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Description

[0001] The present invention relates generally to resistance exercise systems and, more particularly, to an electronically controlled training apparatus able to provide a natural reaction, either a static or a dynamic reaction.

State of the art

[0002] Various electronic and hydraulic exercise systems have been developed over the past number of years which have raised the level of sophistication associated with lifting weights. Nevertheless, the reaction feeling of this kind of systems is still far from the classic training apparatuses reactions, as the dynamic reaction of weight or the static reaction of elastic bands.

[0003] State of the art training apparatuses, as the one disclosed in document US11058908B2, comprise a motor configured to drive a pump which pumps fluid in order to control a hydraulic actuator. In order to select the direction of movement of the actuator, a flow controller controls one or more valves for redirecting the fluid from the pump to the actuator or to a reservoir. When the actuator movement direction changes, the flow controller changes the valves position. Nevertheless, although it is quite fast, valves position change is not instantly, and the user's reaction feeling is unnatural.

[0004] Document US5064193A discloses a training apparatus comprising a linear hydraulic actuator, a hydraulic pump, a motor linked to the hydraulic pump and a control unit. The hydraulic pump includes two pump ports and a pump shaft, being configured to convert hydraulic pressure and/or flow received at any of the pump ports into torque and/or rotation of the pump shaft and vice versa, wherein at least one of said two pump ports is in fluid communication with at least one cavity port of the linear hydraulic actuator. The motor has a rotary part mechanically coupled to said pump shaft in a way that their longitudinal rotation is transferred from one to the other and wherein the control unit is electronically linked to the motor and configured to control the rotation dynamics of the rotary part and, therefore, of the linear hydraulic actuator.

[0005] Document WO2017031585A discloses a training apparatus comprising two clutches linked to two pistons to be able to control and generate an antagonistic displacement of an actuator. It also mentions that the power source may be an electric motor or a hydraulic motor.

[0006] Document US2015224845A1 discloses a vehicle suspension that comprises a hydraulic actuator, a hydraulic motor-pump and an electric motor linked to the hydraulic motor-pump. The hydraulic motor-pump is configured to transmit hydraulic pressure and/or flow to the hydraulic actuator ports.

[0007] Document DE3704841A1 discloses a training apparatus comprising a hydraulic piston as an actuator.

In order to adjust the force and speed of the actuator, it has an adjustable throttle valve. Therefore, the need for a training apparatus which provides a natural reaction, either a static or a dynamic reaction, is still unsolved by the state of the art.

Description of the invention

[0008] The object of the present invention is to provide a muscle training apparatus for applying resistance to movements of a user, the training apparatus comprising:

- at least one hydraulic actuator including a movable element and a housing provided with at least one inner cavity configured to be filled with a fluid, the movable element having at least one outer part and at least one inner part mechanically joined to the at least one outer part, the at least one outer part being arranged outside the housing and configured to be moved by a user in a first direction and/or a second direction opposite the first direction, the at least one inner part being movably arranged inside the at least one inner cavity of the housing and configured to be pushed by the fluid when moved in the first direction and/or to push the fluid outside the at least one inner cavity (111) when moved in the second direction, wherein at least one of the inner cavities comprises a cavity port suitable for fluid flow, and
- a hydraulic device including two device ports suitable for fluid flow and a device shaft configured to bidirectionally rotate through its longitudinal axis, wherein the hydraulic device is configured to convert hydraulic pressure and/or flow received at any of the device ports into torque and/or rotation of the device shaft and vice versa, and wherein at least one of said two device ports is in fluid communication with said at least one cavity port of the at least one hydraulic actuator.

[0009] The present training apparatus is characterized in that comprises a bidirectional electric motor and a control unit, the electric motor having a rotary part, as a shaft or a rotor, which is coupled to said device shaft in a way that their longitudinal rotation is transferred from one to the other, and wherein the control unit is configured to control the rotation dynamics of the rotary part.

[0010] Thanks to the present training apparatus's configuration, the force exerted by the user to the outer movable part is directly transmitted to the electric motor (the dynamics of which are defined by the control unit) and vice versa, so the training apparatus is able to transmit a natural reaction, either static or dynamic (i.e., the resistance perceived by the user may be independent or dependent respectively on the acceleration of the movable element), either at least at a section of the movement path or at the whole movement path. Besides, the training apparatus provides a direct force feedback thanks to the direct connection between the hydraulic

actuator and the hydraulic device. Besides, the present training apparatus allows concentric only or eccentric only movements, as well as both kinds of movement, while applying various dynamic or static profiles, i.e., the training apparatus is able to accommodate any required user configuration.

[0011] In a first embodiment of the training apparatus, the at least one inner part hermetically divides the at least one inner cavity into at least two chambers, wherein the volume of the chambers is variable and defined by the relative position of the at least one inner part position within the at least one inner cavity. In a first implementation of this first embodiment, the training apparatus comprises a reservoir and the at least one hydraulic actuator is a single acting hydraulic cylinder, the cavity port of the at least one single acting hydraulic cylinder being in fluid communication with one of said two device ports of the hydraulic device, and the other of said two device ports of the hydraulic device being in fluid communication with the reservoir. In a second implementation of this embodiment of the training apparatus, at least two chambers of the at least one hydraulic actuator comprise a corresponding cavity port suitable for fluid flow and each of said two device ports of the hydraulic device is in fluid communication with one cavity port. As a first example of this implementation, the at least one hydraulic actuator is a longitudinal double acting hydraulic cylinder. As a second example of this implementation, the at least one hydraulic actuator is a rotary vane actuator, the at least one inner cavity of the rotary vane actuator being defined by a circular sector and the at least one inner part being defined by a rotating lever configured to rotate through an axis located at the circular sector centre, and hence the at least one outer part is also configured to rotate through said axis.

