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(54) **Assembly to command and control a steering means of a marine craft**

Steuereinrichtung für ein Wasserfahrzeug

Ensemble de commande et réglage de direction pour un marine

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Description

[0001] The present invention relates to an assembly to command and control a steering means of a marine craft.

[0002] The use of hydraulically driven commands to control a steering means of a marine craft such as, for example, a rudder or a stabilizer, is known in the prior art. This type of system comprises a hydraulic actuator for each steering means that is connected directly or through a mechanical transmission to the steering means, and a hydraulic unit to operate the hydraulic actuator.

[0003] Although used because they are reliable, these hydraulic drive systems are not very satisfactory, on the one hand, because they involve the conversion of electricity to hydraulic energy and then into mechanical energy with the problems that the presence of operating fluid involves and, on the other hand, because in the event of failure they do not always allow a minimum degree of controllability of the marine craft.

[0004] To overcome the drawbacks described above, the use of electromechanical units is also known for example from in the WO 2004/108523 A1. . Although these ensure a sufficient level of maneuverability of the marine craft even in the event of partial failure of said electromechanical units, they must necessarily be greatly oversized or the actuators must be provided with an additional stroke besides that normally required and, in some other cases, additional slideways must be provided to support loads applied transversely in relation to the normal direction of operation of the steering means, inevitably involving additional costs and unacceptable construction complications.

[0005] The purpose of the present invention is to provide an assembly to command and control a steering means of a marine craft which overcomes the problems described above in a simple and cost-effective manner and that is, in particular, simple and inexpensive to produce, highly efficient and functionally reliable.

[0006] According to the present invention an assembly to command and control a steering means of a marine craft is produced, as claimed in Claim 1.

[0007] Conveniently, each of said couplings is a monostable coupling with frontal teeth normally arranged in the mating condition; actuating means are provided to move each of said monostable couplings to the release condition.

[0008] Conveniently, said couplings also comprise a common torque shaft to which said actuating means are fitted and, for each of said electromechanical drive units, a relative crank driven by the relative actuating means and rotatably coupled to the torque shaft in an axially fixed position; each of said couplings also comprises a relative selector coupled to said torque shaft in an angularly fixed position and in an axially sliding manner and suited to mate with said relative crank to maintain the relative crank in an angularly fixed position in relation to

said torque shaft.

[0009] The invention will now be described with reference to the accompanying figures which illustrate a non-limiting example of an embodiment thereof, in which:

Figure 1 illustrates schematically and essentially as a block diagram a preferred embodiment of the assembly to command and control a steering means of a marine craft according to the present invention; Figure 2 illustrates, on a greatly enlarged scale and partially in cross-section, a detail from Figure 1; and Figure 3 is a block diagram of a control system of a component of the assembly in Figure 1.

[0010] In Figure 1, number 1 indicates, as a whole, a command and control assembly for adjusting the position of a steering means 2, for example a rudder or a stabilizer, of a marine craft, which is not illustrated, about a hinge axis 2a.

[0011] The assembly 1 comprises two mutually independent electromechanical drive units which are indicated by numbers 3 and 4, a transmission device 6 connected in a known and not illustrated way to the rudder 2 and a coupling and selection device 7 interposed between the units 3 and 4 and the actuating device 6 so as to positively connect said actuating device 6 to one or both of the electromechanical units 3,4 as described more fully below.

[0012] Again with reference to Figure 1, each unit 3,4 comprises its own electric motor 10 and a screw-nut transmission 11. Each transmission 11 comprises, in turn, a relative screw 12 hinged at one end to a corresponding fixed support 13 that is connected to the relative electric motor 10 through a respective transmission belt 15, and a relative nut 16 coupled to the screw 12 and housed in a translating casing 18.

[0013] The casings 18 are hinged to the device 7, which, according to that illustrated in Figure 2, comprises a support frame 19, a splined torque shaft 20 having an axis 21 thereof orthogonal to the screws 12 and coupled to the frame 19 through a pair of bearings 22 so as to pivot about said axis 21 and in an axially fixed position.

[0014] The device 7 also comprises a crank 23 with a foot 24 fixed to a central portion of the shaft 20 and a head 25 hinged to the actuating device 6 and, for each electromechanical drive unit 3,4, a respective crank 26. The cranks 26 are arranged symmetrically on opposite sides of the crank 23, are hinged at one end to the relative translating casing 18 and, at the other end, terminate with relative feet 27 rotatably coupled to the respective terminal parts 20a of the shaft 20 and arranged to come up against a relative external radial flange 28 firmly connected to said shaft 20.

[0015] Each foot 27 bears a plurality of frontal teeth 30 facing the frontal teeth of the other foot 27 and constitutes, together with the respective portion 20a of the shaft 20, part of a relative coupling 33 for transmitting the motion to frontal teeth of the normally coupled type (Figure

2).

