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# (54) RAISING AND LOWERING MECHANISM FOR ROLLING ELEMENTS AND METHOD FOR POSITIONING AN OPERATING TABEL PORTABLE ON ROLLING ELEMENTS AND FOR RESETTING THE SAME TO A PORTABLE CONFIGURATION

(57) The invention relates to a raising and lowering mechanism 1 for positioning an operating table 100 portable on rolling elements 5 and for resetting the same to a portable configuration. The operating table 1 includes an upward directed raising column 30 associated with a base 20, as well as a horizontal patient support 40 attaching to a top part of the raising column 30. The mechanism 1 comprises rolling elements 5 in connection with the base 20 of the operating table 100, which elements are, on the one hand, disposable below a plane of the base's 20 bottom edge 201a to bear against a floor or the like as the operating table 100 is maneuvered, and, on the other hand, disposable flush with or above the plane (201a) of the base's (20) bottom edge (201), inside the base, for setting the operating table (100) to rest on the base (20), **characterized** in that the base (20) has coupled thereto two frame members (1a, 1b) of the raising and lowering mechanism (1), each of which has coupled thereto two rolling elements (5; 5', 5") and each of the frame members (1a, 1b) is suspended to its designated swivel axle (3; 3a; 3; 3b) in such a way that the rotary motion of the swivel axle (3; 3a; 3; 3b) around its longitudinal axis (L) displaces the respective frame member (1; 1a; 1; 1b) in vertical direction with respect to the plane (201a) of the bottom edge (201) of the base's (20) frame (200).

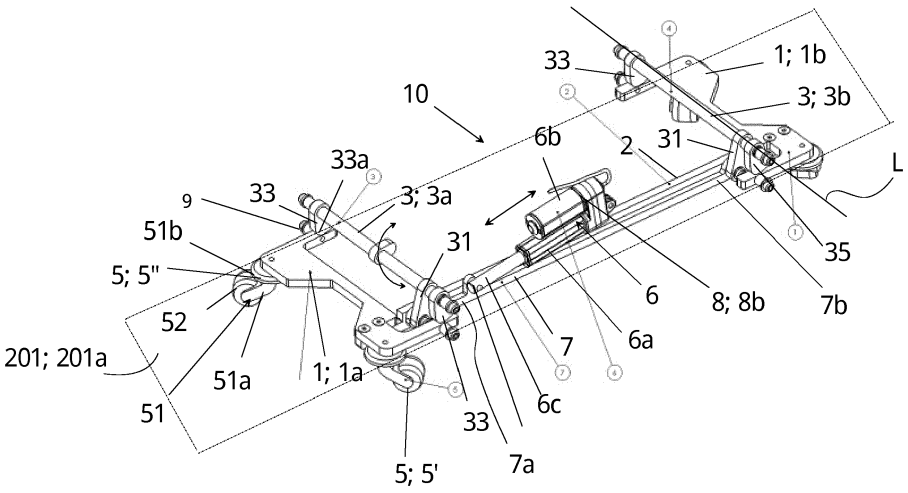


Fig. 1

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## Description

**[0001]** The invention relates to a raising and lowering mechanism for rolling elements according to the preamble of claim 1 for positioning an operating table portable on the rolling elements and for resetting the same to a portable configuration.

**[0002]** The invention relates also to a method for positioning an operating table portable on rolling elements and for resetting the same to a portable configuration.

**[0003]** When it comes to portable operating tables, it is an important aspect to position the same securely in place for the duration of surgical operations. Hence, the secure locking of wheels associated with the base is not alone sufficient but, instead, it is necessary to enable the base to be supported by way of its bottom edge and/or standing supports directly against the floor. On the other hand, when maneuvering an operating table on its transfer wheels, the wheels should adjust to irregularities of a surface, such as the floor, in order to improve the care safety of a patient present on the operating table.

**[0004]** The most common way of resting the bottom edge of a base's frame on the floor is by swiveling the wheels into the base or into the bearing housings of wheels associated with the base as for example in patent document EP 1530858. In the solution described in the cited patent document it has nevertheless been necessary to resort to a comparatively complex wheel mounting and, in addition, each wheel is raised and lowered in an apparently independent manner into and out of the interior of the base or bearing housings associated with the base. Such a swivel mechanism for the wheels is complicated and highly vulnerable. Also, it may be difficult to bring the wheels simultaneously out of the base or back into the base, which may impair patient safety.

**[0005]** With the foregoing prior art as a starting point, it was a principal objective of the invention to provide a portable operating table, wherein the wheel mounting is simple and sturdy and yet bringing all wheels below or above the bottom edge of a base can be achieved as concurrently as possible. A second objective of the invention was to provide a simple and effective way of maintaining floor contact of the wheels in view of compensating for floor irregularities yet without compromising sturdiness of the wheel mounting.

**[0006]** It is with a raising and lowering mechanism for rolling elements according to claim 1 and with a method according to claim 16 for positioning an operating table portable on rolling elements and for resetting the same to a portable configuration that the foregoing objectives will be attained.

**[0007]** More specifically, the invention relates to a raising and lowering mechanism for rolling elements for positioning an operating table, which is portable on rolling elements, and for resetting the same to a portable configuration. The operating table has an upward directed raising column associated with a base, as well as a horizontal patient support attaching to a top part of the raising column. The base, on the other hand, comprises a frame's chassis fitted with downward directed support legs. The raising and lowering mechanism for rolling elements according to the invention omprises rolling elements in connection with the operating table's base, which are, on the one hand, disposable below a plane of a bottom edge of the base's chassis to bear against a floor or the like as the operating table is transferred and, on the other hand, disposable above the plane of the base's bottom edge for setting the operating table to rest upon the chassis and/or the support legs. In the invention, the raising and lowering mechanism further includes two frame members of a sub-frame, which are coupled to the chassis of the base's frame in a floating and vertically linearly movable manner and each of which has supported thereon two rolling elements by way of a rigid link, and each of these frame members is in engagement with its designated swivel axle in such a way that the frame member of the sub-frame is displaceable linearly in vertical direction with respect to the chassis of the base's frame with a rotary motion of the swivel axle in contact with said frame member around its longitudinal axis.

**[0008]** The invention relates also to a method for positioning an operating table, which is portable on rolling elements, and for resetting the same to a portable configuration by means of a raising and lowering mechanism for the rolling elements. The operating table has an upward directed raising column associated with a base, as well as a horizontal patient support attaching to a top part of the raising column, the base comprising a chassis fitted with downward directed support legs,and said raising and lowering mechanism for rolling elements comprises rolling elements in connection with the operating table's base. The method comprises rotating a swivel axle, which is provided for each frame member of a sub-frame coupled in a floating manner to the base and included in the raising and lowering mechanism, around its longitudinal axis, and converting the rotary motion of each frame member's swivel axle into a linear vertical movement of the respective frame member with respect to the base's frame, the rolling elements linked rigidly in vertical direction to said frame member being thereby arranged,

- on the one hand, below the plane of a bottom edge of the base's chassis for resting said rolling elements on a floor as the operating table is maneuvered, and,
- on the other hand, flush with or above the plane of the bottom edge of the base's chassis for resting the bottom edge of the operating table's base on a floor or the like in view of positioning the operating table securely in place.

**[0009]** The plane of the base's bottom edge is understood in this context to represent a horizontal plane extending by way of the lowest point (bottom edge) of the frame's chassis or a plane extending by way of the lowest point of support legs connected to the base in a vertically

pivotable manner.

**[0010]** The rigid link between a sub-frame's frame member and a rolling element refers to the rolling element having a rigid suspension to the overlying frame member with no change in the distance between the rolling element's (horizontal) axis of rotation and said frame member.

**[0011]** In a preferred embodiment of the invention, the lever mechanism further includes a swivel cam by means of which rotary motion of the swivel axle is convertible into motion which raises or lowers a frame member of the raising and lowering mechanism.

