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(54) **Seat assist device for elderly and disabled people**

(57) A seat assist device comprising: a base (1) having a support surface (1a) to be positioned on the seat surface of a chair, armchair or the like; a seat (2) defining a seat surface (2a) with a front side (2b), the seat (2) being movable between a closed configuration, wherein said seat (2) is adjacent to the base (1) with the seat surface (2a) substantially horizontal, and an open configuration, wherein the seat (2) is lifted in relation to the base (1) to assist the assumption of a standing position

by a user sitting on the seat (2) with the legs projecting over said front side (2b); and connection means (3) connecting the seat (2) and the base (1) for ensuring the motion of the seat (2) between the open and closed configurations; the connection means (3) comprising articulation means (4), for bringing the seat (2) in the open configuration in a position which is translated in relation to the base (1), both vertically and horizontally in a frontal direction, and at the same time tilted with the front side in a downward direction.

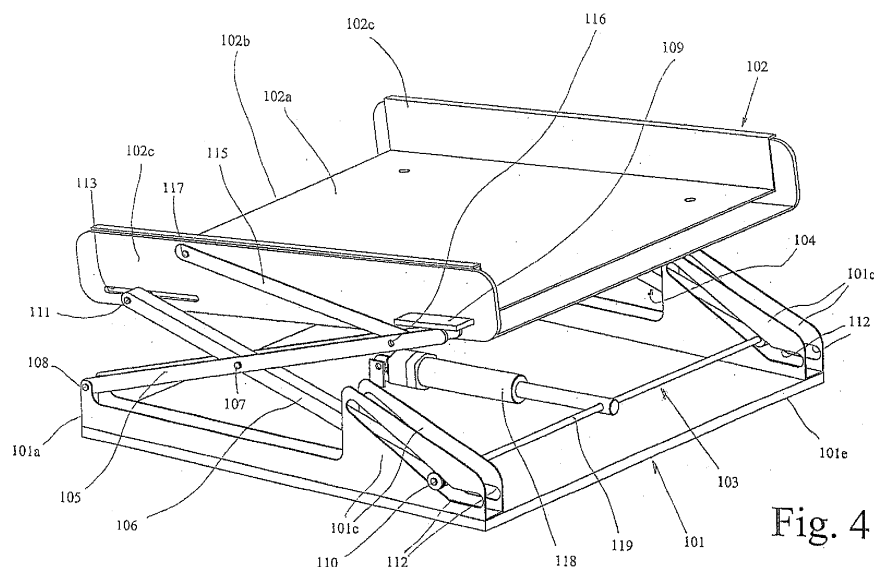


Fig. 4

Description

[0001] The present invention relates to the field of domestic mobility aiding devices destined for persons with reduced mobility, such as those with physical disabilities caused by sickness, injury or simply by the age. More particularly, the invention relates to a new device destined for seat assistance, i.e. for aiding the person to stand starting from a seated position.

[0002] The motion involved in lifting the barycentre of a seated person when attempting to stand erect is comprised of two main components: a translation in a forward direction associated to a translation in an upward direction. In this way, the position of the human body is constantly maintained in such a manner that it is able to ensure uniform and well-balanced weight distribution on the bone and muscle structure of the lower limbs.

[0003] The aforesaid motion involves the participation of a large portion of the bone and muscle structure, in both the lower limbs as well as the medium to lower part of the trunk. After an injury or because of degenerative phenomena due to some pathology or simply because of physiological reasons such as the aging process, it can happen that the person loses considerable mobility functions to the point that even a normally simple movement such as getting up from a chair or an armchair becomes impossible or at the least, extremely difficult.

[0004] For this reason, prior art provides for armchairs, chairs or seats (including some for use on WC toilet seats or other bathroom facilities) which use motorized mechanisms of various kinds that are able to rise up in a controlled manner, inclining and elevating the seating plane, in such a manner that the lumbar region and back of the person is lifted and pushed forward to permit the change from a seated to an erect position with far less effort. Obviously, the reverse movement permits to support and assist the return to a seated position, making the motion more gradual and reducing the possibility of injury.

[0005] However, the solution described above presents a drawback in that it requires a dedicated structure, this meaning that the user is forced to purchase a specific piece of furniture (generally quite expensive) or at least a frame which is rather difficult to move from one particular position. Moreover, the user is forced to use always and exclusively that same piece or frame if he wants to take advantage of the rising aid functionality. Additionally, the size and weight of the structure to be moved also imposes the use of motorised lifting mechanisms that are complex and costly in relation to both production as well as maintenance.