[0012] In a second embodiment of the training apparatus, the at least one hydraulic actuator is a bidirectional hydraulic motor, i.e., a motor that converts hydraulic pressure and flow from the fluid into torque and rotation and vice versa. The hydraulic motor can be of the kind of comprising several chambers defined between several rotating levers acting as said inner parts, as for example a vane motor. As another implementation of the hydraulic motor, it can be of the kind of a piston motor, a gear motor or an orbital motor.

[0013] Preferably, the control unit comprises an interface unit, i.e., an input unit which may comprise a display unit. The control unit is configured to receive from a user the rotating dynamics to be applied to the rotary part of the electric motor. Preferably, the interface unit comprises a touch screen attached to the training apparatus and/or a smart phone linkable to the control unit, so a user may introduce said rotating dynamics through the touch screen attached to the training apparatus and/or through an app installed at its smart phone.

[0014] In a preferred embodiment, the control unit is configurable to command the electric motor to apply a determined torque to the rotary part in at least one rotat-

ing direction, thereby applying a determined resisting force to the movable element when the hydraulic device and the at least one hydraulic actuator comprise hydraulic fluid. For example, the control unit is configurable to command the electric motor to apply a threshold torque for which inhibits movement of the rotary part (and hence of the movable element of the at least one hydraulic actuator (until a user force bigger than threshold torque is applied to the movable element. The control unit may be configurable as well to command the electric motor to apply different torque at different rotating positions of the rotary part, for example, increasing and/or decreasing torques depending on the position of the rotary part and hence of the movable element. Optionally, the control unit may be configurable to command the electric motor to rotate at a determined speed, i.e., when the hydraulic device and the at least one hydraulic actuator comprise hydraulic fluid, a corresponding fluid flow is generated at the hydraulic device which applies the suitable fluid pressure for moving the inner part of the movable element at a determined speed. The control unit may be configurable as well to command the electric motor to apply different rotating speeds at different rotating positions of the rotary part, for example, increasing and/or decreasing speeds depending on the position of the rotary part and hence of the movable element.

[0015] In a possible embodiment, the hydraulic device consists of a hydraulic motor, i.e., a device configured to receive a fluid flow and/or pressure at at least one device port (from the at least one hydraulic actuator in this case) and generate a corresponding device shaft rotation and/or torque. Preferably, it is a back drivable hydraulic motor, i.e., a motor which is also able to be driven by a mechanical force to act as a hydraulic pump, especially when working at a low fluid pressure, for example between 70 and 100 bars. In an alternative embodiment, the hydraulic device consists of a bidirectional hydraulic pump, i.e., a device configured to receive a torque at the device shaft (from the electric motor in this case) and generate a corresponding fluid pressure at at least one device port (which is transmitted to the inner part of the movable element through a cavity port in order to obtain a resistance force at the at least one outer part). Preferably, it is a back drivable pump, i.e., a hydraulic pump able to work as a hydraulic motor.

[0016] Preferably, the training apparatus comprises a shaft coupler configured to coupling the device shaft and the rotary part of the electric motor, in order to adapt axial and/or angular misalignment and/or absorb impacts due to fast accelerations.

Brief description of the drawings

[0017]

FIG. 1 shows a schematic illustration of a first embodiment of the present training apparatus.

FIG. 2 shows a schematic illustration of a second

embodiment of the training apparatus.

FIG. 3 shows a schematic illustration of a third embodiment of the training apparatus.

FIG. 4 shows a schematic illustration of a fourth embodiment of the training apparatus.

FIG. 5 shows a schematic illustration of a fifth embodiment of the training apparatus.

FIG. 6 shows a schematic illustration of a sixth embodiment of the training apparatus.

Description of preferred embodiments

[0018] Figures 1 to 6 schematically show different embodiments of the present training apparatus, all of them comprising:

- a hydraulic device (10) consisting of a back drivable hydraulic motor or a back drivable hydraulic pump, that is to say, the hydraulic device (10) comprises a device shaft (11) and two device ports (12) and is configured to receive a fluid flow and/or pressure at one device port (11) and generate a corresponding device shaft rotation and/or torque, and vice versa,
- a bidirectional electric motor (20) and a control unit (30), the electric motor (20) having a shaft as a rotary part (21), which is mechanically coupled to said device shaft (11) in a way that their longitudinal rotation is transferred from one to the other and wherein the control unit (30) is electronically linked to the electric motor (20) and configured to control the rotation dynamics of the rotary part (21).

[0019] Figure 1 shows a first embodiment of the training apparatus (1), which also comprises a reservoir (40) and a hydraulic actuator (100) consisting of a single acting hydraulic cylinder, of which a sectional view is represented. This hydraulic actuator (100) includes a movable element (101) and a housing (110) provided with an inner cavity (111). The movable element (101) comprises one outer part (102) arranged outside the inner cavity (111) and one inner part (103) arranged inside the inner cavity (111). The inner part (103) acts as a plunger configured to hermetically divide the inner cavity (111) into two variable chambers, the volume of which is defined by the relative position of the inner part (103) position within the inner cavity (111). The outer part (102) is mechanically joined to the inner part (103) through a longitudinal rod (104), so movement and/or force received at the inner part (103) is transmitted to the outer part (102) and vice versa.

[0020] In said first embodiment, one chamber of the hydraulic actuator (100) comprises a cavity port (112) in fluid communication with one of said device ports (12) of the hydraulic device (10), while the other one of said device ports (12) is in fluid communication with said reservoir (40). All together they form a hydraulic circuit wherein, when filled with fluid (represented by hatched area), the movable element (101) is configured to push

the fluid and the hydraulic device (10) is configured to direct the fluid flow that comes from the hydraulic actuator (100) to the reservoir (40) through its device ports (12), and vice versa, while applying a determined fluid pressure if requested by the control unit (30) through the electric motor (20). The hydraulic device (10) is configured so that the rotation speed and torque of its device shaft (11) is inextricably linked to the flow rate and pressure exerted by said fluid through the device ports (12) and vice versa. As the device shaft (11) is mechanically coupled to the rotary part (21) of the electric motor (20), the force exerted at or by the movable element (101) is controlled by the control unit (30) in a dynamic reaction manner.

