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(54) **Method and system for controlling attitude of lifting load utilizing gyro effect**

Verfahren und Anlage zur Lageregelung einer gehobenen Last mittels eines Gyroskops

Procédé et système pour contrôler l'attitude d'une charge levée en utilisant l'effet gyroscopique

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a method and a system for controlling attitude of a lifting load for appropriately pivoting a lifting load lifted by means of a wire rope or so forth. More specifically, the invention relates to a system which carries a gyro on a lifting jig for lifting the lifting load in horizontal attitude by means of the wire rope or so forth and obtaining a horizontal rotating force of the lifting jig in the horizontal direction utilizing a gyro effect.

Description of the Related Art

[0002] Conventionally, there are proposals for a crane with a rigid arm or rotary apparatus utilizing torsion of a rope as reacting force, for automating pivoting operation of a lifting load in a cargo operation. The former apparatus is excessively large in weight in relation to a lifting performance. The latter apparatus is unstable in pivoting behavor of lifting load. In place of these apparatus, there has been proposed a rotating attitude control system utilizing gyro effect (for example, Japanese Examined Patent Publication (Kokoku) No. Heisei 4-17873).

[0003] The rotating attitude controlling system for the lifting load disclosed in the above-identified publication is formed with a lifting jig which is hanged in horizontal attitude on a wire rope and mounting a lifting load at the lower portion thereof, a frame fixed on the lifting jig, and a case rotatable about a rotation axis parallel to an extending direction relative to the frame, and a flywheel capable of spinning shaft perpendicular to a surface including a rotation axis of the case. The case and the flywheel form a gimbal structure to form pseudo gyro scope together with the frame. Then, by detecting an angle of natural pivoting motion of the lifting load by external disturbance, such as wind and so forth, the lifting load is pivoted in the opposite direction in a magnitude corresponding to the natural rotation by driving the gymbal by a motor, while the natural rotation angle is relatively small, for constantly maintaining predetermined azimuth angle.

[0004] On the other hand, in such rotating attitude controlling system of the lifting load utilizing the gyro effect, rotational position of the gimbal in repeated use of the system cannot be constant. Also, when external disturbance, such as wind or so forth, is exerted on the pivot axis of the lifting load (lifting jig), by rotating the gimbal for orienting a spinning shaft of the flywheel at substantially vertical direction, rotation due to external disturbance can be restricted. However, it may maintain oblique position due to shifting of the offset position by rotation of gimbal.

[0005] Here, the offset position is the rotational position of the gimbal when the driving motor of the gimbal is not actuated and the gimbal is not locked.

[0006] Subsequently, when the gimbal is rotated to a initial position (hereinafter simply referred to as "initial position") to orient the spinning shaft, rotation in the direction of external disturbance is accelerated. While such pre-session force is convenient if pivots the lifting load in the same direction to the rotating direction by the external disturbance, when a rotational force in opposite direction is to be applied, it becomes necessary to return to the initial position by tilting the gimbal to exert the pivoting force on the lifting load in the same direction to the rotating direction by the external disturbance.

[0007] On the other hand, when driving of the motor for rotating the gimbal is terminated, a component of accelerating rotation can be canceled by rotating the gimbal. Therefore, it is not possible to return the gimbal to the initial position simply by rotating the gimbal in the opposite direction.

[0008] As set forth above, it is required substantial skill for returning the gimbal from the rotated position to the initial position. Furthermore, since the operator is often stay away from the system, resetting operation by the operator alone is further difficult.

[0009] US-A-3608384 discloses an apparatus for selectively horizontally orienting a freely swiveled cargo load, and for maintaining a desired horizontal position, employs a rotating flywheel attached to a load bearing platform by a mounting gimbal. Apparatus is provided to selectively rotate the spinning flywheel about a horizontal axis disposed along a diameter of the flywheel, thereby applying a torque in a desired direction about the vertical axis of the gimbal, platform and load. Thus, the load may be rotated in a horizontal plane to any desired orientation and, moreover, maintained in that position.

SUMMARY OF THE INVENTION

[0010] The present invention is worked out in view of the problems in the prior art. Therefore, it is an object of the present invention to provide a method and system for controlling a lifting load which can easily return a gimbal which is rotated by external disturbance, to a initial position utilizing a gyro effect without influencing pivoting motion of the lifting load.

