the motors, and such that each of the batteries supplies electric power to at least one of the motors.
2. The electric movable body according to claim 1, wherein the first control unit is configured to, in the first control, assign either the drive state or the stop state to each of the motors, such that each of the output shafts is driven by a same number of the motors, and such that each of the batteries supplies electric power to a same number of the motors, and the second control unit is configured to, when the switching unit performs the switching control, assign, in the second control, either the drive state or the stop state to the motor set, which includes the abnormal motor, and to the motor set, which includes the other motor, such that each of the output shafts is driven by a same number of the motors, and such that each of the batteries supplies electric power to a same number of the motors.
3. The electric movable body according to claim 1, wherein the abnormality determination unit is configured to, when the first control unit performs the first control, determine an abnormality of a

drive motor, to which the drive state is assigned, based on a predetermined state quantity correlated with the drive state of the drive motor.

4. The electric movable body according to claim 3, further comprising: a third control unit configured to perform a third control to assign the drive state to the motors configured to drive the output shafts, wherein the first control unit is configured to perform the first control, when the third control unit performs the third control and on determination that one of the drive motors is abnormal based on the predetermined state quantity, and the abnormality determination unit is configured to, when the first control performs the first control, identify the drive motor, which is abnormal, based on the predetermined state quantity.

5. The electric movable body according to claim 1, further comprising: a clutch configured to switch between a state, in which a torque is transmitted from the motor to the output shaft, and a state, in which the torque is not transmittable, wherein the abnormality determination unit is configured to, when the first control unit performs the first control, cause the clutch to switch into the state, in which the torque is not transmittable from a stopped motor, to which the stop state is assigned, to the output shaft, and change the stopped motor into the drive state, and determine an abnormality of a stopped motor, to which the stop state is assigned, based on a predetermined state quantity correlated with the drive state of the stopped motor.

6. The electric movable body according to claim 5, wherein the clutch is a one-way clutch configured to permit transmission of the torque from the motor to the output shaft and prohibit transmission of a torque from the output shaft to the motors, and the abnormality determination unit is configured to, when the first control unit performs the first control, change the stopped motor into a drive state in which a rotation direction is in a direction opposite to a rotation direction of a drive motor to which the drive state is assigned, and determine an abnormality of the stopped motor based on the predetermined state quantity of the stopped motor.

7. The electric movable body according to claim 1, further comprising: an electric disconnection mechanism configured to electrically disconnect between the motors and the batteries, wherein the electric disconnection mechanism is configured to, when the first control unit performs the first control, electrically disconnect between a stopped motor, to which the stop state is assigned, and the battery corresponding to the stopped motor.

8. The electric movable body according to claim 1, wherein when the first control unit performs the first control, a stopped motor, to which the stop state is assigned from among the motors that drive a same output shaft, is driven with a constant torque that is smaller than an output torque of a drive motor, to which the drive state is assigned.

9. The electric movable body according to claim 1, wherein when a stopped motor, to which the stop state is assigned from among the motors that drive a same output shaft, is not determined to be abnormal, and when temperature of a magnet of the stopped motor is lower than a predetermined temperature, the stopped motor is driven with a constant torque, which is smaller than an output torque of a drive motor to which the drive state is assigned.

10. The electric movable body according to claim 1, further comprising: a plurality of cooling devices, wherein the motors and the cooling devices are connected to each other correspondingly to connection between the motors and the batteries, such that each of the cooling devices is configured to supply coolant to motor sets each configured to drive one of the output shafts, the first control unit is configured to assign, in the first control, either the drive state or the stop state to each of the motors, such that each of the output shafts is driven by at least one of the motors, and such that each of the cooling devices cools at least one of the motors in the drive state, and the second control unit is configured to, when the switching unit performs the switching control, assign, in the second control, either the drive state or the stop state to each of the motors in the motor set, which includes the abnormal motor, and each of the motors in the motor set, which includes the switched motor, such that each of the output shafts is driven by at least one motor, and such that each of the cooling devices cools at least one motor in the drive state.

