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(71) Applicant: **Protecmatic Oy**
31500 Koski TL (FI)

(72) Inventors:
- **Pettersson, Kalervo**
  31500 Koski TL (FI)
- **Pettersson, Mika**
  31500 Koski TL (FI)

(74) Representative: **Turun Patenttitoimisto Oy**
P.O. Box 99
20521 Turku (FI)

(54) Lifting device and method for lifting products

(57) A lifting device (1), which has support means (20) for supporting one or more products (50) for lifting them, which support means (20) comprise at least two support bars (21 a, 21 b). The lifting device additionally comprises means (10, 12, 15) for adjusting the common centre of gravity of the support means (20) and of the product (50) in a first direction, which means comprise a balancing unit (10), which has a frame part (11) and a lifting part (12) arranged to be moveable in relation to the frame part (11) by means of a transfer mechanism (15). Additionally at least one support bar (21 a, 21 b) is arranged to be moveable in order to adjust the common centre of gravity of the support means (20) and of the product (50) in a second direction, by changing the distance between at least two support bars (21 a, 21 b).

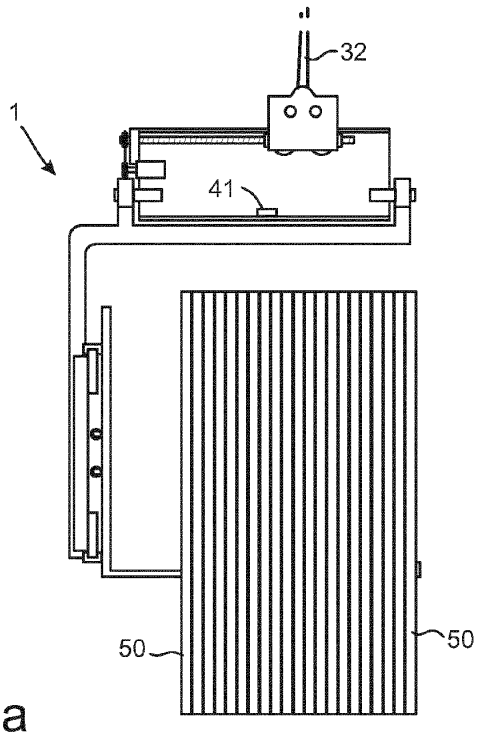

Fig. 4a

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Description

Object of the invention

[0001] The present invention relates to a lifting device, which has means for supporting one or more products for lifting them. The invention additionally relates to a method for lifting products, in which method the product is supported during the lifting.

Background of the invention

[0002] Several different methods for lifting products and lifting devices, with which products can be lifted and moved to another place, are known. A crane can be mentioned as an example, which crane has a lifting means such as a hook, which can typically be moved in a horizontal and vertical direction with the aid of different transmission mechanisms. The hook can be connected to an actuator providing lifting force for example via a steel wire. For example an electric or hydraulic motor can be used as the actuator. The crane can additionally have a boom, which can be turned around its rotational axis or moved to another place, whereby products can by means of this rotation and/or movement be moved within the limits of the operational area of the crane. When using such a crane, the lifting and moving of products can be done for example so that a lifting strap, a wire, a rope or a corresponding binding means can be placed around the product or through a possible opening in the product. This binding means can then be connected to the hook of the crane, whereby when lifting the hook, also the products rise as supported by the binding means and hook. By means of moving and/or rotating the crane, the products can along with the moving of the hook be moved to a desired place, where the hook can be lowered down and the products can be detached from the binding means. One disadvantage of such an arrangement is among others that binding the products can be difficult and even dangerous for a person, who installs the binding means in connection with the products. Finding a suitable attaching point so that the centre of gravity of the products during the lifting event would be as optimal as possible, can also be difficult, if not impossible. When several products are lifted with the aid of such an arrangement, the products can to some extent move in relation to each other, whereby the products or part of the products may be damaged due to the effect of this movement.

Brief summary of the invention

[0003] One object of the present invention is to eliminate disadvantages according to the prior art and to provide an improved lifting device and method for lifting products. The invention is based on the idea that means are arranged in the lifting device, with the aid of which means the common centre of gravity of the means supporting the products and of the products can be adjusted, advantageously so that the centre of gravity of the products is the same as or very close to the own centre of gravity of the means supporting the products (determined when the means are empty i.e. without products). In an advantageous embodiment the adjustment of the centre of gravity is advantageously done so that when the products are placed to be supported by the means supporting the products and the lifting device is lifted, the centre of gravity is adjusted to be such that the products are in a substantially vertical position. In an advantageous embodiment this adjustment can be done automatically.

[0004] The invention is defined in more detail in the enclosed independent claims. Some advantageous embodiments are disclosed in the dependent claims.

[0005] A typical lifting device has support means for supporting one or more products for lifting them, which support means comprise at least two support bars. The lifting device additionally comprises means for adjusting the common centre of gravity of the support means and of the product in at least a first direction, which means comprise a balancing unit, which has a frame part and a lifting part arranged to be moveable in relation to the frame part by means of a transfer mechanism. Additionally at least one support bar is arranged to be moveable in order to adjust the common centre of gravity of the support means and of the product in a second direction, by changing the distance between at least two support bars.

[0006] In the invention the mutual position of the means supporting the products can thus also be adjusted in order to provide a better support for the products and to adjust the centre of gravity in the second direction. This second direction is advantageously substantially perpendicular to the first direction.

[0007] In an advantageous embodiment of the invention the position of the means supporting the products in relation to the direction of the force lifting the lifting device can be adjusted. Thus for example when lifting asymmetrical products, the position of the products can during the lifting be adjusted also in this manner.

