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(54) **A BALANCER DEVICE FOR HOISTING, POSITIONING AND ORIENTATING A LOAD**

(57) A balancer device (101) for hoisting, positioning and orientating a load in space, comprising:

a frame;

a hoist rope (111) attachment means at an upper side of said frame (102) which is arranged to be attached to a hoisting eye (103) or a rope of a crane;

at least two suspension rope attachment means which are each arranged to be attached to a respective suspension rope for suspending, positioning and orientating the load from a lower side of said frame, and a traction assembly (120);

wherein said traction assembly comprises a hydraulic cylinder-and-piston device having a cylinder (121) attached to the frame, a piston movable inside said cylinder by means of a hydraulic fluid and a piston rod (123) attached to said piston at one outer end, and which is arranged to move said one of said suspension rope attachment means relative to the other suspension rope attachment means in order to orientate and position the load in space;

wherein said traction assembly further comprises a balancer chain attached to said frame at a first outer end and to said suspension rope attachment means at a second outer end;

said piston rod is provided with a pulley wheel (124) on its other outer end and said balancer chain is suspended over said pulley wheel, such that if the piston rod is forced to move outward of the cylinder-and-piston device the suspension rope attachment means is pulled towards the upper side of the frame.

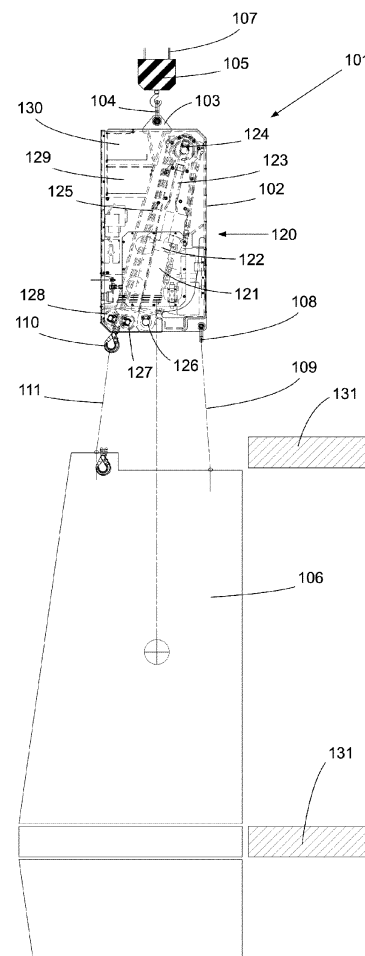


Fig. 1

Description

[0001] The present invention relates to a balancer device for hoisting, positioning and orientating a load in space, comprising:

a frame;
a hoist rope attachment means at an upper side of said frame which is arranged to be attached to a hoisting eye or a rope of a crane;
at least two suspension rope attachment means which are each arranged to be attached to a respective suspension rope for suspending, positioning and orientating the load from a lower side of said frame, and
a traction assembly comprising a linear actuator; wherein said linear actuator is arranged to move said one of said suspension rope attachment means relative to the other suspension rope attachment means in order to orientate and position the load in space.

[0002] Such a balancer device is disclosed in United States Patent no. 4,191,300. In said device, which comprises four of said traction assemblies, each traction assembly is connected to a respective suspension rope such that it can pull up each suspension rope individually by pumping fluid out of a hydraulic cylinder.

[0003] The invention aims at a balancer device which is compact, robust, reliable, safe and/or easy to operate.

[0004] To this end, a balancer device according to the preamble is characterized in that

said traction assembly further comprises a balancer chain attached to said frame at a first outer end and to said suspension rope attachment means at a second outer end;
said linear actuator is provided with a pulley wheel on its other outer end and said balancer chain is suspended over said pulley wheel, such that if the pulley wheel is forced to move the suspension rope attachment means is pulled towards the upper side of the frame.

[0005] Hereby a compact balancer device is provided, wherein an upward extension of linear actuator results in a upward movement of the second end of the balancer chain and the attached rope of twice the length of the extension of the piston. The balancer chain is preferably a metal chain, but the balancer chain may be comprised of any suitable chain, rope or wire. The device may be operated by means of a wireless remote control.

[0006] According to a preferred embodiment, wherein said linear actuator comprises a hydraulic cylinder-and-piston device having a cylinder attached to the frame, a piston movable inside said cylinder by means of a hydraulic fluid and a piston rod attached to said piston at one outer end, and said piston rod is provided with said

pulley wheel on its other outer end, such that if the piston rod is forced to move outward of the cylinder-and-piston device the suspension rope attachment means is pulled towards the upper side of the frame.

[0007] Thus an upward extension of the cylinder-and-piston device by pumping fluid into the hydraulic cylinder results in a upward movement of the second end of the balancer chain.

[0008] According to a favourable embodiment, wherein said linear actuator comprises a spindle actuator device having a spindle attached to the frame, and pulley wheel is mounted on said spindle, such that if the spindle is rotated and the pulley wheel is forced to move the suspension rope attachment means is pulled towards the upper side of the frame.

