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(54) **An exercise machine**

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Description

[0001] The present invention relates to an exercise machine, preferably of isotonic type.

[0002] The fitness sector today offers an extremely wide variety of exercise machines. These machines can be divided broadly into two categories: isotonic machines and cardiovascular machines.

[0003] Isotonic machines normally comprise a working position for the user who uses his/her physical power to apply a force that is opposed by gravity acting on a set of passive elements forming what is normally called a weight stack.

[0004] In the present invention, the working position is the location where the user places his/her body, whether seated or standing, which means that this position coincides with an area where the weight of the user's body is supported by the ground, with or without a footplate.

[0005] Machines of this type have a portal frame which is located in a vertical plane and which accommodates a plurality of blocks, each having a predetermined weight. The user selects the number of blocks to be used for the required exercise, thus creating a stack of desired weight which applies the resistant force that must be overcome by the user's muscular strength; between the resistant force and the active part of the exercise apparatus there is usually a connecting element, normally consisting of a cord or cable wound several times around pulleys and designed to carry the resistant force to the point where the user must apply his/her physical power to overcome it.

[0006] Thus, in the above type of solution, the resistant force is provided by gravity. Alternatively, more complex machines may be used in which the resistant force is produced by a motor or alternator connected to a source of electric power and providing controlled torque.

[0007] Whichever the solution adopted, exercise machines of this kind (as generally used for recreational, rehabilitation and similar applications) are designed in such a way that the user competes against himself/herself. In other words, the user has to perform a training protocol without any active opponent, which, in the long run, may lead to deconcentration or even refusal to perform exercises according to established rules.

[0008] Another disadvantage is that the correct performance of the protocol depends entirely on the user and it is therefore difficult to control the uniformity of the training or to assess (unless this is done in separate stages) the individual progress of two or more trainees, such as, for example, the members of a sports team or persons required to reach a minimum fitness level.

[0009] The present invention therefore has for an object to overcome the above mentioned disadvantages by providing an exercise machine that allows users to train not in isolation but in association with other users so as to be able to interact with each other while performing an exercise.

[0010] According to the invention, this object is

achieved by an exercise machine as defined in the main appended claim 1. A machine according to the preamble of claim 1 is described in US-A-4 627 617.

[0011] The advantages achieved by the invention lie essentially in the fact that the users training simultaneously on the same machine not only follow a predetermined protocol but also have the opportunity of measuring their strength against each other, thus reducing the risk of demotivation and providing a competitive stimulus to achieving the targets set by the protocol.

[0012] Another advantage is that of permitting the activities of different trainees following the same or similar training programmes to be standardised, thus making it possible to assess the effectiveness of a programme on different individuals.

[0013] Further advantages are achieved thanks to the characteristics defined in the dependent claims.

[0014] The technical characteristics of the invention, with reference to the above aims, are clearly described in the claims below and its advantages are apparent from the detailed description which follows, with reference to the accompanying drawings which illustrate preferred embodiments of the invention provided merely by way of example without restricting the scope of the inventive concept, and in which:

- Figure 1 is a general diagram of an exercise machine according to the invention;
- Figure 1a is a diagram showing the connection of adjustable length between the user positions;
- Figure 2 is a graph showing an example curve representing a load applied by the users progressively and compared to a reference level;
- Figures 3a and 3b schematically illustrate further embodiments of the machine according to the invention;
- Figures 4 and 4a-4c schematically illustrate yet another embodiment of the machine according to the invention.

[0015] With reference to Figure 1, an exercise machine according to the invention, in its most general configuration of kinematic components, essentially comprises the following:

- a mounting frame 1;
- a reversible power transmission mechanism 2 mounted on the frame 1;
- at least two user work positions equipped with actuators 3 operatively connected to the transmission mechanism 2 and designed to be operated by the users who alternately and reciprocally apply an active force and a resistant force through the transmission mechanism 2.

[0016] Advantageously, as shown in the diagram of Figure 1, the transmission mechanism may consist wholly or partly of a set of rigid levers joined to each other and, if necessary, combined with cable mechanisms, as

described in more detail below.

[0017] In all its preferred embodiments, the machine is preferably equipped with a load sensor designed to indicate a value (and, if necessary, a threshold) of the force load applied by the users.

[0018] Figure 1a schematically illustrates the connection between the user positions. The length of the connection can be adjusted by means of a motor M designed to move the pin 23x of a pulley 22 vertically in the direction indicated by the arrow F, thus shifting the actuators between the initial positions 3 and 3a.

