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(54) **Swing motion reducing apparatus for ship**

Schaukelbewegungsreduzierungsvorrichtung für Schiff

Appareil de réduction des mouvements de balancement pour navires

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Description

Background of the Invention

1. Field of the Invention

[0001] The present invention relates to an apparatus for reducing a swinging motion of a ship such as a rolling motion, a pitching motion and a yawing motion.

2. Description of Related Art

[0002] Japanese Patent No. 3,556,857 discloses a swinging motion reducing apparatus for reducing rolling, pitching and yawing motions of a ship. The swinging motion reducing apparatus includes a motor, a flywheel that is driven by the motor, a gimbal mechanism that contains the flywheel, a support section for movably supporting the gimbal mechanism, a frictional damper for controlling a motion of the gimbal mechanism, a power supply for supplying electric power to the motor, and a control section. When the gimbal mechanism rolls at a predetermined angle or more, the control section controls such that the power supply to the motor is stopped to prevent the swinging motion reducing apparatus from being damaged because of the motion of the gimbal mechanism exceeding a limitation of the specification. US 5628267 discloses a swinging motion reducing apparatus designed to overcome overheating of the bearings.

Summary of the Invention

[0003] An object of the present invention is to prevent a swinging motion reducing apparatus for a ship from being damaged.

[0004] In an aspect of the present invention, a swing motion reducing apparatus for a ship includes a flywheel, a gimbal mechanism configured to rotatably support the flywheel, a motor configured to rotate the flywheel based on a drive power to be supplied; and a motor driver configured to supply the drive power to the motor. A damper section is configured to brake a swing motion of the gimbal mechanism. A safety unit controls the motor driver to stop the supply of the drive power to the motor when a temperature of the damper section is equal to or higher than a predetermined temperature.

[0005] According to the present invention, damage of a swinging motion reducing apparatus for a ship is prevented.

Brief Description of the Drawings

[0006]

FIG. 1 is a diagram schematically showing a swinging motion reducing apparatus for a ship according to a first embodiment of the present invention; FIG. 2 is a cross-section view of the swinging motion

reducing apparatus body; and

FIG. 3 is a diagram schematically showing the swinging motion reducing apparatus according to a second embodiment of the present invention.

Description of the Embodiments

[0007] Hereinafter, a swinging motion reducing apparatus for a ship according to the present invention will be described with reference to the attached drawings.

[First Embodiment]

[0008] As shown in FIG. 1, a swinging motion reducing apparatus according to a first embodiment of the present invention includes a swinging motion reducing apparatus body 10, a motor driver 20, a generator 30, and a safety unit 40. The swinging motion reducing apparatus body 10 includes a motor 13, a damper 15A, and a damper 15B. The generator 30 and the motor 13 are a 3-phase generator and a 3-phase motor, respectively. The motor driver 20 includes an input terminal 21, an output terminal 22, a CM terminal 23, an X1 terminal 24, and a relay 25. The input terminal 21 includes an R terminal, an S terminal, and a T terminal. The output terminal 22 includes a U terminal, a V terminal, and a W terminal. The relay 25 is provided between the input terminal 21 and the output terminal 22. The relay 25 opens and closes a connection between the R terminal and the U terminal, a connection between the S terminal and the V terminal, and a connection between the T terminal and the W terminal. The input terminal 21 is connected to the generator 30 via a breaker switch 31. The output terminal 22 is connected to a power cable 13a of the motor 13.

[0009] The safety unit 40 includes a bimetal switch 41A provided for the damper 15A and a bimetal switch 41B provided for the damper 15B. The bimetal switches 41A and 41B are in a close state initially, and monitor temperatures of the dampers 15A and 15B, respectively. The bimetal switch 41A opens to set an OFF state when a temperature of the damper 15A increase to a temperature equal to or higher than a predetermined temperature. The bimetal switch 41B opens to set an OFF state when the temperature of the damper 15B increase to a temperature equal to or higher than a predetermined temperature. The CM terminal 23 is connected to the X1 terminal 24 via the bimetal switches 41A and 41B. Since the bimetal switches 41A and 41B are connected to each other in series, the connection between the CM terminal 23 and the X1 terminal 24 is in an ON state (a conduction state) when both of the bimetal switches 41A and 41B close, and the connection between the CM terminal 23 and the X1 terminal 24 is in an OFF state (a non-conduction state) when at least one of the bimetal switches 41A and 41B opens.