[0021] Figure 2 shows a second embodiment of the training apparatus (2) comprising a hydraulic actuator (200) consisting of a double acting double rod hydraulic cylinder, of which a sectional view is represented. The movable element (201) of this second embodiment comprises two outer parts (202, 206) mechanically joined to one inner part (203) through each longitudinal rod (204, 205). The inner part (203) is configured to hermetically divide the inner cavity of the hydraulic actuator (200) into two variable chambers (210, 211) of a same maximum volume. Each chamber (210, 211) comprises a corresponding cavity port (212, 213) in fluid communication with a corresponding device port (12) of the hydraulic device (10). All together they form a hydraulic circuit filled with fluid, wherein the movable element (201) is configured to push the fluid from any of the chambers (210, 211) and the hydraulic device (10) is configured to direct the fluid flow that comes from one chamber (210, 211) to the other one through its device ports (12), and vice versa. Therefore, as in the first embodiment, the force exerted at or by the movable element (201) of the present embodiment is controlled by the control unit (30) in a dynamic reaction manner. As shown in figure 3, the hydraulic actuator (300) may also consist of a double acting hydraulic cylinder while its movable element (301) comprises only one outer part (302) and only one rod (304). Therefore, the maximum volume of the chamber (310) comprising the rod (304) is lower than the maximum volume of the other chamber (311), so the training apparatus (3) needs a reservoir (40) and corresponding valves (41) in order to manage the fluid flow from one chamber (310) to the other chamber (311) and vice versa.

[0022] Figure 4 shows a fourth embodiment of the training apparatus (4) comprising a hydraulic actuator (400) consisting of a rotary vane actuator, of which a sectional view is represented. The inner cavity of this hydraulic actuator (400) is defined by a circular sector, while the inner part (403) of its movable element (401) is defined by a rotating lever configured to rotate through an axis located at the circular sector centre. Hence, its outer part (402), not shown in the figure, is also configured to rotate through said axis. The inner part (403) is configured to hermetically divide the inner cavity of the hydraulic actuator (400) into two variable chambers (410, 411) of

a same maximum volume. Each chamber (410, 411) comprises a corresponding cavity port (412, 413) in fluid communication with a corresponding device port (12) of the hydraulic device (10). All together they form a hydraulic circuit filled with fluid, wherein the movable element (401) is configured to push the fluid from any of the chambers (410, 411) and the hydraulic device (10) is configured to direct the fluid flow that comes from one chamber (410, 411) to the other one through its device ports (12), and vice versa. Therefore, as in the previous embodiments, the force exerted at or by the movable element (401) of the present embodiment is controlled by the control unit (30) in a dynamic reaction manner. A similar fifth embodiment of the training apparatus (5) is shown in figure 5, wherein the hydraulic actuator (500) consist of a rotary vane actuator comprising two inner cavities divided by two inner parts (503, 503') into four chambers (510, 510'. 511, 511'). Each chamber (510, 510'. 511, 511') comprises a corresponding cavity port (512, 512', 513, 513') in fluid communication in pairs with a corresponding device port (12) of the hydraulic device (10).

[0023] Figure 6 shows a sixth embodiment of the training apparatus (6) comprising a hydraulic actuator (600) consisting of a hydraulic motor comprising several variable chambers (610) defined between several rotating levers which act as inner parts (603). Two cavity ports (612) of this hydraulic actuator (600) are in fluid communication with each of the two device ports (12) of the hydraulic device (10). The pressure and fluid flow coming from the hydraulic device (10) is converted into torque and rotation of the rotating levers (603) and vice versa.

Claims

1. Training apparatus (1) comprising:

- at least one hydraulic actuator (100) including a movable element (101) and a housing (110) provided with at least one inner cavity (111) configured to be filled with a fluid, the movable element (101) having at least one outer part (102) and at least one inner part (103) mechanically joined to the at least one outer part (102), the at least one outer part (102) being arranged outside the housing (110) and configured to be moved by a user in a first direction and/or a second direction opposite the first direction, the at least one inner part (103) being movably arranged inside the at least one inner cavity (111) of the housing (110) and configured to be pushed by the fluid when moved in the first direction and/or to push the fluid outside the at least one inner cavity (111) when moved in the second direction, wherein at least one of the inner cavities comprises a cavity port (112) suitable for fluid flow,

- a hydraulic device (10) including two device ports (12) suitable for fluid flow and a device shaft (11) configured to bidirectionally rotate through its longitudinal axis, wherein the hydraulic device (10) is configured to convert hydraulic pressure and/or flow received at any of the device ports (12) into torque and/or rotation of the device shaft (11) and vice versa, and wherein at least one of said two device ports (12) is in fluid communication with said at least one cavity port (112) of the at least one hydraulic actuator (100),

- a bidirectional electric motor (20) and a control unit (30), the electric motor (20) having a rotary part (21) mechanically coupled to said device shaft (11) in a way that their longitudinal rotation is transferred from one to the other and wherein the control unit (30) is electronically linked to the electric motor (20) and configured to control the rotation dynamics of the rotary part (21),

characterized in that the at least one hydraulic actuator (400) is a rotary vane actuator, the at least one inner cavity (411) of the rotary vane actuator being defined by a circular sector and the at least one inner part (403) being defined by a rotating lever configured to rotate through an axis located at the circular sector centre.