[0016] Each coupling 33 also comprises a relative selector 34, which is coupled to a central portion 20b of the shaft 20 in an axially sliding manner and in an angularly fixed position, and is provided with a plurality of frontal teeth 35 of its own suitable to mate with the teeth 30 of the relative foot 27. Each selector 34 is moveable along the relative portion 20b between a forward mating position, in which it holds the relative crank 26 in an angularly fixed position to the shaft 20 and consequently connects the relative unit 3,4 to the device 6 through the crank 23, and a retracted released position, in which it releases the relative crank 26 from the angular position with the shaft 20 and, consequently, uncouples the relative drive unit 3,4 from the actuating device 6.

[0017] The selectors 34 are axially moveable between the mating and release positions under the pressure of respective linear actuators 38, which are part of the device 7 and have respective outer jackets or casings 39 connected to the frame 19, and respective output rods 40 parallel to the axis 21 and hinged to relative fork elements 41 firmly fixed to the respective selectors 34 so as to define a symmetrical actuating system with respect to the crank 23.

[0018] Each linear actuator 38, when activated, moves the respective selector 34 towards its retracted release position, exerting pressure opposing that exerted by a relative spring 43, which is arranged around a relative portion 20b and is forced between the stand 24 of the crank 23 and the relative selector 34 to push said selector 34 towards its mating position.

[0019] Continuing with reference to Figures 1 and 2, the motor 10 and the linear actuator 38 of each of the units 3,4 are controlled by a respective control unit 45 to which a relative sensor 46 is electrically connected, said sensor 46 being associated with the relative nut 16 to emit a signal to the control unit 45 that is proportional to the vibration level of said nut 16; conveniently, the sensor 46 detects an amplitude of vibration of the nut 16 in a direction transversal to the axis of said relative nut 16. Each control unit 45 is also connected to a relative temperature sensor 47 also associated with the relative nut 16 and a current detector 48 that measures the current sent to the respective motor 10.

[0020] The operation of the assembly 1 will now be described with reference to Figure 3 and starting from the condition in which both units 3,4 are operating and both couplings 33 are arranged in their mating positions and only considering, for the sake of simplicity, one of the drive units 3,4, for example, unit 3.

[0021] From this condition, in the absence of any irregularities, the drive unit 3 moves the transmission device 6 under the control of the relative electronic control unit 45. During operation, the sensor 46 detects the vibration level of the relative nut 16 and sends a signal proportional to the level detected to a comparator block 50 of the control unit 45. The comparator block 50 compares the signal that is received with a threshold value

V1 which is the function of the speed of rotation of the screw 12 of the unit 3. At the same time, the sensor 47 measures the temperature of the nut 16 and sends a corresponding signal to another comparator block 51 of the control unit 45 that compares it with a dynamic threshold value V2 which is the function of the torque supplied by the motor 10, the output of the unit 3 and the ambient temperature.

[0022] In the event of one of the above mentioned threshold values being exceeded, a block 52 sends a failure signal for the unit 3 which is stored and sent to the operator of the marine craft by a block 53; in parallel, the block 52 sends the failure signal to another block 54 which determines and performs a proportional reduction of the maximum current supplied to the motor 10 according to the failure signal received, causing a proportional reduction of the torque supplied by the motor 10 to the unit 3.

[0023] During operation, the actual current supplied to the motor 10 of the unit 3 is measured by the sensor 48 and, without prejudice to the checks performed to ensure the integrity of said motor, added by an adding block 55 to the current supplied to the motor 10 of the unit 4. The sum of the supplied currents is sent to a comparator block 56 which compares it with a critical threshold value V3. When the sum of the currents exceeds said threshold value V3 the block 56 sends an emergency signal to a block 57 which also receives the failure signal from the block 53 and to a visual or acoustic emitting device 61. Once enabled by the operator, by means of the button 59, the block 57 controls the actuator 38 which moves the selector 34 of the coupling 33 associated with the unit 3 to its release position, disconnecting the failed unit 3. In this way, the unit 3 is isolated and the steering means 2 is only controlled by the unit 4 which controls the marine craft under emergency conditions.

[0024] From the foregoing it is clear that the constructional characteristics of the assembly 1 described above enable the marine craft to be kept under a minimum level of control, even in the event of a partial or total failure of one of the units without, however, having recourse to considerable oversizing of the two units, keeping the strokes of the movable elements of said units unchanged with respect to normal operating conditions and without the need to provide any additional element for guiding and/or balancing movements or loads as a consequence of the failure.

[0025] In particular, as regards the oversizing of the units 3,4, by isolating the failed unit from the kinematic chain, oversizing of the units 3,4 can be limited to below 10%, clearly reducing operational costs and weight.

[0026] The fact of providing cranks to transmit motion and of using hinges to connect the units to their relative cranks and to the fixed support, on the one hand, eliminates transversal loads without any substantial increase in weight and, on the other hand, enables the assembly 1 to be adapted to suit different devices with different strokes, simply by replacing the cranks.