[0010] The relay 25 turns the connection between the input terminal 21 and the output terminal 22 to be in the ON state (closes the connection between the input ter-

minal 21 and the output terminal 22) when the connection between the CM terminal 23 and the X1 terminal 24 is in the ON state. Also, the relay 25 turns the connection between the input terminal 21 and the output terminal 22 to be in the OFF state (opens the connection between the input terminal 21 and the output terminal 22) when the connection between the CM terminal 23 and the X1 terminal 24 is in the OFF state.

[0011] The motor driver 20 supplies a drive power to the motor 13 when the relay 25 keeps the connection between the input terminal 21 and the output terminal 22 in the ON state, and stops the supply of the drive power when the relay 25 turns the connection between the input terminal 21 and the output terminal 22 to be in the OFF state.

[0012] As shown in FIG. 2, the swinging motion reducing apparatus body 10 includes the flywheel 11, the gimbal mechanism 12, the motor 13, a gimbal mechanism support section 14, and the dampers 15A and 15B. The gimbal mechanism 12 supports the flywheel 11 so that the flywheel 11 can rotate around a rotation axis S1. The motor 13 drives the flywheel 11. The gimbal mechanism support section 14 supports the gimbal mechanism 12 so that the gimbal mechanism 12 can swing around a swing axis S2. Each of the dampers 15A and 15B brakes the swinging motion of the gimbal mechanism 12 with a fluid resistance of a hydraulic oil. For example, the dampers 15A and 15B are rotary dampers. The swing axis S2 is orthogonal to the rotation axis S1. The gimbal mechanism support section 14 is fixed to a hull. The bimetal switches 41A and 41B are attached to the outer sides of the dampers 15A and 15B, respectively.

[0013] A principle that the swinging motion reducing apparatus according to the present embodiment reduces the swinging motion of a ship will be described by exemplifying a case that a left or right direction axis (Pitch axis) of the hull is parallel to the swing axis S2. The flywheel 11 is driven by the motor 13 at a high speed so as to have angular momentum H. When the hull receives a wave in a direction of a roll axis to roll at an angular velocity Q, a gyrotorque T1 represented by an exterior product of the angular momentum H and the angular velocity Ω acts to the gimbal mechanism 12, and the gimbal mechanism 12 rolls around the swing axis S2. At this time, since the flywheel 11 works to maintain the angular momentum H, a counter torque T2 acts to the hull via the gimbal mechanism support section 14. When an angular velocity of the swinging motion of the gimbal mechanism 12 is ω , the counter torque T2 is represented by an exterior product of the angular momentum H and the angular velocity ω . Because the counter torque T2 acts to a direction opposite to the roll direction of the hull, the rolling motion in the roll direction of the hull is reduced.

[0014] For example, when the swinging motion reducing apparatus is used under an overload circumstance such as a case where a ship having the swinging motion reducing apparatus according to the present embodiment sails a high wave area, the gimbal mechanism 12

heavily swings so that the temperatures of the dampers 15A and 15B become high, and thus a seal member for sealing the hydraulic oil may be damaged. Since the gimbal mechanism 12 cannot be broken when the hydraulic oil leaks, the swinging motion reducing apparatus may be damaged.