[0006] Taking these aspects into consideration, more economical aiding devices have been proposed in the form of plain cushions that are placed on the seat of a conventional existing armchair or chair. This means that the user is not forced to buy a new armchair or chair (with all the consequent problems of cost, bulk and appearance), and at the same time the system provides a lifting aid adaptable on all existing types of chair, simply by

moving the device from one chair to another.

[0007] Devices of this type are shown in the European patent application EP1310227 and the United States patent US5316370. Both these devices have a structure with a base which is positioned on the seat of the chair or armchair, and a shell that is articulated in relation to the base. The convex surface of the shell acts as a new (mobile) seat. The articulation of the shell in relation to the base is driven and controlled by a motorized mechanism positioned between the two elements. When in closed position, i.e. when the seating surface is in a substantially horizontal position, the mechanism is housed inside the cavity defined by the convex surface of the shell.

[0008] In these devices, the seating surface simply rotates around an axis that extends along the front side of the seat, in other words, the side adjacent to the knees of the sitting user. This is not totally satisfactory in relation to the need of assisting the natural rising motion in the best possible manner, because, as described above, this motion is composed of a combined forward translation movement with an upward translation of the body. In practice, the user is lifted by means of a simple rotation of his barycentre; further to said rotation, the barycentre becomes displaced backwards with respect to the vertical line conducted from the user's feet. This involves an additional muscular effort which is considerable, and which can also lead to dangerous loss of balance.

[0009] The object of the present invention is to provide a cushion similar to that described above, but wherein the motion of the seating surface is more similar to that naturally performed by the human body when rising to an erect position, and therefore is able to assist the user in a more efficient manner, requiring less effort and minimizing the risk of loss of balance during the lifting action.

[0010] A further object of the present invention is to provide a cushion of the aforementioned type, wherein the motion of the seat surface is driven by a mechanism having a basic structure and simple operation.

[0011] These objects are achieved with the seat assist device according to the present invention, whose essential characteristics are defined by the first of the appended claims.

[0012] The features and advantages of the seat assist device according to the present invention will be made apparent from the following description of embodiments thereof provided as a non-limiting example, with reference to the appended drawings wherein:

- figures 1 and 2 show schematic side views, with parts omitted, of the device according to the invention in a first embodiment, shown respectively in a closed or sitting configuration, and in an open or lifting configuration;
- figure 3 shows a dimensional variant of the device shown in the previous figures in an open configuration as in figure 2;
- figure 4 shows a perspective view of the device in a second embodiment of the invention, in a partially

open configuration; and

- figure 5 shows a perspective view seen from a different angle of the device shown in figure 4 in a constructive variant.

[0013] With reference to figures 1 and 2, a device according to the present invention comprises a base 1 composed, in this example, of a plate-shaped body defining a resting surface 1 on the underside for being positioned in a horizontal position on the surface of the seat of a conventional chair or armchair (not illustrated).

[0014] Furthermore, the device comprises a mobile seat 2, in this example, having a disk-like shape of a size that substantially corresponds to that of the base 1, and defining on the upper side a substantially plane seat surface 2a.

[0015] The seat 2 is connected to the base 1 so as to be movable between a closed configuration (figure 1), wherein the two bodies are adjacent to one another, and an open configuration (figure 2), wherein the seat 2 is displaced both in an orthogonal direction in relation to the base 1, and in a parallel direction with respect to said base towards the front side. This latter side is the one resulting in front, from the point of view of a user sitting on the seat 2, identified at the numeral 1a on the base 1 and at the numeral 2b on the same seat. Moreover, in the open configuration, the seat 2 is set at an angle in relation to the horizontal plane, sloping towards the front side 2b. The two configurations just described clearly correspond, respectively, to that for receiving the user in a sitting position, and to the lifted one required by the user for assuming an erect standing position without effort.

