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**Training machine for strengthen training and rehabilitation**

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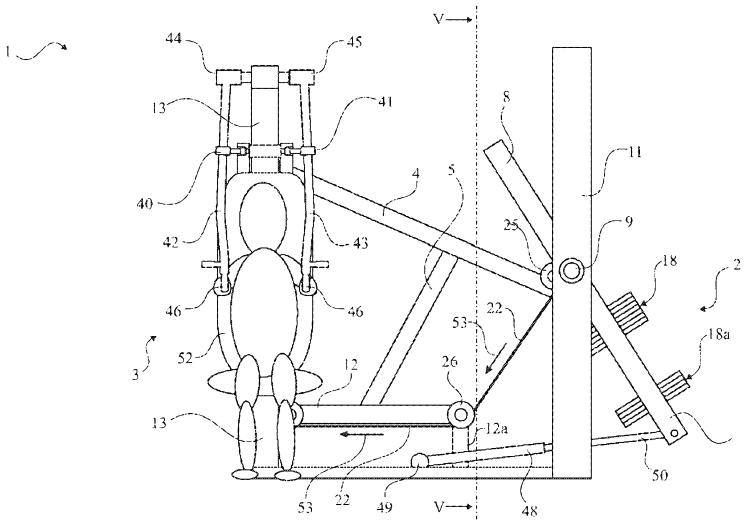
(54) **Title:** TRAINING MACHINE FOR STRENGTHEN TRAINING AND REHABILITATION




(57) **Abstract:** The present invention relates to a training machine for strength training and rehabilitation comprising pull or press means (42, 43), which are arranged to be moved backwards and forwards while a pre-determined number of weights (18, 72) in a weight package is arranged to be lifted and lowered, alternatively, by connection means (22, 19), and means (42, 80) to lift said pre-determined number of weights in a continuous movement by means of a first user intended powered force against said pull or press means (42, 43) and to lower said pre-determined number of weights by means of a second user intended powered force against said pull or press means (42, 43), said first power being less than said second power. The training machine comprises a frame carrying said weights and along which said weights are slidable and which is turnably journalled about a substantially horizontal turning axis (9, 10).

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# TRAINING MACHINE FOR STRENGTHEN TRAINING AND REHABILITATION

The present invention is related to a training machine for strengthen training and rehabilitation.

At many already known training machines for anaerobic training the user exercises intended muscles of the body by performing pre-determined movements so that a weight package of a weight stack is lifted or lowered. At efficient training with single- joint movements, as by means of a biceps curl machine or a leg extension machine, as well as with multiple-joint movements, as by means of a rowing machine, a bench press machine or a leg press machine, it is important that the user of the machine can perform a number of positive and negative working cycles intended for the personal capacity of the training person. The positive work means that weights are being lifted and the negative work means that weights are being lowered.

In US-A-4,648,594 and GB-A-2 227 676 machines are disclosed in which the load increases during of the positive movement and is reduced to its original value at the end of the negative movement.

By instead varying the load so that, during the same total movement cycle, the positive working cycle becomes easier to perform, i.e., less force is required to lift the selected weight package than to lower it, the training person can lift a greater weight package than what was possible with a normal machine or alternatively perform more movements during one and the same workout session.

A machine of the type defined above is shown and described in US-A-4,563,003. This machine has a rod which is pressed against the weight package during the negative movement to increase the load when the weight package moves downwards. To provide a constantly increased load during the negative movement an influence of the rod must occur directly dependent on the movement of the training person during the whole negative movement. If the training person increases or decreases the movement rate during the

negative work the speed of the rod must be amended in the same proportion. Such a regulation is very complex and difficult to perform in practise.

Embodiments of the present invention seek to provide a training machine which sets aside the above mentioned problem.

According to one aspect of the present invention there is provided a training machine for strength training and rehabilitation comprising: a fixed outer frame extending upwardly a predetermined height; an inner frame have an upper end and a lower end, said inner frame extending upwardly a predetermined height and being mounted within the fixed outer frame, said upper and lower ends being free ends of the inner frame not attached to the fixed outer frame; a turning axis operatively positioned between said fixed outer frame and said inner frame, said turning axis being substantially centrally disposed between the upper and lower ends of the inner frame for selectively enabling a pivoting movement of the inner frame relative to the outer frame; pull or press means that are arranged to be moved backwards and forwards by a user; a pre-determined number of weights in one weight package that are carried by, and slidable along, said inner frame; a connection means that connects the pull or press means to the pre-determined number of weights, such that the weights are moved along the inner frame in response to movement of the pull or press means ; and a driving device that is arranged to pivot the inner frame backwards and forwards about said turning axis, wherein a first force is applied against said pull or press means during lifting the pre-determined number of weights, and a second force is applied against said pull or press means during lowering said predetermined number of weights. and wherein the driving device moves the inner frame such that said first force is less than said second force.

According to another aspect of the present invention there is provided a training machine for strength training and rehabilitation comprising: a fixed outer frame extending upwardly a predetermined height; an inner frame have an upper end and a lower end. said inner frame extending upwardly a predetermined height and being mounted within the fixed outer frame, said upper and lower ends being free ends of the inner frame not attached to

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the fixed outer frame; a turning axis operatively positioned between said fixed outer frame and said inner frame, said turning axis being substantially centrally disposed between the upper and lower ends of the inner frame for selectively enabling a pivoting movement of the inner frame relative to the outer frame; pull or press means arranged to be moved backwards and forwards by a user; a predetermined number of weights in one weight package that are carried by, and slidable along, said inner frame; a connection means that connects the pull or press means to the pre-determined number of weights, such that the weights are moved along the inner frame in response to movement of the pull or press means; said inner frame initially supporting said weights in a substantially vertical position; said turning axis enables said inner frame to be moved from said substantially vertical position to a predetermined angle; and drive means for inclining said inner frame between said substantially vertical position to the predetermined angle so that a first force is applied against said pull or press means during lifting said predetermined number of weights, and a second force is applied against said pull or press means during lowering said predetermined number of weights, said first force being less than said second force, wherein said weights are slidable during lifting along said inner frame with the first force when the inner frame is at the predetermined angle and are slidable lowered along said inner frame with the second force when the inner frame is at the substantially vertical position.

When a person lowers and lifts the same number of weights of a weight package, no consideration is taken to the fact that the negative, i.e., lowering, force of the person is greater than the positive, i.e., lifting, force of the person. Therefore, the effect of the training machine is limited. at training with conventional training machines the number of weights must be selected with regard to the weaker, lifting strength of the training person. The same number of weights is thereafter lowered at the negative part of the movement. Hence, this number of weights is not on a level with the negative strength.

With the training machine according to preferred embodiments of the invention the negative strength can be trained with a more optimal weight mass in the selected weight package. The result will be that the fatigue rate of the trained muscle will increase. It is thus possible to stimulate capacity improvement with less training amount than at training

with conventional training machines. Scientific studies have shown that training where the selected weight package is adapted to the negative strength provides faster and greater strength growth than training where the weight package is adapted to the positive strength.

