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(54) **IMPROVED EXERCISE MACHINE AND OPERATING METHOD THEREOF**

VERBESSERTES ÜBUNGSGERÄT UND VERFAHREN ZU DESSEN BETRIEB

APPAREIL D'EXERCICE AMÉLIORÉ ET SA MÉTHODE DE FONCTIONNEMENT

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Description

[0001] The present invention relates to an improved exercise machine, comprising a monitoring system.

[0002] The present invention also relates to the operating method of this machine.

[0003] More specifically, the invention relates to an exercise machine for strength training and for the rehabilitation of the lower limbs, in particular for medical-rehabilitative purposes.

[0004] In the following, the description will be directed to exercise machines for training the lower limbs, but it is clear that the same should not be considered limited to this specific use.

[0005] Currently, machines for training the lower limbs comprise a weight stack or a resistant device are used. Usually, this resistant device is an actuator, connected to one end of a flexible cable, whose resistant force opposes the execution of exercises by a user.

[0006] The other end of the flexible cable is secured to a pulley, which rotates with respect to a fulcrum, integrally with a tubular element, on which the user rests his lower limbs.

[0007] The gymnastic exercise using these machines consists of a concentric movement, when the user lifts the tubular element with his/her leg, overcoming the resistance of the weight stack or of the resistant device, and an eccentric movement, when the user lowers his leg and the tubular element returns to its initial position.

[0008] During the concentric movement, the user must overcome the resistance of the weight stack or resisting device, which transmits its resisting force through the flexible cable.

[0009] During the eccentric movement, the cable continues to exert a resisting force, thus causing an effort for the user during the return of the tubular element to the initial position, since he/she must exercise control over the movement so as not to cause the leg to abruptly fall.

[0010] The distance of the tubular element from the fulcrum of the pulley can be varied, to adapt to the anatomy of each user, in particular, according to the length of the leg.

Document SE1650813 discloses an exercise machine which is suitable for leg extension and leg curl exercises.

[0011] A disadvantage of these exercise machines is given by the fact that, when the distance of the tubular element from the fulcrum of the pulley is varied, the force that a user must exert to lift the same weight changes since the torque which develops on the fulcrum of the pulley depends on the distance of the tubular element from the fulcrum itself.

[0012] This means that, if the tubular element is arranged at two distinct distances from the fulcrum, the effort perceived by the user during the execution of the same gymnastic exercise is different, with the same resistance force.

[0013] Furthermore, a further drawback of the known machines is that the flexible cable exerts the same resisting action both during the concentric and eccentric movement, causing an overload for the user's leg during the eccentric movement.

[0014] In light of the above, it is, therefore, an object of the present invention to accurately control the effort made by the user during the execution of the gymnastic exercise.

[0015] Another object of the present invention is to provide a gymnastic machine in which the return of the tubular element to the initial position is regular and controlled.

[0016] A further object is to provide an operating method for such an exercise machine.

[0017] It is, therefore, a specific object of the present invention an exercise machine for performing at least one gymnastic exercise, of the type comprising a resistant device, configured to provide resistance to the execution of said at least one gymnastic exercise, an arm, connected to said resistant device, capable of rotating around a rotation axis, a tubular element, coupled to said arm, so as to slide along said arm, to vary its distance from said rotation axis, and a logic control unit, connected to said resistant device, in which the parameters relating to said at least one gymnastic exercise are memorized, comprising a detection device for detecting the position of said tubular element along said arm, and for sending the corresponding signals to said control logic unit, and said control logic unit is configured to vary the resistance of said resistant device as a function of the signals sent to said logic control unit, relative to the position of said tubular element.

[0018] According to the invention, said tubular element comprises a first movable end and a second free end, said arm may comprise a plurality of housings, in each of which said first movable end is able to fit, said detection device being able to detect the housing of said plurality of housings, in which said tubular element is arranged, and the data relating to the distance of said housings of said plurality of housings from said rotation axis are stored in said logic control unit.

[0019] Further according to the invention, said detection device may comprise a plurality of sensors, each one arranged in correspondence with a housing of said plurality of housings of said arm.

[0020] Still according to the invention, said detection device comprises at least one reflecting element, coupled to said tubular element, to slide along said plurality of sensors and position in correspondence with the sensor of said plurality of sensors, corresponding to the housing of said plurality of housings in which said tubular element is arranged.

[0021] Always according to the invention, said exercise machine may comprise a pulley, rotating around said rotation axis integrally with said arm, and a closed-circuit cable, to connect said pulley to said resistant device.

[0022] Preferably according to the invention, said cable may comprise a first and a second ends, coupled to said pulley, and said pulley may comprise a first and a

second tensioning element, to adjust respectively the tension on said first and on said second end of said cable.