[0016] The connection between the base 1 and the seat 2, so that the latter is mobile in relation to the former between the closed and open configuration and vice versa, is ensured by a mechanism 3 comprising a couple of articulations 4 arranged among the lateral sides, indicated respectively at the numerals 1b and 2c for base 1 and seat 2, positioned on each flank of the user when sitting. Each articulation 4 comprises two crossed arms 5, 6, mutually hinged in the point of contact by a pivot 7, set in a substantially central position in relation to the lengthwise direction of the arms. A first arm 5 is pivotally connected at respective ends to base 1, in proximity to the front side 1a, and to the seat 2, in proximity to the rear side identified by numeral 2d, by means of pivots 8, 9. A second arm 6 is arranged in the opposite way, extending between the rear part of base 1 and the front side of seat 2. However, in this case the connection of the end of the arm with the base and the seat is carried out by means of roto-translation couplings comprising sliders 10, 11 projecting from arm 6 and slidingly engaged in respective guides 12, 13 set respectively along the lateral sides of base 1 and seat 2.

[0017] Drive means, arranged between the two bodies and acting directly on the bodies or on mechanism 3, are provided to control the motion between the two configurations. Said means, not illustrated but *per se* known or

obvious, can comprise a mechanical or pneumatic actuator, an air spring, an inflatable device or the like, as will be discussed further on. Analogously, the relative propulsion means have not been illustrated for the same reason, but these will comprise suitable electric motor means and relative batteries.

[0018] The geometry of the two articulations 4 and the kinematics of the relative connections is conceived to ensure a very compact closed configuration, with the seat 2 which approaches and is set on top of the base 1; in this configuration the sliders 10, 11 of the second arm move to the ends of their runs, respectively to the rear and front of the guides 12, 13. In the lifting configuration kept stable by the action of the drive means, while the base 1 is maintained in a fixed horizontal configuration, the seat 2 elevates and moves forward slightly sloping, to assist the lumbar region of the user in a movement that is truly similar to the natural rising movement.

[0019] By modifying the geometries of the two arms 5 and 6, it is also possible to adapt the degree of the slope and the translation in the most suitable manner according to the user's requirements. As shown in the dimensional variant in figure 3, wherein components identical to those previously described are identified by the same reference numerals, a second arm 6 in which the segment between the pin 7 and the slider of the upper end 11 is longer than the example described previously, will provide a slope for the seat 2 on a slightly lesser angle. Similar dimensional adjustments are able to regulate the extent of the two translation movements. Said adjustments can also be obtained by using arms 6, 7 having a telescopic structure, or in any case arms that can be adjusted in length, in a discrete manner for pre-established lengths as well as continuously (such as with snap engagement systems or a threaded rod with a nut and counter nut).

[0020] A similar kinematic system to that previously described can be realised with different embodiments of mechanism 3. With reference to figure 4, wherein corresponding reference numerals show components that are identical or equivalent to those previously described for the former embodiment, in each articulation 104, rather than being purely rotational, the connection between the upper end of the first arm 105 and the seat 2, is of a roto-translation type, thanks to a simple sliding contact of said end on a guide strip 109. A tie rod 115 extends between the first arm 105 and the seat, with an arrangement that is substantially parallel to the second arm, being engaged at both ends by the respective pivots 116, 117.

[0021] The tie rod 115 links the translation of the seat 2 with the rotation of the first arm 105, preventing a free horizontal sliding on the guides 109, 113. A further variant can provide for the replacement of the tie rod 115 with a guide cam which, on seat 102, acts as a guiding element for a slider attached to the second arm 106. In this case as well, by adjusting the length of the linear elements (arms and tie rods) it is possible to adapt various functional parameters according to personal requirements: lifting height, forward displacement of the seat, and ro-

tation angle of the same.

[0022] The embodiment shown in figure 4 shows that the guides 112 along the lateral sides 101b of the base 101 are specifically outlined, in particular, with a segment 112a that rises on a slope in an upward direction. This specific shape, or other similar forms, can be used in turn to control the various movements of the seat 2 in different ways. This figure also shows with more precision, and purely as an example, certain constructive solutions that could be adopted as alternatives.

[0023] In particular, the guides 112 are each realised on a double ridge 101c rising along one lateral side 101b of a basic flat rectangular element that forms the main body of the base 101. In turn, the second arms 106 have a structure with two parallel rods 106a, inside which the first arms 105 and, in this case, also the tie rods 115, are inserted at the crossing points. Again, the seat 102 comprises a sliding seat surface 102a, which can travel back and forward, with a certain degree of resistance, in relation to the underlying structure on which the drive mechanism 103 is connected. In this manner, a further possibility is made available to adapt the position for the user.