[0008] The present invention can provide remarkable advantages compared to solutions according to prior art. With the aid of the lifting device according to the invention the position of products being lifted can during the lifting be adjusted to be advantageous with regards to the lifting. For example when lifting roof trusses, the rafter beams can be set in a substantially vertical position for the duration of the lifting, even if the number of rafter beams is different during different lifts. The invention is applicable for lifting also other construction products than roof trusses. Construction elements, such as wall elements and cavity slabs, can be mentioned as some examples. The invention can additionally be applied also to lifting other things than construction products in factories, stores, warehouses, loading stations, harbours etc. According to the invention the centre of gravity can be adjusted also in the second direction, which facilitates the lifting especially of asymmetrical products. The lifting device can be

used among others in product manufacturing plants, in connection with vehicles transporting products, in the premises of the final user of the product, at construction sites etc.

Description of the drawings

[0009] In the following, the present invention will be described in more detail with reference to the appended drawings, in which

Figure 1 shows in a simplified manner a lifting device according to an advantageous embodiment of the invention seen from the side,

Figure 2a shows a balancing unit of the lifting device according to Figure 1 seen from the side,

Figure 2b shows the balancing unit of the lifting device according to Figure 1 seen from the front,

Figure 3a shows support equipment of the lifting device according to Figure 1 seen from the side,

Figure 3b shows the support equipment of the lifting device according to Figure 1 seen from the front,

Figure 4a shows the lifting device according to Figure 1 seen from the side in a situation, where some products are lifted,

Figure 4b shows the lifting device according to Figure 1 seen from the front in a situation, where some products are lifted,

Figure 4c shows the lifting device according to Figure 1 seen from the front in a situation, where some other products are lifted,

Figure 5 shows the lifting device according to Figure 1 as connected to a crane,

Figure 6a shows an advantageous embodiment of a stopper connected to the support equipment seen from the side,

Figure 6b shows an advantageous embodiment of the stopper connected to the support equipment seen from above,

Figure 6c shows in a simplified manner the use of the stopper according to Figure 6a for supporting products in connection with lifting,

Figure 7 shows as a simplified chart a control system of the lifting device according to an advantageous embodiment of the invention, and

Figure 8 shows in a simplified manner a lifting device according to still another advantageous embodiment of the invention.

Detailed description of the invention

[0010] In order to describe the lifting device 1 and method according to the invention, some terms will first be defined. The first direction means the direction, in which products are mainly set in the support equipment of the lifting device for the duration of the lifting. For example in the embodiment of Figure 1 this first direction is in the image plane the left-right direction (horizontal direction). The second direction means a direction perpendicular to the first direction, which in the embodiment of Figure 1 is perpendicular to the image plane. The second direction can in some situations also be named the lateral direction. The third direction means a direction perpendicular to both the first and the second direction, which in the embodiment of Figure 1 means the up-down direction (vertical direction).

[0011] According to one embodiment the means for adjusting the centre of gravity of the support means comprise a motor, with which the position of the lifting part in relation to the frame part is arranged to be adjusted. The motor can for example be a hydraulic motor, an electric motor or a pneumatic motor.

[0012] The lifting device can additionally comprise a position sensor for generating a control signal based on the position of the support means, and a control unit for generating a control signal to the motor based on the signal given by the position sensor. The lifting device then also comprises necessary means for relaying the signals.

[0013] According to still another embodiment the support means are connected to the frame part so that the angle between the support means and the frame part can be changed. The support means can also comprise at least one stopper for providing additional support for the products lifted with the lifting device.

[0014] The invention also relates to a method for lifting products with a lifting device, which has support means for supporting one or more products for lifting them, which support means comprise at least two support bars. In a typical method the common centre of gravity of the support means and of the product is adjusted in at least a first and a second direction, so that the adjustment of the centre of gravity in the first direction is performed by moving the location of the lifting part in the balancing unit belonging to the lifting device, in relation to the frame part in the balancing unit, and the adjustment of the centre of gravity in the second direction is performed by adjusting the distance between at least two support bars.

[0015] In one embodiment when lifting products, the position of the support means is measured, the measured position is compared to a reference value, and if the

measured position deviates from the reference value, the common centre of gravity of the support means and of the product is adjusted.

[0016] In the following, the structure and operation of the lifting device 1 according to an advantageous embodiment of the invention shown in Figure 1 will be described. The lifting device 1 comprises a balancing unit 10 and support equipment 20 which can be connected thereto. Figure 2a shows the balancing unit 10 of the lifting device according to Figure 1 seen from the side and Figure 2b correspondingly seen from the front. Figure 3a shows the support equipment 20 of the lifting device according to Figure 1 seen from the side and Figure 3b correspondingly seen from the front.

[0017] The balancing unit 10 has a frame part 11 and a lifting part 12 arranged to be moveable in relation thereto. In this embodiment the frame part 11 has a cross-section shaped like an I beam, as can be seen in Figure 2b, but it is clear that the cross-sectional shape of the frame part 11 can also be different. An advantage of an I beam structure is on the one hand its rigidity in relation to its weight and on the other hand the horizontal part of the I beam can be used as a counter surface for movement members 13 arranged in connection with the lifting part 12. The movement members 13 are for example wheels. Thus, in a lifting situation the wheels are against the lifting part 12 and rotate, if there is a need to move the position of the lifting part 12 in relation to the frame part 11. One purpose of the movement member 13 is thus to reduce the friction between the lifting part 12 and the frame part 11. The lifting part 12 further has connecting means 14 for connecting the lifting device 1 to a crane 30 (Figure 5) or the like. This connecting can be done with the aid of for example a wire, a rope or another corresponding transmission means 32.