Preferred embodiments of the invention are described in the following, by way of non-limiting example only, with reference to the appended drawings in which:

Fig. 1 shows a front view of an embodiment of a training machine for strength training and rehabilitation.

Fig. 2 shows the training machine in Fig. 1 where a person who uses the machine has been deleted and where a seat with supporting frame is shown with broken lines for clarity.

Fig. 3 shows the training machine of Fig. 1 in a positive movement position.

Fig. 4 shows the training machine of Fig. 1 in a negative movement position.

Fig. 5 shows a section along the line V-V in Fig. 2, where the machine is situated in a position for a positive movement.

Fig. 6 shows a view like that in Fig. 5 of the machine, where the machine is situated in a position to perform a negative movement.

Fig. 7 shows a side view of the training machine of Fig. 1 in a position of rest.
Fig. 8 shows a side view similar to that in Fig. 7 where the person is performing either a positive or a negative movement.
Fig. 9 shows a partial view from above of another embodiment of the machine in which the weight guides have another design.
Fig. 10 is a partial side view of the embodiment shown in Fig. 9
Fig. 11 shows a partial view from above of yet another embodiment of the machine in which the weight guides have yet another design.

In Fig. 1-8 an embodiment of a training machine 1 for strength training and rehabilitation according to the invention is shown, which machine comprises a weight stack section 2 and a training section 3, which are fixed connected to each other by means of inclined beams 4 and 5 as well as beams 6 and 7 which are arranged in a horizontal plane and fixed connected at the lower part of said sections 2 and 3. The weight stack section 2 has an inner substantially rectangular frame portion 8 (see Fig. 5 and 6), which is turnably journalled in pivot pins 9 and 10 within an outer substantially rectangular frame part portion 11. A horizontal beam 12 is via vertical beams 12a, 12b fixed connected between beam 7 and the frame construction 13 of the training section. The lower end of the inclined beam 5 is fixed connected to the beam 12. The portions comprised in the frame construction of the training machine 1, which portions are fixed connected to each other, are advantageously welded to each other to achieve a solid construction, which shall be able to stand high loads concerning pull and press loads as well as vibrations.

Between the upper and lower horizontal beams of the inner frame portion 8 guide rods 14 and 15 are fastened. Along these guide rods 14 and 15 weights 16 of a weight stack are arranged to slide. The weights have besides holes 14a and 15a for the guide rods 14 and 15, respectively, also a central hole for a lifting rod 17 (see Fig. 5), whereby a package 18 containing a pre-determined number of selected number of weights can be lifted by introducing a pin 19 through a hole 20 normal to the central hole through both the lowest weight 16a in the package 18, which is to be lifted, and a corresponding hole 21 in the lifting rod 17. Such corresponding holes 21 are arranged in front of all substantially horizontal holes 20 through the weights 16 of the weight stack, when the frame is vertical. Bearings (not shown), preferably ball or roller bearings, can be mounted in the holes 14a and 15a for the control rods 14 and 15 to reduce the friction at the displacement of the weights along the rods when the inner frame is inclined, which is to be described below. Lifting and lowering of the weight package 18 is performed by

means of a non-elastic belt 22, preferably made by the material Kevlar®, which belt passes via pulleys 23 and 24 arranged on the upper beam of the inner frame portion 8. After the pulley 24 the belt extends along the side beam of the inner frame and is turned 90° to thereafter pass over and abut another pulley 25. From the pulley 25, which is arranged substantially on the same level as the pivot pins 9 and 10, the belt turns off obliquely downwards towards a pulley 26 mounted on the beam 12 (see Fig. 1 - 4). The pulley 26 has been mounted substantially on the same level as the pivot pins 9 and 10 so that the tension in the belt will not influence the movement of the inner frame 8, which is described below. From the pulley 26 the path of the belt extends substantially horizontal towards a further pulley 27 mounted on the beam 12 and runs thereafter upwards through a pulley 28 of an equalisation device 29 to an attachment 30 which is provided on a protrusion on the beam 12b. The equalization device 29 comprises besides the pulley 28 a further pulley 31, which as the pulley 28 is journalled in freely hanging linkage arms 32 and 33. A further non-elastic belt 34, preferably made by the material Kevlar®, is mounted at its end by means of fastening devices 35 to the lower ends of arcuately extending turning arms 36 and 37, respectively. The equalisation device with the further belt 34 has been mounted in a well known way to equalize the power from the arms of the training person at loading towards the arms 42 and 43 which accordingly do not need to be moved away from the person the same distance to achieve effect because a person in most cases is not equal strong in both right and left arm.

At the opposite upper ends of the arms 36 and 37 linkage arms 38 and 39 are mounted, which are moveable in all directions, e.g., by means of a ball-and-socket joint. The arms 38 and 39 are in turn at their other ends in all directions freely moveably connected to couplings 40 and 41 mounted on pull and press arms 42 and 43, which in turn are freely turnably journalled at their upper ends on the frame construction 12 at 44 and 45, respectively. Handles 46 are provided at the lower ends of the arms 42 and 43. The turning arms 36 are journalled on a common through shaft 47 fastened at the frame construction 13. The turning arms 36 are freely journalled independently of each other on said shaft 47. A stop 47a restrains the movements of the turning arms in one direction of rotation.

In Fig. 1-6 a hydraulic cylinder device 48 is shown which at its one end 49 is mounted on a beam (not shown) which is fixed connected between the beams 6 and 7. The other end 50 of the cylinder device 48 is journalled at the lower cross beam 51 of the inner frame part 8. By activating the cylinder device 48, the inner frame 8 of the weight magazine portion 2 is arranged to rotate about the pivot pins 9 and 10, as is best evident

from Fig. 3 and 5. The hydraulic cylinder device 48 is shown as an example of a device to turn the inner frame 8 in relation to the outer frame 11. Other known devices to perform this work can of course be used within the frame of the appended claims, as, e.g., a linear electro motor etc.

A person who shall train using the strength training device 1 according to the invention sets on the chair 52 and then grips the handles 46 on the arms 42 and 43, as is evident from Fig. 1. To facilitate the positive movement, i.e., the person presses the arms 42 and 43 outwardly from the body, the inner frame is turned according to Fig. 3 so that the power which is required to lift the upper weight package 1 is reduced by the inclination of the inner frame 8, whereas the upper weight package 18 slides on the controller rods 14 and 15 and a reduction of the power which is required to press the handles forwards can be reduced with up to over 50%. The positive power which is required to lift the weights will be substantially less than the negative force, i.e., in the order of more than 30%, more precisely about 40%. When the person begins the negative movement, i.e., the person moves the arms 42 and 43 inwardly towards the body to a stop/start position where the stop 47a abuts against the frame construction 13, the inner frame 8 is turned back to its original vertical position in which the person achieves full load from the weight package 18. Turning the inner frame by means of the cylinder device 48 occurs suitably automatically by means of a control unit (not shown) which via censors censing the movement of the belt 22 and turning the inner frame against the position in Fig. 3 when the belt is moved in the direction of the arrows 53 and against the position in Fig. 4 when the belt moves in the direction of the arrows 54.