2. Training apparatus (1) according to claim 1, wherein the at least one inner part (103) hermetically divides the at least one inner cavity (111) into at least two chambers, wherein the volume of the chambers is variable and defined by the relative position of the at least one inner part (103) position within the at least one inner cavity (111).
3. Training apparatus (1) according to claim 2, wherein comprises a reservoir (40) and wherein the at least one hydraulic actuator (100) is a single acting hydraulic cylinder, the cavity port (112) of its inner cavity (111) being in fluid communication with one of said two device ports (12) of the hydraulic device (10), and the other of said two device ports (12) of the hydraulic device (10) being in fluid communication with the reservoir (40).
4. Training apparatus (2) according to claim 2, wherein at least two chambers (210, 211) of the at least one hydraulic actuator (200) comprise a corresponding cavity port (212, 213) suitable for fluid flow and each of said two device ports (12) of the hydraulic device (10) is in fluid communication with each cavity port (212, 213).
5. Training apparatus (2) according to claim 4, wherein the at least one hydraulic actuator (200) is a longitudinal double acting hydraulic cylinder.

6. Training apparatus (6) according to claim 1, wherein the at least one hydraulic actuator (600) is a bidirectional hydraulic motor.
7. Training apparatus (1) according to any of previous claims, wherein the control unit (30) comprises an interface unit configured to receive from a user the rotating dynamics to be applied to the rotary part (21). 5
8. Training apparatus (1) according to claim 7, wherein the control unit (30) is configurable to command the electric motor (20) to apply a determined torque to the rotary part (21) in at least one rotating direction. 10
9. Training apparatus (1) according to claim 8, wherein the control unit (30) is configurable to command the electric motor (20) to inhibit movement of the rotary part (21) until a threshold user force value is applied to the movable element (101). 15
10. Training apparatus (1) according to claim 8 9, wherein the control unit (30) is configurable to command the electric motor (20) to apply different torque at different rotating positions of the rotary part (21). 20
11. Training apparatus (1) according to any of claims 7 to 10, wherein the control unit (30) is configurable to command the electric motor (20) to rotate at a determined speed. 25
12. Training apparatus (1) according to claim 11, wherein the control unit (30) is configurable to command the electric motor (20) to apply different rotating speeds at different rotating positions of the rotary part (21). 30
13. Training apparatus (1) according to any of previous claims, wherein the hydraulic device (10) consists of a hydraulic motor. 35
14. Training apparatus (1) according to any of claims 1 to 13, wherein the hydraulic device (10) consists of a hydraulic pump. 40

Patentansprüche

1. Trainingsvorrichtung (1), umfassend: 45
 - mindestens einen Hydraulikaktor (100) einschließlich eines bewegbaren Elements (101) und eines Gehäuses (110), das mit mindestens einem Innenhohlraum (111) versehen ist, der konfiguriert ist, mit einem Fluid gefüllt zu sein, wobei das bewegbare Element (101) mindestens einen Außenabschnitt (102) und mindestens einen Innenabschnitt (103), der mit dem

mindestens einen Außenabschnitt (102) mechanisch verbunden ist, aufweist, der mindestens eine Außenabschnitt (102) außerhalb des Gehäuses (110) angeordnet ist und konfiguriert ist, durch einen Anwender in einer ersten Richtung und/oder einer zweiten Richtung, die der ersten Richtung entgegengesetzt ist, bewegt zu werden, wobei der mindestens einen Innenabschnitt (103) innerhalb des mindestens einen Innenhohlraums (111) des Gehäuses (110) bewegbar angeordnet ist und konfiguriert ist, durch das Fluid gedrückt zu werden, wenn er in der ersten Richtung bewegt wird, und/oder das Fluid aus dem mindestens einen Innenhohlraum (111) zu drücken, wenn er in der zweiten Richtung bewegt wird, wobei mindestens einer der Innenhohlräume eine Hohlraumöffnung (112) umfasst, die für einen Fluiddurchfluss geeignet ist,

- eine Hydraulikeinrichtung (10) einschließlich zweier Einrichtungsöffnungen (12), die für Fluiddurchfluss geeignet sind, und einer Einrichtungswelle (11), die konfiguriert ist, sich um ihre Längsachse bidirektional zu drehen, wobei die Hydraulikeinrichtung (10) konfiguriert ist, Hydraulikdruck und/oder Durchfluss, die bei beliebigen der Einrichtungsöffnungen (12) empfangen werden, in Drehmoment und/oder Drehung der Einrichtungswelle (11) umzuwandeln und umgekehrt, und mindestens eine der zwei Einrichtungsöffnungen (12) mit der mindestens einen Hohlraumöffnung (112) des mindestens einen Hydraulikaktors (100) in Fluidkommunikation ist, und

- einen bidirektionalen Elektromotor (20) und eine Steuereinheit (30), wobei der Elektromotor (20) einen Drehabschnitt (21) aufweist, der an die Einrichtungswelle (11) in einer Weise mechanisch gekoppelt ist, dass ihre Längsdrehung von einem zu dem anderen übertragen wird, und wobei die Steuereinheit (30) mit dem Elektromotor (20) elektronisch verbunden ist und konfiguriert ist, die Drehdynamik des Drehabschnitts (21) zu steuern,

dadurch gekennzeichnet, dass der mindestens einen Hydraulikaktor (400) ein Drehschaufelaktor ist, der mindestens einen Innenhohlraum (411) des Drehschaufelaktors durch einen kreisförmigen Sektor definiert ist und der mindestens einen Innenabschnitt (403) durch einen Drehhebel definiert ist, der konfiguriert ist, sich um eine Achse zu drehen, die bei dem Zentrum des kreisförmigen Sektors angeordnet ist.

2. Trainingsvorrichtung (1) nach Anspruch 1, wobei der mindestens einen Innenabschnitt (103) den mindestens einen Innenhohlraum (111) in mindestens zwei

Kammern hermetisch unterteilt, wobei das Volumen der Kammern veränderlich ist und durch die Relativposition der Position des mindestens einen Innenabschnitts (103) in dem mindestens einen Innenhohlraum (111) definiert ist.