[0023] It is further object of the present invention an operating method of an exercise machine comprising the following steps:

a. receiving data corresponding to the position of said tubular element along said arm;
b. comparing said data received in said step a. with calibration data;
c. sending a signal corresponding to said comparison performed in said step b. to said logic control unit;
d. adjusting the resistance of said resistant device on the basis of said signal sent in said step c.

[0024] The present invention will be now described, for illustrative but not limitative purposes, according to its preferred embodiments, with particular reference to the figures of the enclosed drawings, wherein:

figure 1 shows an axonometric view of an exercise machine, object of the present invention, in a first adjustment position;
figure 2 shows a side view of a detail of the exercise machine shown in figure 1;
figure 3 shows an isometric view of a detail of the exercise machine shown in figure 1;
figure 4 shows an isometric view of a further detail of the exercise machine shown in figure 1;
figure 5 shows an axonometric view of the exercise machine shown in figure 1, in a second adjustment position; and
figure 6 shows an isometric view of the exercise machine shown in figure 1, in a third adjustment position.

[0025] In the various figures, similar parts will be indicated by the same reference numbers.

[0026] With reference to the attached figures, it is possible to observe an exercise machine M, object of the present invention.

[0027] The exercise machine M comprises a frame 1, a seat 2, an exercise system 3, a control logic unit U, and a user interface I.

[0028] The frame 1 supports the machine M and extends mainly on a vertical plane XY.

[0029] The seat 2 supports a user during the execution of a gymnastic exercise and comprises a seat 21 and a backrest 22.

[0030] The exercise system 3 comprises a resistant device 31, a closed-loop cable 32, a pulley 33, an arm 34, and a tubular element 35.

[0031] Referring in particular to figure 3, the resistant device 31 is coupled to the frame 1, and is configured to provide resistance to the execution of a gymnastic exercise.

[0032] Said resistant device 31 comprises a motor 311, a gearbox 312, and a drum 313.

[0033] The motor 311 is coupled to the drum 313 through the gearbox 312.

[0034] The cable 32 is wound in a closed circuit around the drum 313, and the pulley 33.

[0035] The cable 32 comprises a first end 321, fixed to said pulley 33 by means of a first adjustable tensioner 331, and a second end 322, fixed to said pulley 33 by means of a second adjustable tensioner 332.

[0036] Said first 331 and second 332 tensioner are adjustable, to allow to independently adjust the tension applied to the first 321 and second 322 ends of the cable 32, so as to minimize the play of said pulley 33 with respect to said drum 313.

[0037] Said pulley 33 is coupled to said frame 1 and rotates on itself about a rotation axis Z.

[0038] Said arm 34 comprises a first end 341 and a second free end 342.

[0039] The arm 34 extends radially with respect to said rotation axis Z, rotating in said vertical plane XY.

[0040] Furthermore, said arm 34 comprises a plurality of housings, arranged between said first end 341 and second free end 342.

[0041] Said arm 34 is coupled to said pulley 33 by means of said first end 341 and therefore rotates integrally with said pulley 33 around said rotation axis Z.

[0042] The tubular element 35 develops parallel to said rotation axis Z.

[0043] Said tubular element 35 slides along said arm 34, from said first end 341 towards said second end 342, and vice versa, so that a user can adjust the distance of the tubular element 35 itself from the rotation axis Z.

[0044] Said tubular element 35 is able to engage with said plurality of housings, so as to adjust the distance between the tubular element 35 itself and said rotation axis Z.

[0045] In particular, said tubular element comprises a first end 351 and a second free end 352.

[0046] Said first end 351 comprises a movable portion.

[0047] In said second end 352 a knob is arranged for operating said movable portion.

[0048] Said movable portion is capable of being inserted into each housing of said plurality of housings of said arm 34, when said tubular element slides along said arm 34 from said first end 341 towards said second end 343, and vice versa.

[0049] Said tubular element 35 is configured for supporting the tibia of a user, so as to perform a gymnastic exercise.

[0050] With reference to figures 1, 5, and 6, it is possible to observe the exercise machine M in three possible configurations of use, each with said tubular element 35 placed at a different distance from said rotation axis Z.

[0051] Referring now to figure 4, the exercise machine M also comprises a detection device 4, connected to said control logic unit U.

[0052] The detection device 4 comprises a plurality of sensors $41_{a,b,...,n}$ and a reflecting element 42.

[0053] Each sensor of the plurality of sensors $41_{a,b,...,n}$ is arranged in the vicinity of a housing of said plurality of housings of said arm 34; the distances of each housing of said plurality of housings from said rotation axis Z are stored in the control logic unit U.

[0054] Each sensor of the plurality of sensors $41_{a,b,...,n}$ is connected to the control logic unit U and is associated with the distance from the rotation axis Z of the respective housing. In particular, each sensor of the plurality of sensors $41_{a,b,...,n}$ is of the optical type and is capable of emitting electromagnetic waves and detecting the nature and/or intensity of electromagnetic waves incident upon it.