[0011] In order to accomplish the above-mentioned object, according to the first aspect of the invention, a lifting load attitude control system utilizing a gyro effect, comprises:

a lifting jig to be hanged in horizontal attitude for hanging a lifting load;

a gyro frame fixed to said lifting jig;

a gimbal frame rotatable about a rotating shaft within the gyro frame;

a gimbal rotatable about a rotation shaft with

respect to said gimbal frame, the rotation shaft extending perpendicular to a surface including said rotating shaft of said gimbal frame;
a flywheel capable of spinning about a spinning shaft with respect to said gimbal, the spinning shaft being perpendicular to a surface including said rotation shaft;
a rotational driving portion mounted on said gimbal frame and driving said gimbal in forward and reverse direction;
a spinning driving portion mounted on said gimbal and spinning said flywheel;
a lifting load pivoting clutch for making said gyro frame and said gimbal frame releasable;
a mechanism for cancelling a reaction torque to be exerted on said rotational driving portion from said gimbal frame;
a resetting oblique rotation driving portion for obliquely rotating said gimbal upon returning said gimbal at initial position;
a worm gear mechanism connected to said resetting oblique rotation driving portion;
a resetting obliquely rotating clutch provided between said worm gear mechanism and said gimbal or said rotational driving portion and making them releasable; and
control means for controlling rotation of said lifting load hanged on said lifting jig by controlling driving of said spinning driving portion, said rotational driving portion, and engagement and disengagement of said lifting load pivoting clutch and said resetting obliquely rotating clutch.

[0012] In the construction set forth above, under the normal rotating operation, the lifting load pivoting clutch is placed in engaged or connected position. By driving the spinning driving portion and the rotational driving portion at this condition, rotation and stopping of pivoting motion of the lifting load is performed.

[0013] When external disturbance, such as wind or so forth is exerted on the lifting load for causing pivoting motion about the pivoting axis, the gimbal is rotated to place the spinning shaft of the flywheel at the orientation close to vertical depending upon the magnitude of the externally applied disturbing force. Thereafter, when the gimbal is returned to the initial position, the lifting load pivoting clutch is placed in disengaged condition and the rotational driving portion is driven in reverse direction. Then, the gimbal rotates obliquely. At this time, since the flywheel is held rotating, gyro effect is caused to rotation of the gimbal frame in the same direction. However, since the gimbal frame and the gyro frame (lifting jig) are spaced away from each other, the gimbal may solely rotated without influencing to the gyro frame. Accordingly, the gimbal may be returned to the initial position without exerting pivoting force to the lifting load in the same direction.

[0014] It should be noted that when the switch of the rotational driving portion is turned OFF when the gimbal frame returns to the initial position, inertia force is exerted on the gimbal frame for further rotation to cause opposite gyro effect to act a force (torque) to obliquely rotate the gimbal in the direction way from the initial position on the rotational driving portion. However, since the mechanism for canceling the reaction torque is provided, the gimbal can be maintained at the initial position.

[0015] In the normal rotating operation, in addition to maintaining of the lifting load pivoting clutch in the engaged condition, the resetting obliquely rotating clutch is placed in the disengaged position. Upon oblique rotation for returning the gimbal to the initial position, the resetting obliquely rotating clutch is placed in engaged position and the lifting load pivoting clutch is placed in disengaged position. When the resetting oblique rotation driving portion is driven at this position, similarly to the first aspect of the invention, the gimbal may be rotated without exerting pivoting force for the lifting load.

[0016] Preferably, the lifting load attitude control system further comprises a variable constant torque transmitting device provided between the gyro frame and the gimbal frame.

[0017] Upon obliquely rotating the gimbal to return to the initial position, the gimbal frame is rotated by gyro effect. Then, only relatively small torque set by the variable constant torque transmission device is transmitted to the gyro frame. The gimbal can be quickly returned to the initial position with little influence for gyro frame and thus the lifting jig (lifting load). At this time, As a reaction field of the inertia moment of the lifting load, small transmission torque between the gyro frame and the gimbal frame serves as a force for braking rotation of the gimbal frame.

[0018] According to another aspect of the invention, a method for controlling pivoting motion of a lifting load hanged by a lifting jig employing a lifting load attitude control system as set forth above, comprises the steps of:

placing the lifting load pivoting clutch in engaged condition, placing the resetting obliquely rotating clutch in disengaged condition and driving the spinning driving portion and the rotational driving portion during normal rotating operation; and
placing the resetting obliquely rotating clutch in engaged condition, placing the lifting load pivoting clutch in disengaged condition and driving the resetting oblique rotation driving portion upon returning the gimbal to the initial position.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The present invention will be understood more fully from the detailed description given herebelow and from the accompanying drawings of the preferred embodiment of the invention, which, however, should not

be taken to be limitative to the present invention, but are for explanation and understanding only.