[0024] Lastly, the figure shows the drive means, in the form of a pneumatic jack 118 hinged at one end to the base plate 101, in a central position, and, at the other end, connected to a rod 119 that joins the two sliders 111 transversally at the lower ends of the second arms 106, being pivotable with respect to said arms. Clearly, the retraction of the jack 118 corresponds to a pulling action on rod 119 in a frontal direction, resulting in the elevation of the seat 2 to the open configuration. On the other hand, when the jack 118 is extended, the seat reverts to the closed configuration. The actuator is connected to a pneumatic circuit controlled by an electric pump, or alternatively, manually operated.

[0025] With regard to the drive system, as mentioned, numerous alternatives can be provided. One of these is illustrated in figure 5, wherein the operating means are composed of a rear pantograph 120 that extends between the base 101 and the seat 102 in such a manner that it commands the lifting and lowering of said seat by means of its own closing/opening movement. The movement performed by the pantograph 120 is, in fact, controlled by a worm screw system (not illustrated) which works in correspondence to the connection to the base 101. The rotation of the screw, driven by a motor, causes the mutual contraction or extension movement of the two lower ends of the pantograph, and in a consequential manner, also of the two upper ends attached to the seat 102 by means of hinges 121 and a prismatic guide 122. The approaching corresponds to the closure of the pantograph and therefore to its extension in height, pushing the seat 102 in an upward direction. Vice versa, the distancing movement induces a lowering action to the closed configuration of the device. A worm screw system can also be used to act directly on one or both sliders 111 at the lower end of the second arms 106.

[0026] A further alternative, for example, can also be

the use of an inflatable cushion which, when inserted between the base and seat, through the inflation, generates the upward thrust action necessary to lift and support the seat while the user is still seated. Because of the kinematics described above, this thrust action will result in the various motion components of the seat. A small electric or manually operated pump is sufficient to inflate the air cushion. Again, alternatively, and by no means in a limiting manner, other purely mechanical means can be applied, such as a system using steel wires that pull the rod 119 (figure 4) from opposite directions and in a coordinated manner, controlled by motorized winding means.

[0027] The invention therefore provides for a seat assist device for disabled persons, or more generally, for those who have problems with lower limbs, wherein the seat is equipped with an elevation system that permits the user to perform a movement that is very close to a natural movement. The barycentre of the person follows a course that prevents loss of balance during the lifting action, protecting the bone-muscular structure from excessive overloading caused by unnatural movement, and, at the same time, reducing the force that is necessary to the lifting action. This result is achieved with extremely simple mechanical solutions, and therefore also with low production and maintenance costs, as well as with no drawbacks in relation to bulk and weight. In fact, the device has a size and compactness that make it possible and simple to install it on the seat of any type of chair or armchair, or as a replacement for an existing cushion.

[0028] The terms "horizontal", "vertical", "front", "rear" and similar expressions, used in the present description, obviously refer to the device when positioned on the sitting plane of a conventional chair or armchair, said plane being substantially parallel to the ground, and therefore in the position of normal use. The seat surface 2a on seat 2 can consist of an actual material plane surface, as shown in the example, or an imaginary plane as a result of a linear interpolation or of an envelope plane of a concave or generally undulated surface, and that represents the support with which said surface is schematically representable.

[0029] Numerous variants and/or modifications can be brought to the seat assist device for the elderly and disabled according to the present invention without departing from the scope of the invention itself as defined by the appended claims.

Claims

1. A seat assist device comprising: a base (1) having a support surface (1a) to be positioned on the seat surface of a chair, armchair or the like; a seat (2) defining a seat surface (2a) with a front side (2b), said seat (2) being movable between a closed configuration, wherein said seat (2) is adjacent to the