As described above, the inner frame portion 8 is turnably journalled in pivot pins 9 and 10 so that the frame can be tilted to different positions depending on the difference in loads to be achieved at the negative or positive movements, as described above. The suspension of the inner frame portion 8 in pivot pins shown in the drawings is not a limitation to such a suspension, the importance is actually that the frame portion 8 is tiltable around a substantially horizontal axis. Instead of pivot pins a single shaft can be provided, preferably extending outside the main outline of the inner frame portion 8.

At a further embodiment of the training machine according to the invention as can be seen in Fig. 9 and 10, the weights 14 are guided by means of opposite guide rollers 61 at both short ends thereof. Each roller 61 is mounted on a shaft 62 and is arranged to be movable hence and forth in tracks 63 provided on the tiltable frame 8 of the machine

and at each side thereof. The guide rollers 61 can be firm knobs of preferably a low friction material or coated with such a material. The rollers 61 can also be small wheels which are movable in the tracks 63. The lifting rod 17 extends through the central hole 14a in the weights 14.

At an embodiment not shown in the drawings the guide rollers of figs. 9 and 10 can be provided at other sites of the weights, e.g., both rollers can be provided on anyone of the long side of the weight instead of on the opposite short sides. In this case the tracks are not mounted on the tiltable frame, but across the long sides of the weights and fastened to the frame.

A further development of the training machine according to the invention, wherein the weight package with rollers as shown in figs. 9 and 10 is made as short as possible with respect to the height thereof, yet another embodiment is illustrated in Fig. 11. In this embodiment, the weights 14 are guided by means of two guide rollers 71 at each end thereof, said rollers being mounted in such a way that on one weight the rollers are mounted on opposite ends, but at diametrically opposite corners, whereby next weight is turned 180 degrees so that the rollers of two succeeding weights are partially overlapped. Each roller 71 is mounted on a shaft 72 and is arranged to be movable hence and forth in two parallel tracks 73 and 74 provided on the tiltable frame 8 of the machine and at each side thereof. The guide rollers 71 can be firm knobs of preferably a low friction material or coated with such a material. The rollers 71 can also be small wheels which are movable in the tracks 73. A longitudinal recess can be provided in the inner side wall of each track to guide the rollers in the track when the frame 8 is tilted. The lifting rod 17 extends through the central hole 14a in the weights 14.

At an embodiment which is not shown in the drawings the guide rollers of fig. 11 can be provided at other sites, e.g., all rollers can be provided on anyone of the long side of the weight instead of on the opposite short sides. In this case the tracks are not mounted on the tiltable frame, but across the long sides of the weights and fastened to the frame.

If the tracks in the embodiments shown in figs. 9 – 11 are so oriented that the weights will be hanging on the guide rollers, each roller can be replaced by two parallel wheels and the tracks will have flanges at the outer ridges thereof to receive such parallel wheels.

At both embodiments shown in figs. 9 – 11, at least one weight between weights having rollers mounted thereon can be provided without having a roller, since a predetermined number of weights having guide rollers will be sufficient to guide all weights hence and forth. The weights without rollers can be provided with recesses which are intended to receive protrusions on the following weight having guide rollers to prevent that the weight without rollers is turned around the lifting rod.

At the shown and above described preferred embodiment of the training machine according to the invention it is achieved that the trained person is given the possibility to either lift more weights than what is possible by means of conventional known machine or lift more times with the same weight as was earlier used.

Although different embodiments are disclosed in the description and drawings, the training machine according to the invention can be modified within the scope of the appended claims.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A training machine for strength training and rehabilitation comprising:

a fixed outer frame extending upwardly a predetermined height;

an inner frame have an upper end and a lower end, said inner frame extending upwardly a predetermined height and being mounted within the fixed outer frame, said upper and lower ends being free ends of the inner frame not attached to the fixed outer frame;

a turning axis operatively positioned between said fixed outer frame and said inner frame, said turning axis being substantially centrally disposed between the upper and lower ends of the inner frame for selectively enabling a pivoting movement of the inner frame relative to the outer frame;

pull or press means that are arranged to be moved backwards and forwards by a user;

a pre-determined number of weights in one weight package that are carried by, and slidable along, said inner frame;

a connection means that connects the pull or press means to the pre-determined number of weights, such that the weights are moved along the inner frame in response to movement of the pull or press means ; and

a driving device that is arranged to pivot the inner frame backwards and forwards about said turning axis,

wherein a first force is applied against said pull or press means during lifting the pre-determined number of weights, and a second force is applied against said pull or press means during lowering said predetermined number of weights, and wherein the driving device moves the inner frame such that said first force is less than said second force.

2. The training machine according to claim 1, wherein said turning axis is parallel to a lower substantial horizontal side of the inner frame.

3. The training machine according to claim 1 or 2, wherein said turning axis has two pivot pins which are provided on both sides of said inner frame and which are situated at a substantial distance from the upper end of the inner frame.

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4. The training machine according to claim 1 or 2, wherein said turning axis is a shaft.

5. The training machine according to any of claims 1 or 2, wherein the driving device is an electrical motor or a hydraulic cylinder device.

6. The training machine according to any of claims 1 or 2, wherein said first force is substantially less than said second force.

7. The training machine according to claim 1 or 2, wherein said connection means are constituted of at least one non-elastic belt, said belt being connected between said pull or press means and said pre-determined number of weights via a lever system and freely journalled pulleys arranged on the machine.

8. The training machine according to claim 7, wherein said non-elastic belt is passed from said pre-determined number of weights along the frame about a pulley which is arranged substantially on the level of said turning axis and further on the machine for connection to said pull or press means.

9. The training machine according to claim 3, wherein the pivot pins are at a middle of the inner frame.

10. The training machine according to claim 1, wherein the first force is less than 30% of the second force.

11. The training machine according to claim 1, wherein the first force is less than 40% of the second force.

12. The training machine according to claim 1, wherein the inner frame is inclined relative to a vertical direction during lifting of the weights and is vertical during the lowering of the weights.

13. The training machine according to claim 1, wherein the orientation of the inner frame relative to a vertical direction differs during lifting and lowering of the weights.

14. The training machine according to claim 1, wherein the turning axis about which the inner frame is journalled is vertically stationary during lifting and lowering of the weights.

15. A training machine for strength training and rehabilitation comprising:

a fixed outer frame extending upwardly a predetermined height;

an inner frame have an upper end and a lower end, said inner frame extending upwardly a predetermined height and being mounted within the fixed outer frame, said upper and lower ends being free ends of the inner frame not attached to the fixed outer frame;

a turning axis operatively positioned between said fixed outer frame and said inner frame, said turning axis being substantially centrally disposed between the upper and lower ends of the inner frame for selectively enabling a pivoting movement of the inner frame relative to the outer frame;

pull or press means arranged to be moved backwards and forwards by a user;

a predetermined number of weights in one weight package that are carried by, and slidable along, said inner frame;

a connection means that connects the pull or press means to the pre-determined number of weights, such that the weights are moved along the inner frame in response to movement of the pull or press means;

said inner frame initially supporting said weights in a substantially vertical position; said turning axis enables said inner frame to be moved from said substantially vertical position to a predetermined angle; and

drive means for inclining said inner frame between said substantially vertical position to the predetermined angle so that a first force is applied against said pull or press means during lifting said predetermined number of weights, and a second force is applied against said pull or press means during lowering said predetermined number of weights, said first force being less than said second force, wherein said weights are slidable during lifting along said inner frame with the first force when the inner frame is at the predetermined angle and are slidable lowered along said inner frame with the second force when the inner frame is at the substantially vertical position.