[0015] Referring to FIG. 1, when the temperature of the damper 15A increases the predetermined temperature or more, the bimetal switch 41A opens to turn the connection between the CM terminal 23 and the X1 terminal 24 to be in the OFF state. Then, since the relay 25 turns the connection between the input terminal 21 and the output terminal 22 to be in the OFF state, the motor driver 20 automatically stops the supply of the drive power. Also, when the temperature of the damper 15B increases the predetermined temperature or more, the motor driver 20 automatically stops the supply of the drive power in the same manner as that of the damper 15A. That is, the safety unit 40 stops the supply of the drive power to the motor driver 20 when at least one of the dampers 15A and 15B exceeds the predetermined temperature. In this manner, the swinging motion reducing apparatus body 10 safely stops and the dampers 15A and 15B can be prevented from being damaged.

[0016] Additionally, in case of occurrence of a failure of the damper 15A or 15B, the temperatures of the damper 15A or 15B becomes high. The present embodiment prevents the swinging motion reducing apparatus from continuing to operate under the condition of occurrence of the failure of the damper 15A or 15B. Accordingly, the damage of the damper 15A or 15B can be prevented and the damage of the swinging motion reducing apparatus body 10 is prevented.

[0017] Moreover, when an atmosphere temperature around the swinging motion reducing apparatus body 10 is high, the damper 15A or 15B cannot release the heat to circumference, and accordingly a braking performance of the damper 15A or 15B deteriorates. When the swinging motion reducing apparatus continues to operate in a state that the braking performance of the damper 15A or 15B deteriorates, the swinging motion reducing apparatus body 10 may be damaged. According to the present embodiment, since the swinging motion reducing apparatus is stopped in the case of a high atmosphere temperature, the damage of the swinging motion reducing apparatus body 10 can be prevented.

[0018] Since the bimetal switches 41A and 41B are respectively arranged on the outer sides of the dampers 15A and 15B, the swinging motion reducing apparatus can be easily assembled. Meanwhile, the bimetal switches 41A and 41B may be arranged in the dampers 15A and 15B, respectively.

[Second Embodiment]

[0019] Referring to FIG. 3, the swinging motion reducing apparatus for a ship according to a second embodiment of the present invention will be described. The

swinging motion reducing apparatus according to the second embodiment of the present invention is configured by replacing the safety unit 40 in the first embodiment with a safety unit 50. The safety unit 50 includes temperature sensors 51A and 51B such as a thermocouple or a thermistor, and a determining section 52. The temperature sensors 51A and 51B are provided for the dampers 15A and 15B, respectively. The temperature sensor 51A monitors a temperature of the damper 15A and outputs a signal indicating the temperature of the damper 15A to the determining section 52. The temperature sensor 51B monitors a temperature of the damper 15B and outputs a signal indicating the temperature of the damper 15B to the determining section 52. The determining section 52 is connected to the CM terminal 23 and the X1 terminal 24, respectively. The determining section 52 determines whether or not the temperatures indicated by the signals sent from the temperature sensors 51A and 51B are higher than a predetermined temperature. When both of the signal sent from the temperature sensor 51A and the signal sent from the temperature sensor 51B indicate a temperature lower than the predetermined temperature, the determining section 52 turns the connection between the CM terminal 23 and the X1 terminal 24 to be in the ON state. When the temperature indicated by at least one of the signal sent from the temperature sensor 51A and the signal sent from the temperature sensor 51B exceeds the predetermined temperature, the determining section 52 turns the connection between the CM terminal 23 and the X1 terminal 24 to be in the OFF state. Accordingly, when at least one of the dampers 15A and 15B exceeds the predetermined temperature, the safety unit 50 stops the supply of the drive power to the motor 13.

[0020] When the temperature sensors 51A and 51B are arranged on the outer sides of the dampers 15A and 15B, the swinging motion reducing apparatus can be easily assembled. Meanwhile, the temperature sensors 51A and 51B may be arranged in the dampers 15A and 15B, respectively.

[0021] In the above-mentioned respective embodiments, the generator 30 and the motor 13 may be a single-phase generator and a single-phase motor, respectively. In addition, the dampers 15A and 15B may be a frictional damper, a linear damper, or a hydraulic pump.