**[0012]** It is the basis of the invention that two separate frame members of an operating table's sub-frame have rolling elements, such as wheels, coupled thereto with rigid wheel suspension, and the sub-frame is coupled to the chassis with a floating link enabling mutual vertical linear motion of the sub-frame and the chassis.

**[0013]** The frame members making up the sub-frame are coupled to each other with a rigid beam for preventing the mutual lateral rotation thereof. After this, the sub-frame is linked in a floating manner and allowing movement only in vertical direction relative to the base's chassis. The floating link indicates in this case that between the chassis and the sub-frame there is no direct link which would attach the chassis to the sub-frame. A direct connection is also missing between the sub-frame and the swivel axle coupled to the chassis.

**[0014]** The linear vertical movement of the sub-frame's frame members is particularly independent of swivel axles when the swivel cam supported on the swivel axles is pivoted upward in a vertical plane. When the swivel cam is pivoted downward, the swivel cam bears against the sub-frame and raises the frame. It is by displacing simultaneously the interconnected frame members linearly in vertical direction with respect to the base's bottom edge (i.e. up or down), or by displacing the base's bottom edge respectively with respect to the sub-frame down or up, that a capability is provided for displacing the wheels linked to the frame members simultaneously either below the bottom edge of the base's chassis or to level with or above the plane of the base's chassis.

**[0015]** The relative position between the wheels and the base in vertical direction is changed either by raising the base with respect to the frame members or, alternatively, by pushing the wheels to a position below the base.

**[0016]** In the invention, both frame members of the sub-frame are adapted to be "floating" relative to the base's frame, the contact between wheels and floor having been enhanced thereby. Hence is attained the considerable benefit that, since the sub-frame is not articulated or otherwise connected in a vertically pivotable manner to the frame, there is obtained a frame and sub-frame assembly which is simple and robust. The sub-frame does not have its frame members attached to a camshaft, i.e. a swivel axle, but the swivel axle is only adapted to push the frame member downward by means of swivel cams present at both ends of the swivel axle. The swivel axles are fixed at both ends thereof to the chassis. On the other hand, when the swivel cams are pivoted away from the sub-frame, the base's chassis is able to descend so as to become flush with a bottom edge of the wheels and to make a floor contact.

**[0017]** In a preferred embodiment of the invention, the operating table is set in its transfer position by using swivel cams for forcing the mutual vertical position of the frame members and the base to change in such a way that the base does not have the bottom edge of its chassis any longer in contact with the floor, thus releasing the frame member's wheels to roll. Preferably, the sub-frame is pushed by means of a lever mechanism, whereby the base's chassis rises upward and the bottom edge of the base's chassis proceeds to a position above the wheels as seen from a floor or the like surface.

**[0018]** On the other hand, when it is desirable to dispose the operating table so as to rest by the base or its standing supports on a floor, the swivel cams will be pivoted away from the sub-frame, thereby releasing the mutual vertical position of the raising column and the sub-frame to change. The weight of the raising column causes the base to descend downward to become at least flush with a bottom edge of the wheels. Hence, the mutual distance between a horizontal plane extending by way of the sub-frame and a horizontal plane extending by way of the bottom edge of the base's frame is reduced as a result of the raising column weight acting on the base.

**[0019]** In another preferred embodiment of the invention, the swivel axle is coupled to a piston-equipped pushing element by means of a lever mechanism, which is adapted to convert linear motion of the pushing element's piston into rotary motion of the swivel axle connected to a lever arm. Preferably, the lever mechanism comprises a lever arm coupled to the pushing element's piston, as well as, in addition, a swing arm coupled to the lever arm. The lever arm and the swing arm are jointly adapted to convert linear motion of the pushing element's piston into motion turning the swivel axle around its longitudinal axis.

**[0020]** Preferably, one and the same lever arm is adapted to operate a swivel axle acting simultaneously on each member of the sub-frame in front and rear parts of the base's frame.

**[0021]** Thereby is attained the considerable benefit that the swivel axles provide a capability of operating simultaneously each frame member of the sub-frame for moving wheels suspended rigidly therebelow simultaneously up and down.

**[0022]** The invention will now be described in even more detail with reference to the accompanying figures.

Fig. 1 shows in an oblique top view a wheel mounting of the base and a raising and lowering mechanism for the wheels.

Figs. 2A and 2B show a portable operating table in section views from the front and from a side.

Figs. 3A and 3B show an operating table in views obliquely from above and directly from a side with the wheels retracted inside the base.

Figs. 4A and 4B show an operating table in views from a side and from the front with the wheels extended outside the base.

Fig. 5 illustrates in a view taken obliquely from above an operating table's base and column.

**[0023]** In figs. 1 and 5, details are depicted for a frame 200 of a base 20, as well as for a raising and lowering mechanism 10 for wheels in the base. From figs. 1 and 5 can also be seen how the raising and lowering mechanism 10 for rolling elements 5 of the invention is working.

**[0024]** An operating table 100 of the invention, portable on wheels 5, is illustrated in figs. 2A-2B, 3A-3B, as well as 4A-4B.

**[0025]** First examined hereinafter are the main features illustrated in the figures for the portable operating table 100.

**[0026]** The operating table 100 comprises a per se conventional raising column 30, bearing/abutting at its bottom end on a horizontal support surface 2020 of a base 20 and extending upward from the base 20 as well as from its support surface 2020. Said base 20 includes a base's frame 200 having its support surface 2020 encircled by a horizontal chassis 202. The chassis 202 is quadrangular in its overall shape and has fixedly connected to each of its corners a support leg or standing support 206 carried by a support arm 206a directed downward from the chassis 202. The frame 200 of the base 20 has a plane 201a of its bottom edge 201 extending by way of what is the lowest point of the support legs 206 as seen from the support surface 2020 of its frame 200. The base may also have the plane 201a of its bottom edge 201 extending by way of a bottom edge of the chassis 202, depending on an overall shape of the frame 200 of the operating table 100.

**[0027]** To a top part of the upright raising column 30 is mounted a horizontal patient support 40. The raising column 30 is also provided with a controller 8 used, among other things, for adjusting movements of the patient support 40 relative to the raising column (tilting), the ascent and descent of the raising column 30, as well as the motion of rolling elements 5, in this case wheels, relative to the plane 201a of the base's 20 bottom edge 201.

**[0028]** Best illustrated in figs. 1, 4 and 5 is a raising and lowering mechanism 10 for rolling elements, comprising a horizontal sub-frame 1 which is in connection with the operating table's 100 horizontal base 20 and coupled or propped in a floating manner to the chassis 202 of the frame 200, and below which are mounted the rolling elements 5 by means of a rigid wheel suspension.

**[0029]** As depicted in figs. 1 and 5, said sub-frame 1 of the raising and lowering mechanism 10 includes two horizontal frame members 1a, 1b coupled to each other with a rigid horizontal connecting beam 2. The sub-frame's 1 frame members 1a, 1b are subjected to the action of a lever mechanism coupled/propped to the sub-frame 1 and converting the linear motion of a pushing element 6 (in this case an electric motor) into a motion that raises and lowers the position of the rolling elements 5 with respect to the base's 20 frame 200. This change in a vertical position of the rolling elements 5 relative to the base's frame has thereby an impact also on the vertical distance of a horizontal rotation axis of the sub-frame's 1 rolling elements 5 from the support surface 2020 of the base's 20 frame 200, the raising column 30 being in turn propped on a midsection of said support surface 2002.

**[0030]** The lever mechanism includes a lever arm 7, best shown in figs. 1 and 5, which is attached to a camshaft 3 (subsequently also swivel axle) linked to or mounted on the sub-frame 1. The lever mechanism 7, 3 is operated by a motor 6, such as a spindle motor, which conducts a linear motion co-directional with the connecting beam 2 and is mounted on the connecting beam 2. The spindle motor depicted in the figures operates the lever arm 7 by means of a linear unit or piston 6c.