- base (1) with said seat surface (2a) substantially horizontal, and an open configuration, wherein the seat (2) is lifted in relation to the base (1) to assist the assumption of a standing position by a user sitting on the seat (2) with the legs projecting over said front side (2b); connection means (3) connecting said seat (2) and said base (1) for ensuring the motion of said seat (2) between said open and closed configurations; and drive means for driving said motion, **characterized in that** said connection means (3) comprise articulation means (4), for bringing said seat (2) in said open configuration in a position which is translated in relation to said base (1), both vertically and horizontally in a frontal direction, and at the same time tilted with the front side in a downward direction.
2. The device according to claim 1, wherein said articulation means (4) comprise first articulation means (5) pivotally connected to said base (1) and said seat (2), and second articulation means (6), hinged to said first articulation means (5) and pivotally and slidably connected to said seat (2) and said base (1), along guide means (13,12) respectively arranged on said seat (2), parallel to said seat surface (2a), and on said base (1).
 3. The device according to claim 2, wherein said first and second articulation means (5, 6) comprise at least one pair of crossed-over arms (5, 6), arranged on a plane substantially orthogonal to said seat surface (2a), a first arm (5) extending obliquely between the front side (1a) of said base (1) and the rear area of said seat (2), and a second arm (6) extending obliquely between the front side (2b) of said seat (2) and the rear side of said base (1).
 4. The device according to claim 3, comprising two pairs of arms (5, 6) each arranged on a lateral side substantially orthogonal to said front side (1a, 2b).
 5. The device according to claim 3 or 4, wherein said guide means (12, 13) of said second arm (6) comprise guide grooves (13, 12) formed in said seat (2) and in said base (1), said second arm (6) comprising end sliders (11, 10) slidably engaged in said grooved.
 6. The device according to any of the claims from 3 to 5, wherein said guide means (12) for said second arm (6) are formed in said base (1) so as to extend in a horizontal direction.
 7. The device according to any of the claims from 3 to 5, wherein said guide means (112) for said second arm (106) formed in said base (101) comprise at least one segment extending obliquely in an upward frontal direction.
 8. The device according to any of the claims from 3 to 7, wherein said first arm is hinged directly to said seat (2) on the rear side (2d).
 9. The device according to any of the claims from 3 to 7, wherein said first articulation means (105) comprise, in addition to said first arm (105), a tie rod (115) extending between said first arm (105) and said seat (102) substantially parallel to said second arm (106), said tie rod (115) being hinged to said seat (102) and to said first arm (105) at the upper end, the latter making contact with guide means (109) integral with said seat (2) and substantially parallel to said seat surface (102a).
 10. The device according to claim 9, wherein said tie rod (115) is replaced by a guide cam which, on said seat (102), acts as a guiding element for a slider attached to said second arm (106).
 11. The device according to any of the claims from 3 to 10, wherein one or more of said arms (105, 106) present a structure adjustable in length.
 12. The device according to any of the claims from 4 to 11, comprising a rod (119) that transversally joins the lower ends of said second arms (106), pivotable in relation thereto, said drive means (118) acting on said rod (119) for controlling its forward-backward motion.
 13. The device according to claim 12, wherein said drive means comprise a pneumatic jack (118) hinged at one end to said base (101), in a central position, and at the other end connected to said rod (119), said jack (118) being controlled by a pneumatic circuit commanded by an electric or manually operated pump.
 14. The device according to claim 12, wherein said drive means comprise cable means for pulling said rod (119) from opposite directions and in a coordinated manner, controlled by motorized winding means.
 15. The device according to any of the claims from 4 to 11, wherein said drive means comprise a pantograph (120) extending at the rear between said base (101) and said seat (102) so as to command by its opening/closing action the lifting and lowering of said seat, the motion of the pantograph (120) being controlled by worm screw means that operate on the ends of the pantograph (120) connected to the base (101), the two upper ends of the pantograph being engaged with the seat (102) by hinges and prismatic guide means (121, 122).
 16. The device according to any of the claims from 4 to 11, wherein said drive means comprise worm screw

means operating directly on one or both the sliders (10, 110) at the lower ends of said second arms (6, 106).

17. The device according to any of the claims from 4 to 11, wherein said drive means comprise an inflatable cushion inserted between the base (1) and the seat (2), for generating the thrust in an upward direction necessary to lift and support the seat while the user is in a sitting position on it, electric or manually operated pump means being provided for inflating said cushion. 5 10
18. The device according to any of the previous claims, wherein said seat (2) comprises a sliding seat plane, movable in a backward and forward direction, with a certain degree of resistance, with respect to an underlying structure with which the connecting means (3) between the same seat and the base are engaged. 15 20