[0018] The lifting part 12 can be moved in relation to the frame part 11 with the aid of a transfer mechanism 15. The transfer mechanism 15 in this embodiment comprises a motor 16a, such as a hydraulic motor, an electric motor or a pneumatic motor. The axis of the motor 16a is connected for example by means of a chain 16b and cogwheels 16c to a threaded bar 16d, so that when the axis of the motor 16a rotates, the threaded bar 16d also rotates. The lifting part 12 has a threading corresponding to the threaded bar, for example nuts (not shown), whereby the rotational movement of the threaded bar 16d makes the lifting part 12 move in the longitudinal direction of the threaded bar, which is illustrated by an arrow S1 in Figure 2a. This movement of the lifting part 12 simultaneously makes the centre of gravity of the lifting device 1 move in relation to the position of the connecting means 14.

[0019] Rotators 17a, 17b have further been arranged in connection with the frame part 11, by means of which rotators the support equipment 20 can be connected to the balancing unit 10, so that the support equipment 20 and the balancing unit 10 can at least to some extent rotate in relation to each other, as is shown later in this description.

[0020] It should be mentioned that the transfer mechanism 15 can also use other kind of mechanics than what is shown above and especially in Figures 1 and 2a-2b. For example a roller chain, one or more hydraulic cylinders or other transfer mechanism applicable for the purpose can be used instead of the threaded bar 16d.

[0021] The structure of the support equipment 20 according to an advantageous embodiment of the invention will be described in more detail in the following, with reference to Figures 3a and 3b. The support equipment 20 is meant to support products being lifted and moved with the lifting device 1 during the lifting and moving. The support equipment 20 comprises at least a first support bar 21 a and a second support bar 21 b, by which the products can be supported. The support bars 21 a, 21 b are in this advantageous embodiment formed from bars with a rectangular cross-section, but it is clear that also other cross-sectional shapes can be used. A triangle, a slanted parallelogram, an ellipse, a circle etc. can be mentioned as some advantageous cross-sectional shapes. The selection of the cross-sectional shape can in some cases affect over how large an area the support bars 21 a, 21 b support the products and how large a surface pressure the support causes to the products. In some cases, if the surface pressure is too large, deformations may be formed in the products, such as depressions in the surface of the products, which is not always desirable. In addition to or instead of the cross-sectional shape this surface pressure can be attempted to be reduced by setting a padding between the product and the support bar 21 a, 21 b for the duration of the lifting and moving of the products.

[0022] Even though it is here disclosed that there are two support bars, the invention can also be applied so that there are more than two, for example three or four support bars or the like. Additionally all the support bars do not need to have the same cross-section, but different cross-sectional shapes can be used in different support bars.

[0023] The support bars 21 a, 21 b are connected to suspension means 22a, 22b, which are attached to an arm part 23. Thus the arm part 23, the suspension means 22a, 22b and the support bars 21 a, 21 b form in their entirety a support equipment 20, which can be connected to the balancing unit 10 by means of rotators 17a, 17b. The arm part 23 has bearings 24a, 24b, inside which the rotators 17a, 17b are arranged. The bearings 24a, 24b make possible the rotation of the support equipment 20 in relation to the balancing unit 10.

[0024] According to the invention at least all the support bars, here 21 a, 21 b, are not installed in the suspension means 22a, 22b in a fixed manner, but one or more support bars 21 a, 21 b can be moved in the second direction, i.e. in the direction shown by arrows S2 in Figure 3b. Thus the distance between the support bars 21 a, 21 b can be changed, which makes it possible that the support point of the support bars 21 a, 21 b on the product can be adjusted and thus it can be attempted to find the

optimal support point or points with regards to the lifting. This adjustment possibility can be especially advantageous in the case of asymmetrical products. An example of this is shown in Figure 4c. By changing the position of the support bars 21 a, 21 b, the position of the products can be attempted to be adjusted for example to be such that the lower edge of the products 50 is substantially horizontal, when the products 50 are lifted.

[0025] When one or more support bars 21 a, 21 b are arranged to be moveable, this kind of support bar is not attached to the suspension means 22a, 22b, but the support bar has protrusions 25 or the like, by means of which the support bars stays in contact with the suspension means 22a, 22b, but can move for example by sliding on the suspension means 22a, 22b.

[0026] Movement of the support bars 21 a, 21 b can be implemented for example with the aid of hydraulic cylinders 26a, 26b, threaded bars or the like. The control of these hydraulic cylinders 26a, 26b can take place for example manually, whereby a user of the lifting device 1 can strive to find the optimal lifting position for the products, or the control can take place automatically, whereby sensors can be used for giving information to the control system about the position of the products and the adjustment procedures can be attempted to perform according to this.

[0027] A lifting device 1 according to still another advantageous embodiment of the invention has stoppers 27a, 27b arranged in connection with the support bars 21 a, 21 b. An example of this is shown in Figures 6a and 6b. These stoppers 27a, 27b can among others be used for determining how many products can be lifted at once. On the other hand, the stoppers 27a, 27b can be used for giving the products additional support during the lifting, advantageously so that when a desired number of products has been placed on the support bars 21 a, 21 b, the stoppers 27a, 27b are moved against the bundle comprised of products. Thus the bundle comprised of products is supported in the horizontal direction on the one hand by these stoppers 27a, 27b and on the other hand by platforms 28a, 28b in the outermost ends of the support bars 21 a, 21 b. Thus the movement of the products on the support bars 21 a, 21 b at the stage when the products are lifted and moved can be eliminated or at least reduced. Figure 6c shows this arrangement in a simplified manner.

