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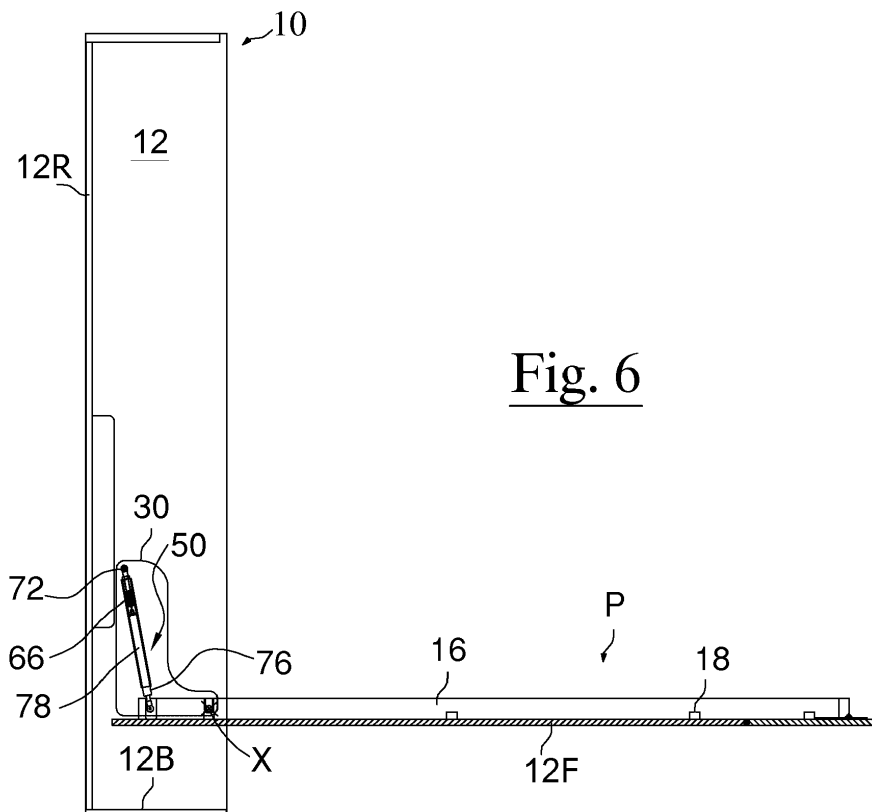
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(54) **LIFTABLE BED**

(57) To improve the motion of a platform or bedspring (P) belonging to a liftable bed (10; 100), the platform or bedspring being rotatable about a horizontal axis (X) to vary its own inclination from vertical to horizontal to make a person lie down on it, or vice versa; antagonist force is

applied to the platform or bedspring in order to compensate for the weight thereof while passing from vertical to horizontal inclination, or vice versa, wherein the antagonist force is the sum of at least two elastic forces (F1a, F2a; F1b, F2b).



**Fig. 6**

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## Description

**[0001]** The present invention relates to a method for servo-assisting the motion of a platform or bedspring belonging to a liftable bed, to the liftable/lowerable bed equipped with an elastic damping device destined to implement the method; and also to the elastic damping device in itself.

**[0002]** A lot of multifunctional furniture includes a hidden platform or bedspring. The platform is hidden in vertical position inside the furniture item and when necessary it can be overturned in horizontal position to sleep on it. An example is the wall bed in WO 2013 190449, which includes a gas spring 40 to help lift the bedspring P. The gas spring 40 is very powerful and exerts a force vertically on the bedspring P, otherwise it would be very difficult to lower it. It is preferred then that the gas spring 40 stops acting when the bedspring P is tilted about 80 degrees with respect to the horizontal (see e.g. Fig. 2 here). For thus the bedspring P would not remain perfectly vertical to close the furniture item, small magnets or hooks are used to keep it upright and attached to the walls of the furniture item. A user can then easily lower the bedspring P because the force to overcome is initially only the one of the magnet, while the subsequent opposition of the gas spring 40 can be overcome using the advantageous lever formed by the bedspring P already a little tilted.