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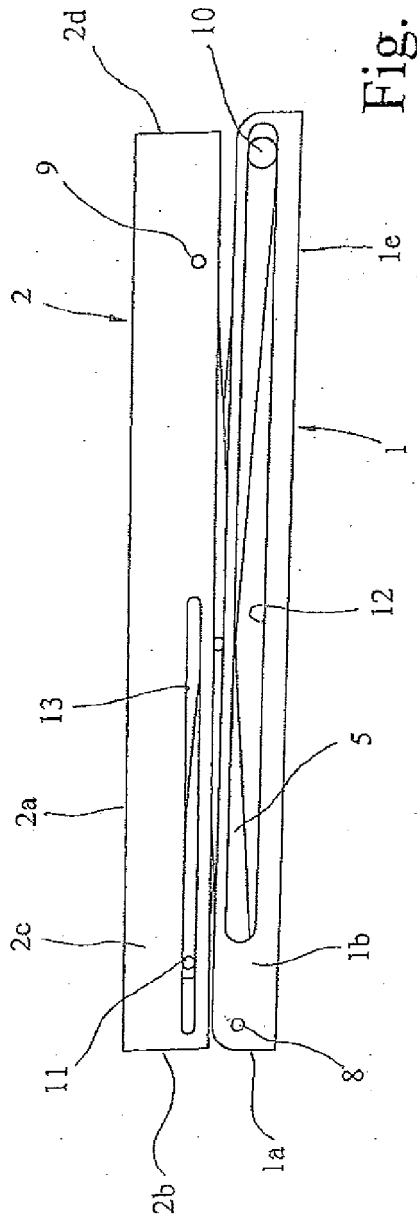