Claims

1. A swing motion reducing apparatus (10) for a ship comprising:

a flywheel (11) ;
 a gimbal mechanism (12) configured to rotatably support said flywheel (11);
 a motor (13) configured to rotate said flywheel (11) based on a drive power to be supplied;
 a motor driver (20) configured to supply the drive

power to said motor (13);

characterized by comprising a first and a second damper (15A, 15B) configured to brake a swing motion of said gimbal mechanism (12); and
 a safety unit (40) configured to control said motor driver to stop the supply of the drive power to said motor (13) when a temperature of at least one of said first and second damper (15A, 15B) is equal to or higher than a predetermined temperature.

2. The swing motion reducing apparatus according to claim 1, wherein said motor driver comprises first and second terminals (21, 22), wherein said safety unit (40) comprises a path from said first terminal (21) to said second terminal (22), and
 said motor driver (20) supplies the drive power to said motor (13) when said path is in an ON state, and stops the supply of the drive power to said motor when said path is in an OFF state.
3. The swing motion reducing apparatus according to claim 2, wherein
 said safety unit (40) comprises a first bimetal switch (41A) provided for said first damper (15A) in said path, and
 said first bimetal switch sets said path to the ON state when the temperature of said first damper (15A) is lower than the predetermined temperature and sets said path to the OFF state when the temperature of said first damper (15A) is equal to or higher than the predetermined temperature.
4. The swing motion reducing apparatus according to claim 3,
 wherein said safety unit (40) further comprises a second bimetal switch (41B) provided for said second damper (15B) in said path and connected with said first bimetal (15A) switch in series, and
 said second bimetal switch (41B) sets said path to the ON state when the temperature of said second damper (15B) is lower than the predetermined temperature and sets said path to the OFF state when the temperature of said second damper (15B) is equal to or higher than the predetermined temperature.

5. The swing motion reducing apparatus according to claim 2, wherein
 said safety unit (40) further comprises:

first and second temperature sensors (51A, 51B) provided for said first and second dampers (15A, 15B) to detect temperatures of said first and second dampers (15A, 15B), respectively; and

a determining section (52) sets said path to the ON state, when both of temperatures detected by said first and second temperature sensors (51A, 51B) are lower than the predetermined temperature, and sets said path to the OFF state, when at least one of temperatures detected by said first and second temperature sensors (51A, 51B) is equal to or higher than the predetermined temperature.

Patentansprüche

1. Schaukelbewegungs-Reduzierungsvorrichtung (10) für ein Schiff, umfassend:

- ein Schwungrad (11);
 - einen Kardanmechanismus (12), der so ausgelegt ist, dass er das Schwungrad (11) drehbar lagern kann;
 - einen Motor (13), der so ausgelegt ist, dass er das Schwungrad (11) aufgrund einer zu liefernden Antriebskraft drehen kann;
 - einen motorischen Antrieb (20), der so ausgelegt ist, dass er die Antriebskraft für den Motor (13) liefern kann;
- dadurch gekennzeichnet, dass** sie einen ersten und einen zweiten Schwingungsdämpfer (15A, 15B) umfasst, der so ausgelegt ist, dass eine Schaukelbewegung des Kardanmechanismus (12) abgebremst werden kann; und
- eine Sicherungseinheit (40), die so ausgelegt ist, dass sie den motorischen Antrieb steuern kann, um die Lieferung der Antriebskraft an den Motor (13) zu stoppen, wenn zumindest einer der beiden Schwingungsdämpfer (15A, 15B) eine Temperatur aufweist, die einer vorgegebenen Temperatur entspricht oder höher als diese ist.