[0019] Preferably, the cable 24 is also equipped with load sensors 224, load cells 226 and dampers 225.

[0020] Figure 2 is a graph showing an example curve representing the load C applied by the user, measured by a sensor and displayed by a display unit indicated schematically by the reference letter D in Figure 2, compared to a reference level R representing the training programme, in such a way as to stimulate the users, individually and in competition with each other, to keep up with the programme.

[0021] Still with reference to Figure 2, the invention also contemplates the possibility of a progressive indication of the load C by the display unit D or by a separate unit in order to enable the users to check the level they have reached at any point in time.

[0022] It should be stressed that all the embodiments described below are offered purely as examples of the inventive concept without thereby limiting the possibility of extending the concept to other solutions, all falling within the scope of the appended claims. This is intended as confirmation of the possibility of extending the inventive concept to a wide range of different machines.

[0023] Moreover, in all the embodiments, the means for connecting the user positions may comprise means for adjusting the length of the connection according to the physical characteristics of the users.

[0024] The connecting means may also include elastic means or dampers to smooth the transient effects of passing from an active force to a resistant force and vice versa.

[0025] Figures 4, 4a and 4b illustrate yet another embodiment of the invention.

[0026] The machine comprises a base 401 mounting an upright 400 consisting preferably of a tube, for example with an oval cross section, acting as a guide for a work unit 404.

[0027] Advantageously, the single upright structure 403 enables the users to move all the way round the machine and to change their positions relative to the actuators to perform different exercises.

[0028] The work unit 404, slidable along the guide 403, may be fixed in position by a locking element 405, consisting, for example, of a clamp screw that moves as one with the work unit 404 and engages by contact or interference with the vertical guide 403.

[0029] At the top end 420 of the upright 400 there are two pulleys 409 positioned horizontally side by side,

whilst another two transmission pulleys 410 are positioned at the bottom end, close to the base 401.

[0030] The sliding work unit 404 is in turn equipped with four pairs of opposing vertical plates 406, between which there are mounted, preferably rotating about vertical axes, four supports 408 arranged in pairs on opposite sides of the upright 403 and each mounting a pair of pulleys 407 with horizontal axes and positioned over each other vertically.

[0031] Advantageously, the rotation of the supports enables users to easily perform exercises requiring the actuators to be moved apart as well as exercises in which the users have to change their positions relative to the actuators by moving around the machine.

[0032] In the embodiment illustrated, the work unit 404 mounts all the pulleys 407 which are therefore adjustable as one.

[0033] It will be understood, however, that the invention also contemplates that the height of the pulleys might also be adjusted independently at the two sides of the upright, in such manner as to individually vary one or both of the pulling points of one or both of the users.

[0034] The machine also comprises two cables 412, 412' passing through respective pulleys 407, 409, 410 and actuated by opposite pairs of handles 414a / 414b and 415a / 415b operated by two users (not illustrated in the drawings) standing on opposite sides of the upright 403 at the schematically illustrated exercise positions labelled 413.

[0035] It will be understood that the handles might be substituted by actuators or handlebars of any kind suitable for performing the exercise.

[0036] Looking in more detail, the cables 412, 412' constitute a twin-cable arrangement, that is to say, a double path of twin cables each of which, with reference, for example, to the cable 412, is fixed at one end to a first actuator 414a, passes through the overlaid pulleys 407 of one support 408 positioned at a first side of the upright 403 and, in succession, through the corresponding upper and lower pulleys 409 and 410 to connect up with the opposite actuator 414b after passing through the central overlaid pulleys 407 of the support 408 at the opposite side of the upright 403.

[0037] An identical path through the corresponding central, upper and lower pulleys 407, 409 and 410, is followed by the second cable 412' which connects the opposing actuator 415a and 415b.

[0038] In the embodiment being described, there are two of each of the pulleys 407, 409, 410 on each side of the machine so as to enable two users to exercise both arms at the same time, but without thereby excluding the possibility of having a single pulley or more than two pulleys, according to requirements.

[0039] During operation, the two users, each in his/her exercise position 413, grip the actuators on the corresponding side of the machine, and alternately pull the two actuators (for example, 414a and 415a) in such that the two users, thanks to the path followed by the cables

412 and 412', oppose each other in alternately pulling the actuators.

[0040] On a machine constructed in this way, the two users may oppose or second each other in performing different types of exercises for the purposes of muscular strengthening, cardiovascular training, muscular stretching or even proprioceptive training in which one of the two users tests the balance of the other.