[0055] The reflecting element 42 is coupled to the tubular element 35 and it is, therefore, able to slide integrally with this along said arm 34. The reflecting element 42 is arranged so that, when the tubular element 35 is in correspondence with a housing of the plurality of housings of said arm 34, the reflecting element 42 is located in front of the sensor corresponding to said housing.

[0056] In a second embodiment of said detection device 4, this comprises a single sensor 41_a coupled to said tubular element 35, and a plurality of reflecting elements arranged along said arm 34, so that, when said tubular element 35 translates along said arm 34, said sensor 41_a arranges in correspondence with a reflecting element, thus detecting the distance of said tubular element 35 from said rotation axis Z.

[0057] In this solution, said reflecting elements absorb or emit the light in different ways with respect to the other, in order to discriminate the position of said sensor 41_a along said arm 34.

[0058] Alternatively, it is possible to use a counter to count the number of reflecting elements that said sensor 41_a encounters during the translation along said arm 34 with respect to a zero reference.

[0059] In a third embodiment, said detection device 4 comprises a magnetic sensor, for example a Hall effect type sensor, comprising in its turn a magnet coupled to said tubular element 35 and a magnetic field detector.

[0060] Said magnetic sensor can, therefore, detect different magnetic field values as the position of the tubular element 35 varies along said arm 34, and therefore detect the position of said tubular element 35 with values that can be correlated to the different positions of the tubular element 35 itself.

[0061] Parameters and data relating to the execution of gymnastic exercises and training programs can be stored in the control logic unit U.

[0062] The control logic unit U can comprise a data communication module of the wireless type, for example of the Bluetooth® or wi-fi or NFC or Ant+ type.

[0063] Said data communication module is capable of sending said data received from said control logic unit U to remote devices, such as a smartphone, or to a cloud unit.

[0064] The control logic unit U is connected to the user interface I, through which a user can select the desired training parameters and/or select gymnastic exercises and training programs stored in the control logic unit U, or in said remote devices.

[0065] The control logic unit U is also connected to the motor 311, to adjust the torque of the motor 311 itself and, consequently, modify the resistance as opposed to the execution of the gymnastic exercise by said resistant device 31.

[0066] In particular, the torque of the motor 311 can be adjusted in intensity and pattern, to simulate resistances of the gravitational, viscous, elastic, isometric type, and the like.

[0067] The exercise machine M described above operates as follows.

[0068] In an initial calibration step, the tensions exerted on the first 321 and second 322 ends of the cable 32, respectively by the first 331 and second 332 tensioner, are adjusted so as to be substantially identical.

[0069] This allows the resistant device 31 to control the rotation of said pulley 33 in both directions of rotation around said rotation axis Z. In fact, the independent adjustment of the tension on said first 321 and on said second 322 end allows to minimize the mechanical play between said drum 313 and said pulley 32 since the cable 32 is placed at the same tension in all its points.

[0070] In particular, said first 331 and second 332 tensioning elements are adjusted manually by an operator, so as to obtain the desired tension on said first 321 and on said second 322 end of said cable 32.

[0071] Furthermore, still in said initial calibration step, said tubular element 35 is coupled to each housing of said plurality of housings of said arm 34.

[0072] For each housing to which said tubular element 35 is coupled, the corresponding signal sent by said plurality of sensors $41_{a,b,...,n}$ is stored in said logic control unit U and associated with the respective distance of said tubular element 35 from said rotation axis Z.

[0073] When a user intends to perform a gymnastic exercise, he/she accesses seat 2 of the gymnastic machine M.

[0074] The user adjusts, based on the own needs, the distance of said tubular element 35 from said rotation axis Z, making the tubular element 35 slide along the arm 34 and fixing it to a housing of said plurality of housings.

[0075] The reflecting element 42 is then arranged in front of the sensor 41_k of said plurality of sensors $41_{a,b,...,n}$ corresponding to said housing.

[0076] The sensor 41_k in front of which said reflecting element 42 is arranged sends a signal corresponding to the control logic unit U.

[0077] The control logic unit U receives said signal and compares it with said data stored in said calibration step.

[0078] The control logic unit U selects the distance from said rotation axis Z whose signal corresponds to said received signal. The control logic unit U then selects a coefficient proportional to said selected distance.

[0079] The user selects, through said user interface I,

the desired training parameters, gymnastic exercises, or training programs memorized in the control logic unit U, or in said remote devices.

[0080] The control logic unit U consequently determines the driving torque corresponding to the load selected by the user. In particular, the driving torque value is multiplied by said selected coefficient.

[0081] Therefore, said control logic unit adjusts the torque of the motor 311 and consequently modifies the resistance opposed to the execution of the gymnastic exercise by said resistant device 31, according to the signals sent by said detection device 4.

[0082] In this way, the control logic unit U allows each user who has selected the same load to perceive the same effort, in different adjustment positions of said tubular element 35.