[0020] In the drawings:

Fig. 1 is a front elevation showing an overall construction of one embodiment of a lifting load attitude controlling system utilizing a gyro effect, according to the present invention; and

Fig. 2 is an explanatory illustration showing a mechanism for canceling a reaction torque.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0021] The present invention will be discussed in detail in terms of the preferred embodiment, with reference to the accompanying drawings. In the following description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be obvious, however, to those skilled in the art that the present invention may be practiced without these specific details. In other instance, well-known structures are not shown in detail in order to unnecessary obscure the present invention.

[0022] Figs. 1 and 2 show a lifting load attitude controlling system utilizing a gyro effect according to the present invention. The shown lifting load attitude controlling system includes a box shaped gyro frame 1 hanged by a crane (not shown), a lifting jig 4 formed with wide flange beam or H steel for hanging down a lifting load 3 (wide flange beam in the shown case) with hanging ropes 2, 2 fixedly integrated in the horizontal condition on the bottom portion of the gyro frame 1, a gimbal frame 6 rotatable about a vertical rotation axis 5 within the gyro frame 1, a gimbal 8 rotatable about a rotation shaft 7 with respect to the gimbal frame 6, and a flywheel 10 which can spin about a spinning shaft 9 with respect to the gimbal 8.

[0023] The gimbal 8 is rotatable at appropriate speed in forward and reverse directions about the rotation axis 7 (axis parallel to the lifting jig 4) perpendicular to a surface including a rotation axis 5 of the gimbal frame 6 by means of a gimbal driving motor 11 (rotary driving portion) mounted on the gimbal frame 6. On the other hand, the flywheel 10 can spin at high speed about the spinning shaft 9 perpendicular to the surface including the rotation shaft 7 of the gimbal 8 by a not shown spinning motor (spin driving portion) mounted on the gimbal. The gimbal driving motor 11 and the spinning motor are electromagnetic motors driving for rotation and spinning of the rotation shaft 7 and the spinning shaft 9 in non-contact state, respectively.

[0024] Further concrete discussion will be given for rotation mechanism of the gimbal 8. Namely, a driven pulley 12 is connected to one end of the rotation shaft 7 of the gimbal 8. A driving pulley 14 is connected to one end of a rotary driving shaft 13 arranged in parallel to the rotation shaft 7. Between both pulleys 12 and 14, a timing belt 15 is wound around. At the intermediate portion of the rotary driving shaft 13, a rotational driving force of the gimbal driving motor 11 is transmitted to the rotary driving shaft 13 via a helical gear box 16.

[0025] Furthermore, the other end of the rotary driving shaft 13 is releasably connected to a resetting obliquely rotating motor 19 (resetting obliquely rotating driving portion) via a resetting obliquely rotating clutch 17 (electromagnetic clutch) and a speed reduction mechanism 18. The gimbal driving motor 11 can drive to rotate the rotary driving shaft 13 in forward and reverse directions in non-contact condition. A warm gear mechanism 18 has non-reversible characteristics for permitting transmission of a driving force from the setting obliquely rotating motor 19 to the rotary driving shaft 13 but prohibiting transmission of driving force from the rotary driving shaft 13 to the resetting oblique rotating motor 19.

[0026] The resetting obliquely rotating clutch 17 is placed in released condition, the rotational driving force of the gimbal driving motor 11 is transmitted to the rotating driving shaft 13 and then transmitted to the rotation shaft 7 of the gimbal 8 via the driving pulley 14, the timing belt 15 and driven pulley 12 in order. On the other hand, when the resetting obliquely rotating clutch 17 is placed in engaged condition, obliquely rotating driving force of the resetting obliquely rotating motor 19 is transmitted to the rotary driving shaft 13 and then transmitted to the rotation shaft 7 of the gimbal 8. Accordingly, the gimbal driving motor 11 drives the gimbal 8 in forward and reverse directions, whereas the resetting obliquely rotating motor 19 is adapted to drive the gimbal obliquely upon returning to the initial position.