3. Trainingsvorrichtung (1) nach Anspruch 2, die einen Behälter (40) umfasst, wobei der mindestens eine Hydraulikaktor (100) ein einfachwirkender Hydraulikzylinder ist, die Hohlraumöffnung (112) seines Innenhohlraums (111) mit einer der zwei Einrichtungsöffnungen (12) der Hydraulikeinrichtung (10) in Fluidkommunikation ist und die weitere der zwei Einrichtungsöffnungen (12) der Hydraulikeinrichtung (10) mit dem Behälter (40) in Fluidkommunikation ist. 5
4. Trainingsvorrichtung (2) nach Anspruch 2, wobei mindestens zwei Kammern (210, 211) des mindestens einen Hydraulikaktors (200) eine entsprechende Hohlraumöffnung (212, 213) umfassen, die für Fluiddurchfluss geeignet ist, und jede der zwei Einrichtungsöffnungen (12) der Hydraulikeinrichtung (10) mit jeder Hohlraumöffnung (212, 213) in Fluidkommunikation ist. 10
5. Trainingsvorrichtung (2) nach Anspruch 4, wobei der mindestens eine Hydraulikaktor (200) ein längs gerichteter doppeltwirkender Hydraulikzylinder ist. 15
6. Trainingsvorrichtung (6) nach Anspruch 1, wobei der mindestens eine Hydraulikaktor (600) ein bidirektionaler Hydraulikmotor ist. 20
7. Trainingsvorrichtung (1) nach einem der vorhergehenden Ansprüche, wobei die Steuereinheit (30) eine Schnittstelleneinheit umfasst, die konfiguriert ist, von einem Anwender die auf den Drehabschnitt (21) auszuübende Drehdynamik zu empfangen. 25
8. Trainingsvorrichtung (1) nach Anspruch 7, wobei die Steuereinheit (30) konfigurierbar ist, den Elektromotor (20) anzuweisen, auf den Drehabschnitt (21) ein bestimmtes Drehmoment in mindestens einer Drehrichtung auszuüben. 30
9. Trainingsvorrichtung (1) nach Anspruch 8, wobei die Steuereinheit (30) konfigurierbar ist, den Elektromotor (20) anzuweisen, Bewegung des Drehabschnitts (21) zu hemmen, bis ein Schwellenanwenderkraftwert auf das bewegbare Element (101) ausgeübt wird. 35
10. Trainingsvorrichtung (1) nach Anspruch 8 oder 9, wobei die Steuereinheit (30) konfigurierbar ist, den Elektromotor (20) anzuweisen, bei verschiedenen Drehstellungen des Drehabschnitts (21) verschiedene Drehmoment auszuüben. 40

11. Trainingsvorrichtung (1) nach einem der Ansprüche 7 bis 10, wobei die Steuereinheit (30) konfigurierbar ist, den Elektromotor (20) anzuweisen, sich mit einer bestimmten Drehzahl zu drehen. 45

12. Trainingsvorrichtung (1) nach Anspruch 11, wobei die Steuereinheit (30) konfigurierbar ist, den Elektromotor (20) anzuweisen, bei verschiedenen Drehstellungen des Drehabschnitts (21) verschiedene Drehahlen auszuüben. 50

13. Trainingsvorrichtung (1) nach einem der vorhergehenden Ansprüche, wobei die Hydraulikeinrichtung (10) aus einem Hydraulikmotor besteht. 55

14. Trainingsvorrichtung (1) nach einem der Ansprüche 1 bis 13, wobei die Hydraulikeinrichtung (10) aus einer Hydraulikpumpe besteht.

Revendications

1. Appareil d'entraînement (1), comprenant :

- au moins un actionneur hydraulique (100) incluant un élément mobile (101) et un logement (110) pourvu d'au moins une cavité intérieure (111) configurée pour être remplie d'un fluide, l'élément mobile (101) présentant au moins une partie extérieure (102) et au moins une partie intérieure (103) jointe mécaniquement à la au moins une partie extérieure (102), la au moins une partie extérieure (102) étant agencée à l'extérieur du logement (110) et configurée pour être déplacée par un utilisateur dans une première direction et/ou une seconde direction opposée à la première direction, la au moins une partie intérieure (103) étant agencée de manière mobile à l'intérieur de la au moins une cavité intérieure (111) du logement (110) et configurée pour être poussée par le fluide lorsqu'elle est déplacée dans la première direction et/ou pour pousser le fluide en dehors de la au moins une cavité intérieure (111) lorsqu'elle est déplacée dans la seconde direction, dans lequel au moins une des cavités intérieures comprend un orifice de cavité (112) adapté à un écoulement de fluide,
- un dispositif hydraulique (10) incluant deux orifices de dispositif (12) adaptés à un écoulement de fluide et un arbre de dispositif (11) configuré pour tourner de manière bidirectionnelle par l'intermédiaire de son axe longitudinal, dans lequel le dispositif hydraulique (10) est configuré pour convertir une pression hydraulique et/ou un écoulement reçu au niveau de l'un quelconque des orifices de dispositif (12) en un couple et/ou une rotation de l'arbre de dispositif