**[0031]** In a so-called portable configuration, depicted in figs. 4A and 4B, the rolling elements 5 carry alone the weight of an operating table 100 as the operating table 100 is being transferred, and there is a distance between the base's support legs 206 (the base's standing supports) and the floor. With the operating table in its portable configuration, the rolling elements 5 are disposable to a position below the plane 201 a of the bottom edge 201 of the frame of the operating table's base 20 (as viewed from the support surface 2020 of the base's frame 200), whereby the rolling elements 5 are resting on a floor or the like foundation. Preferably, however, the rolling elements 5 rest on the floor all the time both in a standstill configuration (figs. 2A, 2B, 3A and 3B) and in a portable configuration (figs. 4A and 4B).

**[0032]** In the standstill configuration, the plane 201a of the base's 20 bottom edge 201 extends by way of the lowest point of the base's 20 support legs 206 as the support legs 206 have been extended (cf. fig. 3B), whereby the support legs are flush with a bottom edge of the chassis 202 of the base's frame 200. Thus, it can be said that the plane 201a of the base's 20 bottom edge 201 also extends by way of the lowest point of the chassis 202, as well as by way of the support legs. The rolling elements can also be disposed slightly above the plane 201a of the base's 20 bottom edge 201 or approximately level with the base's bottom edge 201a, inside the base's 20 chassis 202. In this so-called standstill configuration, the operating table 100 is propped on a bottom edge of the base's 20 chassis 202 and on the support legs or standing supports 206. This configuration of the operating table is illustrated in figs. 2A-2B and 3A-3B.

**[0033]** As can be seen from figs. 1 and 5, to the base's 20 chassis 202 is coupled, in a vertically displaceable manner, two frame members 1a, 1b included in the sub-

frame 1 of the raising and lowering mechanism 10, each of said members having in turn coupled thereto two rolling elements 5; 5', 5" by means of a wheel suspension. Each of the sub-frame's 1 frame members 1a, 1b is connected to the chassis 202 of the base's frame 200 with a coupling element 9, which allows an up-down directed motion of the frame members 1a, 1b relative to the chassis 202 of the base's frame 200 within a specific range irrespective of the vertical position of the base's 20 frame 200 (cf. fig. 5). The frame members 1a, 1b are impacted by way of the respective swivel axle (camshaft) 3; 3a and 3; 3b of the lever mechanism; when the swivel axle 3; 3a and 3; 3b is rotated around its longitudinal axis L, the respective frame member 1; 1a or 1; 1b moves in vertical direction either downward or upward with respect to the base's support surface 2020. The frame member 1 moves downward with respect to the base's 20 support surface 2020 in response to a force applied by a swivel cam 33 coupled to the swivel axle 3 to press the frame member 1a, 1b downward. The frame member 1 moves upward with respect to the base's support surface 2020 in response to the weight of the raising column 30 and a patient support 40 mounted on its top end.

**[0034]** Both swivel axles 3; 3a and 3; 3b are coupled (in a rotatable manner) at both ends thereof to the chassis 202 of the base's 20 frame 200 (cf. fig. 5), such that a lengthwise direction L thereof is co-directional with the lengthwise direction of the frame members 1; 1a and 1; 1b (lateral direction of the base's support surface 2020), and at the same time said lengthwise direction is transverse to the rigid connecting beam 2 linking the frame members 1; 1a and 1; 1b to each other.

**[0035]** Each rolling element 5 comprises a wheel 52, which is connected by way of a wheel mounting onto a bottom surface of the frame member 1a or 1b. The wheel mounting includes a suspension 51 for the wheel 1, which is implemented by way of a rigid suspension arm 51a as well as a horizontal bearing assembly 51b (cf. fig.1). The wheel's horizontal bearing assembly improves steerability of the base. By means of the rigid suspension arm 51b, the wheel 52 is directed downward from its mounting on the bottom surface of the sub-frame's 1 frame member 1a or 1b.

**[0036]** As seen for example from fig. 1, each swivel axle 3; 3a and 3; 3b is operated simultaneously by means of a pushing element 6 equipped with a single piston 6c through the action of a lever mechanism 7, 3; 3a, 3; 3b (cf. fig. 1). This provides a capability of moving each frame member 1; 1a, 1; 1b and the rolling element 5 coupled thereto simultaneously in vertical direction by means of the swivel axles 3; 3a and 3; 3b, which are coupled to one and the same lever arm 7.

**[0037]** Said lever mechanism 3, 7, made up of the swivel axles 3; 3a and 3; 3b and the lever arm 7, is adapted to convert, by means of the lever arm 7, the linear motion of the piston 6c of the pushing element 6 into a motion rotating the swivel axle 3 around its longitudinal axis L. In the embodiment of the invention depicted in fig. 1, the pushing element is a spindle motor 6 whose piston 6c is adapted to perform linear motion via a gear coupled to an electric motor 6b of the spindle motor. The spindle motor's piston and a gear coupled thereto make up the spindle motor's linear unit which is partially accommodated in a housing 6a.

**[0038]** In another embodiment of the invention (not shown in the figures), the linear motion of the piston 6c is achieved with a pneumatic or hydraulic cylinder.

**[0039]** The lever mechanism 7, 3 between the spindle motor 6 and the frame members 1; 1a, 1; 1b is best shown in figs. 1 and 5. In the embodiment of the invention depicted in figs. 1 and 5, the sub-frame's 1 frame members 1; 1a, 1; 1b are pushed downward by means of a swivel cam 33 (swivel axle) coupled to the lever mechanism's 7, 3 swivel axle 3. When the frame members 1a, 1b are subjected by the swivel cams 33, 33 to a pushing force that presses the same downward, the base 20 rises respectively upward as the rolling elements 5 bear against a floor and the swivel axles 33, 33 are mounted at the ends thereof rotatably to the rigid chassis 202 of the base 20 (cf. fig. 5).

**[0040]** The lever mechanism 7, 3 has its elongated lever arm 7 coupled to the spindle motor's 6 piston 6c in such a way that the spindle motor's 6 piston 6c acts upon a midsection of said elongated lever arm 7. On the other hand, the lever arm 7 has each end 7a, 7b thereof coupled to its designated swing bracket 31, 31, which drives a respective swivel axle 3; 3a or 3; 3b that connects at both ends thereof to the chassis 202 of the base's 20 frame 200. The lever arm 7 and the swing bracket 31 coupled thereto convert jointly the linear motion of the spindle motor's 6 piston 6c into a motion that rotates each swivel axle 3; 3a, 3; 3b around its longitudinal axis L.

**[0041]** The frame members 1a, 1b are adapted to move solely in vertical direction by connecting each frame member 1; 1a, 1; 1b to a frame 102 of the operating table 100, here specifically to the chassis 202 of the base's 20 frame 200, by means of a coupling element 9 which enables only an up-down directed linear motion of said frame members 1a, 1b of the sub-frame 1 relative to the chassis. As can be seen from figs. 1 and 5, said coupling element 9 comprises a rod present 9; 91 at the end of the swivel axle 3, said rod extending through a vertical, elongated (upright) slot 9; 92 present in the base's 20 chassis 202.

**[0042]** When it is now desirable to bring the operating table to a portable configuration, the rolling elements 5 of the sub-frame's 1 each frame member 1; 1a, 1; 1b will be disposed below the plane 201a of the base's 20 bottom edge 201. This is carried out by displacing the frame 200 of the base 20 vertically upward with respect to the frame members 1; 1a, 1; 1b equipped with the rolling elements 5. The frame members 1; 1a, 1; 1b, and wheels or rollers 52 protruding downward therefrom, are pushed by means of the above-described lever mechanism 7, 31, 33, whereby the bottom edge 201 of the base's 20 frame 200 rises relative to the rolling elements 5 as

viewed from a floor or the like.