[0041] Further, thanks to the adjustability of the vertical position of the work unit 404 and to the rotatability of the supports 408, the point and angle at which the cable is pulled outwards, that is to say, the direction of the force applied by the users, can be varied according to the type of exercise and to the part of the body to be exercised.

[0042] It follows that the upper or the lower pulley in the pairs of pulleys 407 mounted on the work unit 404 is activated according to the position of the work unit relative to the user's grip.

[0043] Further, the length of the cables 412 / 412' pulled out of the machine can be adjusted to suit the type of exercise which the users have to perform, and according to the distance from the machine required by the exercise.

[0044] Looking in more detail, the length of the cable 412/412' that can be pulled out of the machine can be adjusted by making the cable follow a path such that, on leaving the lower pulley 410, it winds one or more times around a corresponding pulley 419, mounted on idle rollers on the upright 403 and then proceeds along the path described above towards the upper pulley 409 and from there to the opposite actuator.

[0045] With this solution, each turn around the pulley 419 corresponds to a reduction of the active length of the cable 412/412', that is to say, the extent to which the cable can be pulled out of the machine using the opposite actuator 414a,b and 415a,b.

[0046] According to another characteristic of the machine, the upper pulleys 409 are mounted in a protective guard 427 and are connected to a dynamo 423 which powers a lamp 422 located above the user work positions 413.

[0047] When the lamp switches on, it provides an indication of the speed at which the exercise is being carried out and may also constitute a performance target to be achieved.

[0048] In addition, the base 401, which must normally have a certain weight to guarantee machine stability, may consist of a hollow container 426 equipped with a filler opening 425, so that the machine itself is relatively light for transportation purposes but, once positioned, can be weighted down by filling the container with liquid (or sand or other suitable material) to increase the stability of the machine during use. To facilitate handling, the machine of Figure 4 may also be equipped with wheels 424 fitted to the edge of the base 401 slightly off the ground so as to touch the ground only if the upright 403 is tilted to enable it to be moved from one place to another.

[0049] In the embodiments described above, an addi-

tional resistant force, consisting, for example, of traditional weights, may be applied to one or both sides of the machine besides the alternate active /resistant force applied by the users. This would compensate for excessive differences in strength between the two users.

[0050] By way of example, Figures 3a and 3b schematically illustrate a machine according to the invention in which a set of weights P, variable in number and composition according to requirements, is applied to one of two user positions.

[0051] In the embodiment of Figure 3a, the weights are positioned close to one of the actuators 3, so as to increase the resistant force applied to the other actuator.

[0052] In Figure 3b the weights P are applied to one of the two actuators by means of an additional system of cables 24 and pulleys 22.

[0053] Looking in more detail at the embodiment illustrated in Figure 3b, the pulleys of the additional system have two grooves so that the actuator concerned is connected to the other actuator through a first cable 24 passing around one groove in the pulleys 22 and to the weight stack P through a second cable passing around the other groove in the same pulleys.

[0054] Obviously, the weight stack P may be varied according to requirements and may be applied to one or both user positions.

[0055] Figure 3b also shows a load cell CC advantageously applied to a point 29 where one of the pulleys 22 is fixed to the frame 1.

[0056] In this case, the load cell is applied to the point where the pulley located at the centre of symmetry is attached to the frame but it may be fitted at any other suitable position.

[0057] This solution offers the advantage of measuring the load in a structurally and functionally simple manner.

[0058] The invention described has evident industrial applications and can be subject to modifications and variations without thereby departing from the scope of the claims.

Claims

1. An exercise machine comprising: a mounting frame (1); at least two user positions (413); power transmission means (2) designed to connect corresponding machine actuators (3) and accessible by the users in such a way that the power applied by the users on one or more of the actuators (3) is transmitted by the transmission means (2) to one or more of the remaining actuators and reciprocally and alternately constitutes for the users an active force and a resistant force for moving the actuators relative to the user positions,
characterised in that the frame consists of a single upright element (403) and the transmission means consist of at least one cable (412, 412') passing in succession through a plurality of pulleys; the ma-

chine actuators consisting of at least two handles (414a,b; 415a,b) fitted at the ends of the cable (412, 412') on each side of the upright (403) for use by at least two users in their respective work positions (413).