[0027] It should be noted that the resetting obliquely rotating clutch may be directly connected to the gimbal via the driven pulley 12 instead of connecting to the resetting obliquely rotating motor 19.

[0028] Also, between the bottom surface of the gyro frame 1 and the upper surface of the bottom portion of the gimbal frame 6, a lifting road rotating clutch 20 for contacting and releasing the surfaces. The lifting load pivoting clutch 20 is placed in connecting condition, the gimbal frame 6 rotates integrally with the gyro frame 1, namely the lifting jig 4 (lifting load 3). On the other hand, when the lifting load pivoting clutch 20 is released, even when rotation of the gimbal 8 is transmitted to the gimbal frame 6, the transmitted rotation force will never influence to the lifting jig 4 (lifting load).

[0029] Between the lower surface of a ceiling portion of the gyro frame 1 and the upper surface of the ceiling portion of the gimbal frame 6, a variable constant torque transmitting device 21 is provided. The variable constant torque transmitting device 21 is adapted to transmit only torque preliminarily set to be smaller among rotating forces of the gimbal frame 6.

[0030] The gimbal frame 6, the gimbal 8, the flywheel 10 and so forth form a gyro. It should be noted that, at the position of other end of the rotation shaft 7 of the gimbal, an oblique rotation detector 22 for detecting ob-

liquely rotating condition of the gimbal, is provided. Within the gyro frame 1, a control unit 23 and so forth controlling the gyro, the oblique rotation detector 22 and so forth control rotational driving of the gimbal driving motor 11, the spinning motor and the resetting obliquely rotating motor 19, and controlling rotational driving of the resetting oblique rotation clutch 17, the lifting load pivoting clutch 20 for contacting and releasing.

[0031] Next, operation will be discussed.

[0032] Upon normal rotating operation, the lifting load pivoting clutch 20 is placed in connected condition and the resetting obliquely rotating clutch 17 is placed in disconnected or released condition. At this condition, the spinning driving motor and the gimbal driving motor 11 are driven to rotatingly drive the gimbal for generating gyro effect to cause rotation of the lifting load 3 via the gimbal frame 6, the gyro frame 1 and the lifting jig 4. On the other hand, when rotational driving of the gimbal 8 is stopped, the gimbal 8 is driven to rotate by rotational force of the lifting load 3. By the gyro effect thus generated, the pivoting force of the lifting load 3 can be canceled to stop pivoting motion of the lifting load 3.

[0033] When external disturbance, such as wind and so forth is exerted on the lifting load 3, the gimbal 8 is rotated to orient spinning shaft 9 of the flywheel 10 at an angle close to vertical depending upon the force of external disturbance. Subsequently, upon obliquely driving the gimbal to return to the initial position, the resetting obliquely rotating clutch 17 is placed in the connected condition and the lifting load pivoting clutch 20 is placed in released condition. At this condition, when the resetting obliquely rotating motor 19 is driven, the gimbal 8 is obliquely rotated via the warm gear mechanism 18 and the rotatingly driving shaft 13. When the gimbal frame 6 is driven to obliquely rotate in the resetting direction, the gimbal frame 6 is rotated in the same direction to the external disturbance by the gyro effect. At this time, since the gyro frame 1 (lifting jig 4) and the gimbal frame 6 are placed in released condition, the rotational force of the gimbal 8 by gyro effect is not transmitted to the gyro frame 1. Accordingly, the rotational force is not transmitted to the lifting jig 4.

[0034] It should be noted that the resetting obliquely rotating motor 19 is connected to the warm gear mechanism having non-reversible characteristics, anti-gyro moment due to inertia moment of the gimbal frame 6 can be dumped. Accordingly, by applying large torque at low rotation speed for the gimbal, the gimbal frame 6 is rotated by the gyro moment. The rotational force to be transmitted to the gyro frame 1 acts on the variable constant torque transmitting device 21 to be only smaller rotational torque. Thus, the transmitted rotation force may give little influence to the gyro frame 1.

[0035] Furthermore, if acceleration and deceleration control, such as speed control for accelerating zone, constant speed zone and decelerating zone or so forth, is performed upon obliquely rotating the gimbal frame 6, operations of the variable constant torque transmission device 21 and the warm gear mechanism 18 may be caused depending upon oblique rotation speed and torque of the gimbal and pivoting speed of the gimbal frame 6, in chained manner so as to position of the gimbal at the predetermined position without significantly influencing for pivoting motion of the lifting load 3, and to control braking for the gimbal frame 6.