Despite the magnets or the hooks, actually to bring the bedspring P perfectly vertical at the end of its stroke it is necessary that the user exceeds the weight thereof, because the gas spring 40 at that moment juncture is inert. Obviously, this makes the furniture item uncomfortable. In addition, the magnets may accidentally lose the grip on the bedspring P, e.g. following a collision, and the bedspring P reopen slightly due to its own weight. Obviously, this makes the furniture item impractical.

**[0003]** The state of the art should be enriched with a new method for servo-assisting a liftable/lowerable bed as well as the bed that implements the method, which results easy to manufacture and more reliable to operate.

**[0004]** It is therefore proposed the method defined in claim 1, i.e. a method for servoing the motion of a platform or bedspring belonging to a liftable bed, the platform or bedspring being rotatable about a horizontal axis (X) to vary its own inclination from vertical to horizontal to allow a person lying down thereon, or vice versa;

wherein an antagonist force is applied to the platform or bedspring in order to compensate for the weight thereof while passing from vertical to horizontal inclination, or vice versa,

characterized in that

the antagonist force is the sum of at least two elastic forces.

**[0005]** By *elastic element* here it is meant a means capable of generating an opposition force when is compressed, along a stroke of at least some centimeters, and

returning to the starting configuration when the compression force decreases. The reaction force may or may not be substantially proportional to the deformation during the compression. Examples of elastic element are: any type of mechanical deformation spring or a gas or fluid spring.

By *elastic force* here it is meant generally a force generated or able to be generated by a said elastic element.

One or each elastic element and/or one or each elastic force may act directly or indirectly (that is, by direct contact or through interposed mechanisms or pieces) on the bedspring or platform P.

**[0006]** Preferably the elastic forces, or the corresponding elastic elements, are only two, for simplicity and economy, but the invention also comprises more sophisticated cases of  $n$  forces,  $n > 2$ .

**[0007]** Thanks to the modulation and composition of the two forces a platform or bedspring P can be servo-assisted with different forces when the platform or bedspring P takes different inclinations. Therefore, by keeping e.g. small one of the two forces, or by making it intervene alone canceling or reducing a lot (i.e. to a relatively negligible value) the other, the aforesaid problem of having, at the opening, to overcome a very strong resistance, is also solved.

**[0008]** One can program an overall antagonist force having different elastic constants in different points or ranges of the angular trajectory of the platform or bedspring P. This allows e.g. programming the antagonist force to reduce the user's effort and/or determine the motion speed of the platform or bedspring P.

Here by *positive or greater-than-zero force* ( $> 0$ ) it is meant a force directed to withstand the weight of the platform or bedspring P.

**[0009]** According to a preferred embodiment, said two elastic forces are such that

one force is always different from zero, i.e. it acts by pushing the platform or bedspring during substantially the whole rotational stroke of the platform or bedspring; while the other force is zero or much smaller than the first force (e.g.  $\leq 1/10$  of the first force) in a certain angular range of the rotational stroke of the bedspring or platform.

**[0010]** In particular, said other force may be non-zero in a given range of the rotational stroke of the bedspring or platform, and may be

null or much lower ( $\leq 1/10$ ) than the first force outside such a range, or

substantially equal or much greater ( $> 2$  or  $< 5$ ) than the first force outside such a range.

These configurations allow with only two forces obtaining both advantageous dynamic responses for the bedspring or platform P, and an intervention delay for one force.

**[0011]** In fig. 1 there is shown a furniture item with a lowerable bedspring or platform P.

**[0012]** On the bedspring or platform P the series of two elastic elements M1a, M2a acts to generate two forces (e.g. M1a, M2a are mounted one beside the other to have one same direction for the generated force). M1a is e.g.

a gas spring thrusting on the bedspring P, M2a a compressed helical spring (see better below) which decompresses only when the bedspring or platform P is going to arrange itself vertical. The graph of Fig. 3a shows qualitatively the trend of the forces F1a, F2a expressed by M1a, M2a and of the sum force FTA on the bedspring P along the angular stroke  $\alpha$  (see fig. 1) of the bedspring or platform P, wherein  $\alpha = 0$  when the bedspring or platform P is horizontal and  $\alpha = 90$  degrees when the bedspring or platform P is vertical (see fig. 1).