[0009] Preferably, the linear actuator is rotatably mounted to the frame.

[0010] According to a favourable embodiment, the frame comprises a rail or guide which guides linear movement of the outer end of the linear actuator or the pulley wheel in the frame.

[0011] Preferably, the linear actuator is mounted to the frame near the bottom side thereof.

[0012] Preferably, the linear actuator extends obliquely upward towards the upper side of the frame.

[0013] Preferably, the first outer end of the balancer chain is mounted to the frame at a location in the lower half of the frame.

[0014] Preferably, the balancer chain is movably guided into and out of the frame by means of a guide pulley wheel.

[0015] Preferably, said suspension rope attachment means comprise a shackle, a hook or a carabiner shackle which is attached to the second outer end of the balancer chain.

[0016] According to a preferred embodiment, at least two, preferably three, more preferably four ones of said traction assemblies are mounted to the frame.

[0017] Preferably, four ones of said traction assemblies are mounted to the frame, wherein the four traction assemblies are mounted in a mirror symmetric manner with two perpendicular planes of symmetry.

[0018] Preferably, each of the linear actuators is mounted to the frame near the vertical centre line of the frame and in an extended state the pulley wheel is located near a respective lateral sides of the frame.

[0019] Preferably, each balancer chain is movably guided into and out of the frame by means of a guide pulley wheel, wherein each guide pulley wheel is rotatably mounted to a hinge arm, which hinge arm is rotatably mounted to the frame, such that the hinge arms can swing around a hinge axis between a position wherein they are parallel with the frame and a position wherein they are perpendicular to the frame, wherein preferably each hinge axis extends obliquely in a direction which lies between the direction of the axis of the respective actuator and a vertical direction.

[0020] Preferably, the first outer end of the or each bal-

ancer chain is mounted to the frame at a location in the space facing obliquely upward from the linear actuator axis.

[0021] The present invention will now be illustrated with reference to the drawing where

Fig. 1 shows a cross sectional view of a first embodiment of a balancer device in use;

Fig. 2 shows a cross sectional view of the balancer device of Fig 1;

Fig. 3 shows a perspective view of a second embodiment of a balancer device;

Fig. 4 shows a top view of the balancer device of Fig 3;

Fig. 5A shows a front view of the balancer device of Fig 3;

Fig. 5B shows a cross sectional view of the balancer device of Fig 3; and

Fig. 6 shows a side view of the balancer device of Fig 3.

[0022] According to Figs. 1 and 2 a balancer device 101 comprises a frame 102 with a mounting eye 103 with a shackle 104 on its upper side at the centre thereof, which shackle 104 is suspended from a crane hook block 105 which is carried by a hoisting rope 107 of a crane. In this embodiment the frame 102 may comprise two substantially rectangular plate shaped mounting elements which extend parallel to each other and between which the traction assembly 120 is mounted. The circumference of the space between the plate shaped mounting elements may be substantially closed off by a side wall so as to form a housing around the traction assembly.

[0023] A load 106 is suspended from the balancer device 101 by means of a shackle 108 which is connected to the bottom side of the frame 102 at a first connecting point at one side thereof and one or more rope) 109 connected to the shackle 108, and a carabiner shackle 110 which is connected to the bottom side of the frame 102 at a second connecting point at the opposite side thereof in a movable manner by means of a traction assembly 120 as explained below, and one or more ropes 111 connected to the carabiner shackle 110.

[0024] By moving the carabiner shackle 110 with the rope(s) 111 up and down by means of the traction assembly 120 the position and orientation of the load 106 can be adjusted. In the example of Fig. 1 the load 106 is a prefabricated concrete vertical wall element which is to be inserted into the space between two horizontal concrete floors 131 of a prefabricated building, for which two-dimensional object one rope 109 and one rope 111 would be sufficient. The balancer device 101 is designed to rotate the wall element 106 in a very precise manner with small increments such that it fits narrowly and smoothly between the floors 131. Other typical applications of the balancer device may include removing a tunnel formwork from a newly cast and set concrete tunnel segment, and for such three-dimensional objects typically two ropes 109 at-

tached to the shackle 108 and two ropes 111 attached to the carabiner shackle 110 is used.

[0025] The traction assembly comprises a hydraulic cylinder-and-piston device with a cylinder 121, a piston 122 and a piston rod 123. The bottom end of the cylinder 121 is rotatably mounted to the frame 102 by means of a shaft 126 near the bottom side of the frame 102, between the vertical centre line and the lateral side where the carabiner shackle 110 is movably connected to the frame 102. The cylinder 121 extends obliquely upward towards the upper side of the frame 102. The outer end of the piston rod 123 is located in the upper half of the frame 102 between vertical centre line and the lateral side opposite the side where the carabiner shackle 110 is movably connected to the frame 102. The outer end of the piston rod 123 or the shaft of the pulley wheel 124 is slidably mounted between two opposite rails which are fixed to the frame 102, so that the linear movement of the outer end with the pulley wheel is guided in the oblique direction.