[0036] While the foregoing discussion has been given for the case where the dedicated resetting obliquely rotating motor 19 is employed, it should be possible to reset the gimbal driving motor 11 without employing such dedicated motor.

[0037] In such case, it becomes necessary to provide a mechanism for canceling the reaction torque, as set forth above. As such mechanism,

① the gimbal driving motor 11 is constructed with a motor 11A with a brake (Fig. 2a);
② an electromagnetic brake 24 a is provided on a transmission shaft between the gimbal driving motor 11 (rotatingly driving portion) and the gimbal (Fig. 2b);
③ A ratchet mechanism is provided on the transmission shaft between the gimbal driving motor 11 and the gimbal for selective engagement of the claw of the rachet (Fig. 2c).

Claims

1. A lifting load attitude control system utilizing a gyro effect, comprising:

a lifting jig (4) to be hanged in horizontal attitude for hanging a lifting load (3);
a gyro frame (1) fixed to said lifting jig;
a gimbal frame (6) rotatable about a rotating shaft (5) perpendicular to the gyro frame (1);
a gimbal (8) rotatable about a rotation shaft (7) with respect to said gimbal frame, the rotation shaft (7) extending perpendicular to a surface including said rotating shaft (5) of said gimbal frame (6);
a flywheel (10) capable of spinning about a spinning shaft (9) with respect to said gimbal (8), the spinning shaft (9) being perpendicular to a surface including said rotation shaft (7);
a rotational driving portion (11) mounted on said gimbal frame (6) and driving said gimbal (8) in forward and reverse direction;
a spinning driving portion mounted on said gimbal (8) and spinning said flywheel (11);
a lifting load pivoting clutch (20) for making said gyro frame and said gimbal frame releasable; and **characterized by**:

a mechanism for cancelling a reaction torque to be exerted on said rotational driv-

ing portion from said gimbal frame;
a resetting oblique rotation driving portion (19) for obliquely rotating said gimbal (8) upon returning said gimbal at initial position;
a worm gear mechanism (18) connected to said resetting oblique rotation driving portion;
a resetting obliquely rotating clutch (17) provided between said worm gear mechanism and said gimbal or said rotational driving portion and making them releasable; and
control means for controlling rotation of said lifting load hanged on said lifting jig by controlling driving of said spinning driving portion, said rotational driving portion, and engagement and disengagement of said lifting load pivoting clutch and said resetting obliquely rotating clutch.

2. A lifting load attitude control system as set forth in claim 1, which further comprises a variable constant torque transmitting device (21) provided between said gyro frame and said gimbal frame.

3. A method for controlling pivoting motion of a lifting load hanged by a lifting jig employing a lifting load attitude control system as set forth in claim 1 or 2, comprising the steps of:

placing said lifting load pivoting clutch (20) in engaged condition, placing said resetting obliquely rotating clutch (17) in disengaged condition and driving said spinning driving portion and said rotational driving portion during normal rotating operation; and
placing said resetting obliquely rotating clutch (17) in engaged condition, placing said lifting load pivoting clutch (20) in disengaged condition and driving said resetting oblique rotation driving portion (19) upon returning said gimbal to the initial position.

Patentansprüche

1. Ein Hebelast-Lagesteuerungssystem, das einen Gyroeffekt nutzt, mit folgenden Merkmalen:

einer Hebevorrichtung (4), die in horizontaler Lage aufgehängt sein soll, zum Aufhängen einer Hebelast (3);

einem Gyro-Rahmen (1), der an der Hebevorrichtung befestigt ist;

einem Kardanrahmen (6), der um eine Drehwelle (5) senkrecht zu dem Gryo-Rahmen (1) drehbar ist;

einem Kardanelement (8), das bezüglich des Kardanrahmens um eine Drehwelle (7) drehbar ist, wobei die Drehwelle (7) sich senkrecht zu einer Oberfläche erstreckt, die die Dreh-Welle (5) des Kardanrahmens (6) umfaßt;

einem Schwungrad (10), das in der Lage ist bezüglich des Kardanelements (8) um eine Rotationswelle (9) zu rotieren, wobei die Rotationswelle (9) senkrecht zu einer Oberfläche ist, die die Drehwelle (7) umfaßt;