[0083] During the execution of the gymnastic exercise, in the concentric step, the user, pressing with the tibia against said tubular element 35, causes said arm 34 to lift, overcoming the resistance of said resistant device 31 through said cable 32.

[0084] During the execution of the gymnastic exercise, in the eccentric step, the user, by lowering the tibia, causes the lowering of said arm 34, assisted by said cable 32, which allows the user to control the return movement.

[0085] As evident from the above description, an advantage of the present invention is that of regulating the training parameters and the gymnastic exercises according to the distance of the tubular element from the rotation axis of the pulley, so that a user can carry out a workout regardless of his physical conformation, and the effort perceived by the user corresponds to that actually foreseen by the chosen workout.

[0086] A further advantage of the present invention is that of assisting the user both during the concentric step and in particular during the eccentric step when the user lowers his leg and returns the arm 34 to the lowered position.

[0087] This advantage is particularly important when the machine M is used for medical rehabilitation purposes, in which it is essential to avoid kickbacks or overloads of the user's limbs.

[0088] The present invention has been described for illustrative but not limitative purposes, according to its preferred embodiments, but it is to be understood that modifications and/or changes can be introduced by those skilled in the art without departing from the relevant scope as defined in the enclosed claims.

Claims

1. Exercise machine (M) for performing at least one gymnastic exercise, of the type comprising

a resistant device (31), configured to provide resistance to the execution of said at least one gymnastic exercise,

an arm (34), connected to said resistant device (31), capable of rotating around a rotation axis (Z),

a tubular element (35), coupled to said arm (34), so as to slide along said arm (34), to vary its distance from said rotation axis (Z), and

a logic control unit (U), connected to said resistant device (31), in which the parameters relating to said at least one gymnastic exercise are memorized,

a detection device (4) for detecting the position of said tubular element (35) along said arm (34), and for sending the corresponding signals to said control logic unit (U), wherein

said control logic unit (U) is configured to vary the resistance of said resistant device (31) as a function of the signals sent to said logic control unit (U), relative to the position of said tubular element (35), said gymnastic machine (M) being **characterized**

in that said tubular element (35) comprises a first movable end (351) and a second free end (352),

in that said arm (34) comprises a plurality of housings, in each of which said first movable end (351) is able to fit,

in that said detection device (4) is able to detect the housing of said plurality of housings, in which said tubular element is arranged (35), and

in that the data relating to the distance of said housings of said plurality of housings from said rotation axis (Z) are stored in said logic control unit (U).

2. Exercise machine (M) according to the preceding claim, **characterized**

in that said detection device (4) comprises a plurality of sensors (41a, b, ..., n), each one arranged in correspondence with a housing of said plurality of housings of said arm (34).

3. Exercise machine (M) according to the preceding claim, **characterized**

in that said detection device (4) comprises at least one reflecting element (42), coupled to said tubular element (35), to slide along said plurality of sensors (41a, b, ..., n) and position in correspondence with the sensor (41k) of said plurality of sensors (41a, b,..., n), corresponding to the housing of said plurality of housings in which said tubular element (35) is arranged.

4. Exercise machine (M) according to any one of the preceding claims, **characterized**

in that it comprises a pulley (33), rotating around said rotation axis (Z) integrally with said arm

(34), and
in that it comprises a closed-circuit cable (32), to connect said pulley (33) to said resistant device (31).

5. Exercise machine (M) according to the preceding claim, **characterized**

in that said cable (32) comprises a first (321) and a second (322) ends, coupled to said pulley (33), and
in that said pulley (33) comprises a first (331) and a second (332) tensioning element, to adjust respectively the tension on said first (321) and on said second (322) end of said cable (32).

6. Operating method of the exercise machine (M) according to any one of the claims 1-5, **characterized in that** it comprises the following steps:

a. receiving data corresponding to the position of said tubular element (35) along said arm (34);
b. comparing said data received in said step a. with calibration data;
c. sending a signal corresponding to said comparison performed in said step b. to said logic control unit (U);
d. adjusting the resistance of said resistant device (31) on the basis of said signal sent in said step c.