2. Schaukelbewegungs-Reduzierungsvorrichtung nach Anspruch 1, wobei der motorische Antrieb einen ersten und einen zweiten Anschluss (21, 22) umfasst, wobei die Sicherungseinheit (40) eine Strecke von dem ersten Anschluss (21) zu dem zweiten Anschluss (22) umfasst, und der motorische Antrieb (20) den Motor (13) mit der Antriebskraft beliefert, wenn sich die Strecke im Zustand EIN befindet und die Belieferung der Antriebskraft an den Motor stoppt, wenn sich die Strecke im Zustand AUS befindet.
3. Schaukelbewegungs-Reduzierungsvorrichtung nach Anspruch 2, wobei die Sicherungseinheit (40) einen ersten Bimetallschalter (41A) umfasst, der für den ersten Schwingungsdämpfer (15A) auf der Strecke vorgesehen ist, und der erste Bimetallschal-

ter die Strecke in den Zustand EIN schaltet, wenn die Temperatur des ersten Schwingungsdämpfers (15A) niedriger als die vorgegebene Temperatur ist, und die Strecke in den Zustand AUS schaltet, wenn die Temperatur des ersten Schwingungsdämpfers (15A) gleich oder höher als die vorgegebene Temperatur ist.

4. Schaukelbewegungs-Reduzierungsvorrichtung nach Anspruch 3, wobei die Sicherungseinheit (40) weiterhin einen zweiten Bimetallschalter (41B) umfasst, der für den zweiten Schwingungsdämpfer (15B) auf der Strecke vorgesehen ist und mit dem ersten Bimetall-Schalter (15A) in Reihe geschaltet ist, und der zweite Bimetallschalter (41B) die Strecke in den Zustand EIN schaltet, wenn die Temperatur des zweiten Schwingungsdämpfers (15B) niedriger als die vorgegebene Temperatur ist und die Strecke in den Zustand AUS schaltet, wenn die Temperatur des zweiten Schwingungsdämpfers (15B) gleich oder höher als die vorgegebene Temperatur ist.

5. Schaukelbewegungs-Reduzierungsvorrichtung nach Anspruch 2, wobei die Sicherungseinheit (40) weiterhin umfasst:

einen ersten und einen zweiten für den ersten und den zweiten Schwingungsdämpfer (15A, 15B) vorgesehenen Temperatursensor (51A, 51B), um Temperaturen des ersten bzw. des zweiten Schwingungsdämpfers (15A, 15B) zu detektieren und ein Festlegungsabschnitt (52) die Strecke in den Zustand EIN schaltet, wenn beide von dem ersten und dem zweiten Temperatursensor (51A, 51B) detektierte Temperaturen niedriger als die vorgegebene Temperatur sind, und die Strecke in den Zustand AUS schaltet, wenn zumindest eine von dem ersten und dem zweiten Temperatursensor (51A, 51B) detektierte Temperatur gleich oder höher als die vorgegebene Temperatur ist.

Revendications

1. Appareil (10) de réduction des mouvements de balancement pour navires, comprenant :

un volant (11) ;
 un mécanisme à cardan (12) agencé pour supporter ledit volant (11) en rotation ;
 un moteur (13) agencé pour entraîner ledit volant (11) en rotation sur la base d'une puissance devant être fournie ;
 un actionneur motorisé (20) agencé pour assurer l'approvisionnement en puissance dudit moteur (13) ;