2. The machine according to claim 1, **characterised in that** it comprises a first and a second cable (412, 412') having handles at their ends, so that two pair of handles (414a-415a; 414b-415b) are available at two respective user work positions (413), each of said pair of handles being formed by two handles which are fitted respectively to an end of said first and of said second cable (412, 412').
3. The machine according to claim 2, **characterised in that** the plurality of pulleys comprises an initial pulley (407) mounted on the upright (403), at least one intermediate pulley (409, 410) vertically offset from the first pulley and an end pulley (407) mounted on the upright (403) and vertically offset from the intermediate pulley.
4. The machine according to one of the foregoing claims, **characterised in that** either the initial or the end pulley (407) or both are adjustably mounted for height on the upright.
5. The machine according to claim 4, **characterised in that** the initial and end pulleys (407) are adjustable in height independently of each other.
6. The machine according to one of the foregoing claims, **characterised in that** the upright consists of a central tubular element (403) on which there slides a work unit (404) mounting the initial and end pulleys (407) and comprising at least two pairs of handles (414a-415a; 414b-415b) fitted at respective user work positions (413) at the respective ends of two transmission cables (412, 412').
7. The machine according to one of the foregoing claims, **characterised in that** at the connecting means there are means (214, 216) for detecting the applied force designed to detect a value proportional to the force itself and to send it to display means.
8. The machine according to claim 7, **characterised in that** the detecting means consist of an extensometric cell connected in series on a cable.
9. The machine according to one of the foregoing claims, **characterised in that** the means for connecting the actuators (3) comprise means (M, 23x, 419) for correcting their length according to the physical characteristics of the users.
10. The machine according to one of the foregoing

claims, **characterised in that** the connecting means comprise elastic or damping means designed to smooth the transient effects of passing from an active force to a resistant force and vice versa.

11. The machine according to one of the foregoing claims, **characterised in that** it comprises force detecting means consisting of one or more load sensors (214, 216) located on a cable or joint and designed to indicate when a predetermined load has been reached.
12. The machine according to one of the foregoing claims, **characterised in that** it comprises a device (D) for displaying the level of the load (C) reached, as a progressive value or as a value compared to a reference level (R) representing the training programme.
13. The machine according to one of the foregoing claims, **characterised in that** it comprises additional means for applying a resistant force to oppose the active force exerted by a user on one or more actuators.
14. The machine according to claim 13, **characterised in that** the additional resistant means consist of one or more weights (P) applied to the actuator (3) of at least one of the user work positions in such a way as to increase the resistant force exerted on the other actuators.
15. The machine according to claim 14, **characterised in that** the additional resistant means consist of one or more weights (P) applied to one of the two actuators by means of an additional system of cables and pulleys.
16. The machine according to one of the foregoing claims, **characterised in that** it comprises a load cell (CC) applied to a point (29) where one of the pulleys (22) is fixed to the frame (1).
17. The machine according to one of the foregoing claims, **characterised in that** the connecting means comprise means (215) for damping the load.
18. The machine according to one of the foregoing claims, **characterised in that** the connecting means comprise articulated levers (2) and/or pulley systems (22) with one or more cables (24) connecting the actuators (3).