16. The training machine according to claim 15, wherein the first force is applied as a

continuous movement for lifting the predetermined number of weights.

17. A training machine for strength training and rehabilitation substantially as hereinbefore described with reference to the accompanying drawings.

Fig.1

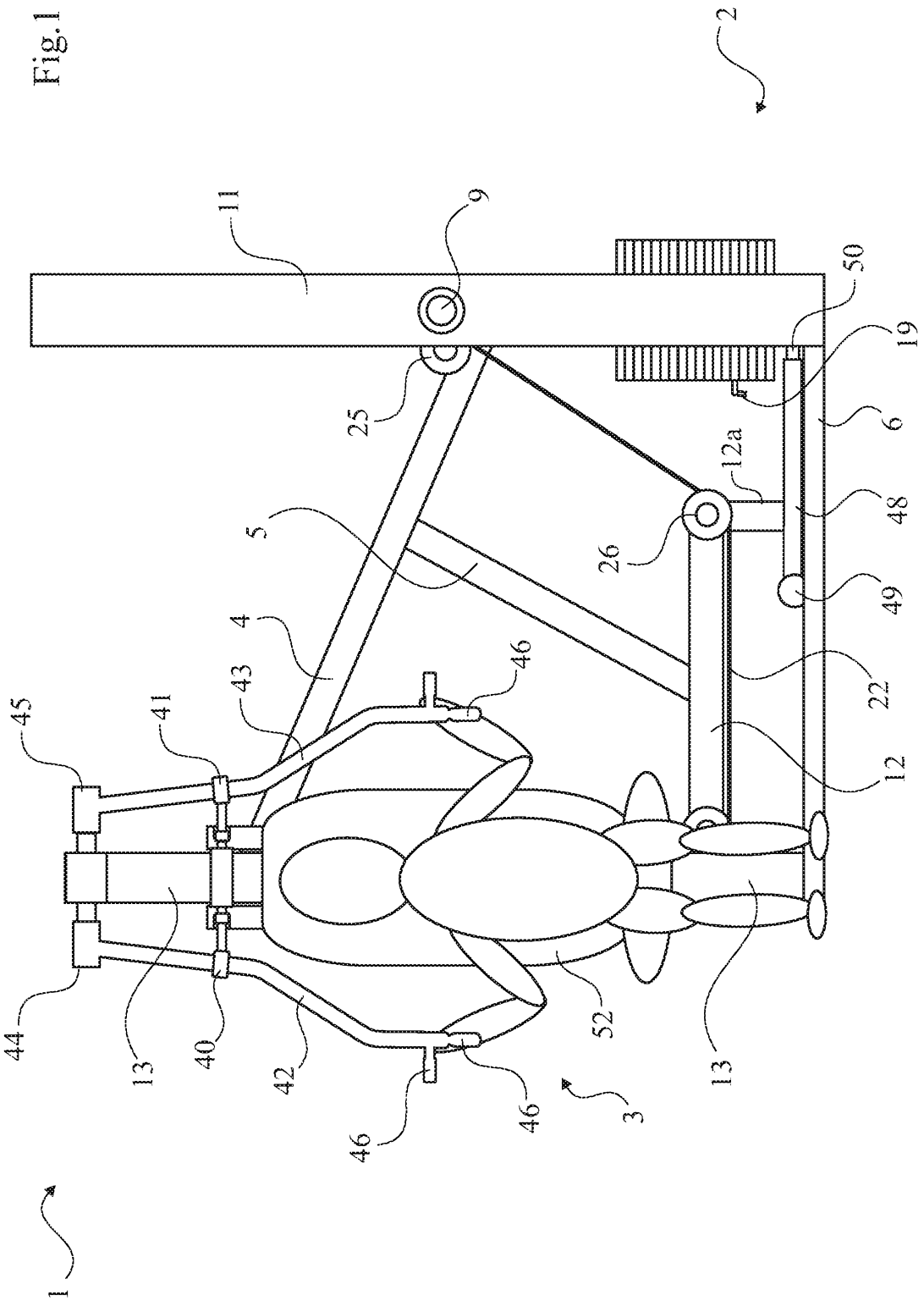
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Fig.2

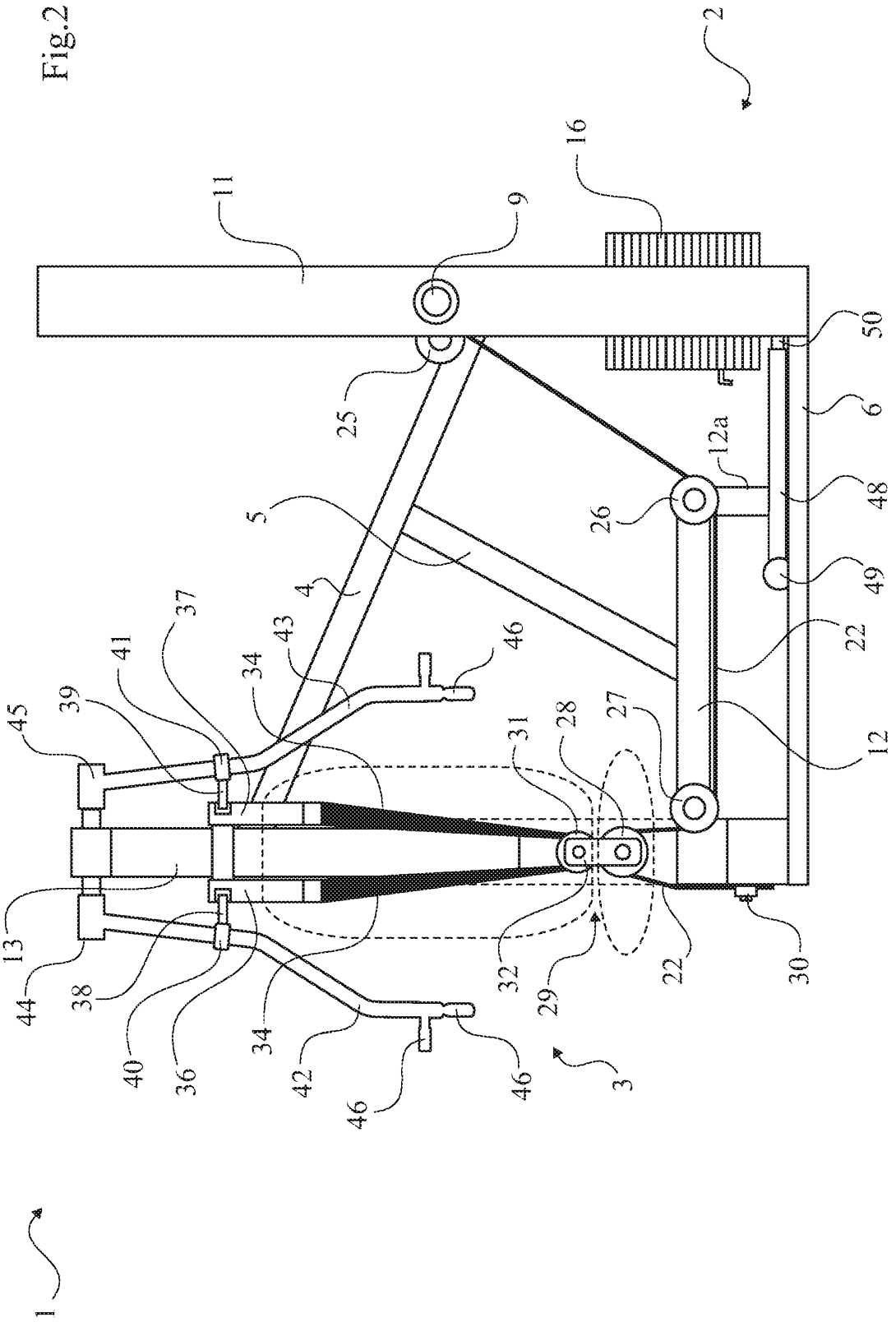
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Fig.3