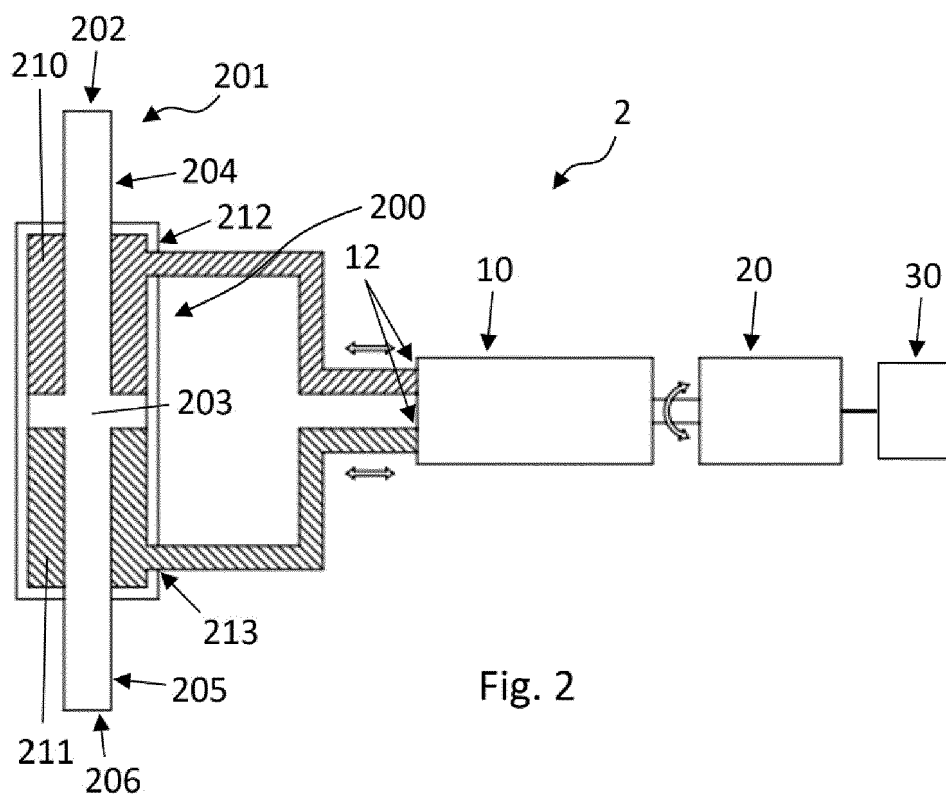
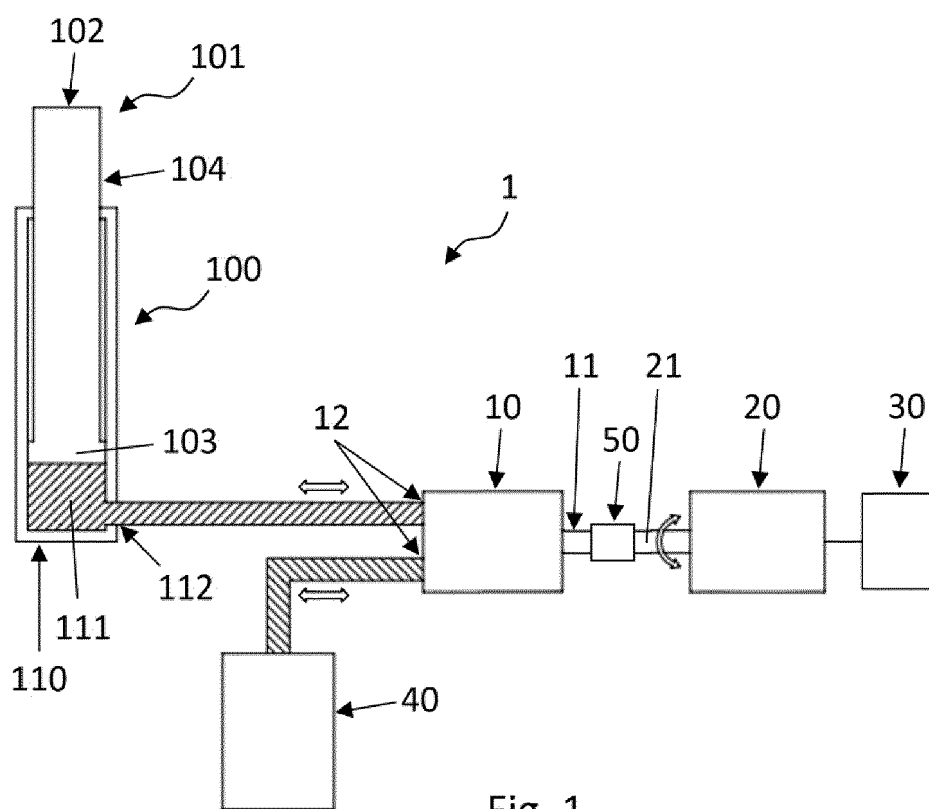
(11) et vice versa, et dans lequel au moins un desdits deux orifices de dispositif (12) est en communication fluide avec ledit au moins un orifice de cavité (112) du au moins un actionneur hydraulique (100),