[0027] From the foregoing, it follows that the assembly 1 described above is far lighter and less expensive than the known assemblies while providing the same standard of performance and reliability.

[0028] Finally, the particular single transmission shaft structure enables the assembly 1 described herein to be adapted to suit particular constructional requirements or arrangements of the steering means 2. In particular, the shaft 20 might comprise a terminal portion, which protrudes beyond the relative bearing 22 and/or the hull of the marine craft and bear the crank 23 or another equivalent device for transmitting the motion to the steering means 2 angularly coupled thereto. In that case, the steering means 2 can be connected to the crank 23 or to the above mentioned transmission device directly or through a mechanical transmission interposed in a position coaxial to the axis 21 or transversely distanced from said axis 21.

[0029] If the crank 23 is arranged on the outside of one of the bearings 22, a shoulder for the springs is provided between the two springs 43 coupled to the shaft 20 in the same way that the stand 24 of the crank 23 is coupled.

[0030] Finally, it is clear that thanks to the constructional characteristics of the assembly 1 described herein the drive units already in place on marine craft can easily be replaced without requiring special modifications or adaptations.

Claims

1. Assembly (1) to command and control a steering means (2) of a marine craft; the assembly (1) comprising actuating means (3)(4) and transmission means (7) controlled by said actuating means so as to rotate the steering means (2) about at least one hinge axis (2a); said actuating means comprising a first (3) and a second mutually independent electromechanical drive unit (4), and said transmission means comprising a single actuating device (23) to control said steering means and selector means (33,38,45) to positively connect said single actuating device (23) to one or to both of said electromechanical units (3)(4); said selector means comprise, for each of said electromechanical drive units, a relative coupling (33) for transmitting motion, and command means (38,45) to switch said coupling (33) between a mating condition, in which it couples the relative electromechanical drive unit to said actuating device (23), and a release condition, in which it uncouples the relative electromechanical drive unit from said actuating device,
characterized in that each drive unit is comprising a relative translating casing (18), and the relative coupling (33) is interposed between the relative translating casing (18) and said actuating device (23).
2. Assembly according to claim 1, **characterized by** the fact that each coupling (33) is a monostable coupling normally arranged in the mating condition, and by the fact that it comprises actuating means (38) to move each of said couplings into its released condition.
3. Assembly according to claim 2, **characterized by** the fact that each coupling (33) is a coupling with frontal teeth.
4. Assembly according to any one of the previous claims **characterized by** the fact that said couplings (33) comprise a common torque shaft (20) to which said actuating device (23) is fitted and, for each of said electromechanical drive units (3)(4), a relative crank (26) driven by the relative electromechanical drive unit (3)(4) and rotatably coupled to the torque shaft (20) and in an axially fixed position; each of said couplings also comprising a relative selector (34) coupled to said torque shaft (20) in an angularly fixed position and in an axially sliding manner and suited to mate with said relative crank (26) to maintain the relative crank in an angularly fixed position in relation to said torque shaft (20).
5. Assembly according to claim 4, **characterized by** the fact that each of said couplings comprises elastic means (43) for pushing said selector (34) towards said relative crank.
6. Assembly according to claim 4 or 5, **characterized by** the fact that said selector means are arranged symmetrically in relation to said actuating device (23).
7. Assembly according to claim 4 or 5, **characterized by** the fact that said actuating device (23) is coupled to a terminal portion of said torque shaft (20) in an angularly fixed manner.
8. Assembly according to any one of the previous claims, **characterized by** the fact that said selector means comprise, for each of said electromechanical drive units (3) (4), first means (46) to detect a vibration level of at least one element (16) of said electromechanical unit, first comparator means (50) to compare the detected vibration level with a vibration level (V1) of reference and first operator means (54) to reduce the action exerted by said electromechanical unit when the detected vibration level exceeds the vibration level of reference.
9. Assembly according to any one of the previous claims, **characterized by** the fact that said selector means also comprise; for each of said electromechanical driving units (3) (4), second means (47) to detect the temperature of at least one element (16)

of said electromechanical unit, second comparator means (51) to compare the detected temperature with a threshold temperature limit (V2) and second operator means (54) to reduce the action exerted by said electromechanical unit when the detected temperature exceeds the threshold temperature.

10. Assembly according to claim 8 or 9, **characterized by** the fact that said operator means comprise, for each of said electromechanical units (3) (4) electrical variator means (54) to reduce the current supplied to the electromechanical unit.

11. Assembly according to any one of the previous claims, **characterized by** the fact that said selector means comprise for each of said electromechanical drive units (3)(4), calculating means (46,47,50,51,52) to calculate a fault condition of said electromechanical drive unit and to emit a relative failure signal, third means (48) to detect the value of the current supplied to each of said electromechanical driving units (3) (4), adding means (55) to determine the total current supplied to said electromechanical units (3) (4), third comparator means (56) to compare said total current supplied with a current threshold limit (V3) and emit an emergency signal and third operator means (33,38,57) to disconnect each of said electromechanical units (3,4) from said actuating device (23) in the presence of said failure signal and said emergency signal.