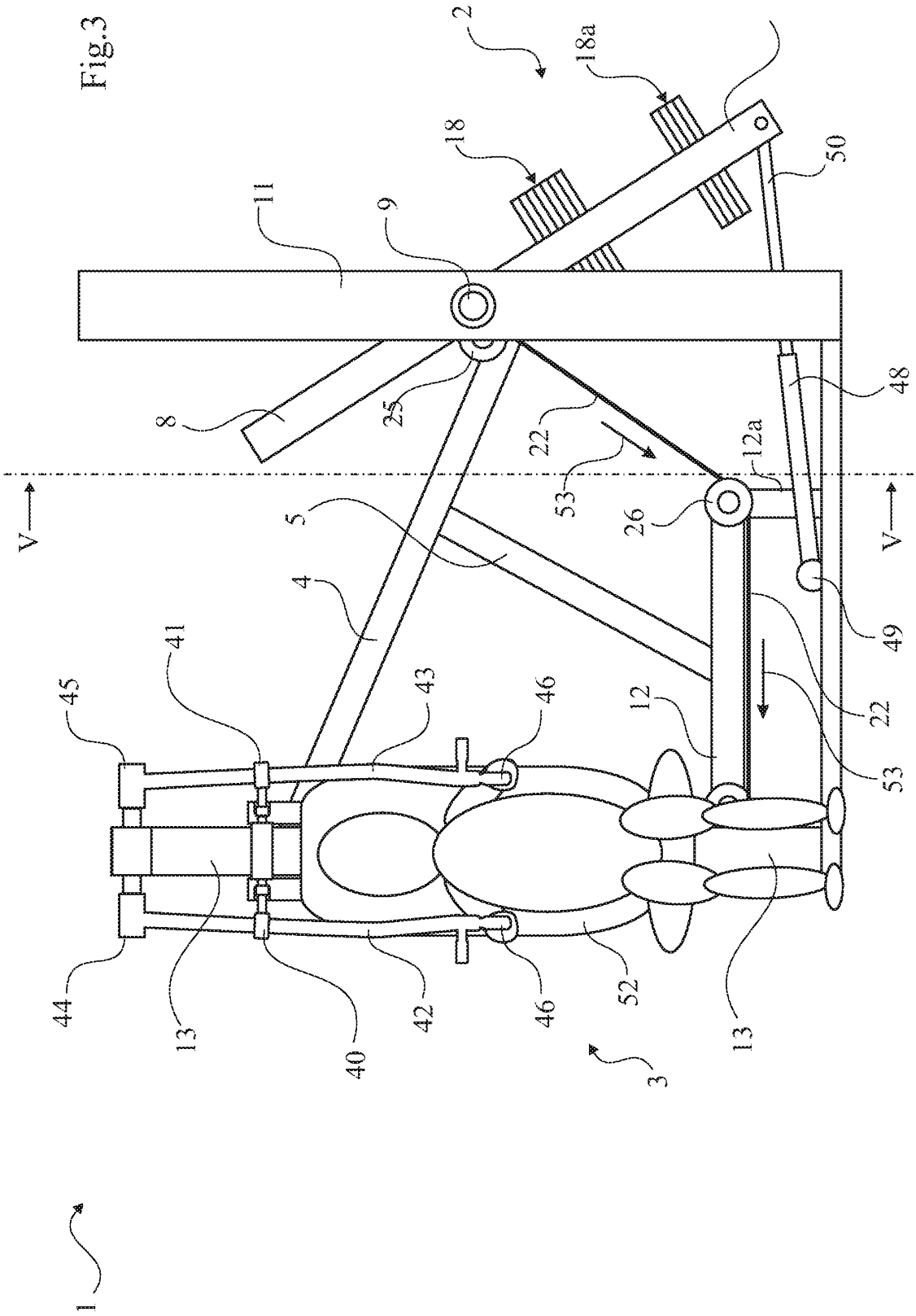
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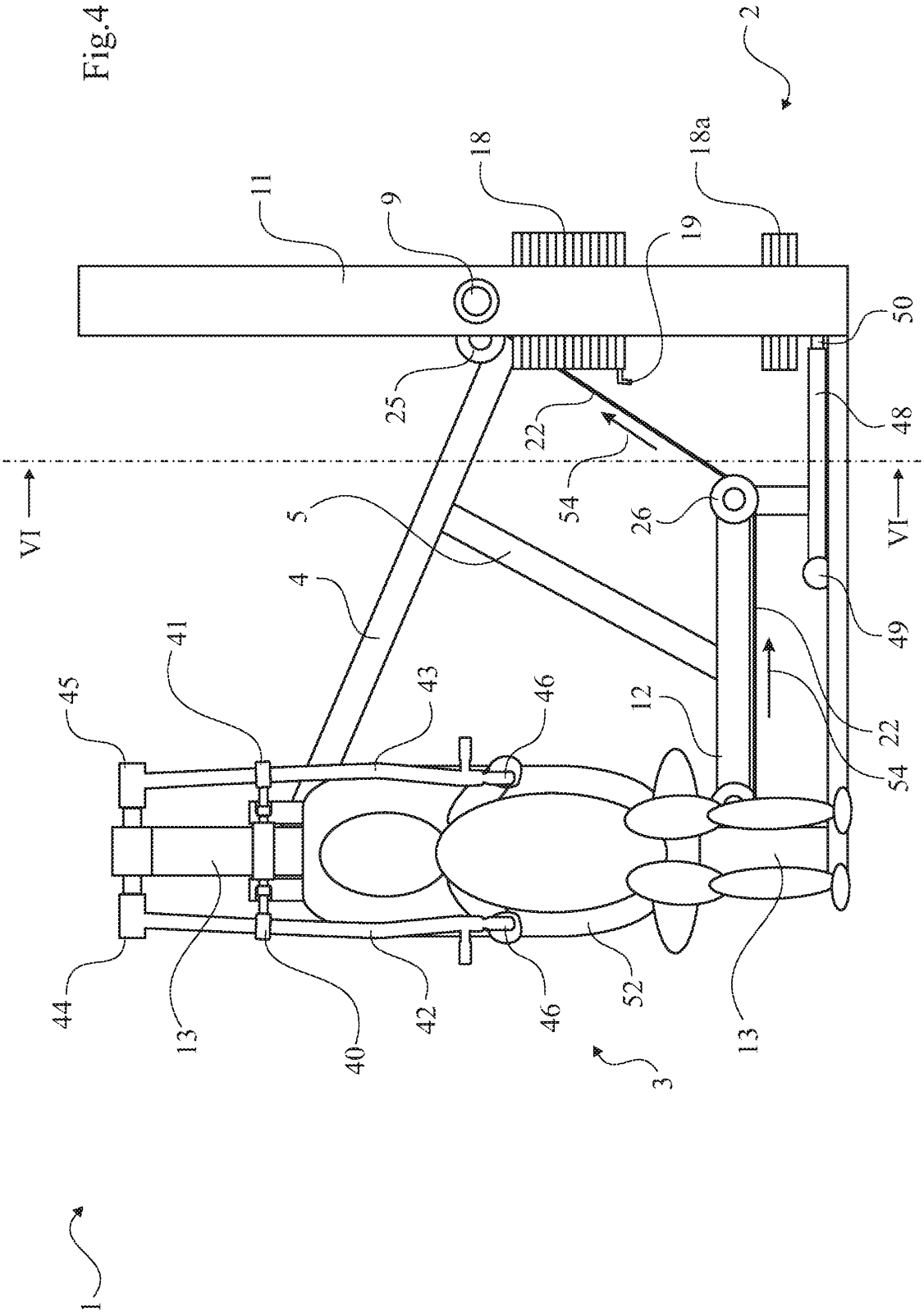
Fig.4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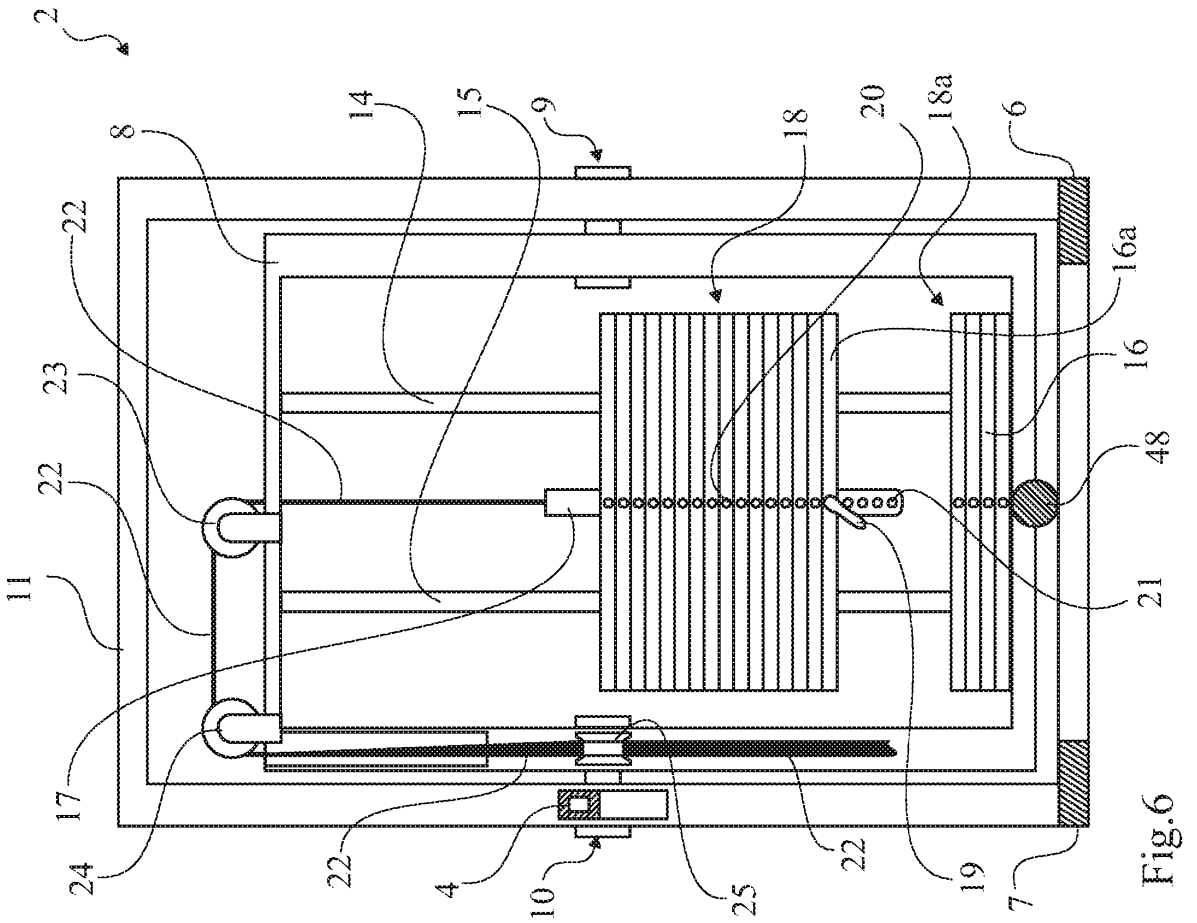