It is noted in particular that here the force F2a continues to act when the other force F1a, for  $90 > \alpha > \alpha_x$  wherein  $\alpha_x$  is a determined angle, is zero or much smaller; therefore, practically, F2a is the only force applied to the bedspring P for  $90 > \alpha > \alpha_x$ . The force F2a can also be zero in a sub-range of  $90 > \alpha > \alpha_x$ .

**[0013]** Also, in this variant F2a decreases only when the other force F1a is zero or much smaller (e.g.  $< 1/10$  or even  $< 1/6$ ) than the (e.g. average) value of F1a for  $\alpha < \alpha_x$ . Other trends for F1a, which may also hold for F1b, are shown in dashed line. In Fig. 2 there is shown another furniture item with lowerable bedspring or platform P, wherein the furniture item comprises a lowerable seat S in front of the bedspring or platform P thanks to pairs of movable arms B, which form e.g. an articulated parallelogram. The seat S is bound to the bedspring or platform P, e.g. by means of an arm K.

Two elastic elements M1b, M2b act cooperatively on the bedspring or platform P, respectively. The elastic elements M1b, M2b develop respectively two forces F1b, F2b (see Fig. 3b). M1b is e.g. a gas spring always in compression, and mounted as M1a. M2b is e.g. a gas spring (see better below) mounted between an arm B and a horizontal extension 112 of the furniture item for beginning to compress only after the bedspring or platform P from vertical is tilted slightly at the angle  $\alpha_x$ .

This can be achieved e.g. by creating a mechanical play between the element M2b and the connection point with the extension W or the arm B.

Note that for simplicity in the graphs the force of a gas spring is depicted in some ranges as almost constant when the gas spring is compressed. Obviously the actual trend depends on the type of gas spring, or on the spring type altogether

**[0014]** The graph of Fig. 3b shows the trend of the forces F1b, F2b and their sum Ftb. Essentially F2b  $> 0$  only if  $\alpha < \alpha_x$ ; while F1b  $> 0$  for  $0 \leq \alpha \leq 90$  degrees.

In this way the total antagonist force F2b can be small, and e.g. not zero, when the bedspring or platform P is substantially vertical, and greater when the bedspring or platform P is tilted or horizontal. In Fig. 2 the element M1b can e.g. be weakened to ease the opening of the bedspring or platform P since the weight of the latter will then be supported when needed, that is with the bedspring downwardly inclined ( $\alpha < \alpha_x$ ), by the element M2b.

**[0015]** According to a preferred embodiment (see e.g. Fig. 1), an antagonist force is applied to the platform or bedspring P, for example by creating it through at least

two elastic elements (e.g. M1a and M2a, placed in series to each other, i.e. in tandem fashion) so that it is the sum of two forces in which

a first force is always positive for all the angular excursion of the bedspring P ( $0 \leq \alpha \leq 90$  degrees) and the other (second) force, in a range of such excursion, is minimum or zero, or much lower ( $< 1/10$  or  $< 1/6$ ) than said first positive force. Preferably the second force outside said range is positive, even more preferably it has a value greater than that assumed in said range.

**[0016]** This is a simple but effective system to modulate the force applied on the platform or bedspring P, and have two ranges in the stroke  $0 \leq \alpha \leq 90$  degrees with two different and programmable antagonist forces.

E.g. according to a preferred embodiment, said two elastic forces are such that

both forces have positive value in a certain angular range comprised in the rotational stroke of the bedspring or platform, and at least one force is zero or much smaller than the positive value (e.g.  $\leq 1/10$  or  $\leq 1/6$  of the positive value) outside said range.

**[0017]** According to a preferred embodiment, an elastic element, e.g. M2a or M1b, is a mechanical structural deformation spring (e.g. a helical or disc spring) and the other, e.g. M1a or M1b, is a gas or fluid spring. Other combinations are anyway possible and comprised within the scope of the invention.