[0028] In the following the operation of the lifting device 1 according to still another embodiment of the invention in connection with the lifting of products will be described. The lifting device 1 is moved for example with a crane 30 (Figure 5) close to the products 50, so that the products 50 can be set to be supported by the support bars 21 a, 21 b. For example when lifting roof trusses the support can usually be arranged on the upper flange 51 and/or reinforcements 52. It can generally be noted that the support point is determined for each product. When a suitable number of products 50 is set to be lifted with the lifting device 1, the stoppers 27a, 27b can be adjusted so that they are against the last product 50n of the pile comprised of products, as the matter is illustrated in Figure 6c. Thereafter the lift can be started by lifting the hook 31 or corresponding lifting means of the crane 30 upwards. When the lifting device 1 and the thereon supported products 50 rise into the air, it may happen that the support bars 21 a, 21 b of the support equipment 20 and at the same time also the products 50 are not in a horizontal position. Thus the common centre of gravity of the lifting device 1 and of the products 50 are advantageously moved so that the support bars 21 a, 21 b of the support equipment 20 can be set in a substantially horizontal position. If the moving of the centre of gravity has been arranged to be performed at least partly automatically, for example an adjustment system 40 shown in Figure 7 can be used. Thus a sensor 41 placed in the frame part 11 of the lifting device 1 gives a signal, based on which the control unit 42 deduces in which direction the lifting part 12 must be moved in relation to the frame part 11. This can be deduced for example by comparing the magnitude of the signal given by the sensor 41 to a reference value, and if the magnitude of the signal is smaller than the reference value, the lifting part 12 is moved in the first direction, and correspondingly if the magnitude of the signal is larger than the reference value, the lifting part 12 is moved in the second direction. For a person skilled in the art it is obvious that a so-called hysteresis can be used in this comparison, whereby a small difference between the signal and the reference value does not necessarily cause movement of the lifting part 12. When the control unit 42 has detected a need for moving the lifting part 12, the control unit 42 can for example give a signal to a motor 16a or to a motor controller 43 controlling the motor, which provides a rotational movement of the axis of the motor 16a in a desired direction. As was noted already earlier in this description, the rotational movement of the axis is relayed to a transfer mechanism 15, whereby the threaded bar 16d belonging to the transfer mechanism 15 in this embodiment causes the lifting part 12 to move.

[0029] The control unit 42 can also control the operation of a hydraulic pump 44, whereby the hydraulic pump is switched on only when necessary. When hydraulics-driven actuators, such as a hydraulic motor and/or hydraulic cylinders are used, this kind of hydraulic system further needs a hydraulic fluid container 45 in order to function.

[0030] It should further be mentioned that the enclosed Figures do not show hydraulic hoses etc., by means of which hydraulic fluid is led to the hydraulics-driven actuators. It can further be noted that the adjustment system 40 can also contain other elements and functions than what is shown in Figure 7.

[0031] The above-mentioned moving of the lifting part 12 can be done also by manual control, whereby a sensor 41 is not necessarily needed. In such a case the user of the lifting device 1 can give the necessary control commands to the motor 16a. The adjustment above causes

a change of the common centre of gravity in the first direction, i.e. in the longitudinal direction of the support bars 21 a, 21 b. In some cases there may be a need to change the centre of gravity also in a direction perpendicular to this direction, i.e. in the second direction (sideways in relation to the longitudinal direction of the support bars 21 a, 21 b). In the lifting device 1 according to the invention this can be done by adjusting the position of at least one support bar 21 a, 21 b in the lateral direction. Here it is presumed that the two support bars 21 a, 21 b shown among others in Figure 1 are arranged to be moveable in the lateral direction, but it is clear that both support bars 21 a, 21 b do not in all situations need to be moved, but a sufficient balance can be achieved by moving only one support bar 21 a, 21 b. By moving the support bars 21 a, 21 b the products 50 can be attempted to get in such a position that their lower surface is substantially horizontal, as is shown in Figure 4c.

[0032] In practice the adjustment movement described above results in that the frame part 11 of the balancing unit 10 stays substantially in the same (vertical) position, but the rotators 17a, 17b arranged in connection with the frame part 11 make it possible for the support equipment 20 to rotate in relation to the balancing unit 10. This can also be seen in Figure 4c.

[0033] Figure 8 shows still another advantageous example of the composition of the lifting device 1 and the crane 30. In this embodiment a telescope boom 33 is used instead of the hook and wire combination of the crane, in one end of which telescope boom the lifting device 1 according to the invention is attached with an attaching device 34. The attaching is advantageously arranged so that the lifting device 1 can also be rotated in the horizontal plane. Additionally the cross-section of the telescopic boom 33 is advantageously angular, for example rectangular, whereby uncontrolled rotation of the lifting device 1 is prevented to a very large extent.

[0034] The invention is described above with a few examples, but it is clear that the invention is not limited only to the examples presented here. The structures, materials, dimensions and details of the lifting device 1 according to the invention can vary in different applications. Additionally the lifting device 1 according to the invention can also be used with other devices than the crane shown in Figure 7, such as a forklift. On the other hand the crane can be moveable, for example a crane arranged in connection with a vehicle. Thus the lifting device 1 can be used for example at construction sites for lifting roof trusses and/or other products.

Claims

1. A lifting device (1), which has support means (20) for supporting one or more products (50) for lifting them, which support means (20) comprise at least two support bars (21 a, 21 b), **characterised in that** the lifting device (1) additionally comprises means (10, 12, 15) for adjusting the common centre of gravity of the support means (20) and of the product (50) in at least a first direction, which means comprise a balancing unit (10), which has a frame part (11) and a lifting part (12) arranged to be moveable in relation to the frame part (11) by means of a transfer mechanism (15), and **in that** at least one support bar (21 a, 21 b) is arranged to be moveable in order to adjust the common centre of gravity of the support means (20) and the product (50) in a second direction by changing the distance between at least two support bars (21 a, 21 b).

2. The lifting device (1) according to claim 1, **characterised in that** the means (10, 12, 15) for adjusting the common centre of gravity comprise a motor (16a), with which the position of the lifting part (12) in relation to the frame part (11) is arranged to be adjusted.