Patentansprüche

1. Übungsgerät (M) zur Durchführung mindestens einer gymnastischen Übung, von der Art, die Folgendes umfasst

eine Widerstandsvorrichtung (31), die so konfiguriert ist, dass sie bei der Ausführung der mindestens eine gymnastische Übung einen Widerstand erzeugt,
einen Arm (34), der mit der Widerstandsvorrichtung (31) verbunden ist und sich um eine Drehachse (Z) drehen kann,
ein rohrförmiges Element (35), das mit dem Arm (34) so verbunden ist, dass es entlang des Arms (34) gleitet, um seinen Abstand von der Drehachse (Z) zu verändern, und
einer logischen Steuereinheit (U), die mit der widerstandsfähigen Vorrichtung (31) verbunden ist und in der die Parameter, die sich auf die mindestens eine gymnastische Übung beziehen, abgespeichert werden,
Erfassungsvorrichtung (4) zum Erfassen der Position des röhrenförmigen Elements (35) entlang den Arm (34) und zum Senden der entsprechenden Signale an die Steuerlogikeinheit (U), wobei
die Steuerlogikeinheit (U) so konfiguriert ist, dass sie den Widerstand der Widerstandsvorrichtung (31) in Abhängigkeit von den an die Logiksteuereinheit (U) gesendeten Signalen relativ zur Position des röhrenförmigen Elements (35) des Turngeräts variiert Maschine (M) Wesen
gekennzeichnet,
dass das rohrförmige Element (35) ein erstes bewegliches Ende (351) und ein zweites freies Ende (352) aufweist,
dass der Arm (34) eine Vielzahl von Aufnahmen umfasst, in die jeweils das erste bewegliche Ende (351) passen kann,
dass die Erfassungsvorrichtung (4) in der Lage ist, das Gehäuse der Vielzahl von Gehäusen zu erfassen, in dem das rohrförmige Element (35) angeordnet ist, und
dass die Daten, die sich auf den Abstand der Gehäuse der Vielzahl von Gehäusen von der Drehachse (Z) beziehen, in der logischen Steuereinheit (U) gespeichert werden.

2. Übungsgerät (M) nach dem vorhergehenden Anspruch, **dadurch gekennzeichnet**
dass die Erfassungsvorrichtung (4) eine Vielzahl von Sensoren (41a, b, ..., n) umfasst, von denen jeder in Übereinstimmung mit einem Gehäuse der Vielzahl von Gehäusen des Arms (34) angeordnet ist.

3. Trainingsgerät (M) nach dem vorhergehenden Anspruch, **dadurch gekennzeichnet**
dass die Erfassungsvorrichtung (4) mindestens ein reflektierendes Element (42) umfasst, das mit dem rohrförmigen Element (35) gekoppelt ist, um entlang der Vielzahl von Sensoren (41a, b, ..., n) zu gleiten und in Übereinstimmung mit dem Sensor (41k) der Vielzahl von Sensoren (41a, b, ..., n) zu positionieren, der dem Gehäuse der Vielzahl von Gehäusen entspricht, in dem das rohrförmige Element (35) angeordnet ist.

4. Trainingsgerät (M) nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet**

dass es eine Riemenscheibe (33) umfasst, die sich um die Drehachse (Z) dreht und mit dem Arm (34) verbunden ist, und
dass es ein Kabel (32) mit geschlossenem Kreislauf umfasst, um die Rolle (33) mit der Widerstandsvorrichtung (31) zu verbinden.

5. Trainingsgerät (M) nach dem vorhergehenden Anspruch, **dadurch gekennzeichnet**

dass das Kabel (32) ein erstes (321) und ein

zweites (322) Ende aufweist, die mit der Riemenscheibe (33) verbunden sind, und
dass die Rolle (33) ein erstes (331) und ein zweites (332) Spannelement aufweist, um die Spannung am ersten (321) bzw. am zweiten (322) Ende des Seils (32) einzustellen.

6. Verfahren zum Betrieb eines Trainingsgeräts (M) nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** es die folgenden Schritte umfasst:

a. Empfang von Daten, die der Position des rohrförmigen Elements (35) entlang des Arms (34) entsprechen;
b. Vergleichen der in Schritt a. empfangenen Daten mit Kalibrierungsdaten;
c. Senden eines Signals, das dem in Schritt b. durchgeführten Vergleich entspricht, an die logische Steuereinheit (U);
d. Einstellen des Widerstands der Widerstandsvorrichtung (31) auf der Grundlage des in Schritt c. gesendeten Signals.

Revendications

1. Appareil d'exercice (M) pour l'exécution d'au moins un exercice de gymnastique, du type comprenant

un dispositif de résistance (31), configuré pour fournir une résistance à l'exécution dudit au moins un exercice de gymnastique,
un bras (34), relié au dispositif résistant (31), capable de tourner autour d'un axe de rotation (Z),
un élément tubulaire (35), couplé audit bras (34), de manière à coulisser le long dudit bras (34), pour faire varier sa distance par rapport audit axe de rotation (Z), et
une unité logique de commande (U), reliée audit dispositif résistant (31), dans laquelle sont mémorisés les paramètres relatifs audit au moins un exercice de gymnastique,
un dispositif de détection (4) pour détecter la position dudit élément tubulaire (35) le long dudit bras (34), et pour envoyer les signaux correspondants à ladite unité logique de commande (U), dans laquelle ladite unité logique de commande (U) est configurée pour faire varier la résistance dudit dispositif résistant (31) en fonction des signaux envoyés à ladite unité logique de commande (U), par rapport à la position dudit élément tubulaire (35) ladite unité logique la machine (M) étant,
caractérisé
en ce que ledit élément tubulaire (35) comprend une première extrémité mobile (351) et une deuxième extrémité libre (352),
en ce que ledit bras (34) comprend une pluralité de logements, dans chacun desquels la première extrémité mobile (351) peut s'insérer,
en ce que ledit dispositif de détection (4) est capable de détecter le logement de ladite pluralité de logements, dans lequel ledit élément tubulaire est disposé (35), et
en ce que les données relatives à la distance desdits logements de ladite pluralité de logements par rapport à l'axe de rotation (Z) sont stockées dans l'unité de commande logique (U).