einem Drehantriebsabschnitt (11), der an dem Kardanrahmen (6) angebracht ist und das Kardanelement (8) in einer Vorwärts- und Rückwärtsrichtung treibt;

einem Rotationsantriebsabschnitt, der an dem Kardanelement (8) angebracht ist und das Schwungrad (10) rotieren läßt;

einer Hebelast-Schwenkkupplung (20), um den Gryo-Rahmen und den Kardanrahmen lösbar zu machen; und **gekennzeichnet durch**:

einen Mechanismus zum Unterbinden, daß ein Reaktionsdrehmoment von dem Kardanrahmen auf den Drehantriebsabschnitt ausgeübt wird;

einen Schrägdrehrücksetzantriebsabschnitt (19) zum Schrägdrehen des Kardanelements (8) auf ein Rückkehren des Kardanelements zu einer Ausgangsposition hin;

einen Schneckenradmechanismus (18), der mit dem Schrägdrehrücksetzantriebsabschnitt verbunden ist;

eine Schrägdrehrücksetzkupplung (17), die zwischen dem Schneckenradmechanismus und dem Kardanelement oder dem Drehantriebsabschnitt vorgesehen ist und dieselben lösbar macht; und

eine Steuereinrichtung zum Steuern einer Drehung der Hebelast, die an der Hebevorrichtung aufgehängt ist, **durch** Steuern eines Treibens des Rotationsantriebsabschnitts, des Drehantriebsabschnitts und der Ineingriffnahme und Außereingriffnahme der Hebelast-Schwenkkupplung und der Schrägdrehrücksetzkupplung.

2. Ein Hebelast-Lagesteuerungssystem gemäß Anspruch 1, das ferner eine variable Konstantdrehmoment-Übertragungsvorrichtung (21) aufweist, die zwischen dem Gryo-Rahmen und dem Kardanrahmen vorgesehen ist.

3. Ein Verfahren zum Steuern einer Schwenkbewegung einer Hebelast, die durch eine Hebevorrichtung aufgehängt ist, die ein Hebelast-Lagesteuerungssystem gemäß Anspruch 1 oder 2 verwendet, das folgende Schritte aufweist:

Versetzen der Hebelast-Schwenkkupplung (20) in einen Eingriffszustand, Versetzen der Schrägdrehrücksetzkupplung (17) in einen Außereingriffszustand und Treiben des Rotationsantriebsabschnitts und des Drehantriebsabschnitts während einer normalen Drehoperation; und

Versetzen der Schrägdrehrücksetzkupplung (17) in einen Eingriffszustand, Versetzen der Hebelast-Schwenkkupplung (20) in einen Außereingriffszustand und Treiben des Schrägdrehrücksetzantriebsabschnitts (19) auf ein Rückkehren des Kardanelements zu der Ausgangsposition hin.

Revendications

1. Système pour contrôler l'attitude d'une charge levée en utilisant l'effet gyroscopique comprenant :

- un dispositif de levage (4) à accrocher horizontalement afin d'y accrocher une charge levée (3) ;
- une structure gyroscopique (1) fixée audit dispositif de levage ;
- une structure de cardan (6) pouvant tourner autour d'un arbre de rotation (5) perpendiculaire à la structure gyroscopique (1) ;
- un cardan (8) pouvànt tourner autour d'un arbre de rotation (7) par rapport à ladite structure de cardan, l'arbre de rotation (7) s'étendant perpendiculairement par rapport à une surface comprenant ledit arbre de rotation (5) de ladite structure de cardan (6) ;
- un volant (10) susceptible de tourner autour d'un arbre giratoire (9), par rapport audit cardan (8), l'arbre giratoire (9) étant perpendiculaire à une surface comprenant ledit arbre de rotation (7) ;
- un bloc d'entraînement en rotation (11) monté sur ladite structure de cardan (6) et entraînant ledit cardan (8) vers l'avant et vers l'arrière ;
- un bloc d'entraînement en rotation monté sur ledit cardan (8) et tournant ledit volant (11) ;
- un embrayage pivotant une charge levée (20) permettant de relâcher ladite structure gyroscopique et ladite structure de cardan ;

caractérisé en ce qu'il comprend :