3. The lifting device (1) according to claim 2, **characterised in that** the lifting device (1) additionally comprises a position sensor (41) for generating a control signal based on the position of the support means (20), and a control unit (42) for generating a control signal to the motor (16a) based on the signal given by the position sensor (41).

4. The lifting device (1) according to any of the claims 1-3, **characterised in that** the support means (20) are connected to the frame part (11) so that the angle between the support means (20) and the frame part (11) can be changed.

5. The lifting device (1) according to any of the claims 1-4, **characterised in that** the support means (20) additionally comprise at least one stopper (27a, 27b) for providing additional support for the products (50) lifted with the lifting device (1).

6. The lifting device (1) according to any of the claims 2-5, **characterised in that** the motor (16a) is one of the following:

   - a hydraulic motor,
   - an electric motor,
   - a pneumatic motor.

7. A method for lifting products with a lifting device (1), which has support means (20) for supporting one or more products (50) for lifting them, which support means (20) comprise at least two support bars (21 a, 21 b), **characterised in that** in the method the common centre of gravity of the support means (20) and of the product (50) is adjusted in at least a first and a second direction, and **in that** the adjustment of the common centre of gravity in the first direction is performed by moving the position of a lifting part

(12) in a balancing unit (10) belonging to the lifting device (1) in relation to a frame part (11) in the balancing unit (10), and the adjustment of the common centre of gravity in the second direction is performed by adjusting the distance between at least two support bars (21 a, 21 b).

8. The method according to claim 7, **characterised in that** when lifting products (50), the position of the support means (20) is measured, the measured position is compared to a reference value, and if the measured position deviates from the reference value, the common centre of gravity of the support means (20) and of the product (50) is adjusted.