**[0018]** A liftable bed implementing the method may comprise

a platform or bedspring, on which one can lie down, which is rotatable about a horizontal axis to vary its own inclination from vertical to horizontal, or vice versa;

a servomechanism mounted to apply a force to the platform or bedspring in order to compensate for the weight thereof while going from vertical to horizontal inclination or vice versa,

characterized in that

the servomechanism comprises at least two elastic elements mounted to exert on the bedspring or platform a force adapted to servo the motion thereof.

**[0019]** The two elastic elements may be mounted in tandem fashion (e.g. as described above, or in fig. 1), and/or configured so that

one always applies a positive force for substantially all of the angular excursion of the bedspring or platform P, and

the other, in a range of such excursion, applies a zero or minimum force (namely: with respect to the one it can exert or exerts along all the excursion), e.g. lower than  $1/10$  of the positive force.

Preferably said other element, outside said range, is adapted to apply a positive force, still more preferably a force having a value greater than that generated in said range.

**[0020]** This is a simple but effective system to modulate the force applied on the platform or bedspring P.

The advantages of the bed are the same of the method.

**[0021]** Preferably, the bed comprises a box-shaped

cabinet that forms a compartment inside which the platform or bedspring is hinged about a horizontal axis, and the servomechanism is mounted between the platform or bedspring, and the compartment.

**[0022]** Advantageously one or each elastic element, or the force that it exerts, may be adjustable in various parameters, such as e.g. the maximum and/or minimal force (applied to the bedspring or platform P), the time or time delay of intervention or action on the bedspring or platform P, the point  $o_x$  where the force begins to be applied to the bedspring P or to decrease or is zero, or the elastic constant.

**[0023]** Preferably the servo-mechanism comprises an elastic damping device adapted to carry out the method, comprising

a hollow tubular casing;

a linear actuator which is housed within the casing so as to slide longitudinally in it and protrude partially from the casing to provide a thrust toward the outside;

an elastic element, which is placed between the actuator and an abutment internal to the casing and is mounted to oppose a greater insertion of the actuator inside the housing.

**[0024]** The series arrangement of the actuator and the elastic element provides outside the device a variable elastic force, as a function of the shortening of the device, and the device has substantially two elastic different constants corresponding to two different shortening ranges.

**[0025]** According to a preferred embodiment, the linear actuator comprises or consists of

- a cylinder and a piston, and e.g. is a gas spring; and/or
- an electric actuator, and/or
- a mechanical compression spring.

**[0026]** The abutment inside the housing may be a cap or an element that closes, in part or completely, part of the hollow section of the housing.

Preferably, the inner abutment and/or the said cap or closing element is adjustable in position co-axially along the axis of the housing, so as to adjust the elastic response of the elastic element and/or the timing of its intervention by varying the distance between said cap or element and the actuator.

The elastic element of the device may be a, e.g. helical, spring or in general a mechanical deformation spring (a disc or spiral spring).

Note that the device itself offers the advantage of providing a modular and programmable force as a function of its shortening, and can be used not only for a liftable bed but e.g. to servo-assist furniture leaves, doors or windows.

**[0027]** The advantages of the invention will be better clarified by the following description of an exemplary embodiment thereof, illustrated in the annexed drawing wherein:

Fig. 1 shows a schematic side view of a liftable bed; Fig. 2 shows a schematic side view of a liftable bed coupled to a lowerable seat;

Fig. 3a and 3b show qualitative graphs of forces;

Fig. 4 shows a side view of a liftable bed when closed; Fig. 5 shows a view of the bed of Fig. 1 when partially open;

Fig. 6 shows a view of the bed of Fig. 1 when open; Fig. 7 shows an exploded view of an elastic damping device;

Fig. 8 shows in transparency the device of Fig. 4 when mounted;

Fig. 9 shows a side view of a second liftable bed when closed;

Fig. 10 shows a view of the bed of Fig. 9 when open.

**[0028]** In the following the furniture items are described as in use, and equal numerals indicate equal parts.

10 indicates overall a liftable bed, contained in a parallelepiped closet or cabinet 12. The cabinet 12 comprises two side walls 12L, a bottom 12B, a ceiling 12T and a back 12R which together define a cavity or compartment. Inside the cavity is mounted a bedspring or platform P. The bedspring or platform P serves to support a resting person, and it may comprise a, e.g. rectangular, perimeter frame 16 with a bedspring or slats 18 in the center, and a panel 12F mounted toward the outside.