Patentansprüche

1. Anordnung (1) zum Steuern und Kontrollieren einer Lenkeinrichtung (2) eines Wasserfahrzeugs; wobei die Anordnung (1) aufweist eine Betätigungseinrichtung (3) (4) und eine Übertragungseinrichtung (7), die durch die Betätigungseinrichtung so gesteuert wird, dass die Lenkeinrichtung (2) um wenigstens eine Gelenkachse (2a) dreht; wobei die Betätigungseinrichtung eine erste (3) und eine zweite gegenseitig voneinander abhängige elektromechanische Antriebseinheit (4) aufweist, und wobei die Übertragungseinrichtung eine einzelne Betätigungseinrichtung (23) aufweist, um die Lenkeinrichtung und eine Auswahleinrichtung (33, 38, 45) so zu steuern, dass die einzelne Betätigungseinrichtung (23) mit einer oder mit beiden der elektromechanischen Einheiten (3) (4) positiv verbunden ist; wobei die Auswahleinrichtung für jede der elektromechanischen Antriebseinheiten aufweist eine jeweilige Kupplung (33) zum Übertragen einer Bewegung und eine Steuereinrichtung (38, 45), um die Kupplung (33) zwischen einem zusammenpassenden Zustand, in welchem diese die jeweilige elektromechanische Antriebseinheit mit der Betätigungseinrichtung (23) kuppelt, und einem voneinander gelösten Zustand, in welchem die-

se die jeweilige elektromechanische Antriebseinheit von der Betätigungseinrichtung entkuppelt, zu schalten,

dadurch gekennzeichnet, dass jede Antriebseinheit ein jeweiliges Translationsgehäuse (18) umfasst und die jeweilige Kupplung (33) zwischen dem jeweiligen Translationsgehäuse (18) und der Betätigungseinrichtung (23) angeordnet ist.

2. Anordnung nach Anspruch 1, **gekennzeichnet durch** die Tatsache, dass jede Kupplung (33) eine monostabile Kupplung ist, die normalerweise in dem zusammenpassenden Zustand angeordnet ist, und **durch** die Tatsache, dass diese eine Betätigungseinrichtung (38) umfasst, um jede der Kupplungen in ihren voneinander gelösten Zustand zu bewegen.

3. Anordnung nach Anspruch 2, **gekennzeichnet durch** die Tatsache, dass jede Kupplung (33) eine Kupplung mit Frontalzähnen ist.

4. Anordnung nach einem der vorhergehenden Ansprüche, **gekennzeichnet, durch** die Tatsache, dass die Kupplungen (33) umfassen eine gemeinsame Drehmomentwelle (20), an welcher die Betätigungseinrichtung (23) angebracht ist, eine jeweilige Kurbel (26), die **durch** die jeweilige elektromechanische Antriebseinheit (3) (4) angetrieben und mit der Drehmomentwelle (20) und in einer axial befestigten Position drehend gekuppelt ist; wobei jede der Kupplungen auch eine jeweilige Auswahleinrichtung (34) umfasst, die mit der Drehmomentwelle (20) in einer winkelfixierten Position und in einer axial verschieblichen Weise gekuppelt ist und dazu geeignet ist, mit der jeweiligen Kurbel (26) zusammenzupassen, um die jeweilige Kurbel in einer winkelfixierten Position in Bezug zu der Drehmomentwelle (20) zu halten.

5. Anordnung nach Anspruch 4, **gekennzeichnet durch** die Tatsache, dass jede der Kupplungen elastische Mittel (43) zum Drücken der Auswahleinrichtung (34) in Richtung der jeweiligen Kurbel umfasst.

6. Anordnung nach Anspruch 4 oder 5, **gekennzeichnet durch** die Tatsache, dass die Auswahleinrichtung symmetrisch in Bezug zu der Betätigungseinrichtung (23) angeordnet ist.

7. Anordnung nach Anspruch 4 oder 5, **gekennzeichnet durch** die Tatsache, dass die Betätigungseinrichtung (23) mit einem Endbereich der Drehmomentwelle (20) in einer winkelfixierten Weise gekuppelt ist.

8. Anordnung nach einem der vorhergehenden Ansprüche, **gekennzeichnet durch** die Tatsache, dass die Auswahleinrichtung aufweist, für jede der

elektromechanischen Antriebseinheiten (3) (4), eine erste Einrichtung (46), um einen Vibrationspegel wenigstens eines Elements (16) der elektromechanischen Einheit zu detektieren, eine erste Vergleichseinrichtung (50), um den detektierten Vibrationspegel mit einem Bezugs-Vibrationspegel (V1) zu vergleichen, und eine erste Betriebseinrichtung (24), um die **durch** die elektromechanische Einheit ausgeübte Wirkung zu verringern, wenn der detektierte Vibrationspegel den Bezugs-Vibrationspegel übersteigt.