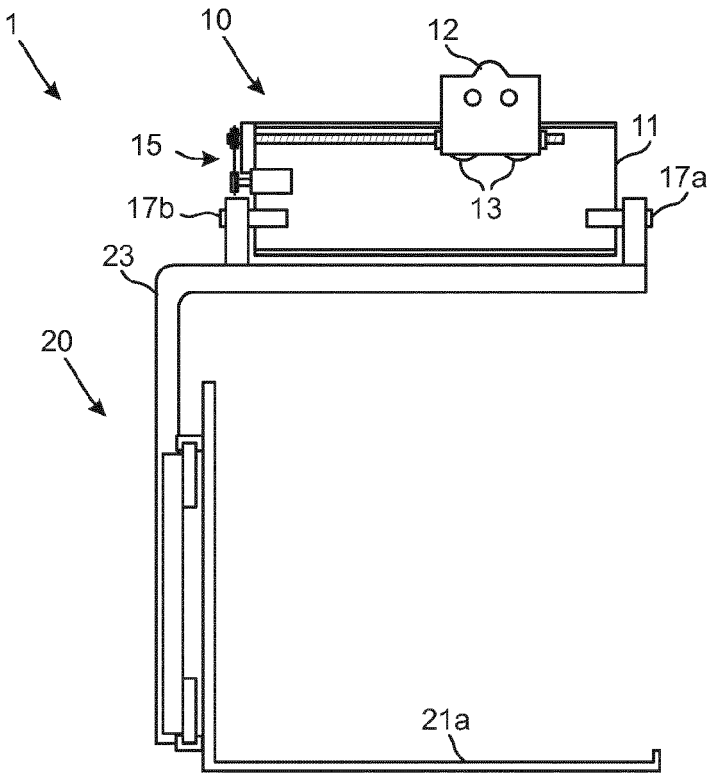


Fig. 1

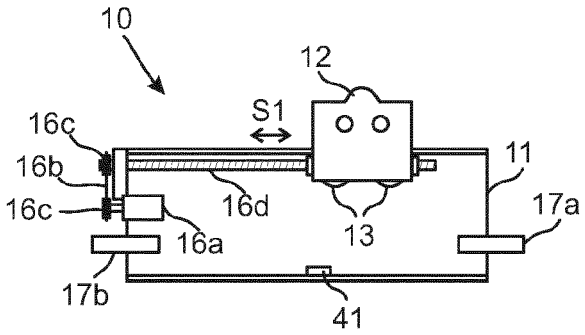


Fig. 2a

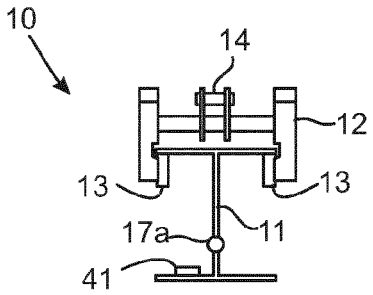


Fig. 2b

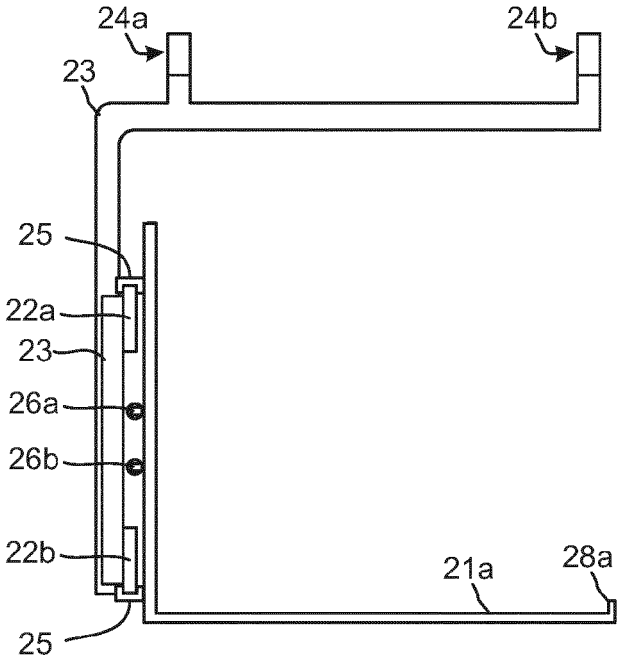
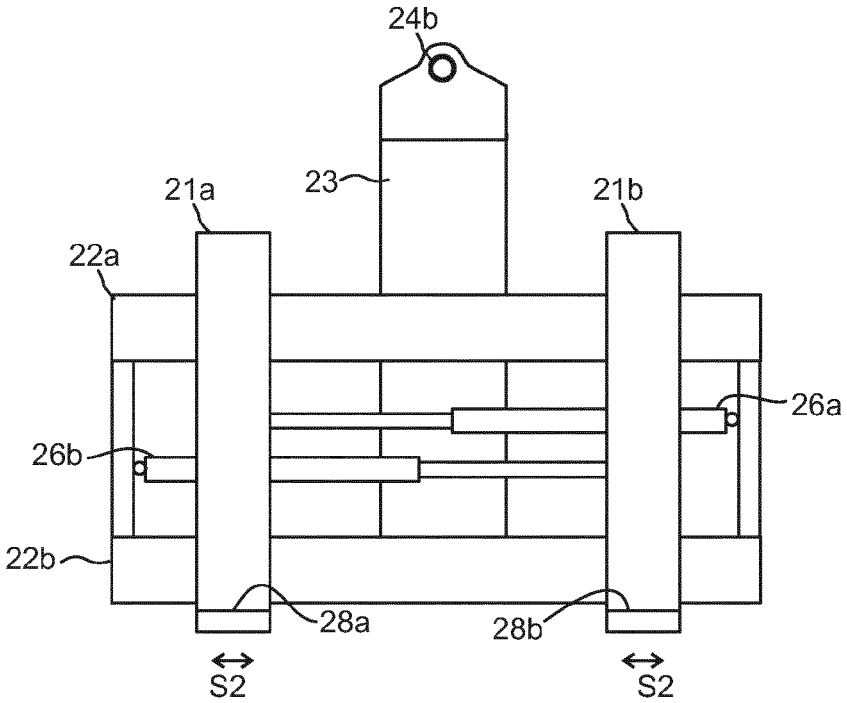

24a
24b
23
25
22a
23
26a
26b
22b
21a
28a
25

Fig. 3a


24b
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23
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S2
S2