The bedspring P is pivoted to the walls 12L so as to be rotatable about a horizontal axis X and to vary its inclination from vertical (Fig. 4, position of non-use) to horizontal (Fig. 6, when someone can sleep above the bedspring or platform P), or vice versa, passing through an intermediate position (Fig. 5).

To this aim, inside the walls 12L there are symmetrically fixed two plates 30 to which the frame 16 is hinged. To each plate 30 there is also hinged an elastic damping device 50, better visible in Fig. 7 and 8.

The device 50 comprises a cylindrical tubular hollow casing 68 with axis Y in which an actuator in the form of a gas spring 60 comprising a movable piston 76 and a casing 68, is housed. The movable piston 76 of the gas spring 60 protrudes from the casing 68, while the cylinder 78 is fully inserted longitudinally inside the casing 68 in a sliding manner along the axis Y.

A spring 66 is present between the cylinder 78's end inside the casing 68 and an abutment element 70, e.g. a cylindrical bushing, plugging the cylinder 68 on a side.

**[0029]** Preferably on the cylinder 78's head there is mounted a pin 62 comprising a portion 64 of radial width approximately equal to the inner diameter of the spring 66, so that the spring 66 can be inserted on the portion 64, for greater stability. The spring 66 is longer than the portion 64, thus upon shortening it can oppose a greater insertion of the gas spring 60 within the casing 68 along Y. Note that the pin 62 forms a simple but effective end-of-travel stop by touching the abutment element 70.

Preferably, the position along the axis Y of the element 70 is adjustable. A system to do this is providing the el-

ement 70 with a threaded lateral surface that engages with a counter-thread of the inner surface of the casing 68.

Integral and coaxial to the element 70 is a cylinder 74, which extends out from the casing 68 with a pin 72. By rotating the pin 72 the element 70 is screwed and moved axially inside the tubular cavity, thereby changing the tension of the spring 66 at rest and/or the idle position of the spring 60.

As it can be seen from figures 4-6, the device 50 replaces the known gas spring in the cabinet 10 (see e.g. reference 40 in WO 2013 190449), namely is mounted between the plate 30 and the bedspring P.

Note the correspondence between the device 50 and the assembly {M1a+M2a} in fig. 1.

## OPERATION

**[0030]** The adoption of the device 50 induces in the cabinet 10 huge benefits.

In the open-bed position (Fig. 6), the gas spring 60 has the piston 76 maximally compressed and it is maximally compressed inside the casing 68 (maximum compression of the spring 66).

To hide the bed one gradually rise the bedspring P, see Fig. 5. The force of the gas spring 60 supports the weight of the bedspring P until the piston 76 is escaped completely from the cylinder 60, see Fig. 5.

Despite the bedspring P being not vertical yet at this point, its center of gravity has travelled the main part of the trajectory without difficulty for the user. Within the last closing path ( $\alpha > \alpha_x$ ) the force of the spring 66 intervenes, which by pushing the gas spring 60 out of the casing 68 assists the final motion of the bedspring P until it brings the latter vertical (Fig. 6). The force of the spring 66 may be smaller, because it is enough to overcome the weight of the bedspring P due to a less resistant torque (the force of gravity acts with less lever arm).

To lower the bedspring P one pulls it downwards. Now, however, the user must initially overcome only the antagonist force of the spring 66 and not of the gas spring 60. Since the user makes the bigger effort when the bedspring P is vertical, due to the inconvenience of the operation, the bed is thus much more comfortable and lightweight to lower. For a given inclination of the bedspring P ( $\alpha = \alpha_x$ ), the spring 66 compresses entirely and/or the portion 64 abuts against the element 70 (fig. 5), and from here onwards the gas spring 60 will come into play, whose piston 76 will be pressed into the cylinder 78 and by reaction the bedspring P will come down slowly.

Note that the device 50 continuously supplies an elastic return force to the bedspring P when the latter is vertical. So, even if the bedspring P were to suffer a shock that destabilizes it, there would always be a return to the vertical position.