9. Anordnung nach einem der vorhergehenden Ansprüche, **gekennzeichnet durch** die Tatsache, dass die Auswahleinrichtung auch umfasst, für jede der elektromechanischen Antriebseinheiten (3) (4), eine zweite Einrichtung (47), um die Temperatur wenigstens eines Elements (16) der elektromechanischen Einheit zu detektieren, eine zweite Vergleichseinrichtung (51), um die erfasste Temperatur mit einer Schwellenwert-Temperaturgrenze (V2) zu vergleichen, und eine zweite Betriebseinrichtung (54), um die **durch** die elektromechanische Einheit ausgeübte Wirkung zu verringern, wenn die detektierte Temperatur die Schwellenwerttemperatur übersteigt.
10. Anordnung nach Anspruch 8 oder 9, **gekennzeichnet durch** die Tatsache, dass die Betriebseinrichtung umfasst, für jede der elektromechanischen Einheiten (3) (4), eine elektrische Variationseinrichtung (54), um den Strom zu verringern, mit dem die elektromechanische Einheit versorgt wird.
11. Anordnung nach einem der vorhergehenden Ansprüche, **gekennzeichnet durch** die Tatsache, dass die Auswahleinrichtung für jede der elektromechanischen Antriebseinheiten (3) (4) umfasst eine Berechnungseinrichtung (46, 47, 50, 51, 52), um einen Fehlerzustand der elektromechanischen Antriebseinheit zu berechnen und ein jeweiliges Fehlersignal auszugeben, eine dritte Einrichtung (48), um den Wert des Stroms zu detektieren, der jeder der elektromechanischen Antriebseinheiten (3) (4) zugeführt wird, eine Addiereinrichtung (55), um den Gesamtstrom zu bestimmen, mit dem die elektromechanischen Einheiten (3) (4) versorgt werden, eine dritte Vergleichseinrichtung (56), um den gelieferten Gesamtstrom mit einem StromGrenzwert (V3) zu vergleichen und ein Notfallsignal auszugeben, und eine dritte Vergleichseinrichtung (33, 38, 57), um jede der elektromechanischen Einheiten (3, 4) von der Betätigungseinrichtung (23) bei Vorhandensein des Fehlersignals und des Notfallsignals zu lösen.

Revendications

1. Ensemble (1) pour commander et contrôler des moyens de direction (2) d'une unité navale; l'ensemble (1) comprenant des moyens d'actionnement (3) (4) et des moyens de transmission (7) contrôlés par lesdits moyens d'actionnement afin de faire tourner les moyens de direction (2) autour d'un axe de charnière (2a) ; lesdits moyens d'actionnement comprenant une première (3) et une deuxième unité d'entraînement électromécanique (4) mutuellement indépendantes, et lesdits moyens de transmission comprenant un seul dispositif d'actionnement (23) pour contrôler lesdits moyens de direction et des moyens de sélection (33, 38, 45) pour raccorder de manière positive ledit dispositif d'actionnement unique (23) à l'une ou aux deux desdites unités électromécaniques (3) (4) ; lesdits moyens de sélection comprennent, pour chacune desdites unités d'entraînement électromécaniques, un couplage relatif (33) pour transmettre le mouvement, et des moyens de commande (38, 45) pour faire passer ledit couplage (33) d'une condition de couplage dans laquelle il couple l'unité d'entraînement électromécanique relative audit dispositif d'actionnement (23) à une condition de libération dans laquelle il découple l'unité d'entraînement électromécanique relative dudit dispositif d'actionnement, **caractérisé en ce que** :

chaque unité d'entraînement comprend un boîtier de translation relatif (18), et
le couplage relatif (33) est intercalé entre le boîtier de translation relatif (18) et ledit dispositif d'actionnement (23).
2. Ensemble selon la revendication 1, **caractérisé en ce que** chaque couplage (33) est un couplage monostable normalement agencé dans la condition de couplage, et **en ce qu'il** comprend des moyens d'actionnement (38) pour déplacer chacun desdits couplages dans sa condition libérée.
3. Ensemble selon la revendication 2, **caractérisé en ce que** chaque couplage (33) est un couplage avec des dents frontales.
4. Ensemble selon l'une quelconque des revendications précédentes, **caractérisé en ce que** lesdits couplages (33) comprennent un arbre de torsion commun (20) sur lequel ledit dispositif d'actionnement (23) est monté et, pour chacune desdites unités d'entraînement électromécaniques (3) (4), une manivelle relative (26) entraînée par l'unité d'entraînement électromécanique relative (3) (4) et couplée en rotation à l'arbre de torsion (20) et dans une position axialement fixe ; chacun desdits couplages comprenant également un sélecteur relatif (34) couplé audit