2. Machine d'exercice (M) selon la revendication précédente, **caractérisée**
en ce que ledit dispositif de détection (4) comprend une pluralité de capteurs (41a, b, ..., n), chacun disposé en correspondance avec un logement de ladite pluralité de logements dudit bras (34).

3. Machine d'exercice (M) selon la revendication précédente, **caractérisée**
en ce que ledit dispositif de détection (4) comprend au moins un élément réfléchissant (42), couplé audit élément tubulaire (35), pour coulisser le long de ladite pluralité de capteurs (41a, b, ..., n) et se positionner en correspondance avec le capteur (41k) de ladite pluralité de capteurs (41a, b, ..., n), correspondant au logement de ladite pluralité de logements dans lequel est agencé ledit élément tubulaire (35).

4. Machine d'exercice (M) selon l'une quelconque des revendications précédentes, **caractérisée**

en ce qu'elle comprend une poulie (33), tournant autour dudit axe de rotation (Z) d'un seul tenant avec ledit bras (34), et
en ce qu'il comprend un câble en circuit fermé (32), pour relier ladite poulie (33) audit dispositif résistant (31).

5. Appareil d'exercice (M) selon la revendication précédente, **caractérisé**

en ce que ledit câble (32) comprend une première (321) et une deuxième (322) extrémités, couplées à ladite poulie (33), et
en ce que ladite poulie (33) comprend un premier (331) et un second (332) élément de tension, pour ajuster respectivement la tension sur ladite première (321) et sur ladite seconde (322) extrémité dudit câble (32).

6. Procédé d'utilisation d'une machine d'exercice (M) selon l'une quelconque des revendications 1 à 5, **caractérisé en ce qu'**il comprend les étapes suivantes:

a. réception de données correspondant à la position dudit élément tubulaire (35) le long dudit bras (34);
b. comparer ces données reçues à l'étape a. avec des données d'étalonnage;
c. envoyer un signal correspondant à la comparaison effectuée à l'étape b. à l'unité de commande logique (U) ;
d. régler la résistance dudit dispositif résistant (31) sur la base du signal envoyé dans ladite étape c.

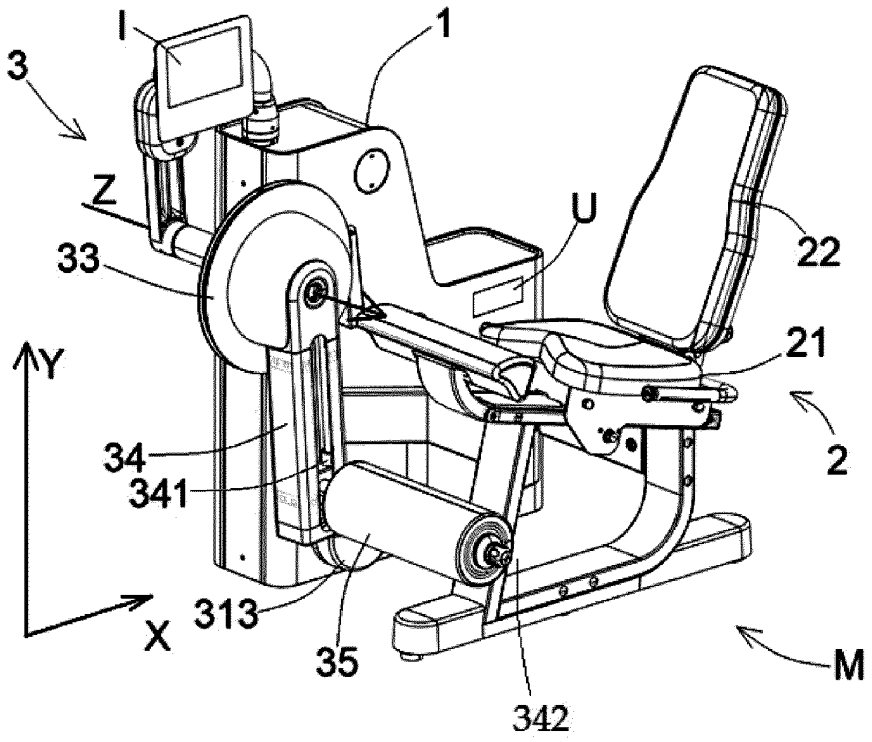
I
1
3
Z
U
22
33
21
Y
34
2
341
313
X
35
M
342