**[0031]** Another advantage is the elimination of magnets or hooks of the known art, with saving in overall dimensions and pieces.

**[0032]** Fig. 9 and 10 show a variant of the cabinet, of the type described e.g. in US 5 353 452. For simplicity and conciseness we describe only the differences with the previous variant.

100 indicates overall a liftable bed, contained in a (optional) parallelepiped closet or cabinet, like the 12, inside whose cavity is mounted a bedspring or platform P movable as in the previous variant.

Outside the panel 12F there is a sofa 150 to sit on formed by a movable seat 152 and a backrest 154 integral with the panel 12F. Optionally the cabinet includes two extensions or bases 112, spaced apart about as the panel 12F when lowered, which extend on the sides of the seat 152.

The cabinet 100 comprises a mechanism which, when the bedspring P is lowered, is adapted to collapse and break up the sofa 150, to reduce its bulk under the panel 12F. The mechanism comprises two identical pairs of arms 164, 166, one for each extension 112, which are hinged via pins, with axis horizontal and parallel to X, at a lower end thereof on an extension 112 (or to the compartment 14), and at the upper end thereof to a support element 168 for supporting the seat 152. Altogether an arm 164, 166, the extension 112 and the support 168 are mounted to form an articulated parallelogram. The support 168 can be replaced, when the extensions 112 are absent, e.g. by a bar connected to the compartment 14 or by a socle resting on the ground.

To the panel 12F and to an arm 166 or 168 there is hinged a rigid lever 180 that connects them, so that the motion of one is transferred to the other.

On the back of panel 12F or on the bedspring P a thrusting gas spring 190 acts, made and functioning as the gas spring 60.

Between one of the arms 164, 166 and an extension 112, or the compartment 14, there is mounted a gas spring 192, slidably contained inside a tube 194. The gas spring 192 serves and is mounted for pushing the arm connected thereto towards the compartment 14, namely it serves and is mounted for opposing the lowering of the seat 152, or - which is the same - the lowering of the bedspring P. The spring 192 can slide idly by a certain distance inside the tube 194 when it is maximally extended, that is, when the arm connected to it is closer to the compartment 14. This creates a delay in the compression of the spring 192 when the bedspring P starts to tilt from the vertical position. The benefit is to not contrast the lowering of the bedspring P in the first inclination tract ( $\alpha_x \leq \alpha \leq 90$ ) and to make the spring 192 intervene only when the weight of the bedspring P becomes substantial for the user.

## OPERATION

**[0033]** When the bedspring P is raised (fig. 9) the sofa is composed, with the seat 152 attached to the back 154. The arms 164, 166 are inclined towards the bedspring P (or, which it is the same, toward the X axis) with respect to a vertical plane Z orthogonal to the base or extension

112.

When the bedspring P is lowered and placed horizontal (fig. 10) the lever 180 pushes an arm 164 or 166, and rotates the arms 164, 166 (clockwise in fig. 9 and 10) on the opposite side of the X axis, moving it away from the latter. The motion of the arms 164, 166 involves both the seat 152 horizontally going away from the X axis, and its lowering to ground. At the end-of-travel position, the arms 164, 166 are bent on the other side with respect to the Z plane (Fig. 10) and the backrest 154, which has rotated and lowered together with the panel 12F, sets horizontal and locates itself in the space vacated by the moved seat 152. This is possible because the arms 164, 166 have length and/or angular stroke such as to move the seat 152 away from the panel 12F by at least a distance equal to the horizontal length of the backrest 152 when lowered (fig. 10), or in any case a distance enough to leave the required space to it.

When the bedspring P from vertical tilts slightly, is affected only by the force of the gas spring 190, because the gas spring 192 slides inside the tube 194 without imparting any force to the arm 164.

When the bedspring P is inclined to the point (for  $\alpha_x$  being e.g. 10 to 20 degrees) that the arm 164 is rotated enough to abut the spring 192 against the interior of the tube 194, the spring 192 begins to press and support too, via the arm 164 or 166 and the lever 180, on the bedspring P, cooperating with the spring 190.