- arbre de torsion (20) dans une position angulairement fixe et d'une manière axialement coulissante et appropriée pour se coupler avec la manivelle relative (26) afin de maintenir la manivelle relative dans une position angulairement fixe par rapport audit arbre de torsion (20). 5
5. Ensemble selon la revendication 4, **caractérisé en ce que** chacun desdits couplages comprend des moyens élastiques (43) pour pousser ledit sélecteur (34) vers ladite manivelle relative. 10
6. Ensemble selon la revendication 4 ou 5, **caractérisé en ce que** lesdits moyens de sélection sont agencés symétriquement par rapport audit dispositif d'actionnement (23). 15
7. Ensemble selon la revendication 4 ou 5, **caractérisé en ce que** ledit dispositif d'actionnement (23) est couplé à une partie terminale dudit arbre de torsion (20) d'une manière angulairement fixe. 20
8. Ensemble selon l'une quelconque des revendications précédentes, **caractérisé en ce que** lesdits moyens de sélection comprennent, pour chacune desdites unités d'entraînement électromécaniques (3) (4), des premiers moyens (46) pour détecter un niveau de vibration d'au moins un élément (16) de ladite unité électromécanique, des premiers moyens comparateurs (50) pour comparer le niveau de vibration détecté avec un niveau de vibration (V1) de référence et des premiers moyens opérateurs (54) pour réduire l'action exercée par ladite unité électromécanique lorsque le niveau de vibration détecté dépasse le niveau de vibration de référence. 25 30 35
9. Ensemble selon l'une quelconque des revendications précédentes, **caractérisé en ce que** lesdits moyens de sélection comprennent également, pour chacune desdites unités d'entraînement électromécaniques (3) (4), des deuxièmes moyens (47) pour détecter la température d'au moins un élément (16) de ladite unité électromécanique, des deuxièmes moyens comparateurs (51) pour comparer la température détectée avec une limite de température de seuil (V2) et des deuxièmes moyens opérateurs (54) pour réduire l'action exercée par ladite unité électromécanique lorsque la température détectée dépasse la température de seuil. 40 45 50
10. Ensemble selon la revendication 8 ou 9, **caractérisé en ce que** lesdits moyens opérateurs comprennent, pour chacune desdites unités électromécaniques (3) (4), des moyens de variateur électrique (54) pour réduire le courant alimenté à l'unité électromécanique. 55
11. Ensemble selon l'une quelconque des revendica-

tions précédentes, **caractérisé en ce que** lesdits moyens de sélection comprennent pour chacune desdites unités d'entraînement électromécaniques (3) (4), des moyens de calcul (46, 47, 50, 51, 52) pour calculer une condition d'anomalie de ladite unité d'entraînement électromécanique et pour émettre un signal de défaillance relatif, des troisièmes moyens (48) pour détecter la valeur du courant fournie à chacune desdites unités d'entraînement électromécaniques (3) (4), des moyens d'addition (55) pour déterminer le courant total fourni auxdites unités électromécaniques (3) (4), des troisièmes moyens comparateurs (56) pour comparer ledit courant total fourni avec une limite de seuil de courant (V3) et émettre un signal d'urgence et des troisièmes moyens opérateurs (33, 38, 57) pour déconnecter chacune desdites unités électromécaniques (3, 4) dudit dispositif d'actionnement (23) en présence dudit signal de défaillance et dudit signal d'urgence.