Fig. 3b

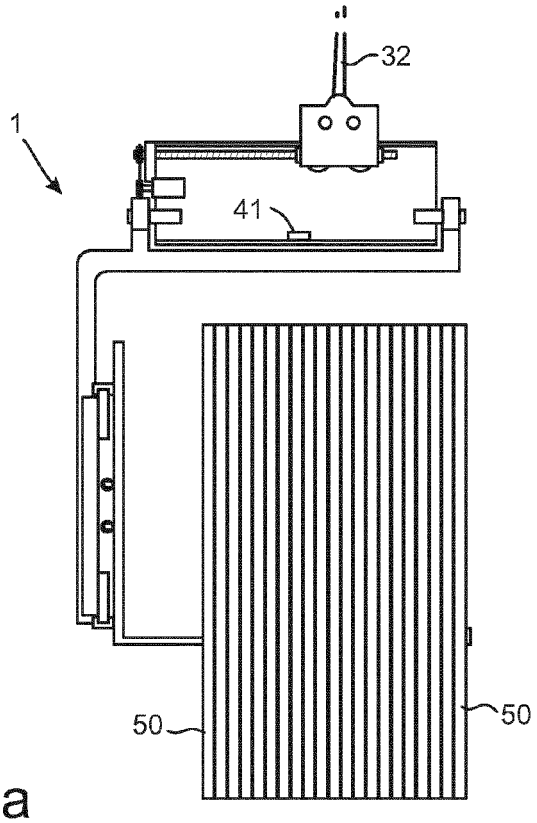

Fig. 4a

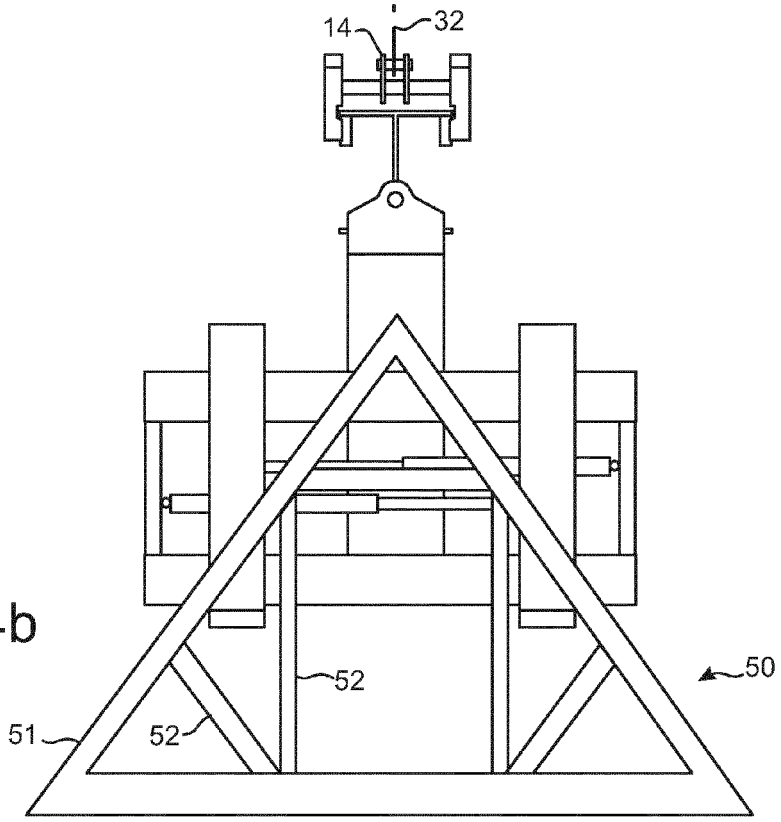

Fig. 4b

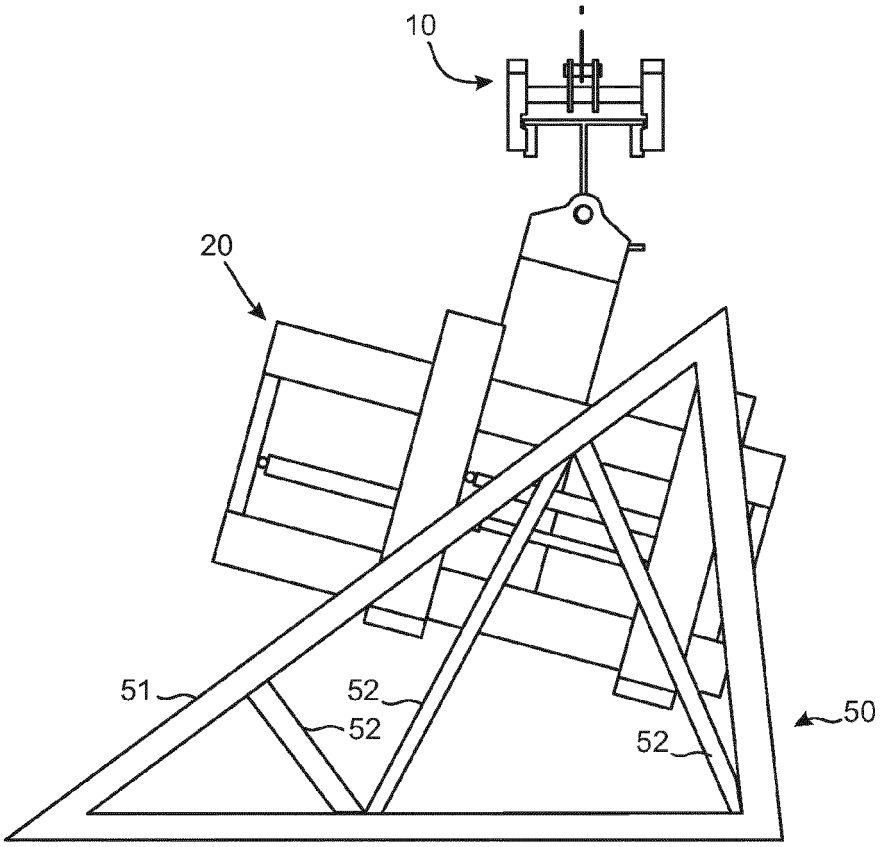

Fig. 4c

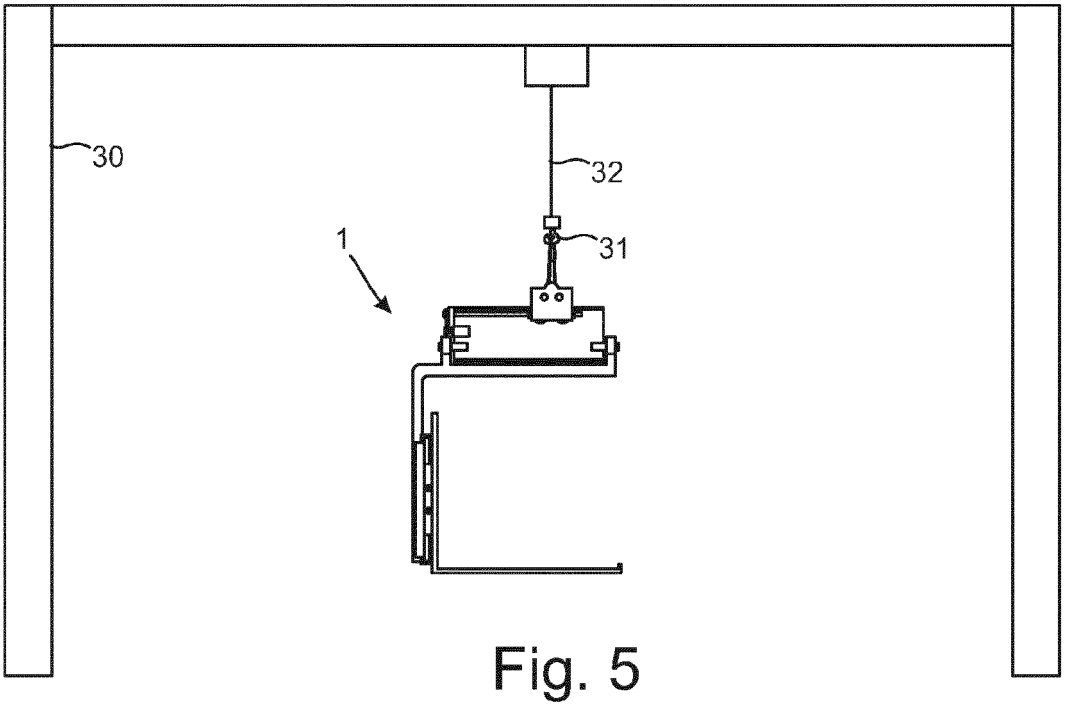

Fig. 5

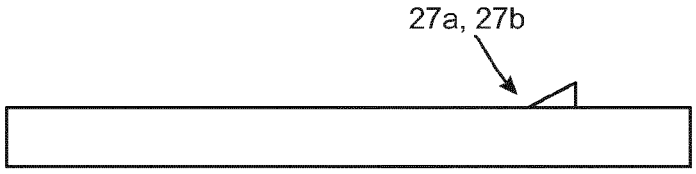

Fig. 6a

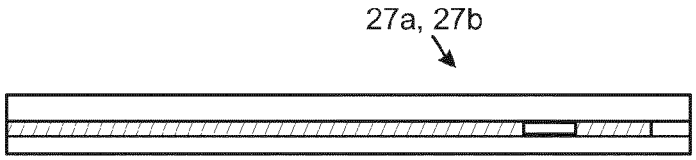