[0026] A rotatable pulley wheel 124 is attached to the outer end of the piston rod 123, with its rotation axis extending horizontally and perpendicular to the line between the first connecting point and second connecting point at the bottom side of the frame 102. In the retracted position of the hydraulic cylinder-and-piston device the pulley wheel 124 extends near the centre of the frame 102, whereas in the extended position of the hydraulic cylinder-and-piston device the pulley wheel 124 extends near the upper edge of the frame 102.

[0027] A balancer chain 125 extends over the pulley wheel 124. A first outer end of the balancer chain 125 is mounted to the frame 102 at a location in the lower half of the frame 102, at a location in the space facing obliquely downward from the axis of the cylinder 121, and between the vertical centre line and the lateral side opposite the side where the carabiner shackle 110 is movably connected to the frame 102. The other outer end of the balancer chain 125 is connected to the carabiner shackle 110. The balancer chain 125 with the carabiner shackle 110 is movably guided into and out of the frame at the lateral side thereof by means of pulley wheels 127, 128 which are rotatably mounted to the frame 102 next to the shaft 126.

[0028] The hydraulic cylinder-and-piston device is powered by a hydraulic pump unit 129 and a battery 130 which are mounted on the frame.

[0029] According to Figs. 3 to 6 in another embodiment of a balancer device 101 for positioning and orientating three-dimensional loads the frame 102 may comprise a substantially rectangular plate shaped mounting element 102 to which four traction assemblies 320 are mounted. The four traction assemblies 320 are mounted in a mirror symmetric manner with two perpendicular planes of symmetry, seen from above. A housing (not shown) may be provided around the frame 102 and the traction assemblies 320.

[0030] By moving each of the respective carabiner

shackles 110 with the respective ropes 111 up and down individually by means of the respective traction assemblies 320 the position and orientation of a three-dimensional load 106 can be adjusted in every direction.

[0031] The bottom end of each of the cylinders 121 is rotatably mounted to the frame 102 by means of a respective shaft 126 near the bottom side of the frame 102, near the vertical centre line of the frame 102. The cylinders 121 extend obliquely upward towards the upper side of the frame 102. The outer end of the piston rod 123 is located in the upper half of the frame 102 near the lateral sides of the frame 102.

[0032] A rotatable pulley wheel 124 is attached to the outer end of each of the piston rods 123, with its rotation axis extending horizontally and perpendicular to the lower edge of the frame 102. In the retracted position of the hydraulic cylinder-and-piston systems the pulley wheels 124 extend near the centre of the frame 102, whereas in the extended position of the hydraulic cylinder-and-piston systems the pulley wheels 124 extend near the upper edge of the frame 102.

[0033] A balancer chain 125 extends over each of the pulley wheels 124. A first outer end of each balancer chain 125 is mounted to the frame 102 at a location above the respective shaft 126, at a location in the space facing obliquely upward from the axis of the cylinder 121. The other outer end of each balancer chain 125 is connected to a respective carabiner shackle 110. Each balancer chain 125 with the respective carabiner shackle 110 is movably guided into and out of the frame at the bottom side thereof by means of a pulley wheel 327 which is rotatably mounted to a hinge arm 332, which hinge arm 332 is rotatably mounted to a hinge base 333 around a hinge axis 334. The balancer chain 125 extends between the pulley wheel 327 and the hinge base 333. The hinge base 333 is mounted to the frame 102 in the area under the respective pulley wheel 124, with the hinge axis 334 extending obliquely in a direction which lies between the direction of the axis of the respective cylinder 121 and a vertical direction, and as shown in Fig. 4 the hinge arms 332 can swing between a position wherein they are parallel with the frame 102 and a position wherein they are perpendicular to the frame 102.

[0034] The invention has thus been described by means of preferred embodiments. It is to be understood, however, that this disclosure is merely illustrative. Various details of the structure and function were presented, but changes made therein, to the full extent extended by the general meaning of the terms in which the appended claims are expressed, are understood to be within the principle of the present invention. The description and drawings shall be used to interpret the claims. The claims should not be interpreted as meaning that the extent of the protection sought is to be understood as that defined by the strict, literal meaning of the wording used in the claims, the description and drawings being employed only for the purpose of resolving an ambiguity found in the claims. For the purpose of determining the extent of pro-

tection sought by the claims, due account shall be taken of any element which is equivalent to an element specified therein. An element is to be considered equivalent to an element specified in the claims at least if said element performs substantially the same function in substantially the same way to yield substantially the same result as the element specified in the claims.

10 Claims

1. A balancer device for hoisting, positioning and orientating a load in space, comprising:

a frame;
 a hoist rope attachment means at an upper side of said frame which is arranged to be attached to a hoisting eye or a rope of a crane;
 at least two suspension rope attachment means which are each arranged to be attached to a respective suspension rope for suspending, positioning and orientating the load from a lower side of said frame, and
 a traction assembly comprising a linear actuator; wherein said linear actuator is arranged to move said one of said suspension rope attachment means relative to the other suspension rope attachment means in order to orientate and position the load in space; wherein
 said traction assembly further comprises a balancer chain attached to said frame at a first outer end and to said suspension rope attachment means at a second outer end;
 said linear actuator is provided with a pulley wheel on its other outer end and said balancer chain is suspended over said pulley wheel, such that if the pulley wheel is forced to move the suspension rope attachment means is pulled towards the upper side of the frame.