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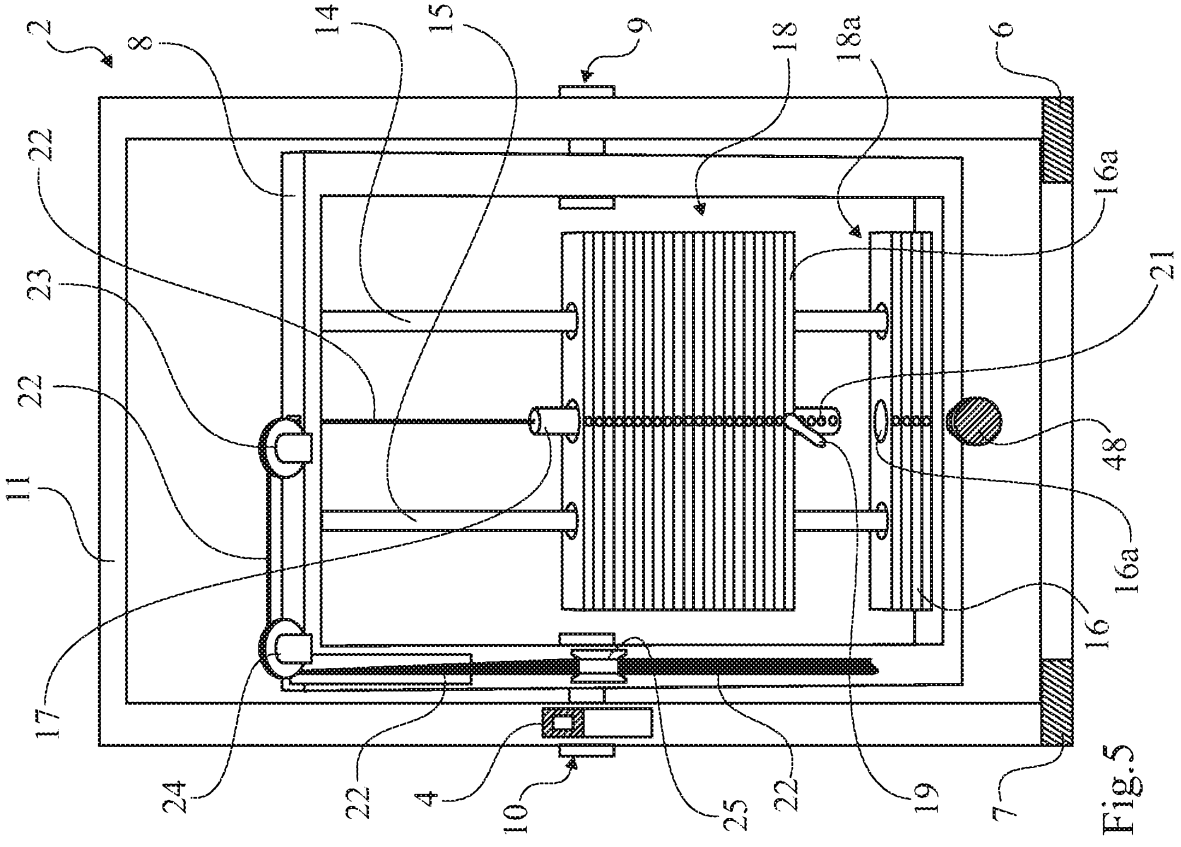
Fig.6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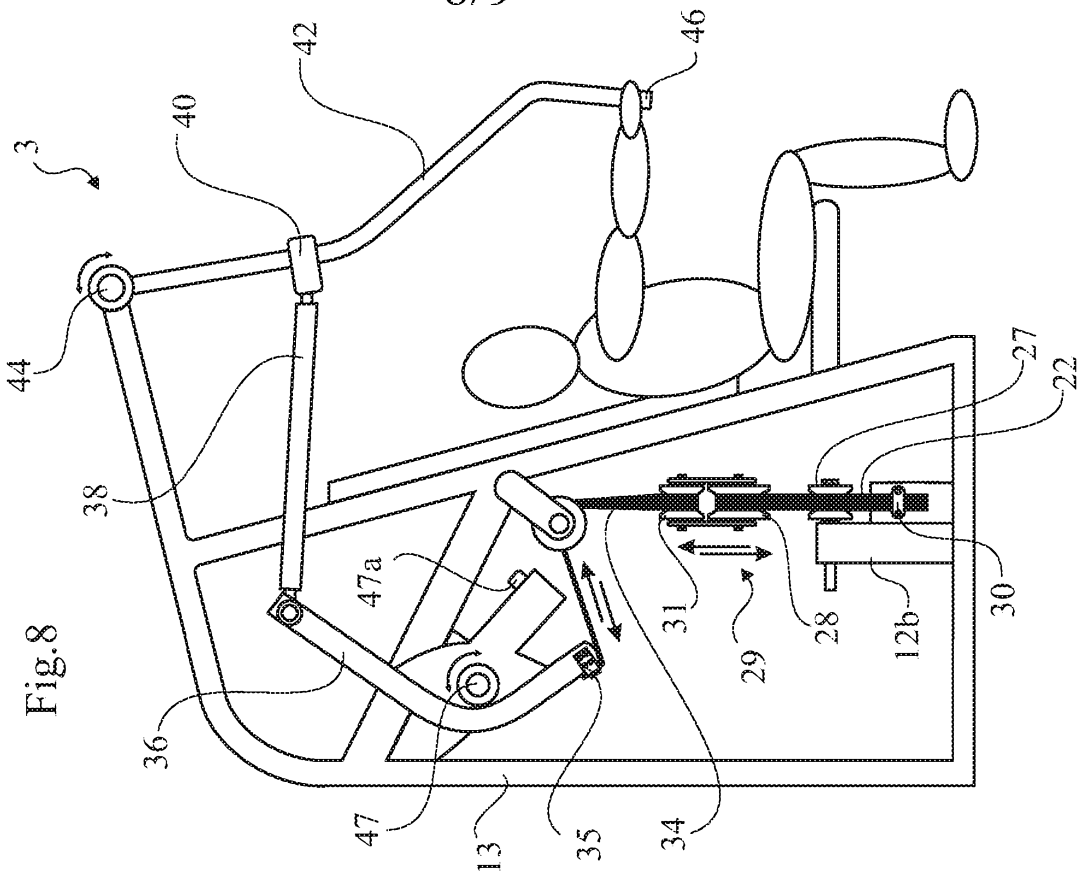
9
18
18a
6
22
16a
23
21
22
48
11
16a
16
17
24
22
4
10
25
22
19
7