**[0043]** Because the swivel axle 3 attaches to the base's 20 chassis 202 and the wheels or rollers 5; 52 mounted to the sub-frame's 1 frame members 1a, 1b rest on the floor, the pushing action applied by the swivel cam 33 onto the surface of the frame members 1a, 1b compels the base's 20 chassis 202 to rise vertically upward relative to the frame members 1a, 1b. Hence, the plane 201a of the bottom edge 201 of the base's 20 chassis 202 (cf. fig. 1) rises to a position higher than the bottom surface of the operating table's 100 wheels or rollers 5; 52 resting on a floor or the like foundation and releases the sub-frame's 1 wheels or rollers 5; 52 to a transfer condition. It is in the transfer condition that only the sub-frame's 1 wheels or rollers 5; 52 rest against a floor or the like foundation and the operating table 100 can be maneuvered freely on the floor or the like foundation.

**[0044]** When it is desirable to position the operating table 100 again securely in place, such that the bottom edge 201 of the base's 20 chassis 202 and the standing supports 206 are resting on the floor, an engagement plane 33a of the swivel cam 33 is pivoted away as seen from the surface of the sub-frame's 1 frame member 1; 1a, 1; 1b (for example upward). Thus, the chassis 202 of the base's 20 frame 200 is able to descend in response to a gravitational force of the raising column 30 down towards a floor because the rod 91 of the coupling element 9 for the end of the sub-frame's camshaft 3 is able to rise upward in the vertical slot 92 present in the base's 2 chassis 202. The absolute position of the sub-frame's frame member 1; 1a, 1; 1b with respect to the floor does not change as such, but the bottom edge plane of the chassis 202 of the base's 20 frame 200 descends with respect to the bottom edge plane of the sub-frame's frame member 1a, 1b as viewed from a floor or the like.

**[0045]** When the bottom edge 201 of the base's 20 chassis 202 has its plane flush with or below the bottom edge plane of the rolling elements 5 (cf. the use of a sub-frame 60 below), the rolling elements 5 will be located inside the base's 20 chassis 202, fig. 5.

**[0046]** The movement of the chassis 202 of the operating table's 100 base 20 with respect to the sub-frame's frame members 1a, 1b is controlled either with a controller present alongside the raising column 30 or with a remote controller (not shown in the figures) by acting upon the operation (on/off) of a pushing element (motor) 6.

**[0047]** Presented above are just a few embodiments of the invention and it is obvious for a skilled artisan that many other implementations of the invention are possible within the scope of the inventive idea defined in the claims.

**List of reference numerals**

**[0048]**

| | |
|---|---|
| 1 | Floating sub-frame in the raising and lowering mechanism |
| 1a, 1b | frame members of the sub-frame |
| 1b | rod-like coupling element for a frame member |
| 2 | Connecting beam |
| 3 | Camshaft, swivel axle |
| 31 | swing bracket |
| 33 | swivel cam |
| 5 | Rolling element |
| 51 | wheel suspension |
| 51a | suspension arm |
| 51b | bearing assembly |
| 52 | wheel or roller |
| 6 | Spindle motor |
| 6a | cylinder |
| 6b | electric motor |
| 6c | piston (linear unit) |
| 7 | Lever arm |
| 8 | Controller |
| 9 | Coupling element |
| 91 | rod |
| 92 | slot in the base's frame |
| 10 | Raising and lowering mechanism |
| 20 | Base |
| 200 | frame of the base |
| 201 | bottom edge of the base |
| 201a | bottom edge plane of the base |
| 202 | chassis |
| 2020 | support surface |
| 206 | support legs |
| 206a | support arm |
| 30 | Raising column |
| 40 | Patient support |
| 50 | Positioning mechanism |
| 100 | Operating table |
| 1002 | frame |

**Claims**

**1.** A raising and lowering mechanism for rolling elements for positioning an operating table (100) portable on rolling elements (5) and for resetting the same to a portable configuration, said operating table (100) having an upward directed raising column (30) associated with a base (20), as well as a horizontal patient support (40) attaching to a top part of said raising column (30), the base (20) comprising a frame's (200) chassis (202) to which are connected downward directed support legs (206), said raising and lowering mechanism comprising rolling elements (5) in connection with the operating table's (100) base (20), which are, on the one hand, disposable below a plane (201a) of a bottom edge (201) of the chassis (202) of the base's (20) frame (200) to bear against a floor or the like as the operating table (100) is transferred and, on the other hand, disposable above the plane (201) of the base's (20) bottom edge (201a) for setting the operating table (100) to rest upon the base's (20) chassis (202) and/or the

support legs (206), **characterized in that** the raising and lowering mechanism further includes two frame members (1; 1a, 1; 1b) of a sub-frame (1), which are coupled to the chassis (202) of the base's (20) frame (200) in a floating and vertically linearly movable manner and each of which has coupled thereto two rolling elements (5; 5', 5; 5") by way of a rigid link, and each of said frame members (1a, 1b) is in engagement with its designated swivel axle (3; 3a; 3; 3b) in such a way that the frame member (1; 1a; 1; 1b) of the sub-frame (1) is displaceable linearly in vertical direction with respect to the chassis (202) of the base's (20) frame (200) with a rotary motion of the swivel axle (3; 3a; 3; 3b) in contact with said frame member (1; 1a or 1; 1b) around its longitudinal axis (L).

**2.** A raising and lowering mechanism for rolling elements according to claim 1, **characterized in that** each frame member (1; 1a, 1; 1b) of the sub-frame is coupled to a frame (1002) of the operating table (100), specifically to the chassis (202) of the base's (20) frame (200), with a coupling element (9) which enables an up-down directed linear movement of said frame members (1; 1a, 1; 1b) relative to the chassis (202) of the base's (20) frame (200).

**3.** A raising and lowering mechanism for rolling elements according to claim 1 or 2, **characterized in that** the sub-frame's (1) frame members (1; 1a, 1; 1b) are adapted to move only in a vertical direction relative to the chassis (202) of the base's (20) frame (200).

**4.** A raising and lowering mechanism for rolling elements according to claim 2 or 3, **characterized in that** each coupling element (9) between the sub-frame's frame member (1; 1a; 1; 1b) and the chassis (202) comprises a rod (9; 91), which is capable of being fitted in a vertical slot (9; 92) present in the operating table's (100) frame, specifically in the base's (20) chassis (202), whereby said coupling element (9; 91, 92) enables only an up-down directed movement of the sub-frame's frame member (1; 1a; 1; 1b) with respect to said chassis (202) of the base (20).

**5.** A raising and lowering mechanism for rolling elements according to any of the preceding claims, **characterized in that** the swivel axles (3; 3a and 3; 3b) of a lever mechanism (7, 3) are coupled at both ends thereof to the chassis (202) of the base's (20) frame (200) in a manner rotatable around the longitudinal axes thereof.

**6.** A raising and lowering mechanism (1) for rolling elements according to claim 1, **characterized in that** the vertical raising column (30) connects to a midsection of a support surface (2020) of the base's (20) frame (200).

**7.** A raising and lowering mechanism for rolling elements according to claim 1, **characterized in that** the swivel axle (3; 3a; 3; 3b) is connected to a pushing element (6) equipped with a piston (6c) by means of a lever mechanism (7, 3), which is adapted to convert a linear movement of the piston (6c) into a motion that rotates the swivel axle (3; 3a; 3; 3b) around its longitudinal axis (L).

**8.** A raising and lowering mechanism for rolling elements according to claim 7, **characterized in that** the pushing element (6) is a spindle motor whose piston (6c) is adapted to perform a linear movement by way of a gear coupled to the spindle motor's electric motor (6b).