Patentansprüche

1. Ein Übungsgerät, das Folgendes umfasst: Einen Montagerahmen (1); mindestens zwei Benutzerpo-

- sitionen (413); Kraftübertragungsmittel (2), die dazu vorgesehen sind, um entsprechende Stellelemente (3) für das Gerät anzuschließen, und die solcherart für die Benutzer /Benutzerinnen zugänglich sind, dass die Kraft, die von den Benutzern / Benutzerinnen auf eines oder mehrere der Stellelemente (3) ausgeübt wird, durch die Übertragungsmittel (2) an eines oder mehrere der restlichen Stellelemente übertragen wird und für die Benutzer / Benutzerinnen gegenseitig und abwechselnd eine aktive Kraft und eine Widerstandskraft darstellt, um die Stellelemente in Hinsicht auf die Benutzerpositionen zu bewegen; **gekennzeichnet dadurch, dass** der Rahmen aus einem einzelnen Ständerelement (403) besteht und dass die Übertragungsmittel aus mindestens einem Drahtseil (412, 412') bestehen, das nacheinander durch eine gewisse Anzahl von Riemenscheiben läuft; die Stellelemente des Geräts bestehen aus mindestens zwei Griffen (414a,b; 415a,b), die an jeder Seite des Ständers (403) an den Enden des Drahtseils (412, 412') befestigt sind, um von mindestens zwei Benutzern / Benutzerinnen in ihrer jeweiligen Trainingsposition (413) verwendet zu werden.
2. Das Gerät nach Patentanspruch 1, **gekennzeichnet dadurch, dass** es ein erstes und ein zweites Drahtseil (412, 412') umfasst, die an ihren Enden Griffe haben, so dass zwei Griffpaare (414a, 415a; 414b, 415b) an zwei entsprechenden Benutzertrainingspositionen (413) verfügbar sind, wobei jedes der besagten Griffpaare aus zwei Griffen besteht, die jeweils an einem Ende des besagten ersten und des besagten zweiten Drahtseils (412, 412') angebracht sind.
 3. Das Gerät nach Patentanspruch 2, **gekennzeichnet dadurch, dass** die gewisse Anzahl von Riemenscheiben eine Anfangsriemenscheibe (407) umfasst, die am Ständer (403) montiert ist, sowie mindestens eine Zwischenriemenscheibe (409, 410), die vertikal von der ersten Riemenscheibe abgesetzt ist, und eine Endriemenscheibe (407), die am Ständer (403) montiert und vertikal von der Zwischenriemenscheibe abgesetzt ist.
 4. Das Gerät nach einem der vorherigen Patentansprüche, **gekennzeichnet dadurch, dass** entweder die Anfangs- oder die Endriemenscheibe (407) oder beide höhenverstellbar am Ständer montiert sind.
 5. Das Gerät nach Patentanspruch 4, **gekennzeichnet dadurch, dass** die Anfangs- und Endriemenscheiben (407) unabhängig voneinander in der Höhe verstellbar sind.
 6. Das Gerät nach einem der vorherigen Patentansprüche, **gekennzeichnet dadurch, dass** der Ständer aus einem zentralen, rohrförmigen Element (403) besteht, an dem eine Arbeitseinheit (404) entlanggleitet, an der die Anfangs- und Endriemenscheiben (407) montiert sind, und das mindestens zwei Griffpaare (414a,415a; 414b,415b) umfasst, die an den entsprechenden Benutzertrainingspositionen (413) an den jeweiligen Enden der beiden Übertragungsdrahtseile (412, 412') befestigt sind.
 7. Das Gerät nach einem der vorherigen Patentansprüche, **gekennzeichnet dadurch, dass** sich an den Verbindungsmitteln Mittel (214, 216) zur Messung der ausgeübten Kraft befinden, die so entworfen sind, dass sie einen Wert erfassen, der proportional zur Kraft selbst ist, und diesen an Anzeigemittel senden.
 8. Das Gerät nach Patentanspruch 7, **gekennzeichnet dadurch, dass** die Messmittel aus einer Dehnungsmessdose, die reihengeschaltet mit einem Drahtseil verbunden ist, bestehen.
 9. Das Gerät nach einem der vorherigen Patentansprüche, **gekennzeichnet dadurch, dass** die Mittel zur Verbindung der Stellelemente (3) Mittel (M, 23x, 419) zur Korrektur deren Länge in Übereinstimmung mit den körperlichen Merkmalen der Benutzer /Benutzerinnen umfassen.
 10. Das Gerät nach einem der vorherigen Patentansprüche, **gekennzeichnet dadurch, dass** die Verbindungsmittel elastische oder dämpfende Mittel umfassen, die dazu dienen, die Auswirkungen beim Übergang von einer aktiven Kraft auf eine Widerstandskraft und umgekehrt zu mildern.
 11. Das Gerät nach einem der vorherigen Patentansprüche, **gekennzeichnet dadurch, dass** es Kraftmessmittel umfasst, die aus einem oder mehreren Lastsensoren (214, 216) bestehen, die an einem Drahtseil oder einer Verbindungsstelle angebracht sind und dazu dienen, anzuzeigen, wenn eine bestimmte Belastung erreicht wurde.
 12. Das Gerät nach einem der vorherigen Patentansprüche, **gekennzeichnet dadurch, dass** es eine Vorrichtung (D) zur Anzeige des erreichten Belastungsniveaus (C) als fortlaufender Wert oder als Vergleichswert zu einem Bezugsniveau (R), das das Trainingsprogramm darstellt, umfasst.
 13. Das Gerät nach einem der vorherigen Patentansprüche, **gekennzeichnet dadurch, dass** es zusätzliche Mittel zur Ausübung einer Widerstandskraft als Gegenkraft zur aktiven Kraft, die von einem Benutzer / einer Benutzerin auf ein oder mehrere Stellelemente ausgeübt wird, umfasst.
 14. Das Gerät nach Patentanspruch 13, **gekennzeichnet**

net dadurch, dass die zusätzlichen Widerstandsmittel aus einem oder mehreren Gewichten (P) bestehen, die an das Stellelement (3) mindestens einer der Benutzertrainingspositionen angebracht sind, so dass die Widerstandskraft, die auf die anderen Stellelemente ausgeübt wird, erhöht wird.