Fig. 6b

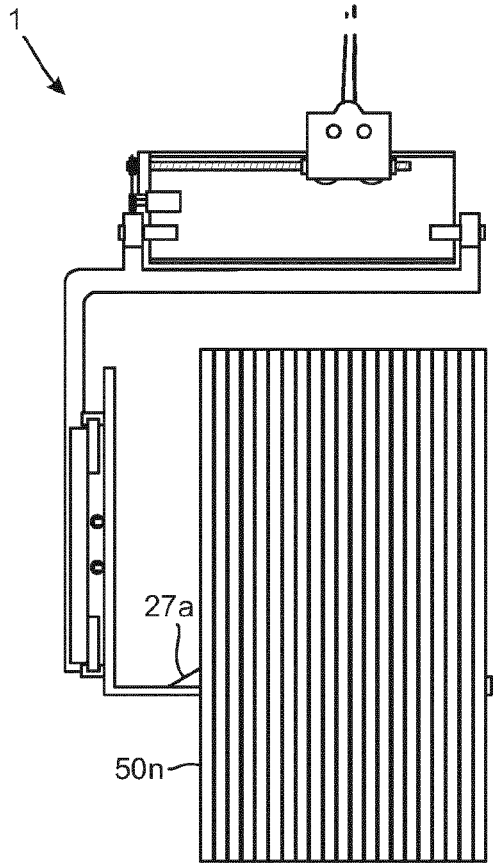

Fig. 6c

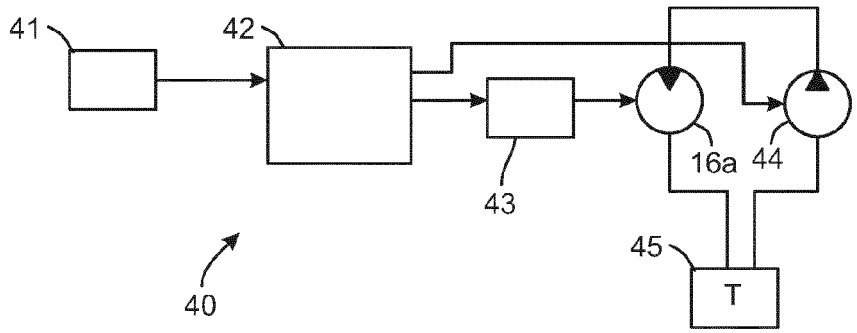

Fig. 7

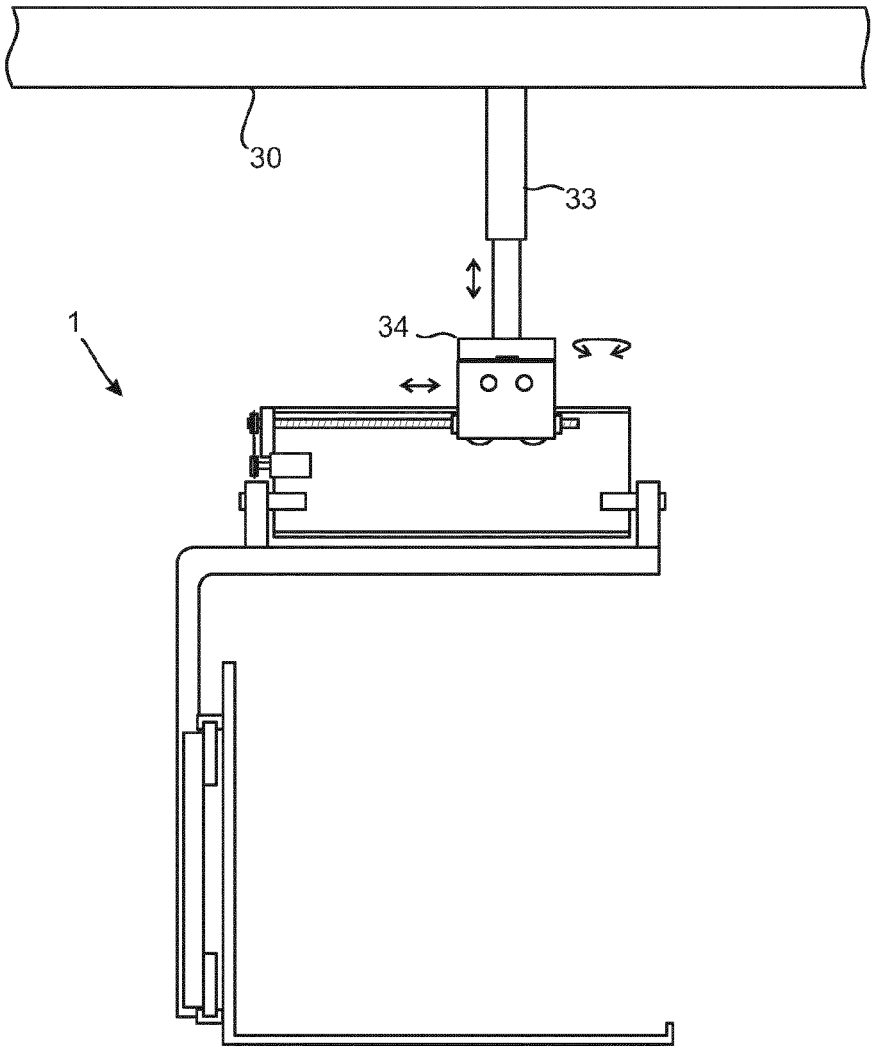

Fig. 8

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EUROPEAN SEARCH REPORT

Application Number
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