**9.** A raising and lowering mechanism for rolling elements according to claim 7 or 8, **characterized in that** the lever mechanism (7, 3) comprises a lever arm (71) connected to the pushing element's (6) piston (6a), as well as a swivel bracket (31) connected to the lever arm (71), which are jointly adapted to convert a linear movement of the pushing element's (6) piston (6a) into a motion that rotates the swivel axle (3) around its longitudinal axis (L).

**10.** A raising and lowering mechanism for rolling elements according to any of claims 7-9, **characterized in that** one and the same lever arm (7) of the lever mechanism is adapted to operate simultaneously the swivel axle (3a, 3b) of each sub-frame (1; 1a; 1b).

**11.** A raising and lowering mechanism for rolling elements according to claim 10, **characterized in that** the pushing element's (6) piston (6a) is connected to a midsection of the elongated lever arm (7) and each end (7a, 7b) of this lever arm (7) is further connected to its designated swivel bracket (31, 31) which operates the respective swivel axle (3; 3a or 3; 3b).

**12.** A raising and lowering mechanism for rolling elements according to any of claims 9-11, **characterized in that** the lever mechanism (7, 3) further includes a swivel cam (33) by means of which a rotary motion of the swivel axle (3; 3a or 3; 3b) is convertible into a linearly rising or linearly descending movement of the base's (20) frame (200) with respect to a horizontal plane extending by way of the center line of the respective sub-frame (1; 1a; 1; 1b).

**13.** A raising and lowering mechanism for rolling elements according to any of the preceding claims, **characterized in that** both frame members (1; 1a, 1b) of the sub-frame (1) are coupled to each other

by way of an elongated, horizontal rigid connecting beam (2).

**14.** A raising and lowering mechanism for rolling elements according to claim 1, **characterized in that** there is no mechanical coupling (connection) between the swivel axles (3: 3a; 3: 3b) and the sub-frame (1) as these are linked to each other in a floating manner.

**15.** A raising and lowering mechanism for rolling elements according to claim 1, **characterized in that** the frame members (1; 1a, 1; 1b) of the sub-frame (1) are coupled to each other by way of a rigid connecting beam (2) in order to preclude rotation of the frame members (1; 1a, 1; 1b) relative to each other.

**16.** A method for positioning an operating table (100) portable on rolling elements (5) and for resetting the same to a portable configuration by means of a raising and lowering mechanism of rolling elements, said operating table (100) having an upward directed raising column (30) associated with a base (20), as well as a horizontal patient support (40) attaching to a top part of said raising column (30), the base (20) comprising a chassis (202) to which are connected downward directed support legs (206), and said raising and lowering mechanism for rolling elements comprising rolling elements (5) in connection with the operating table's (100) base (20), **characterized in that** the method comprises rotating a swivel axle (3; 3a; 3; 3b), which is provided for each frame member (1a, 1b) of a sub-frame (1) coupled in a floating manner to the base and included in the raising and lowering mechanism, around its longitudinal axis (L), and converting the rotary motion of each frame member's (1; 1a, 1; 1b) swivel axle (3; 3a; 3; 3b) into a linear vertical movement of the respective frame member (1; 1a, 1; 1b) with respect to the base's (20) frame (200), the rolling elements (5) linked rigidly in vertical direction to said frame member (1; 1a, 1; 1b) being thereby arranged,

- on the one hand, below the plane of a bottom edge (201a) of the base's (20) chassis (202) for resting said rolling elements (5) on a floor as the operating table (100) is transferred, and,
- on the other hand, flush with or above the plane (201) of the bottom edge (201a) of the base's (20) chassis for resting the bottom edge (201a) of the operating table's (100) base (20) on a floor or the like in view of positioning the operating table (100) securely in place.

**17.** A method according to claim 16, **characterized in that** a rotary motion along the axial direction of the swivel axle (3: 3a; 3: 3b) is converted into a vertical linear movement of the respective frame member (1; 1a, 1; 1b) of the raising and lowering mechanism's sub-frame (1) by way of a swivel bracket (31) propped on the swivel axle (3; 3a, 3; 3b).

**18.** A method according to claim 16, **characterized in that** the chassis (202) of the base's (20) frame (200) is adapted to be movable in a direction perpendicular to a plane of the frame members (1; 1a, 1; 1b) of the raising and lowering mechanism's floating sub-frame (1) by mounting with bearings each swivel axle (3: 3a; 3: 3b), in a manner rotatable around its longitudinal axis, on the operating table's (100) frame (1002), especially on the chassis (202) of the base's (20) frame (200).

**19.** A method according to claim 16, **characterized in that** there is no direct coupling/connection between the swivel axles (3: 3a; 3: 3b) and the sub-frame (1), whereby, when the swivel bracket (31) propped on the swivel axles (3; 3a, 3; 3b) is pivoted in vertical plane upward, the vertical movement of the sub-frame's (1) frame members (1; 1a, 1; 1b) will be independent of the swivel axles (3: 3a; 3: 3b).

**20.** A method according to any of claims 16-19, **characterized in that**, when the swivel axle (3; 3a; 3; 3b) is rotated around its longitudinal axis (L) with a pushing element (6) equipped with a piston (6c) by means of a lever mechanism (7, 3), said lever mechanism converts a linear movement of the piston (6c) into a motion that rotates the swivel axle (3) around its longitudinal axis (L).

**21.** A method according to claim 20, **characterized in that**, when the swivel cams (33) of the lever mechanism (7, 3) attached to the base's (20) frame (200) are pivoted towards the sub-frame's (1) frame members (1; 1a, 1; 1b), the plane (201a) of the bottom edge (201) of the base's (20) frame (200) rises to a position above a bottom edge plane of the operating table's (100) wheels or rollers (52) as viewed from a floor or the like on which the operating table (100) is resting by way of said wheels or rollers (52), thereby releasing the wheels or rollers (52) to travel along a floor or the like.

**22.** A method according to claim 21, **characterized in that**, when an engagement plane (33a) of the swivel cam (33) included in the lever mechanism (7, 3) is pivoted away from the sub-frame's (1) frame members (1; 1a, 1; 1b), the base (20) descends in response to a weight of the raising column (30) acting upon the base (20) until the plane (201a) of the base's bottom edge (201) is flush with a bottom edge of the wheels or rollers (52) and the operating table settles in its position.

**23.** A method according to any of claims 13-20, **charac-**

**terized in that** the pushing element (6) equipped with the piston (6c) operates simultaneously each swivel axle (3a, 3b) by way of the lever mechanism (7, 31).