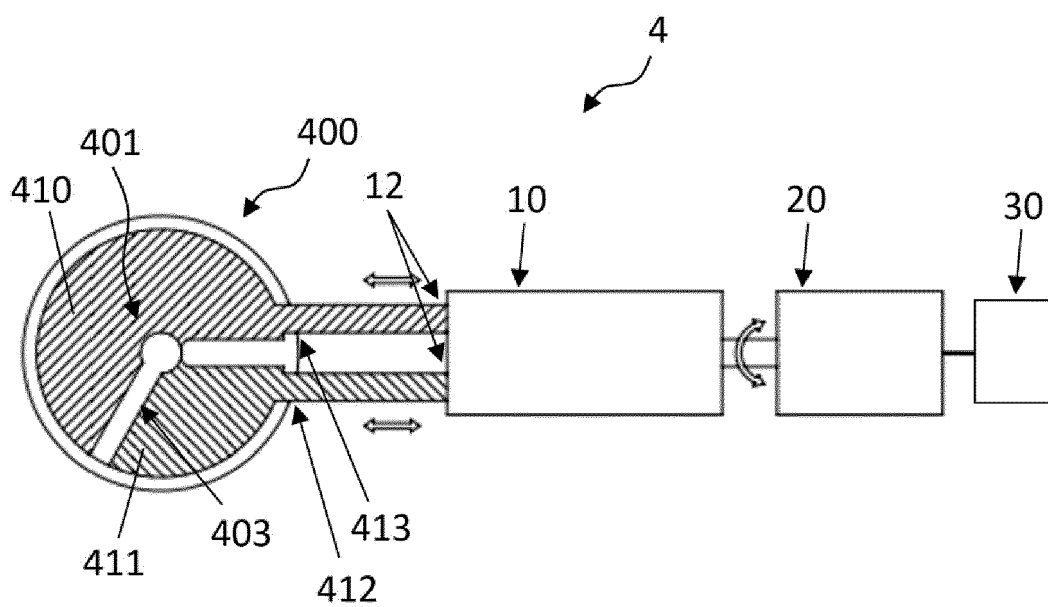
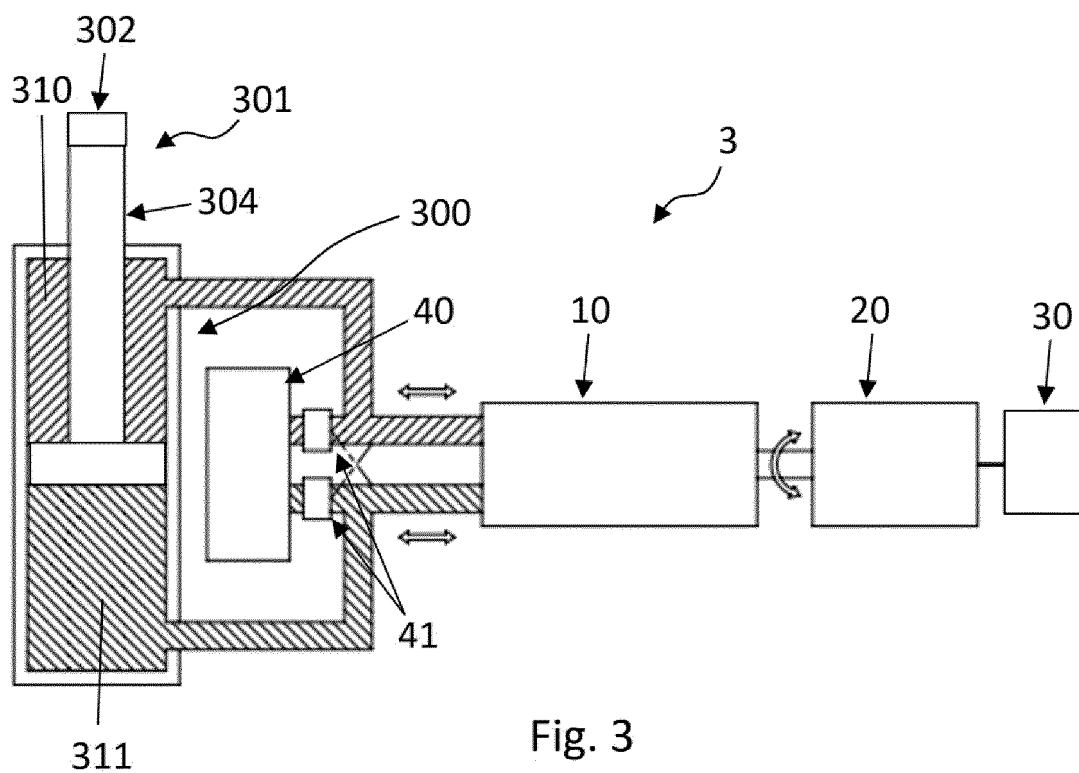
- un moteur électrique bidirectionnel (20) et une unité de commande (30), le moteur électrique (20) présentant une partie rotative (21) couplée mécaniquement audit arbre de dispositif (11) de manière à ce que leur rotation longitudinale soit transférée de l'un à l'autre et dans lequel l'unité de commande (30) est reliée électroniquement au moteur électrique (20) et configurée pour commander la dynamique de rotation de la partie rotative (21),