15. Das Gerät nach Patentanspruch 14, **gekennzeichnet dadurch, dass** die zusätzlichen Widerstandsmittel aus einem oder mehreren Gewichten (P) bestehen, die mithilfe eines zusätzlichen Systems aus Drahtseilen und Riemenscheiben an einem oder mehreren Stellelementen angebracht sind.

16. Das Gerät nach einem der vorherigen Patentansprüche, **gekennzeichnet dadurch, dass** es eine Druckmessdose (CC) umfasst, die an einem Punkt (29) angebracht ist, an dem eine der Riemenscheiben (22) am Rahmen (1) befestigt ist.

17. Das Gerät nach einem der vorherigen Patentansprüche, **gekennzeichnet dadurch, dass** die Verbindungsmittel Mittel (215) zur Dämpfung der Belastung umfassen.

18. Das Gerät nach einem der vorherigen Patentansprüche, **gekennzeichnet dadurch, dass** die Verbindungsmittel Gelenkhebel (2) und/oder Riemenscheibensysteme (22) mit einem oder mehreren Drahtseilen (24) umfassen, durch die die Stellelemente (3) verbunden sind.

Revendications

1. Un appareil d'exercice comprenant un cadre de montage (1); au moins deux positions utilisateur (413); des moyens de transmission de puissance (2) destinés à connecter les actionneurs correspondants de la machine (3) et accessibles par les utilisateurs de telle sorte que la puissance appliquée par les utilisateurs sur un ou plusieurs actionneurs (3) est transmise par les moyens de transmission (2) à un ou plusieurs des actionneurs restants et réciproquement et constitue de façon alternée pour les utilisateurs une force active et une force résistante permettant de déplacer les actionneurs par rapport aux positions utilisateurs.

Caractérisé en ce que le cadre consiste en un montant simple (403) et les moyens de transmission consistent en au moins un câble (412, 412') passant en succession à travers une pluralité de poulies; les actionneurs de la machine consistant en au moins deux poignées (414 a, b; 415 a, b) montées aux extrémités du câble (412, 412') sur chaque côté du montant (403) de façon à être utilisées par au moins deux utilisateurs dans leurs positions de travail respectives (413).

2. La machine selon la revendication 1, **caractérisée en ce qu'elle** comprend un premier et un deuxième câbles (412, 412') ayant des poignées à leurs extrémités, de telle sorte que deux paires de poignées (414a-415a; 414b-415b) sont disponibles dans les positions de travail utilisateur respectives (413), chacune des dites paires de poignées étant formée de deux poignées qui sont montées respectivement à une extrémité du dit premier et du dit deuxième câble (412, 412').

3. La machine selon la revendication 2, **caractérisée en ce que** la pluralité de poulies comprend une poulie initiale (407) montée sur le montant (403), au moins une poulie intermédiaire (409, 410) verticalement décalée par rapport à la première poulie et une poulie finale (407) montée sur le montant (403) et verticalement décalée par rapport à la poulie intermédiaire.

4. La machine selon l'une des revendications précédentes, **caractérisée en ce que** la poulie initiale ou la poulie finale (407) ou bien les deux sont montées de façon réglable à hauteur sur le montant.

5. La machine selon la revendication 4, **caractérisée en ce que** les poulies initiales et finales (407) sont réglables en hauteur indépendamment l'une de l'autre.

6. La machine selon l'une des revendications précédentes, **caractérisée en ce que** le montant consiste en un élément tubulaire central (403) sur lequel coulisse une unité de travail (404) comprenant les poulies initiales et finales (407), comprenant au moins deux paires de poignées (414a-415a; 414b-415b) montées dans les positions de travail utilisateur respectives (413) aux extrémités respectives des deux câbles de transmission (412, 412').

7. La machine selon l'une des revendications précédentes, **caractérisée en ce qu'au** niveau des moyens de connexion se trouvent des moyens (214, 216) de détection de la force appliquée, destinés à détecter une valeur proportionnelle à la force et à l'envoyer aux moyens d'affichage.

8. La machine selon la revendication 7, **caractérisée en ce que** les moyens de détection consistent en une cellule extensométrique connectée en série sur un câble.

9. La machine selon l'une des revendications précédentes, **caractérisée en ce que** les moyens de connexion des actionneurs (3) comprennent des moyens (M, 23x, 419) permettant de corriger leur longueur selon les caractéristiques physiques des utilisateurs.