- un mécanisme d'annulation du couple de réaction à exercer sur ledit bloc d'entraînement en rotation à partir de ladite structure de cardan ;
- un bloc d'entraînement en rotation oblique de réinitialisation (19) pour tourner obliquement ledit cardan (8) tout en le remettant dans sa position initiale ;
- un mécanisme de roue à vis sans fin (18) relié audit bloc d'entraînement en rotation oblique de réinitialisation ;
- un embrayage en rotation oblique de réinitialisation (17) disposé entre ledit mécanisme de vis sans fin et ledit cardan ou ledit bloc d'entraînement en rotation et permettant de les relâcher ; et
- des moyens de contrôle pour contrôler la rotation de ladite charge levée accrochée sur ledit dispositif de levage en contrôlant l'entraînement dudit bloc d'entraînement giratoire, dudit bloc d'entraînement en rotation et l'engagement et le désengagement dudit embrayage pivotant la charge levée et dudit embrayage en rotation oblique de réinitialisation.

2. Système pour contrôler l'attitude d'une charge levée selon la revendication 1, **caractérisé en ce qu'**il comprend en outre un dispositif transmettant un couple constant variable (21) disposé entre ladite structure gyroscopique et ladite structure de cardan.

3. Procédé pour contrôler le mouvement de pivotement d'une charge levée accrochée par un dispositif de levage utilisant un système de contrôle de l'attitude d'une charge levée selon les revendications 1 ou 2, **caractérisé en ce qu'**il comprend les étapes suivantes :

- placer ledit embrayage pivotant la charge levée (20) en position engagée, placer ledit embrayage en rotation oblique de réinitialisation (17) en position désengagée et entraîner normalement en rotation ledit bloc d'entraînement giratoire et ledit bloc d'entraînement en rotation ; et
- placer ledit embrayage en rotation oblique de réinitialisation (17) en position engagée, placer ledit embrayage pivotant la charge levée (20) en position désengagée et entraîner ledit bloc d'entraînement en rotation oblique de réinitialisation (19) tout en remettant ledit cardan dans sa position initiale.