The intervention delay of the spring 192 can also be achieved by hinging it through a slot, e.g. to the arm 164, so as to create a mechanical play.

Note that in the cabinet 100 the gas spring 190 and/or 192 may be replaced by the device 50, obtaining three or four distinct angular ranges for the bedspring P in which three or four different elastic elements act or not, further improving the convenience of use of the bedspring P or of the relevant cabinet.

**[0034]** The cabinet 10 or 100 is advantageously to be motorized. E.g. inside the compartment 14 a linear actuator may be mounted exerting a thrust on the bedspring P.

## Claims

1. Method for servoing the motion of a platform or bedspring (P) belonging to a liftable bed (10; 100), the platform or bedspring being rotatable about a horizontal axis (X) to vary its own inclination from vertical to horizontal to make a person lie down on it, or vice versa; wherein an antagonist force is applied to the platform or bedspring in order to compensate for the weight thereof while passing from vertical to horizontal inclination, or vice versa, **characterized in that** the antagonist force is the sum of at least two elastic forces (F1a, F2a; F1b, F2b).

2. Method according to claim 1, wherein said two elastic forces are such that one force is always different from zero, and the other force is zero or much smaller than the first force in a certain angular range of the rotational stroke of the bedspring or platform.
3. Method according to claim 1 or 2, wherein the elastic forces, or the relevant elastic elements, are only two.
4. Method according to claim 2 or 3, wherein said other force is non-zero in a given range of rotational stroke of the bedspring or platform, and is null or lower than 1/10 of the first force outside such a range, or substantially equal or greater than the double or of 5 times than the first force outside such a range.
5. Liftable bed (10; 100), comprising a platform or bedspring (P), on which one can lie down, which is rotatable about a horizontal axis (X) to vary its own inclination from vertical to horizontal, or vice versa; a servomechanism (50; 190, 194) mounted to apply a force to the platform or bedspring in order to compensate for the weight thereof while going from vertical to horizontal inclination or vice versa, **characterized in that** the servomechanism comprises at least two elastic elements (66, 60; 190, 194) mounted to exert on the bedspring or platform a force adapted to servo its motion.
6. Bed according to claim 5, wherein the two elastic elements are mounted in tandem fashion.
7. Bed according to claim 5 or 6, wherein the two elastic elements are configured so that one always applies a positive force for substantially all of the angular excursion of the bedspring or platform, and the other, in a range of such excursion, applies a zero or minimum force.
8. Bed according to claim 7, wherein the said other element, outside said range, is adapted to exert a positive force.
9. Bed according to claim 5 or 6 or 7 or 8, wherein one of the elastic elements comprises or consists in the device according to one of the following claims.
10. Elastic damping device (50), comprising a hollow tubular casing (78); a linear actuator (76) which is housed within the casing so as to slide longitudinally in it and protrude partially from the casing to provide a thrust toward the outside;

an elastic element (66), which is placed between the actuator and an abutment (70) internal to the casing and is mounted to oppose a greater insertion of the actuator inside the housing.

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**11.** Device according to claim 10, wherein the linear actuator comprises a gas spring (60).

**12.** Device according to claim 10 or 11, wherein the abutment is positionally adjustable inside the casing co-axially along the axis (Y) of the casing.