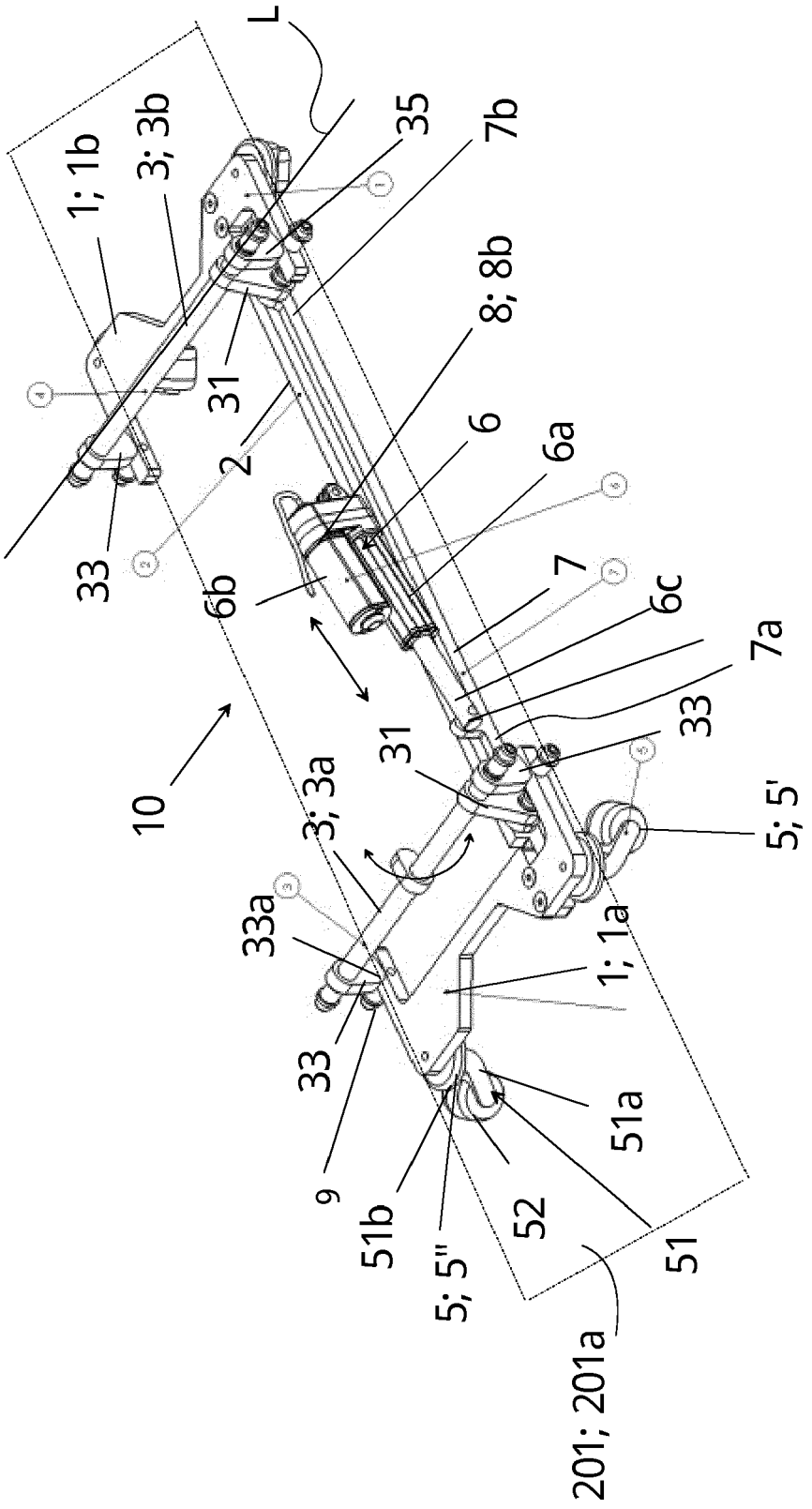
L
1; 1b
3; 3b
35
7b
8; 8b
31
2
6
6a
33
6b
7
6c
7a
10
31
33
3; 3a
5; 5'
33a
1; 1a
33
9
51a
51b
52
5; 5"
51
201; 201a