- caractérisé en ce qu'il** comporte un premier et un second amortisseur (15A, 15B) pour freiner un mouvement de balancement dudit mécanisme à cardan (12) ; et
 une unité de sécurité (40) agencée pour commander ledit actionneur motorisé pour arrêter l'alimentation en puissance fournie par l'actionneur audit moteur (13) lorsque la température d'au moins un desdits premier et second amortisseur (15A, 15B) est égale ou supérieure à une température prédéterminée. 5 10
2. Appareil de réduction des mouvements de balancement selon la revendication 1, dans lequel l'actionneur motorisé comprend des premières et des secondes bornes (21, 22), dans lequel ladite unité de sécurité (40) comporte un circuit allant desdites premières bornes (21) auxdites secondes bornes (22), et ledit actionneur motorisé (20) alimente en puissance d'entraînement ledit moteur (13) lorsque ledit circuit est dans l'état ouvert et arrête l'alimentation dudit moteur lorsque ledit circuit est dans l'état fermé. 15 20
3. Appareil de réduction des mouvements de balancement selon la revendication 2, dans lequel ladite unité de sécurité (40) comporte un premier interrupteur bimétallique (41A) affecté audit premier amortisseur (15A) dans ledit circuit, et ledit premier interrupteur bimétallique fait passer ledit circuit dans l'état ouvert lorsque la température dudit premier amortisseur (15A) est inférieure à la température prédéterminée et fait passer ledit circuit dans l'état fermé, lorsque la température dudit premier amortisseur (15A) est égale ou supérieure à la température prédéterminée. 25 30 35
4. Appareil de réduction des mouvements de balancement selon la revendication 3, dans lequel ladite unité de sécurité (40) comporte en outre un second interrupteur bimétallique (41 B) affecté audit second amortisseur (15B) dans ledit circuit, et connecté en série audit premier interrupteur bimétallique (41 A), et ledit second interrupteur bimétallique (41 B) fait passer ledit circuit dans l'état ouvert lorsque la température dudit second amortisseur (15B) est inférieure à la température prédéterminée et fait passer ledit circuit dans l'état fermé, lorsque la température dudit second amortisseur (15B) est égale ou supérieure à la température prédéterminée. 40 45 50
5. Appareil de réduction des mouvements de balancement selon la revendication 2, dans lequel ladite unité de sécurité (40) comporte en outre des premiers et des seconds capteurs (51A, 51 B), affectés audit premier et audit second amortisseurs (15A, 15B) pour détecter les températures respecti- 55
- ves dudit premier et dudit second amortisseurs (15A, 15B), et une section décisionnelle (52) qui fait passer ledit circuit dans l'état ouvert lorsque les deux températures détectées par ledit premier et ledit second capteurs (51A, 51 B) sont inférieures à la température prédéterminée, et qui fait passer ledit circuit dans l'état fermé lorsqu'au moins une des deux températures détectées par ledit premier et ledit second capteurs (51A, 51 B) est égale ou supérieure à la température prédéterminée.