Fig.5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44
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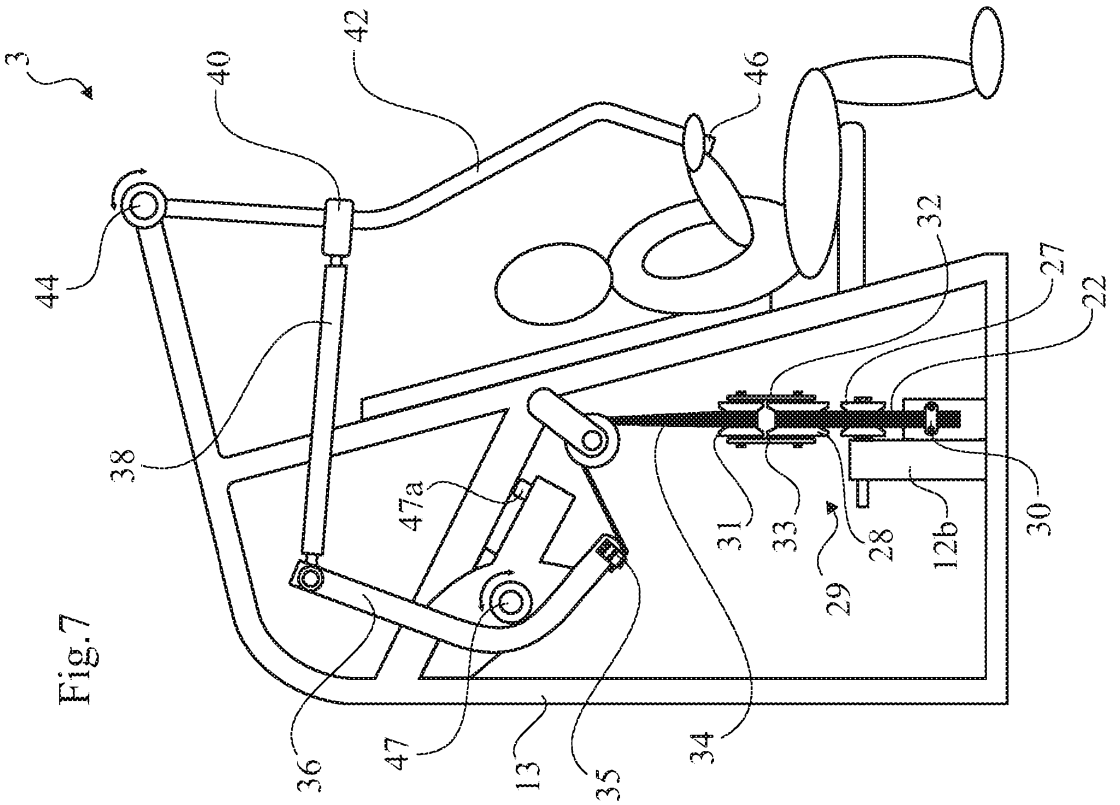
47a
36
47
13
35
34
31
29
28
12b
30
27
22