Fig. 1

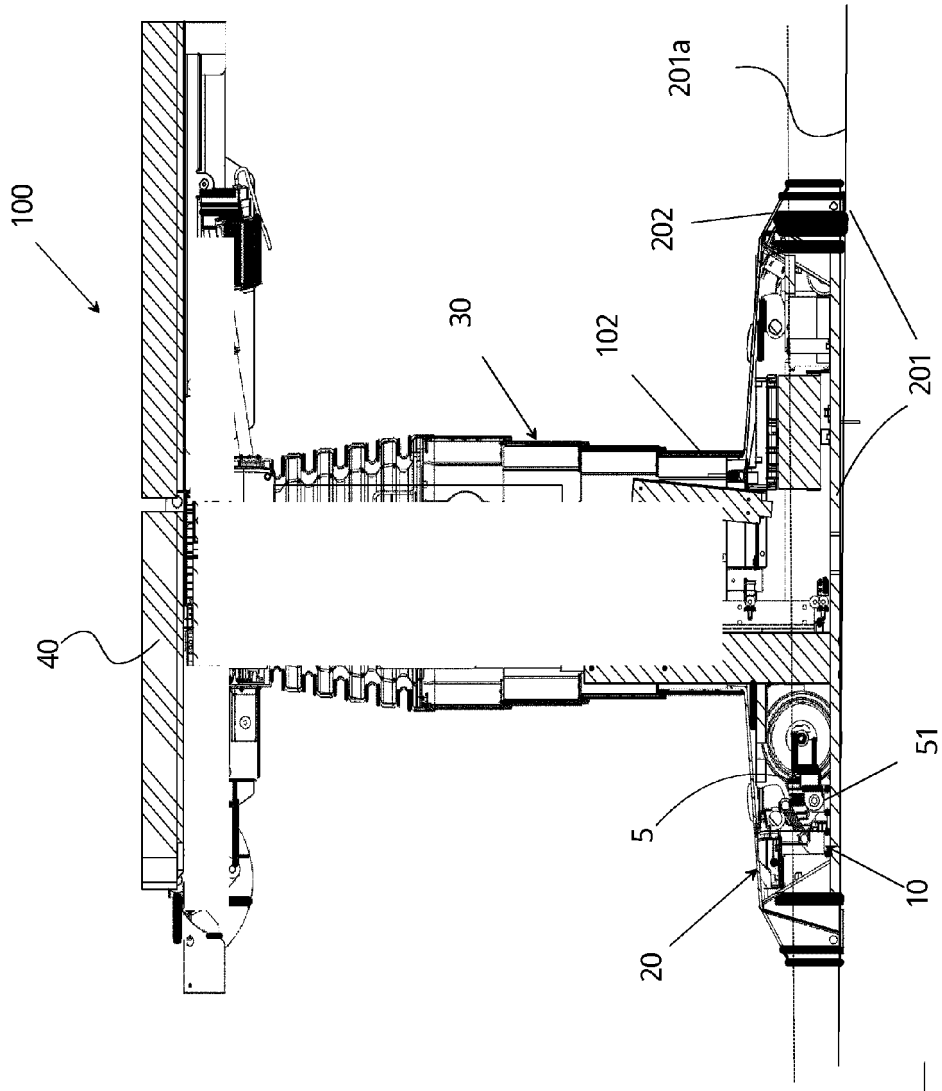


Fig. 2B

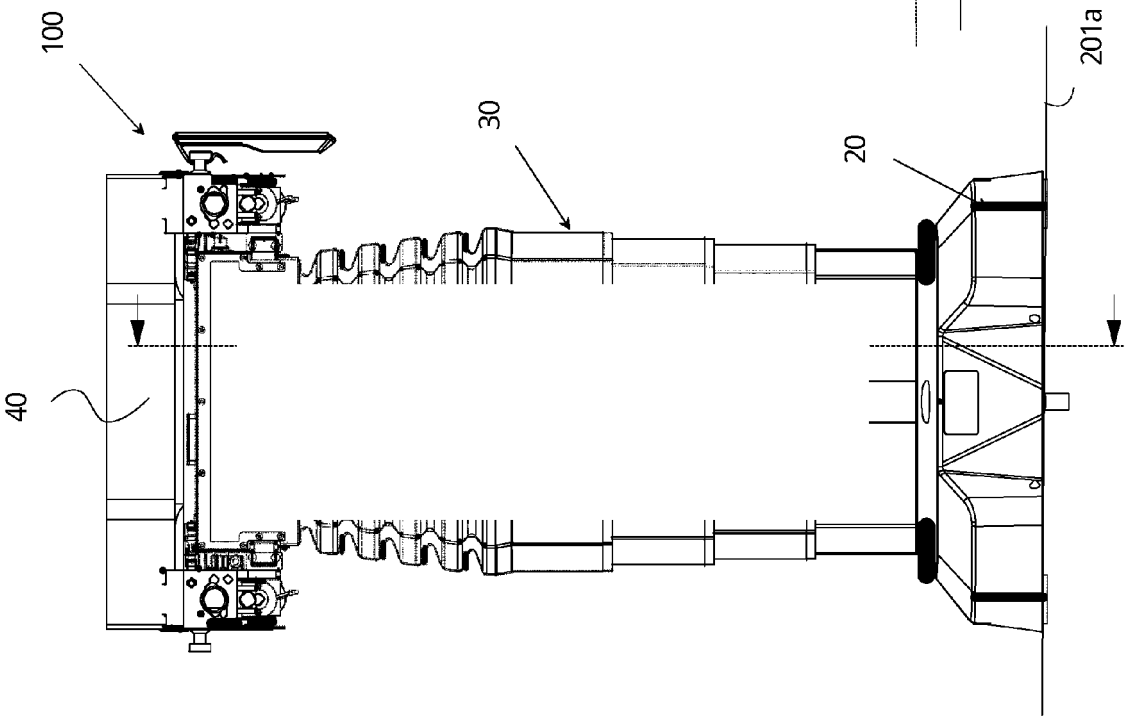


Fig. 2A

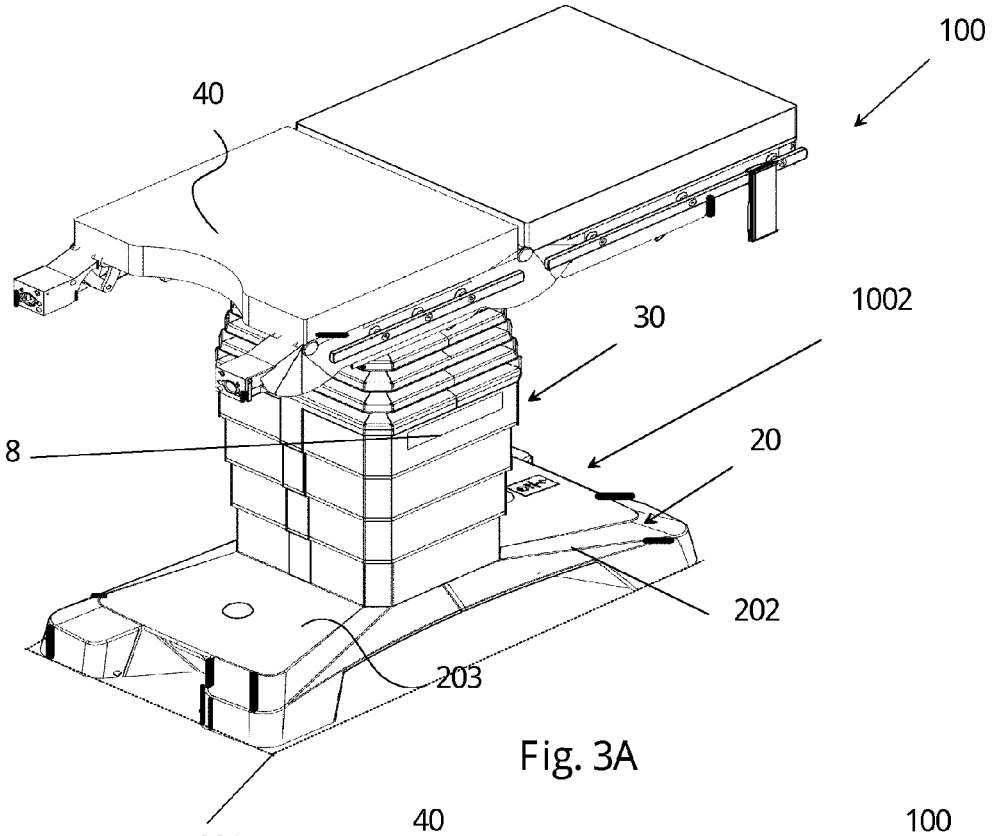
100
40
1002
30
8
20
202
203
201a

Fig. 3A

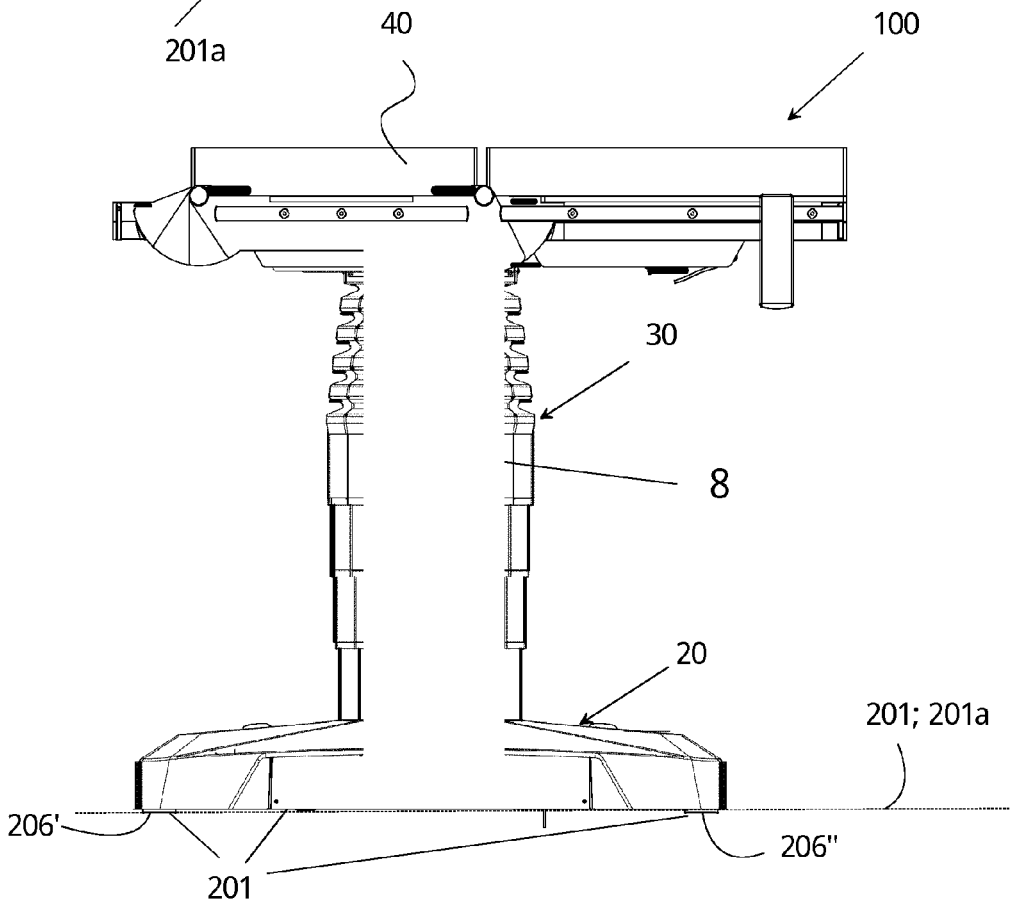
40
100
30
8
20
201; 201a
206'
206"
201

Fig. 3B

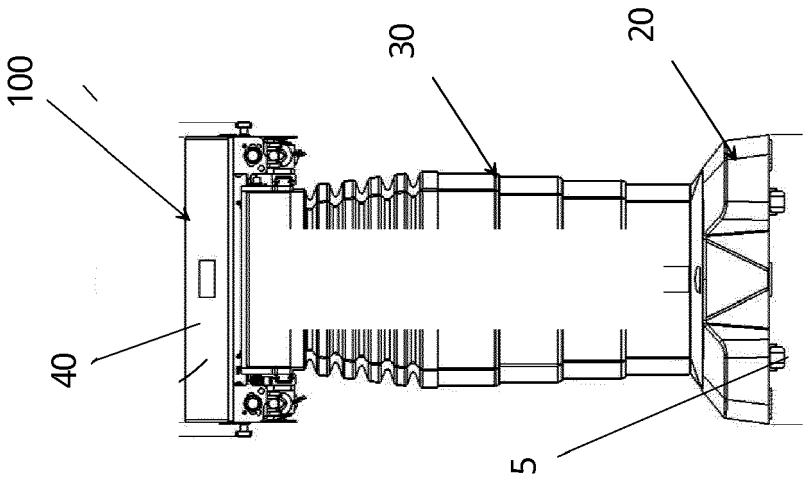


Fig. 4B

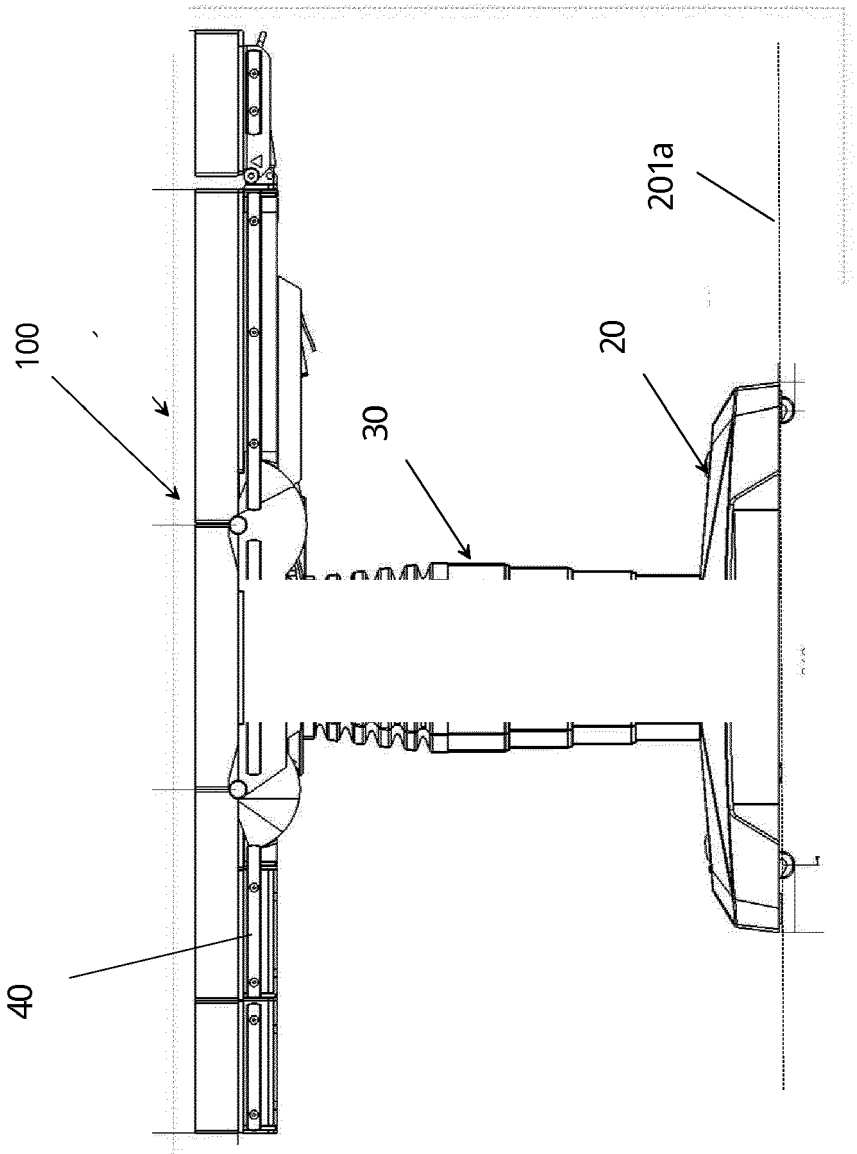


Fig. 4A