Fig. 1

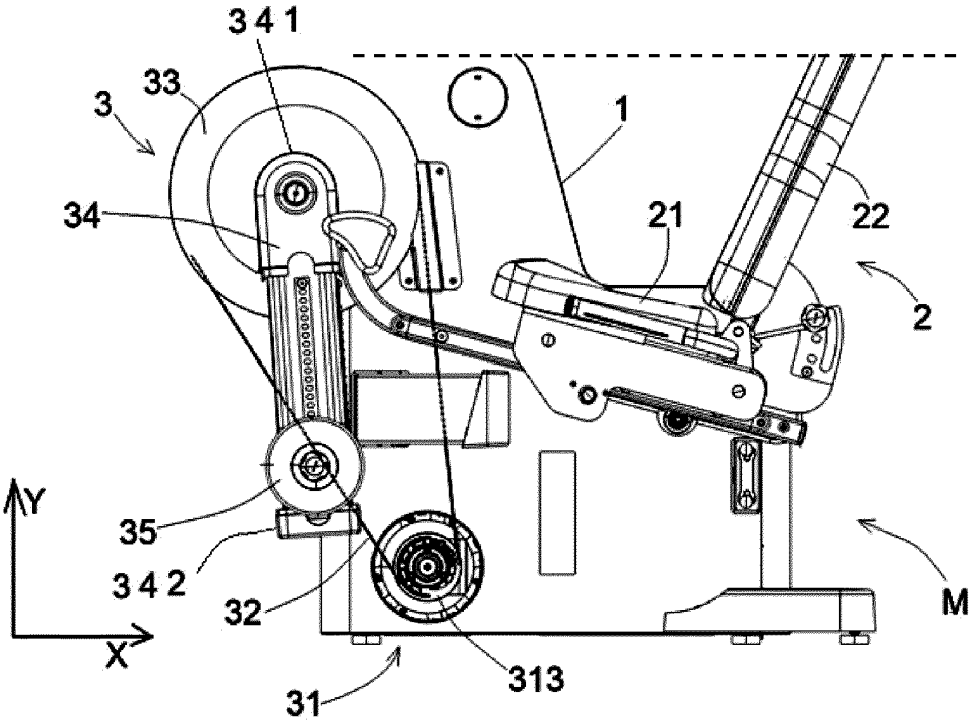
341
33
3
1
34
21
22
2
Y
35
342
32
M
313
X
31