10. La machine selon l'une des revendications précédentes, **caractérisée en ce que** les moyens de connexion comprennent des moyens élastiques ou amortisseurs conçus pour atténuer les effets transitoires du passage d'une force active à une force résistante et renversement. 5

11. La machine selon l'une des revendications précédentes, **caractérisée en ce qu'**elle comprend des moyens de détection de force consistant en un ou plusieurs capteurs de charge (214, 216) situés sur un câble ou un joint et conçus pour indiquer quand une charge prédéterminée a été atteinte. 10

12. La machine selon l'une des revendications précédentes, **caractérisée en ce qu'**elle comprend un dispositif (D) d'affichage du niveau de la charge (C) atteinte, sous forme d'une valeur progressive ou d'une valeur comparée à un niveau de référence (R) représentant le programme d'entraînement. 15
20

13. La machine selon l'une des revendications précédentes, **caractérisée en ce qu'**elle comprend des moyens supplémentaires permettant d'appliquer une force résistante pour s'opposer à la force active exercée par un utilisateur sur un ou plusieurs actionneurs. 25

14. La machine selon la revendication 13, **caractérisée en ce que** les moyens résistants supplémentaires consistent en un ou plusieurs poids (P) appliqués à l'actionneur (3) d'au moins l'une des positions de travail utilisateur de façon à augmenter la force résistante exercée sur les autres actionneurs. 30
35

15. La machine selon la revendication 14, **caractérisée en ce que** les moyens résistants supplémentaires consistent en un ou plusieurs poids (P) appliqués à l'un des deux actionneurs aux moyens d'un système supplémentaire de câbles et de poulies. 40

16. La machine selon l'une des revendications précédentes, **caractérisée en ce qu'**elle comprend d'une cellule de charge (CC) appliquée sur un poids (29) où l'une des poulies (22) est fixée au cadre (1). 45

17. La machine selon l'une des revendications précédentes, **caractérisée en ce que** les moyens de connexion comprennent des moyens (215) permettant d'amortir la charge. 50

18. La machine selon l'une des revendications précédentes, **caractérisée en ce que** les moyens de connexion comprennent des leviers articulés (2) et/ou des systèmes de poulies (22) avec un ou plusieurs câbles (24) connectant les actionneurs (3). 55