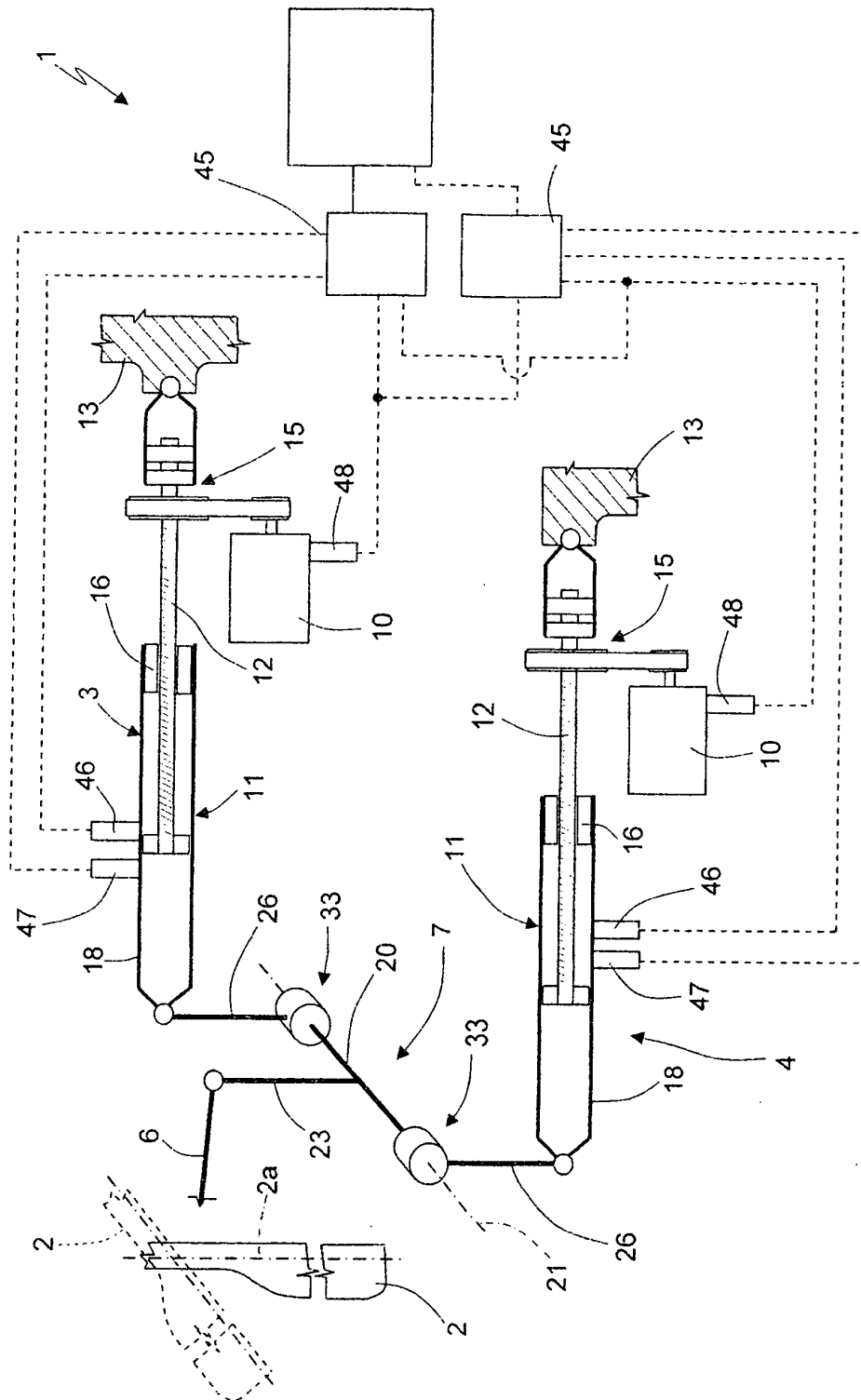


Fig.1

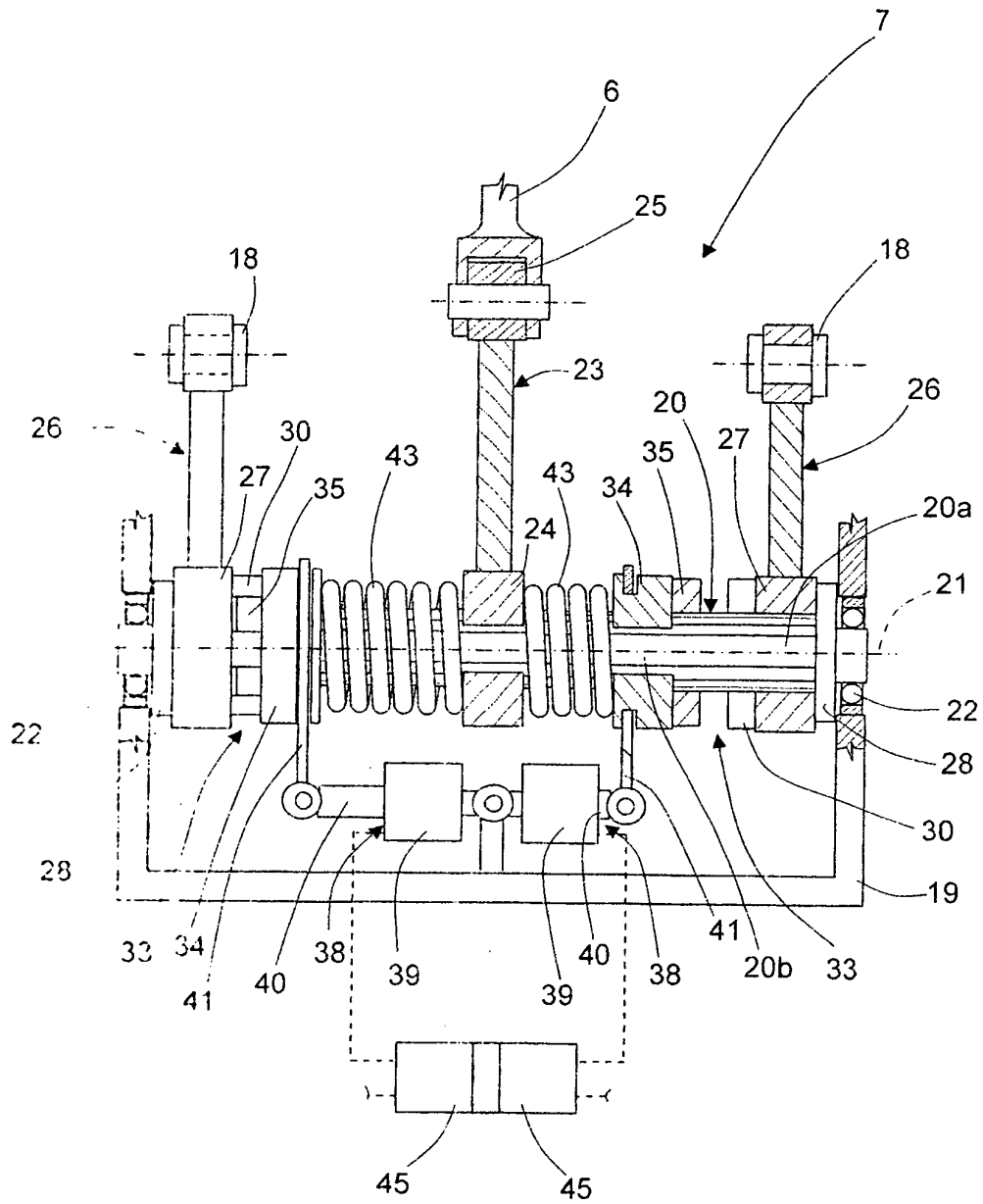


Fig.2

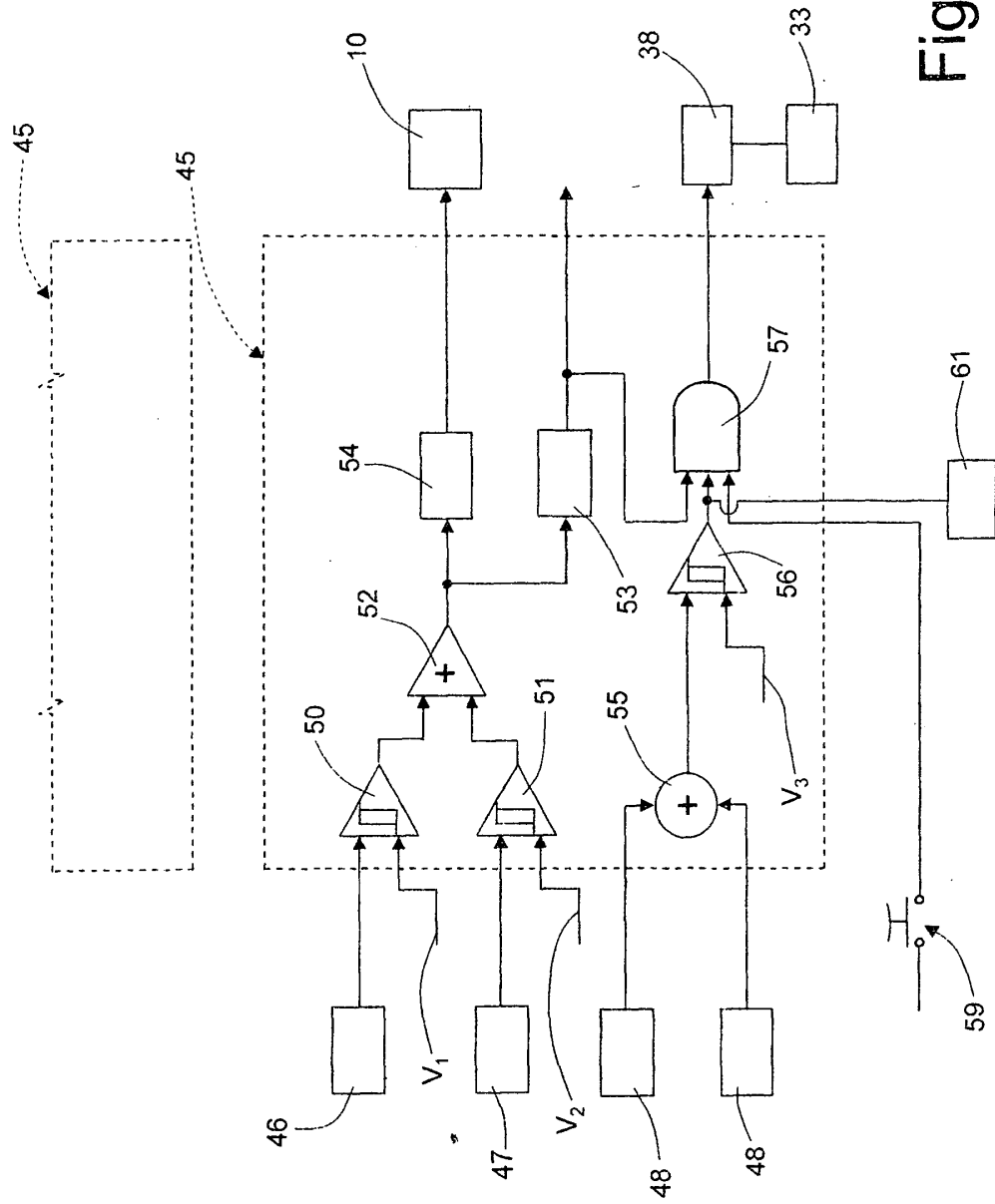


Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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