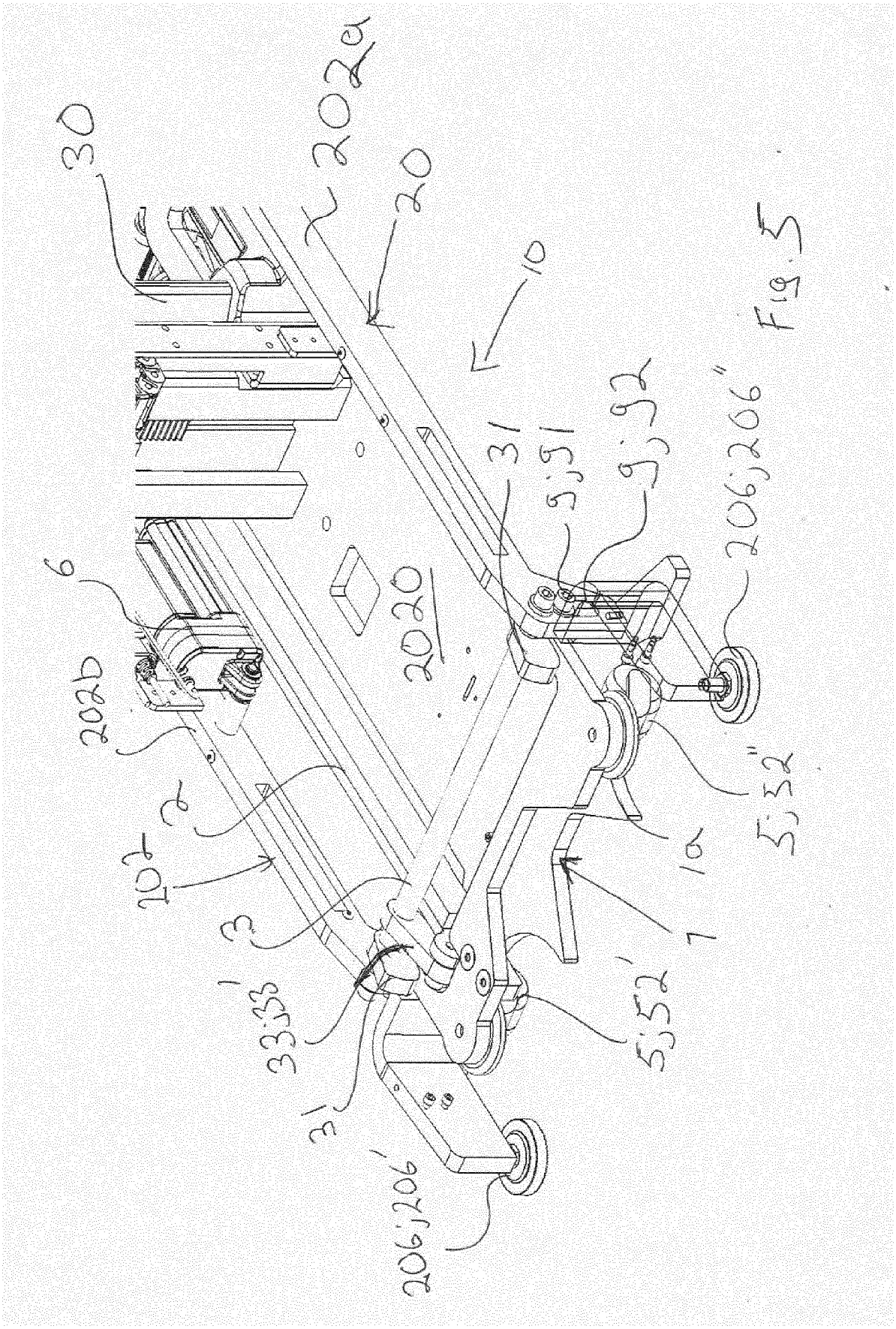
30
2020
20
10
31
5,51
5,52
206,206"
5,52"
6
2020
2020
2021
2
3
1
33,33
31
206,206'
5,52'
10'
7

Fig. 3

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# EUROPEAN SEARCH REPORT

Application Number
EP 18 20 6470

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| The Hague | 14 February 2019 | Birlanga Pérez, J |

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