Fig.8


3
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12b
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Fig.7

Fig.9

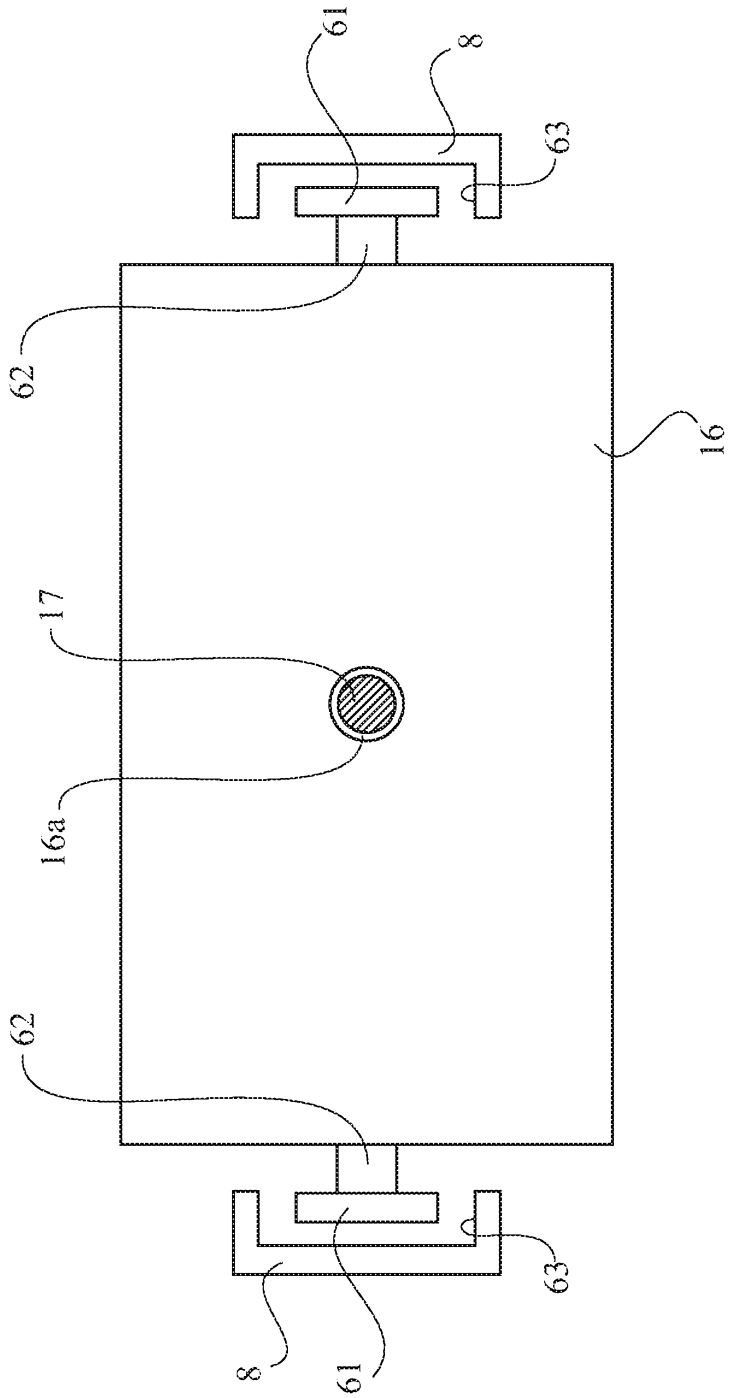

Fig.10

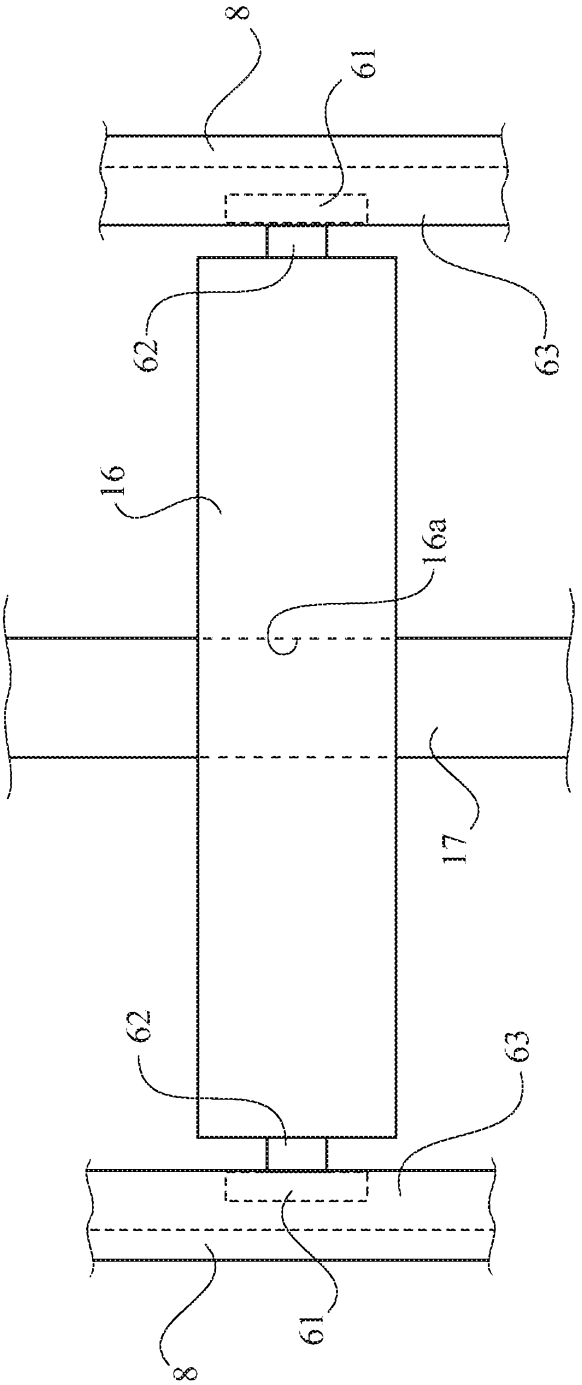

Fig.11