Fig. 1

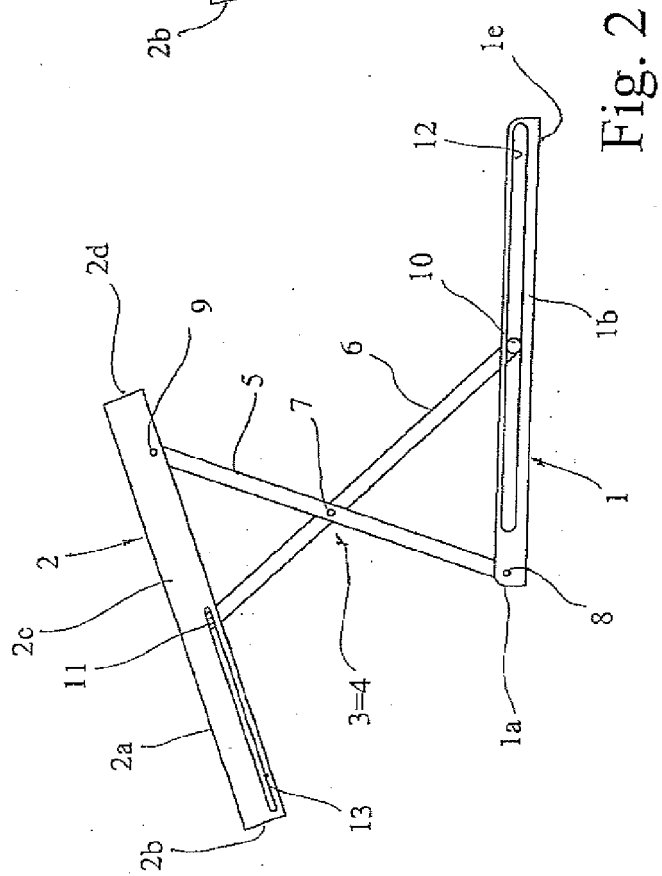


Fig. 2

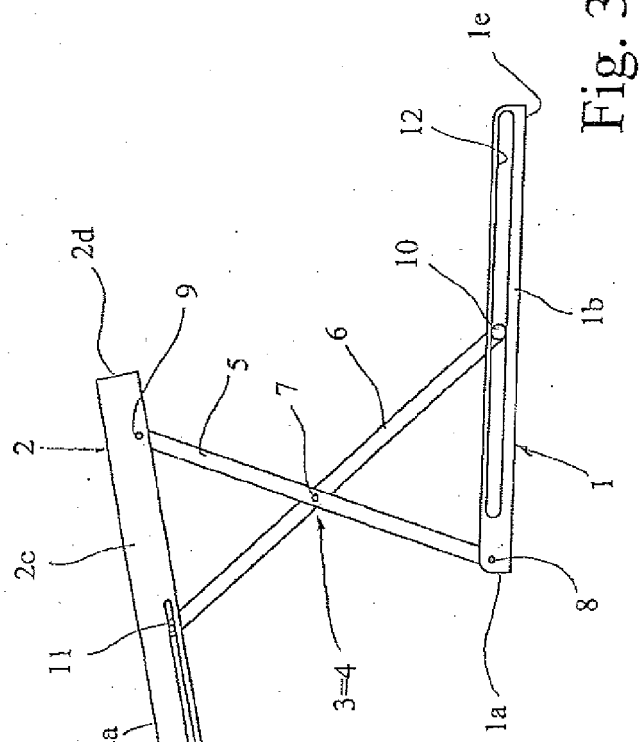


Fig. 3

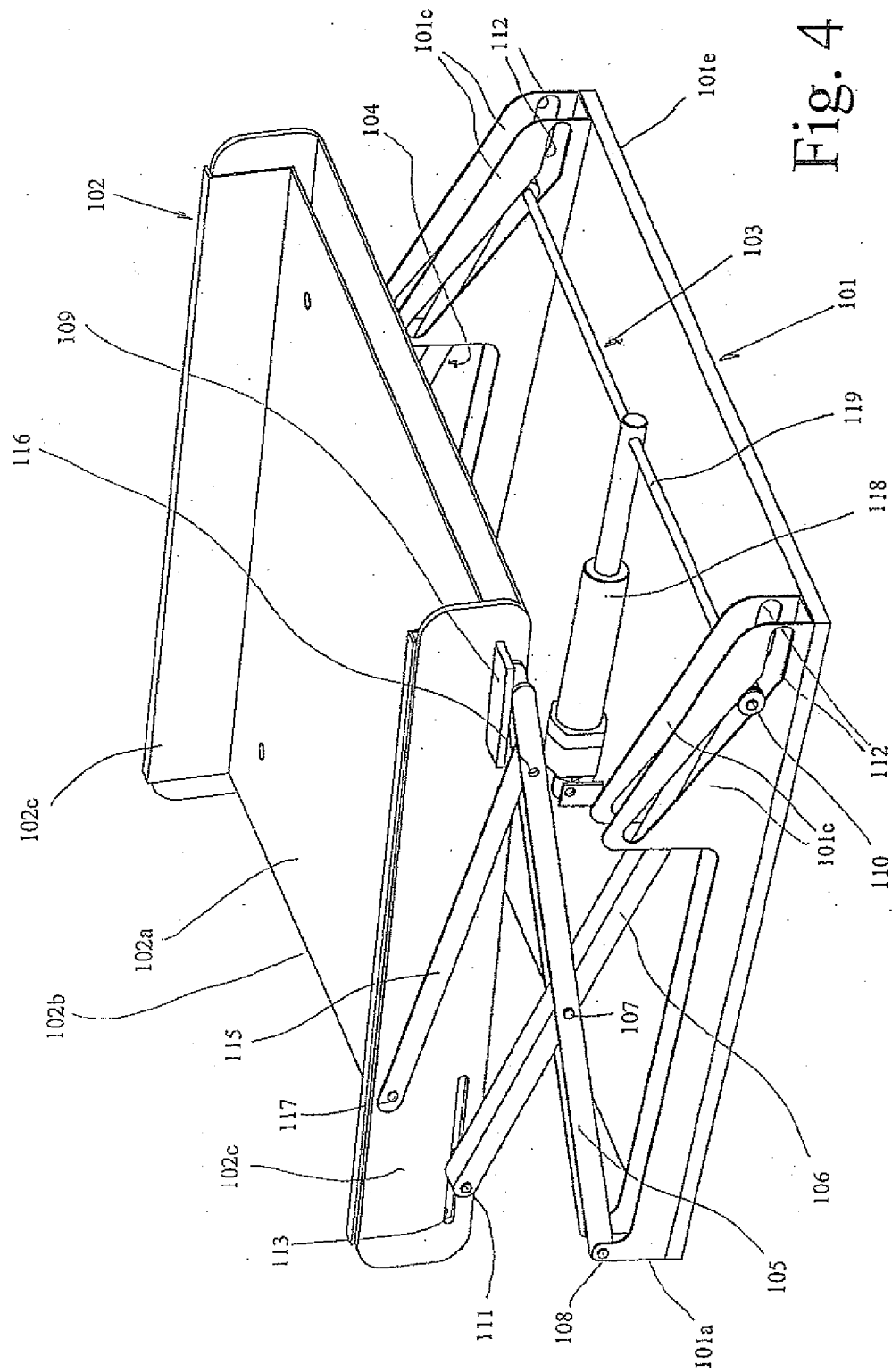