FIG.1

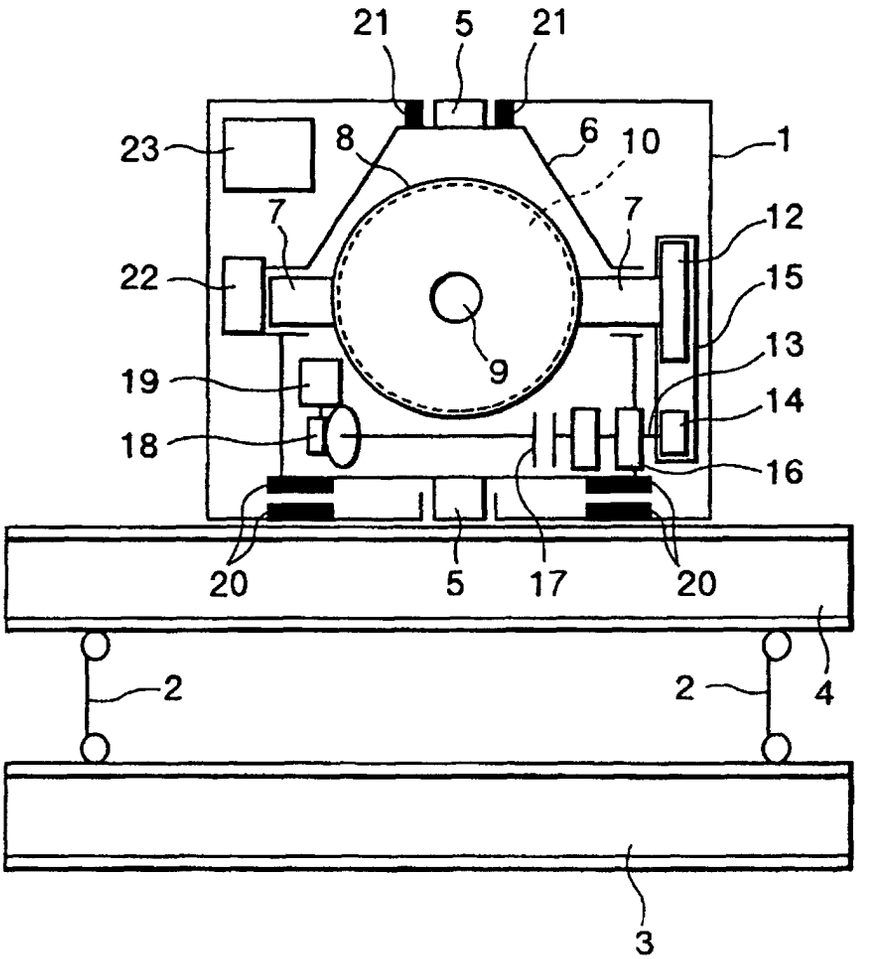
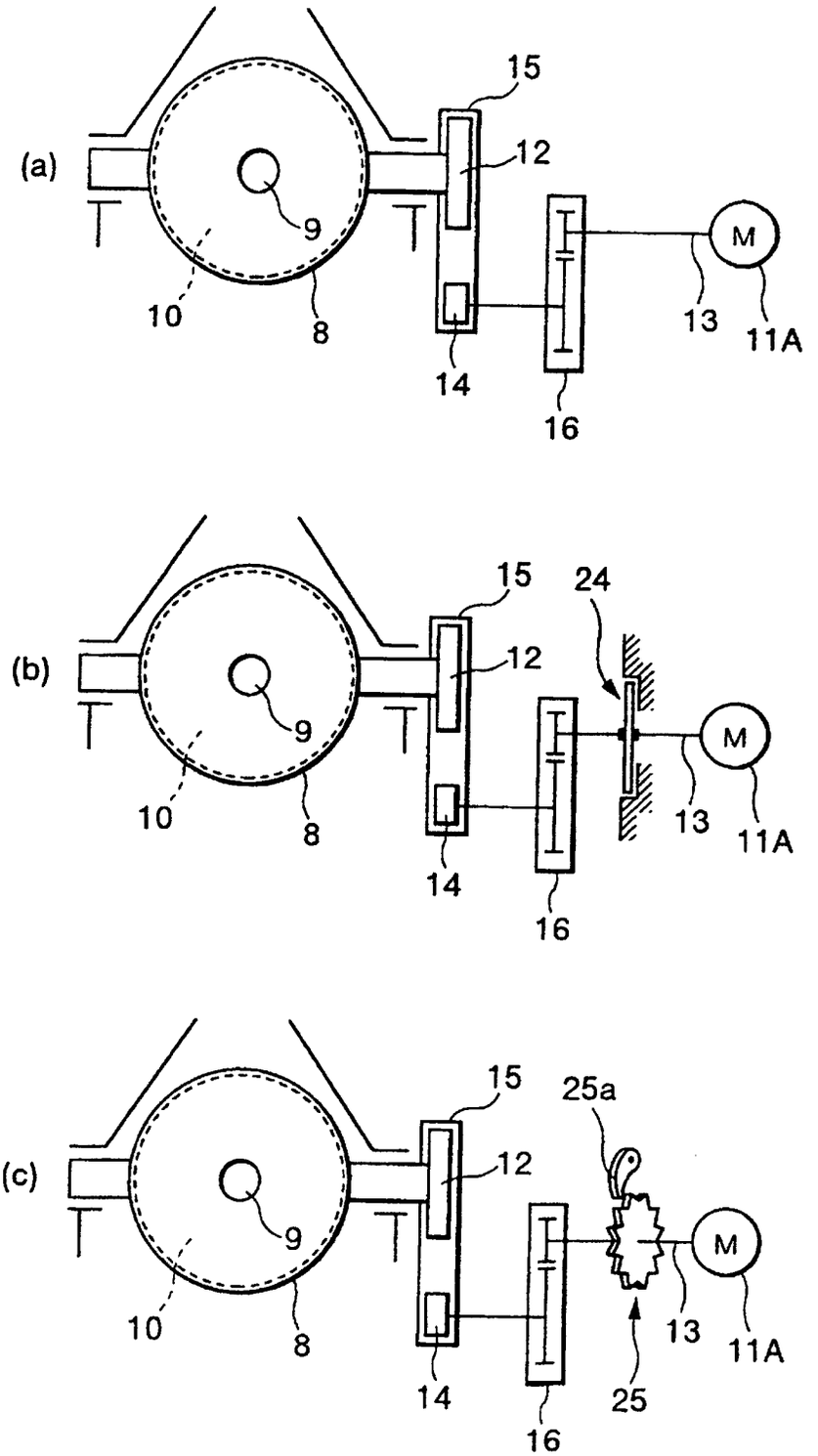


FIG.2


(a)
15
12
9
10
8
14
16
M
13
11A
(b)
15
24
12
9
10
8
14
16
M
13
11A
(c)
15
25a
12
9
10
8
14
16
25
M
13
11A