2. The balancer device according to claim 1, wherein wherein said linear actuator comprises a hydraulic cylinder-and-piston device having a cylinder attached to the frame, a piston movable inside said cylinder by means of a hydraulic fluid and a piston rod attached to said piston at one outer end, and said piston rod is provided with said pulley wheel on its other outer end, such that if the piston rod is forced to move outward of the cylinder-and-piston device the suspension rope attachment means is pulled towards the upper side of the frame.
3. The balancer device according to claim 1 or 2, wherein wherein said linear actuator comprises a spindle actuator device having a spindle attached to the frame, and pulley wheel is mounted on said spindle, such that if the spindle is rotated and the pulley wheel is forced to move the suspension rope attachment

means is pulled towards the upper side of the frame.

4. The balancer device according to any of the preceding claims, wherein the linear actuator is rotatably mounted to the frame. 5
5. The balancer device according to any of the preceding claims, wherein the frame comprises a rail or guide which guides linear movement of the outer end of the linear actuator or the pulley wheel in the frame. 10
6. The balancer device according to any of the preceding claims, wherein the linear actuator is mounted to the frame near the bottom side thereof. 15
7. The balancer device according to any of the preceding claims, wherein the linear actuator extends obliquely upward towards the upper side of the frame.
8. The balancer device according to any of the preceding claims, wherein the first outer end of the balancer chain is mounted to the frame at a location in the lower half of the frame. 20
9. The balancer device according to any of the preceding claims, wherein the balancer chain is movably guided into and out of the frame by means of a guide pulley wheel. 25
10. The balancer device according to any of the preceding claims, wherein said suspension rope attachment means comprise a shackle, a hook or a carabiner shackle which is attached to the second outer end of the balancer chain. 30
11. The balancer device according to any of the preceding claims, wherein at least two, preferably three, more preferably four ones of said traction assemblies are mounted to the frame. 35
12. The balancer device according to claim 11, wherein four ones of said traction assemblies are mounted to the frame, wherein the four traction assemblies are mounted in a mirror symmetric manner with two perpendicular planes of symmetry. 40
13. The balancer device according to claim 12, wherein each of the linear actuators is mounted to the frame near the vertical centre line of the frame and in an extended state the pulley wheel is located near a respective lateral sides of the frame. 45
14. The balancer device according to any of the claims 11 to 13, wherein each balancer chain is movably guided into and out of the frame by means of a guide pulley wheel, wherein each guide pulley wheel is rotatably mounted to a hinge arm, which hinge arm is rotatably mounted to the frame, such that the hinge 55

arms can swing around a hinge axis between a position wherein they are parallel with the frame and a position wherein they are perpendicular to the frame, wherein preferably each hinge axis extends obliquely in a direction which lies between the direction of the axis of the respective actuator and a vertical direction.

15. The balancer device according to any of the preceding claims, wherein the first outer end of the or each balancer chain is mounted to the frame at a location in the space facing obliquely upward from the linear actuator axis.