Fig. 2

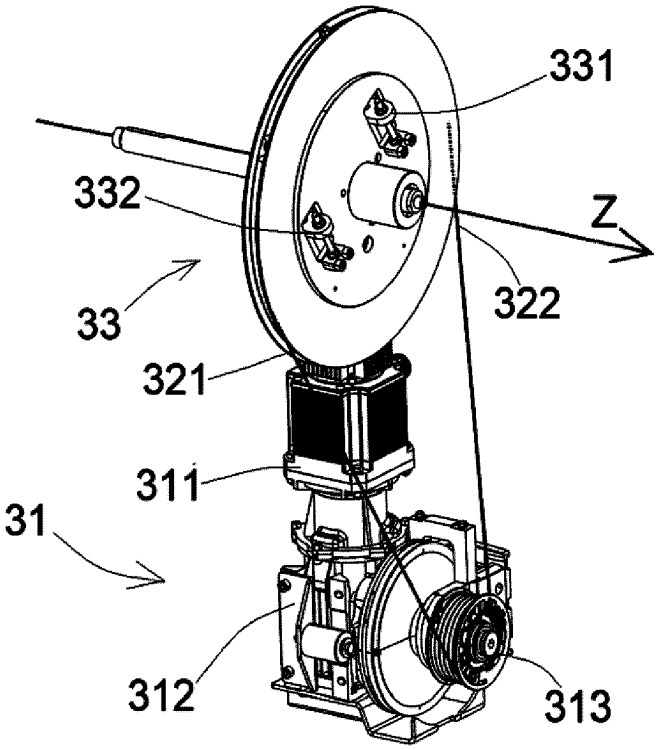

Fig. 3

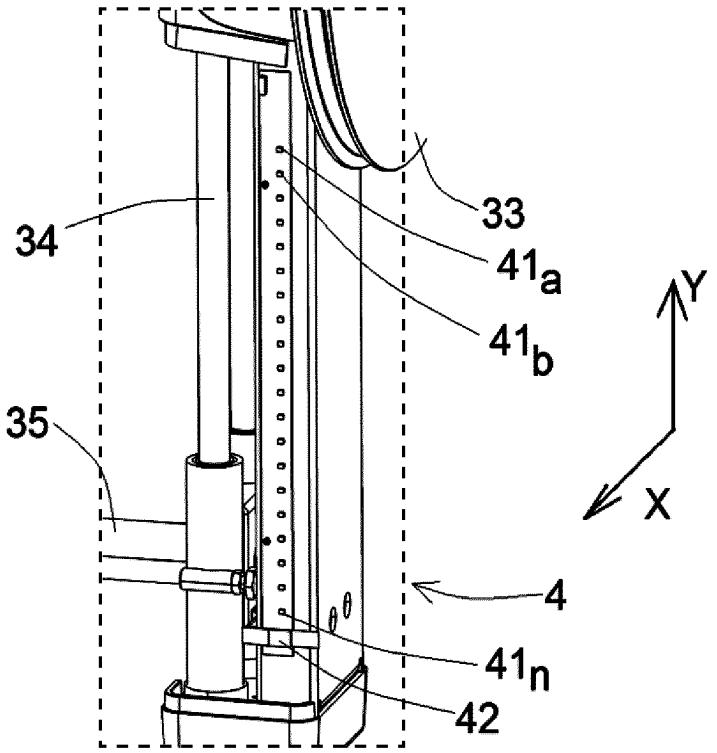

Fig. 4

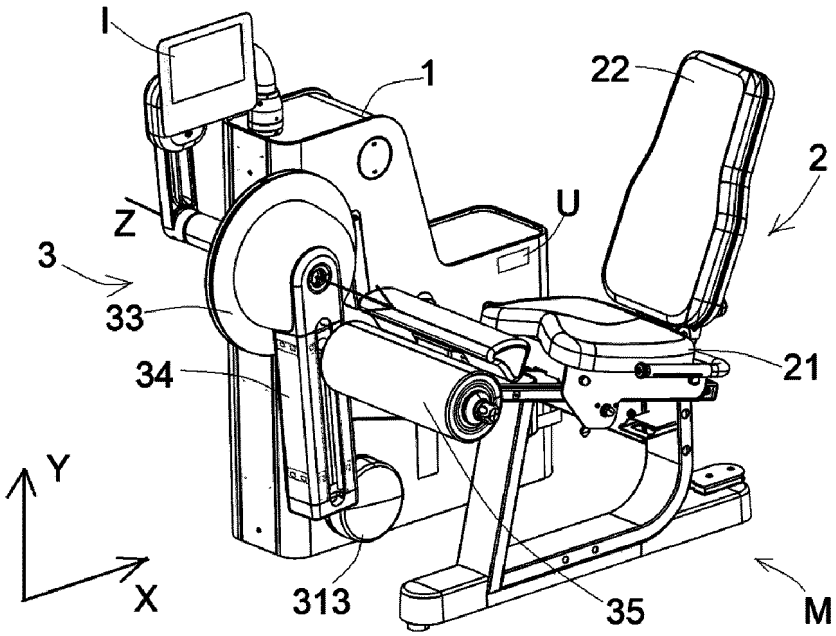

Fig. 5

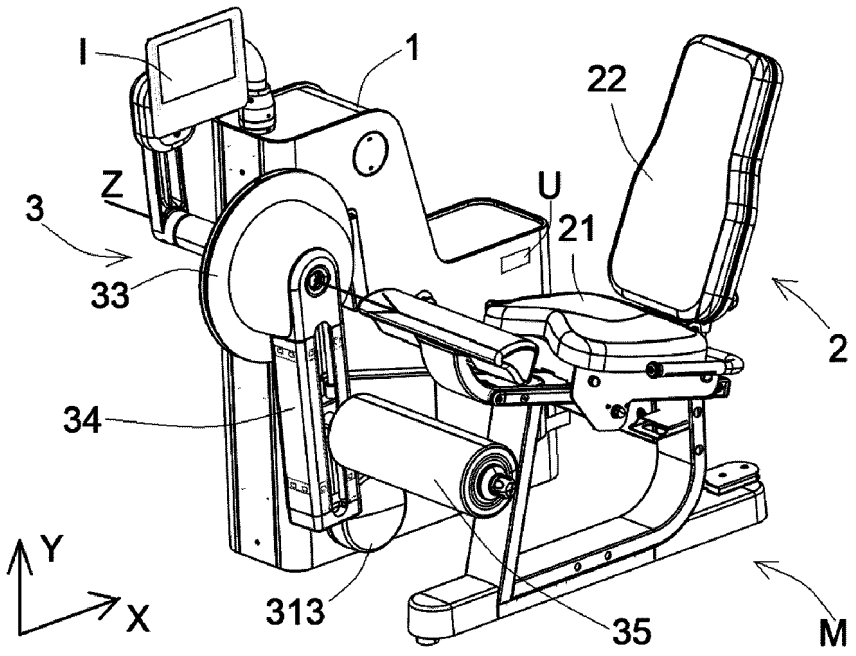

Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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