Fig. 4

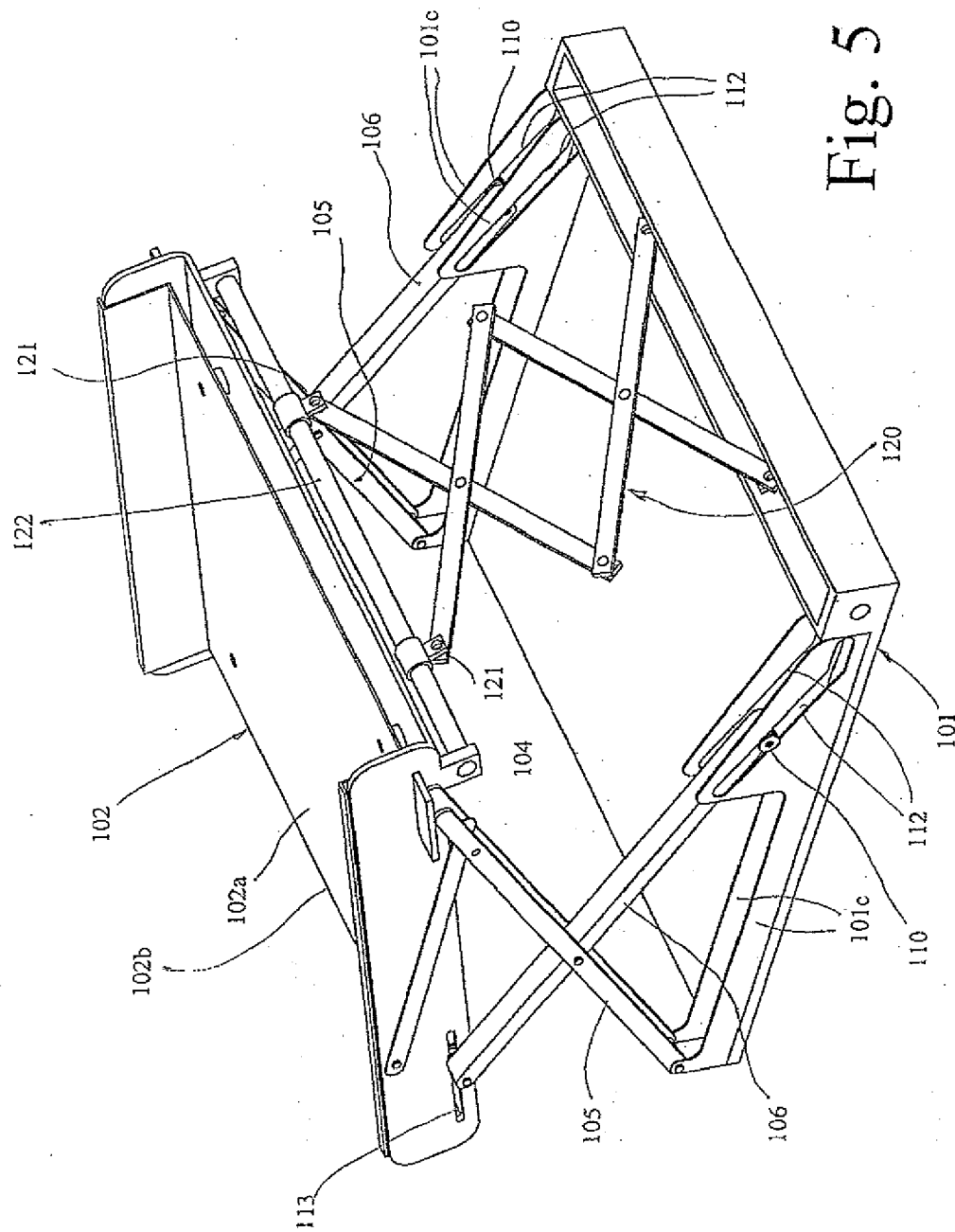


Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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