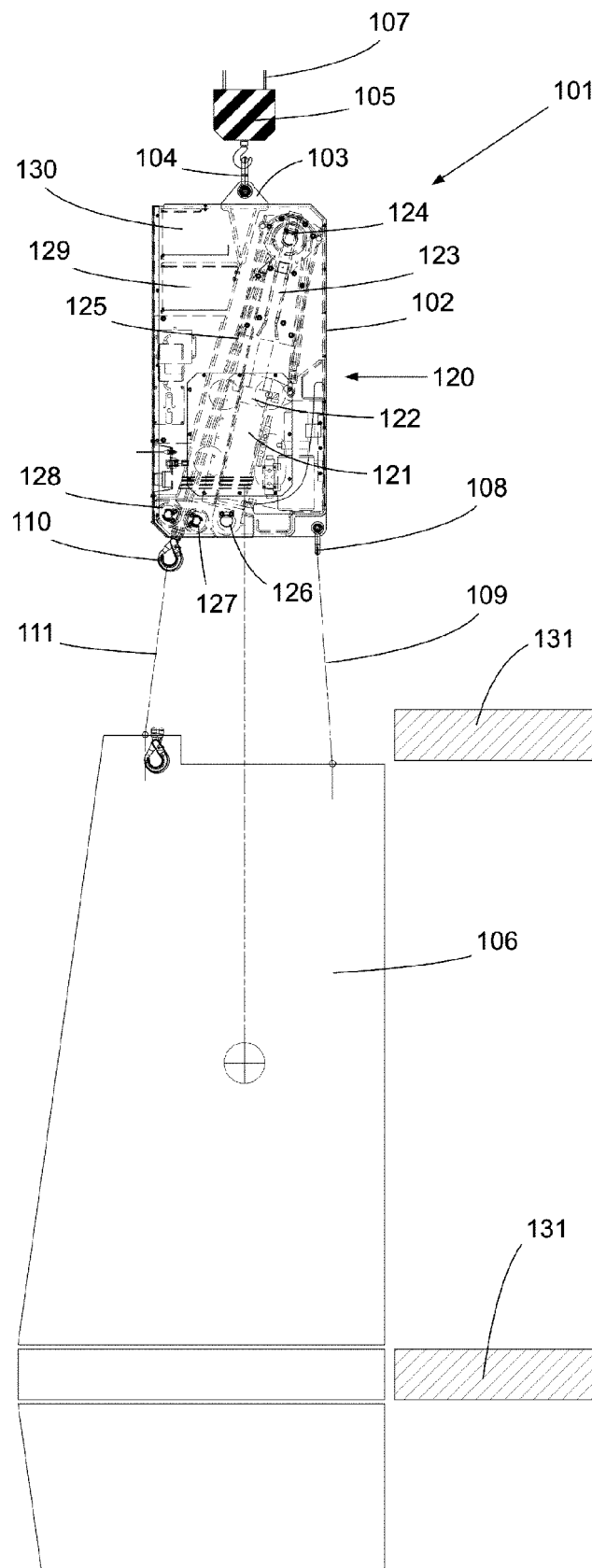


Fig. 1

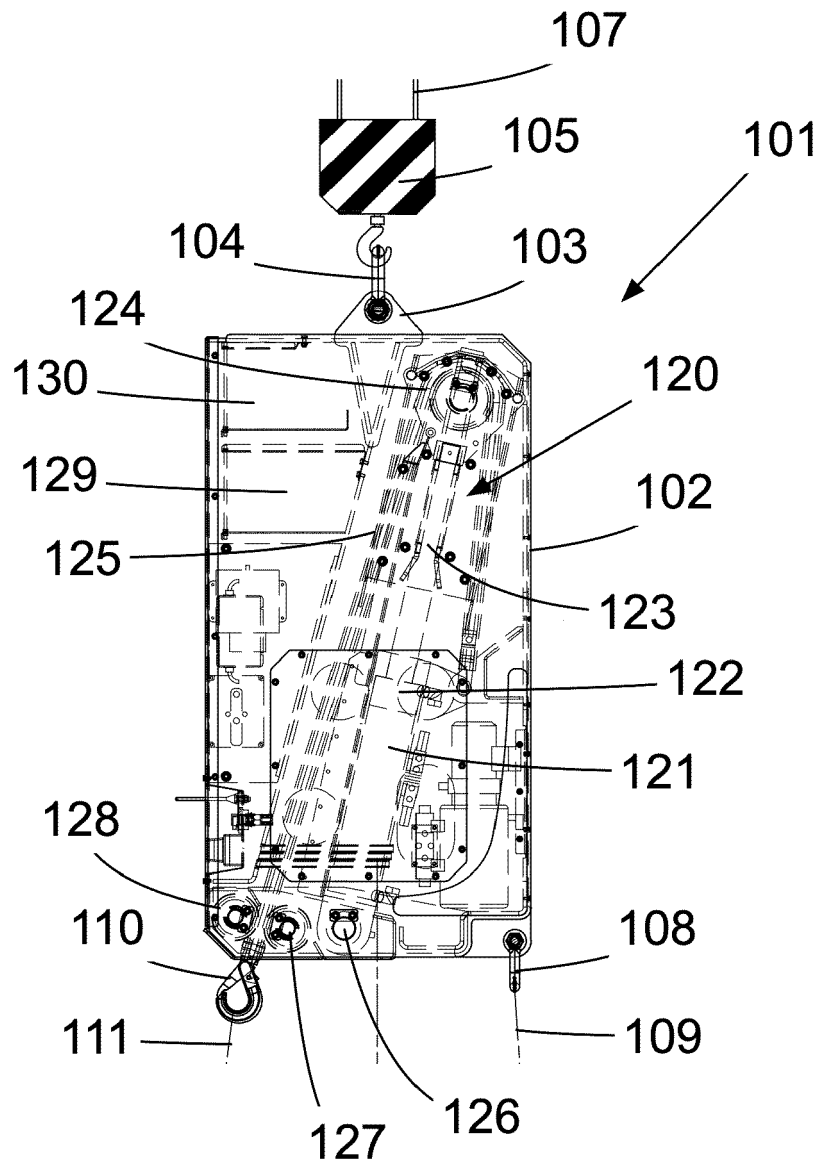


Fig. 2

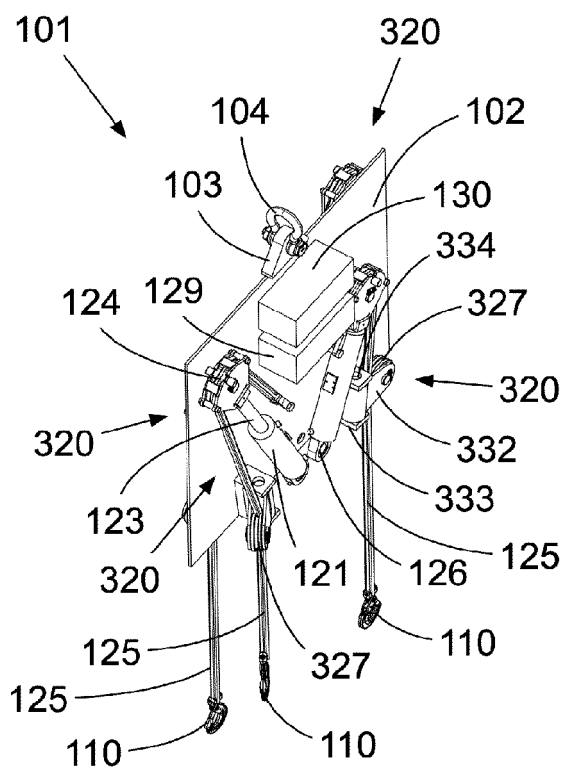


Fig. 3