11. The electric movable body according to claim 10, wherein the first control unit is configured to assign, in the first control, either the drive state or the stop state to each of the motors driving the output shaft, such that each of the output shafts is driven by a same number of the motors, and such that each of the cooling devices cools a same number of the motors in the drive state, and the second control unit is configured to, when the switching unit performs the switching control, assign, in the second control, either the drive state or the stop state to the motor set, which includes the abnormal motor, and to the motor set, which includes the other motor, such that each of the output shafts is driven by a same number of the motors, and such that each of the cooling devices cools a same number of the motors in the drive state.
12. An electric movable body comprising: a plurality of output shafts; a plurality of motors each configured to drive an output shaft of the output shafts; a plurality of cooling devices, the motors and the cooling devices being connected to each other, such that each of the cooling devices is configured to supply coolant to a motor set each configured to drive one of the output shafts; a first control unit configured to perform a first control to assign either a drive state or a stop state to the motors, such that each of the output shafts is driven by at least one of the motors, and such that each of the cooling devices cools an at least one of the motors in the drive state; an abnormality determination unit configured to determine an abnormality of the motors; a switching unit configured to, when an abnormal motor determined by the abnormality determination unit is in the drive state, perform a switching control to switch the abnormal motor into the stop state and to switch an other one of the plurality of motors, which is in the stop state and configured to drive the same output shaft as the abnormal motor, into the drive state; and a second control unit configured to, when the switching unit performs the switching control, perform a second control to assign either the drive state or the stop state to the motor, which constitutes the motor set including the abnormal motor, and to the motor, which constitutes the motor set including the other motor, such that each of the output shafts is driven by at least one of the motors, and such that each of the cooling devices cools at least one of the motors in the drive state.
13. An electric movable body comprising: a plurality of output shafts; a plurality of motors each configured to drive an output shaft of the output shafts; a plurality of batteries, the motors and the batteries being connected to each other, such that each of the batteries is configured to supply electric power to a motor set each configured to drive one of the output shafts; a processor configured to perform a first control to assign either a drive state or a stop state to each of the motors, such that the output shaft is driven by at least one of the motors, and such that each of the batteries supplies electric power to at least one of the motors, determine an abnormality of the motors, perform a switching control, when an abnormal motor, which is determined to be abnormal, is in the drive state, to switch the abnormal motor into the stop state and to switch an other one of the plurality of motors, which is in the stop state and configured to drive the same output shaft as the abnormal motor, into the drive state, and perform a second control, when performing the switching control, to assign either the drive state or the stop state to one of the motors, which constitutes the motor set including the abnormal motor, and to one of the motors, which constitutes the motor set including the other motor, such that each of the output shafts is driven by at least one of the motors, and such that each of the batteries supplies electric power to at least one of the motors.
14. An electric movable body comprising: a plurality of output shafts; a plurality of motors each configured to drive an output shaft of the output shafts; a plurality of cooling devices, the motors and the cooling devices being connected to each other, such that each of the cooling devices is configured to supply coolant to a motor set each configured to drive one of the output shafts; a processor configured to perform a first control to assign either a drive state or a stop state to the motors, such that each of the output shafts is driven by at least one of the motors, and such that each of the cooling devices cools an at least one of the motors in the drive state, determine an abnormality of the motors, perform a switching control, when an abnormal motor, which is

determined to be abnormal, is in the drive state, to switch the abnormal motor into the stop state and to switch an other one of the plurality of motors, which is in the stop state and configured to drive the same output shaft as the abnormal motor, into the drive state, and perform a second control, when performing the switching control, to assign either the drive state or the stop state to the motor, which constitutes the motor set including the abnormal motor, and to the motor, which constitutes the motor set including the other motor, such that each of the output shafts is driven by at least one of the motors, and such that each of the cooling devices cools at least one of the motors in the drive state.