Fig. 1

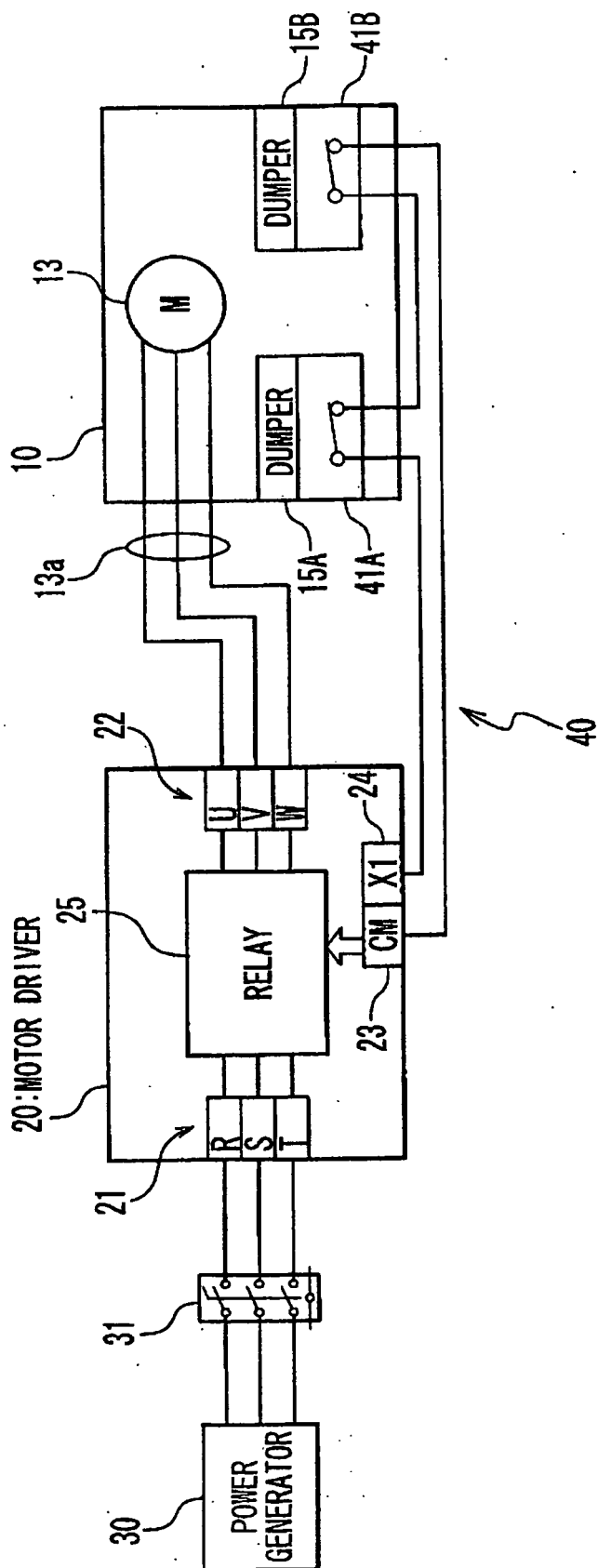


Fig. 2

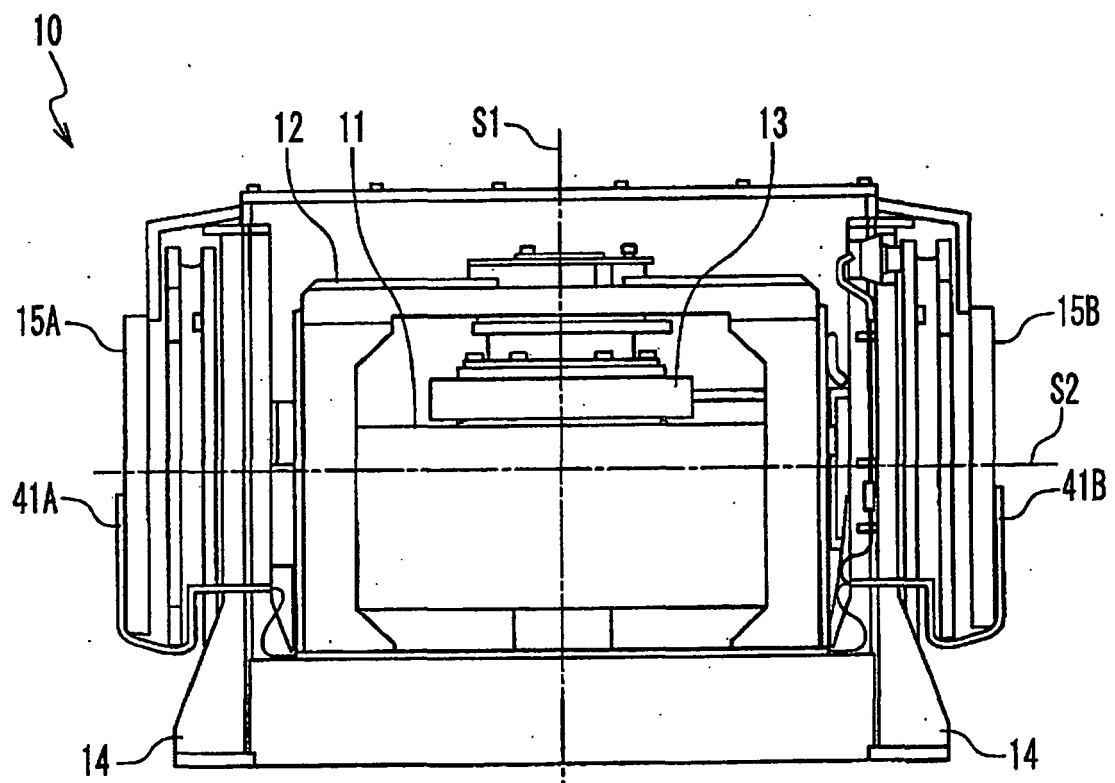
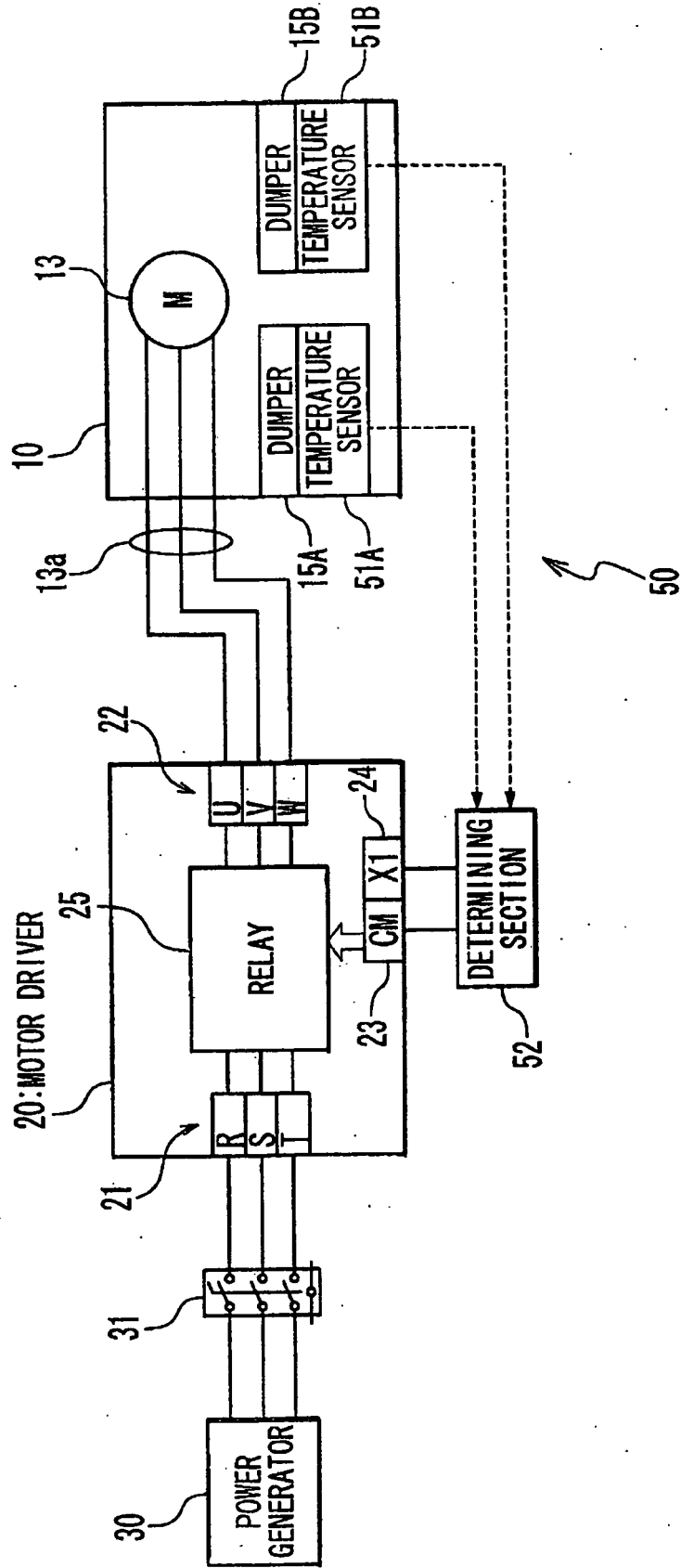


Fig. 3



REFERENCES CITED IN THE DESCRIPTION

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