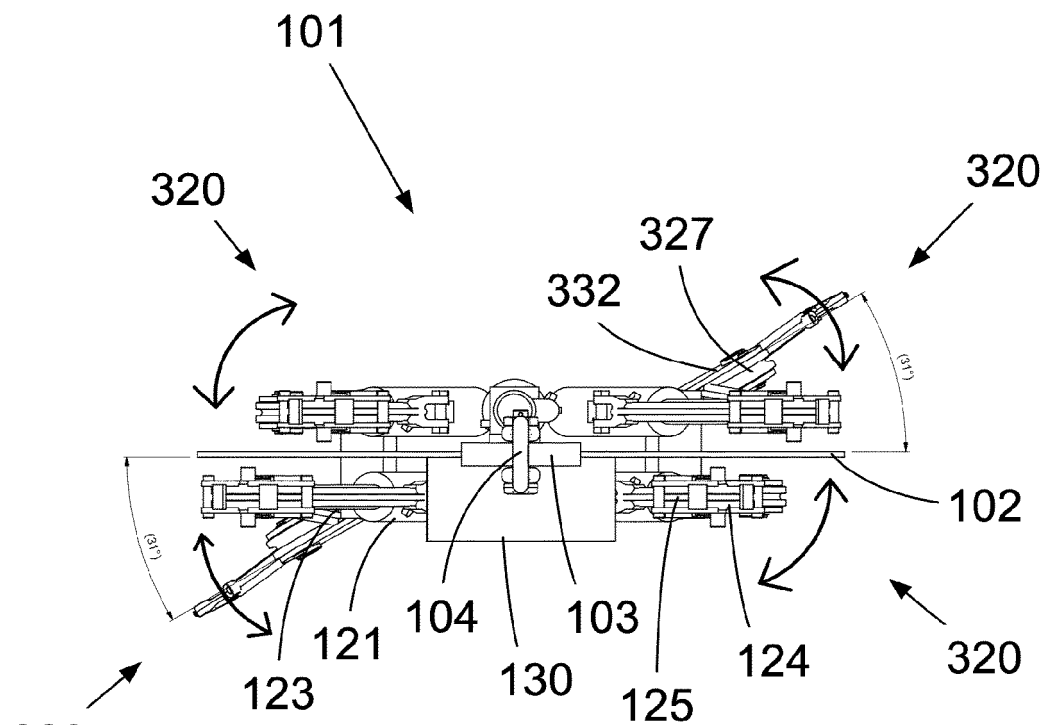


Fig. 4

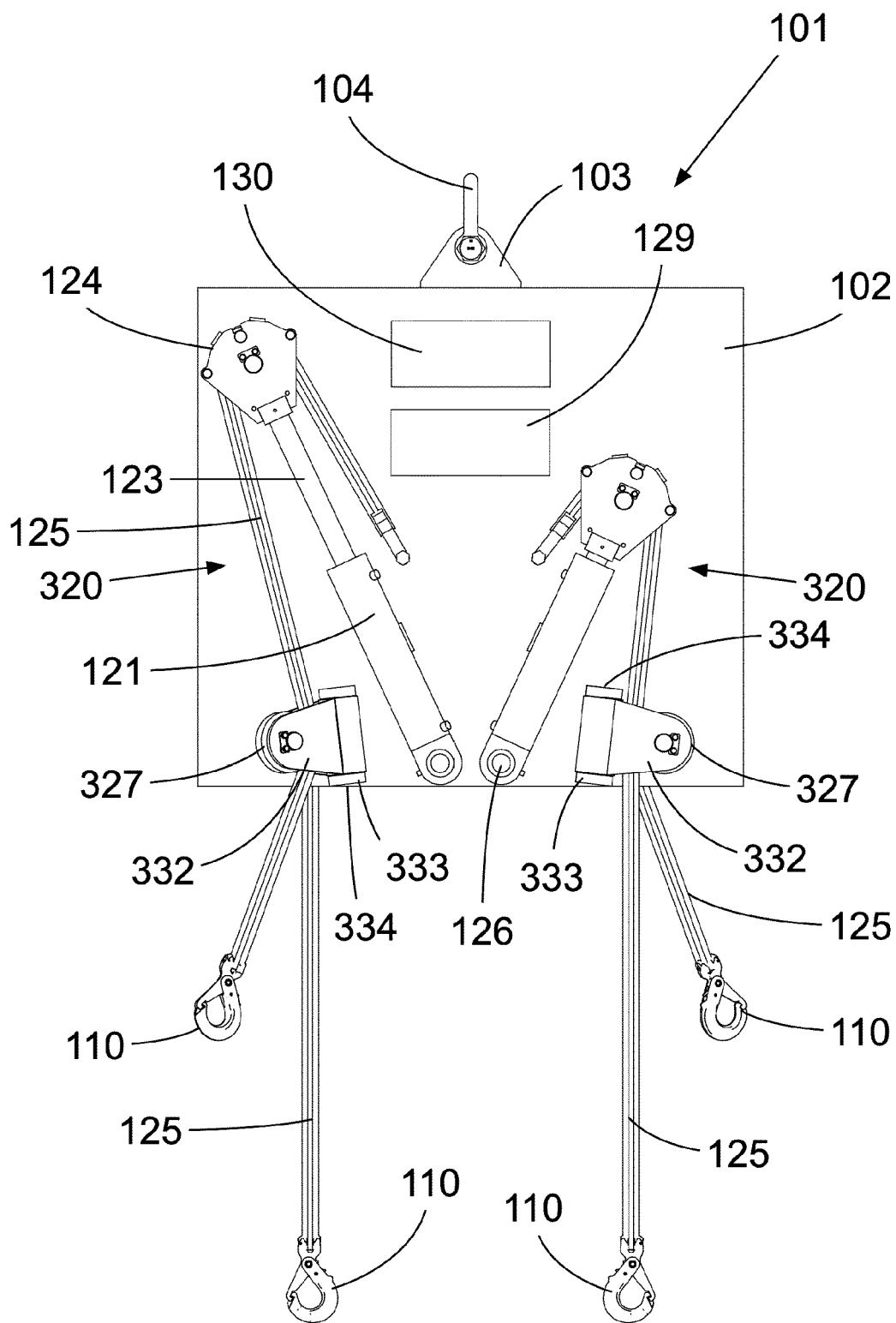


Fig. 5A

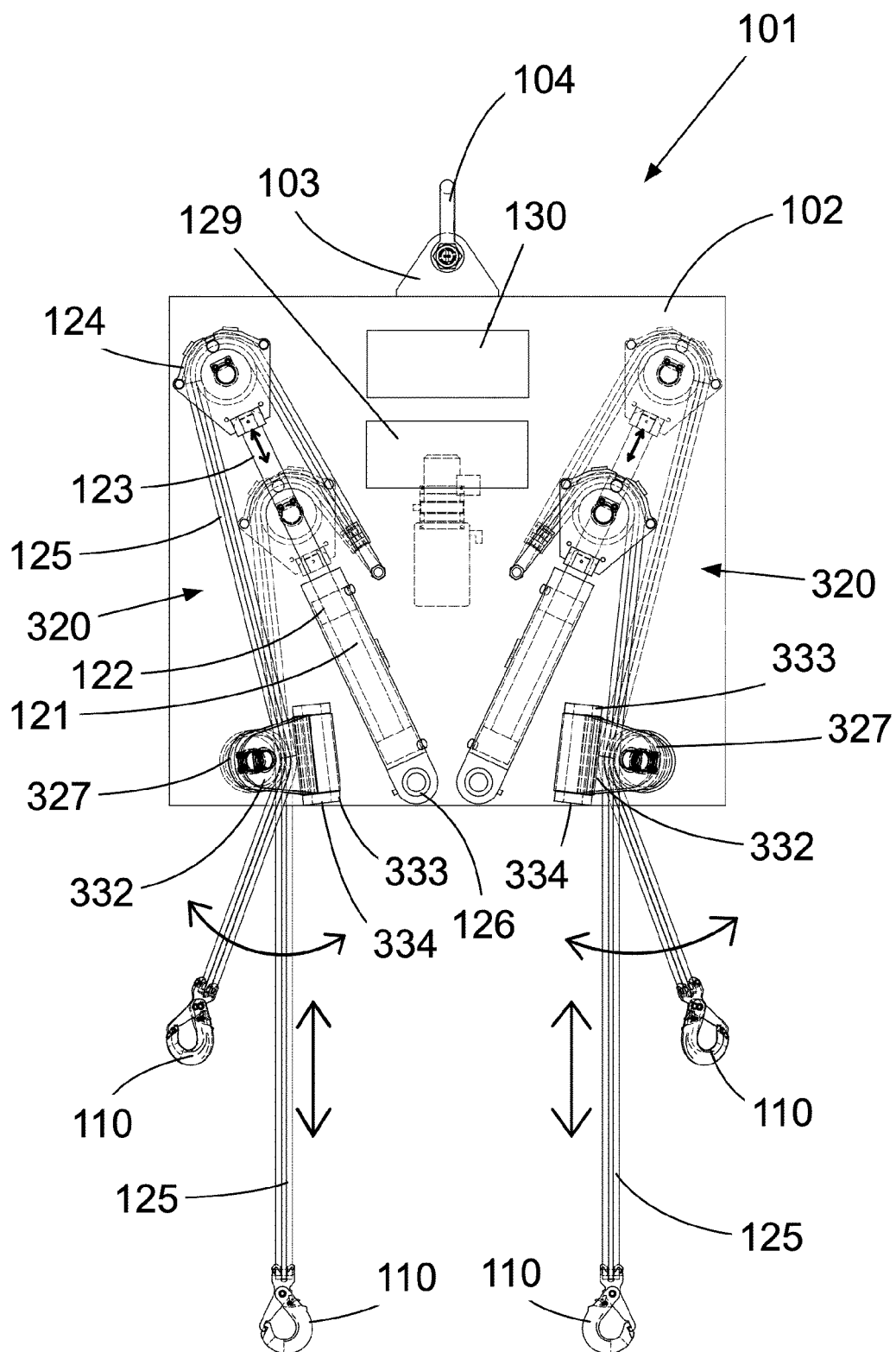


Fig. 5B

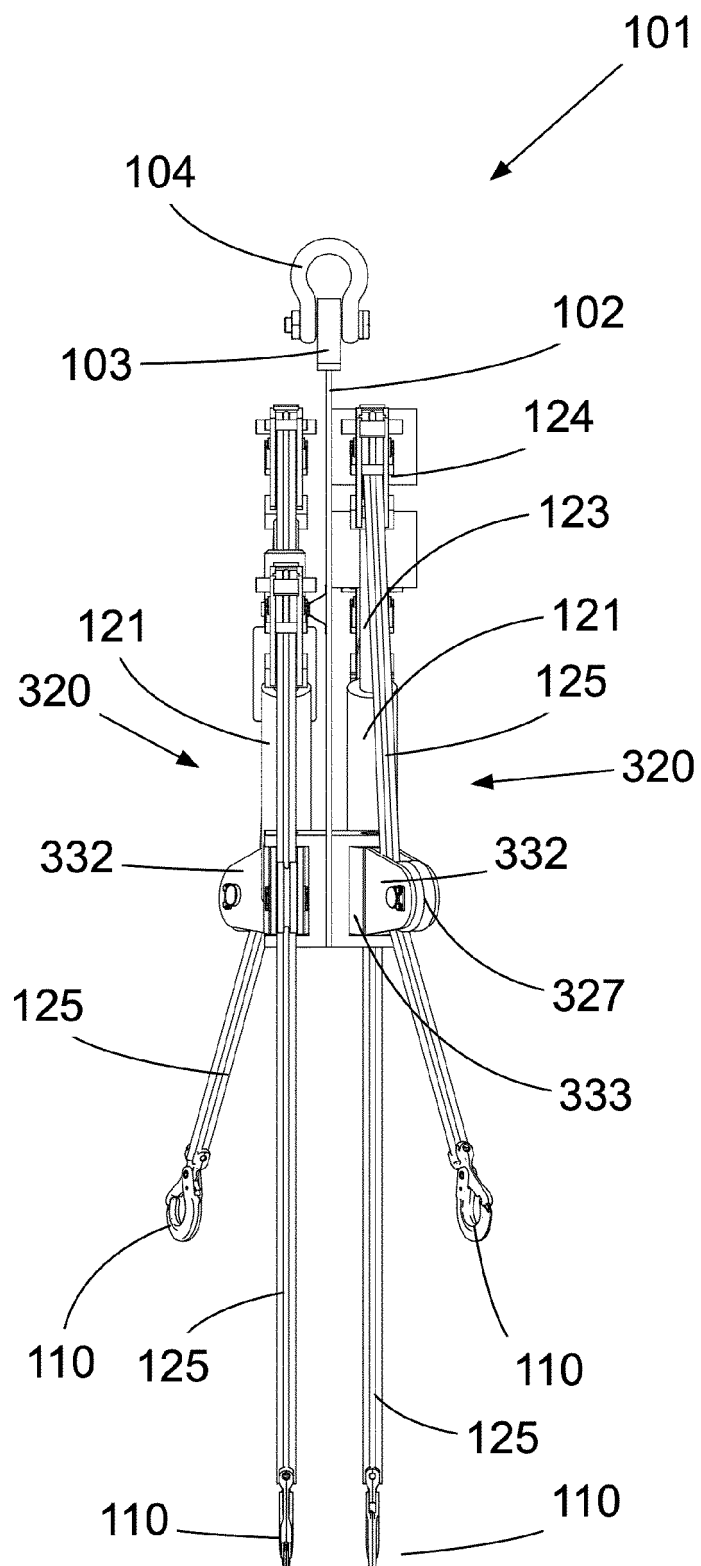


Fig. 6



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Application Number

EP 23 18 3527

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EPO FORM 1503 03.82 (P04C01)

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 15 November 2023	Examiner Verheul, Omiros
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