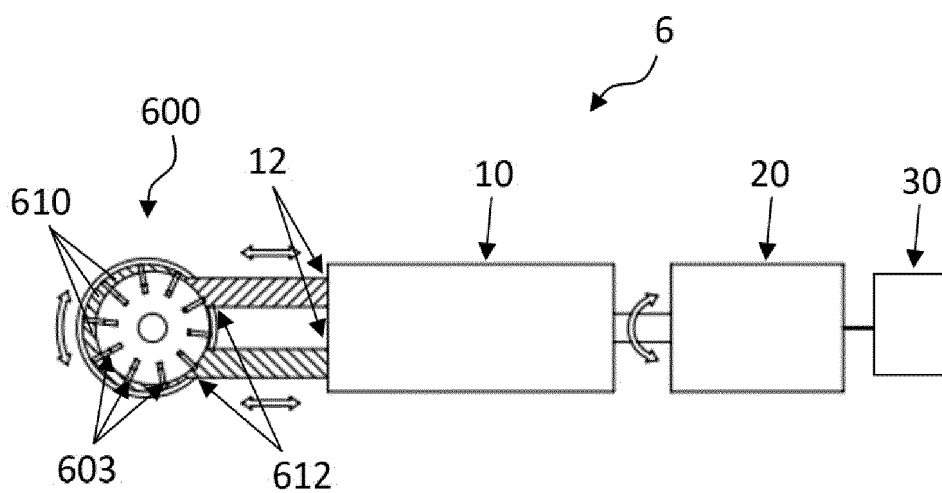
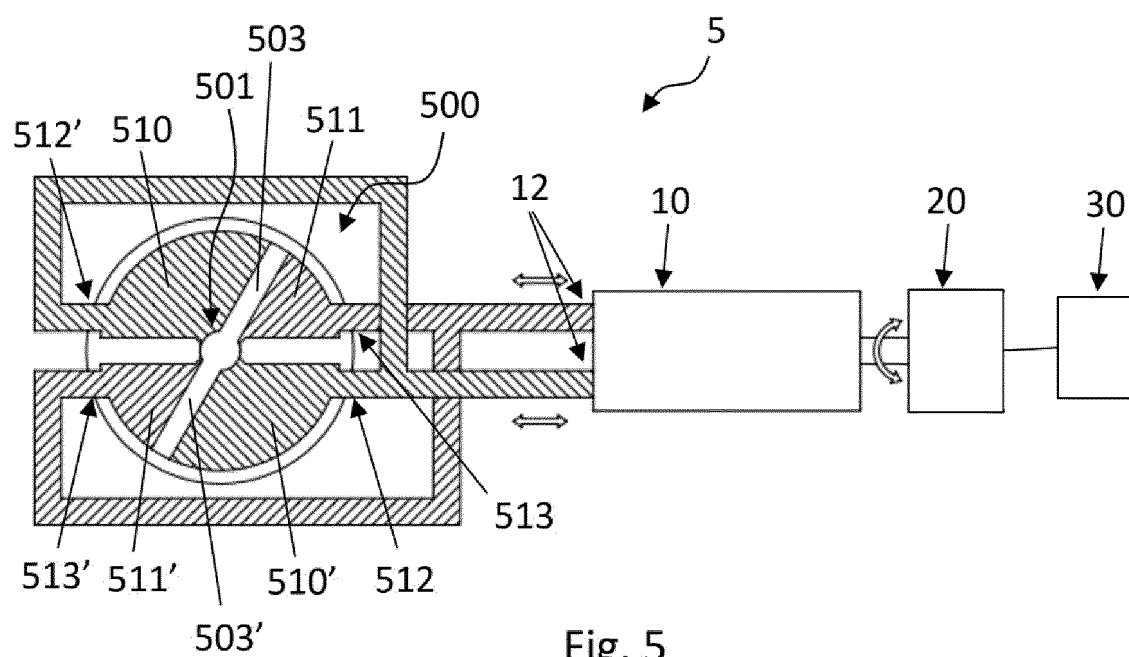
caractérisé en ce que le au moins un actionneur hydraulique (400) est un actionneur rotatif à palette, la au moins une cavité intérieure (411) de l'actionneur rotatif à palette étant définie par un secteur circulaire et la au moins une partie intérieure (403) étant définie par un levier rotatif configuré pour tourner via un axe situé au centre du secteur circulaire.

2. Appareil d'entraînement (1) selon la revendication 1, dans lequel la au moins une partie intérieure (103) divise hermétiquement la au moins une cavité intérieure (111) en au moins deux chambres, dans lequel le volume des chambres est variable et défini par la position relative de la au moins une position de partie intérieure (103) à l'intérieur de la au moins une cavité intérieure (111).
3. Appareil d'entraînement (1) selon la revendication 2, comprenant un réservoir (40) et dans lequel le au moins un actionneur hydraulique (100) est un vérin hydraulique à simple effet, l'orifice de cavité (112) de sa cavité intérieure (111) étant en communication fluide avec un certain desdits deux orifices de dispositif (12) du dispositif hydraulique (10), et l'autre desdits deux orifices de dispositif (12) du dispositif hydraulique (10) étant en communication fluide avec le réservoir (40).
4. Appareil d'entraînement (2) selon la revendication 2, dans lequel au moins deux chambres (210, 211) du au moins un actionneur hydraulique (200) comprennent un orifice de cavité correspondant (212, 213) adapté à un écoulement de fluide et chacun desdits deux orifices de dispositif (12) du dispositif hydraulique (10) est en communication de fluide avec chaque orifice de cavité (212, 213).
5. Appareil d'entraînement (2) selon la revendication 4, dans lequel le au moins un actionneur hydraulique (200) est un vérin hydraulique à double effet longitudinal.

6. Appareil d'entraînement (6) selon la revendication 1, dans lequel le au moins un actionneur hydraulique (600) est un moteur hydraulique bidirectionnel.
7. Appareil d'entraînement (1) selon l'une quelconque des revendications précédentes, dans lequel l'unité de commande (30) comprend une unité d'interface configurée pour recevoir d'un utilisateur la dynamique de rotation à appliquer à la partie rotative (21).
8. Appareil d'entraînement (1) selon la revendication 7, dans lequel l'unité de commande (30) peut être configurée pour commander au moteur électrique (20) d'appliquer un couple déterminé à la partie rotative (21) dans au moins une direction de rotation.
9. Appareil d'entraînement (1) selon la revendication 8, dans lequel l'unité de commande (30) peut être configurée pour commander au moteur électrique (20) d'empêcher un déplacement de la partie rotative (21) jusqu'à ce qu'une valeur de force d'utilisateur de seuil soit appliquée à l'élément mobile (101).
10. Appareil d'entraînement (1) selon la revendication 8 ou 9, dans lequel l'unité de commande (30) peut être configurée pour commander au moteur électrique (20) d'appliquer un couple différent à différentes positions de rotation de la partie rotative (21).
11. Appareil d'entraînement (1) selon l'une quelconque des revendications 7 à 10, dans lequel l'unité de commande (30) peut être configurée pour commander au moteur électrique (20) de tourner à une vitesse déterminée.
12. Appareil d'entraînement (1) selon la revendication 11, dans lequel l'unité de commande (30) peut être configurée pour commander au moteur électrique (20) d'appliquer différentes vitesses de rotation à différentes positions de rotation de la partie rotative (21).
13. Appareil d'entraînement (1) selon l'une quelconque des revendications précédentes, dans lequel le dispositif hydraulique (10) consiste en un moteur hydraulique.
14. Appareil d'entraînement (1) selon l'une quelconque des revendications 1 à 13, dans lequel le dispositif hydraulique (10) consiste en une pompe hydraulique.







REFERENCES CITED IN THE DESCRIPTION

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