FIG.1

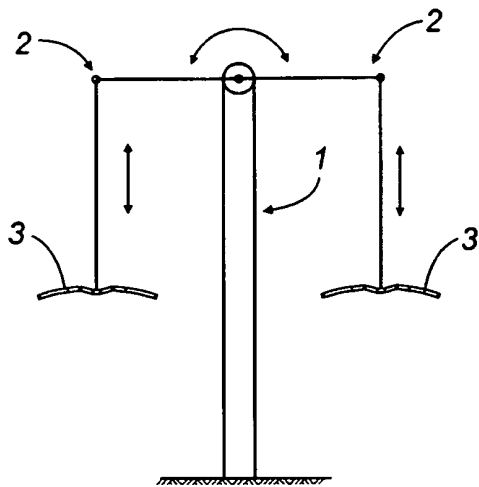


FIG.1a

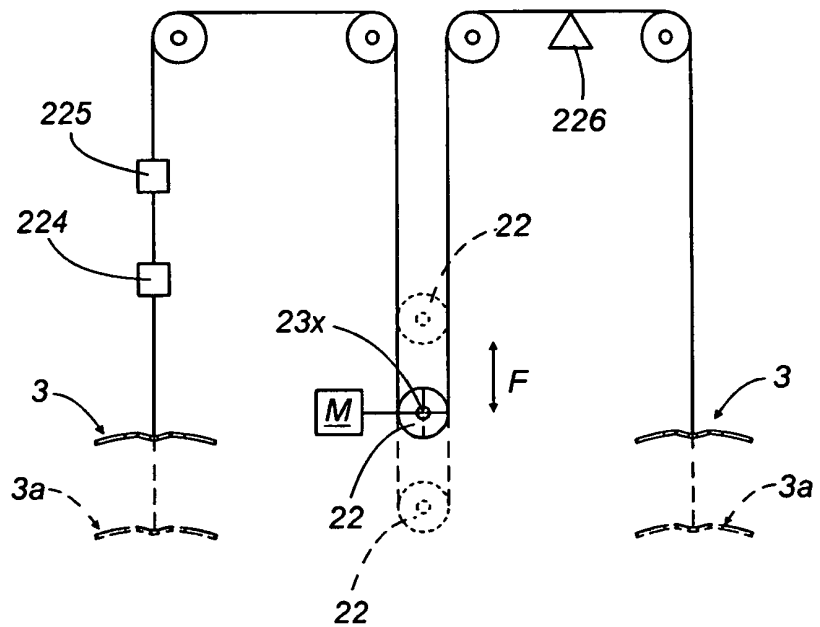


FIG.2

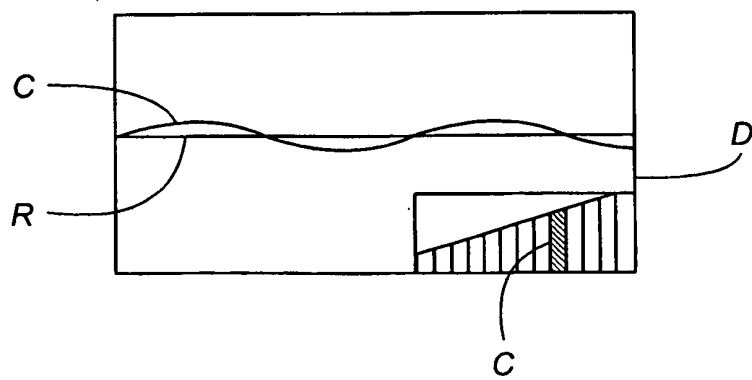


FIG.3a

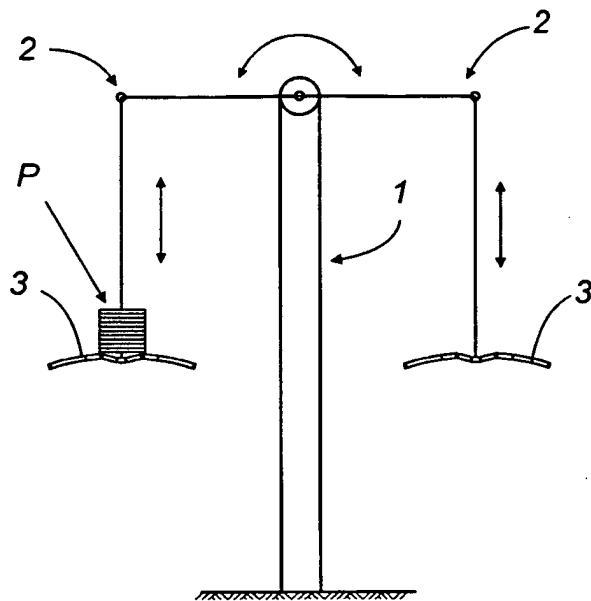


FIG.3b

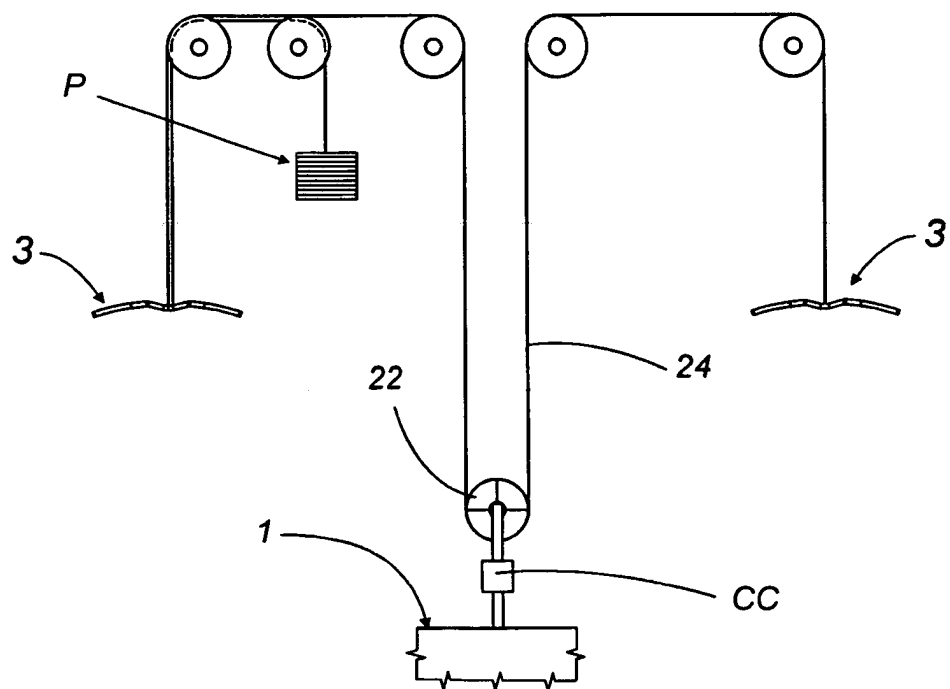


FIG.4