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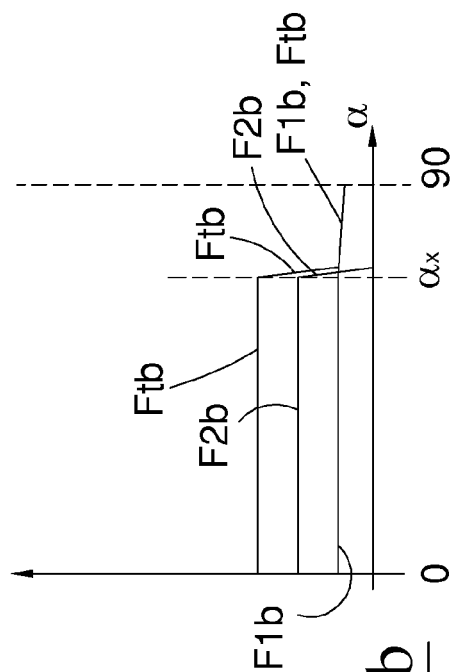
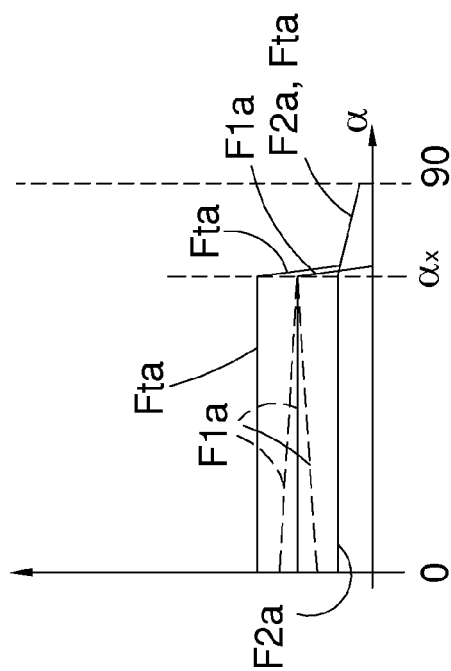
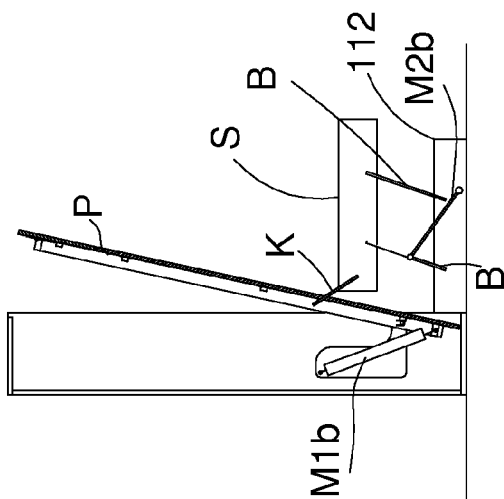
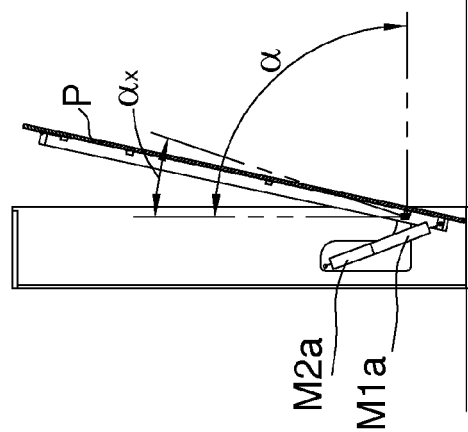
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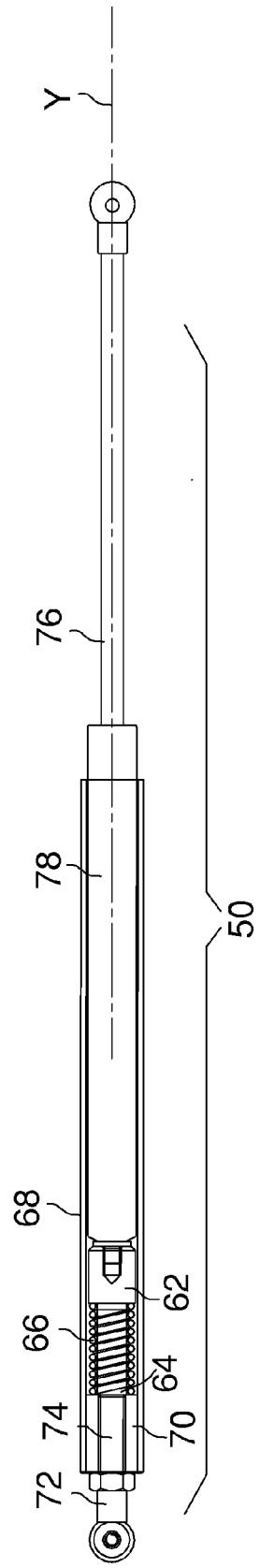
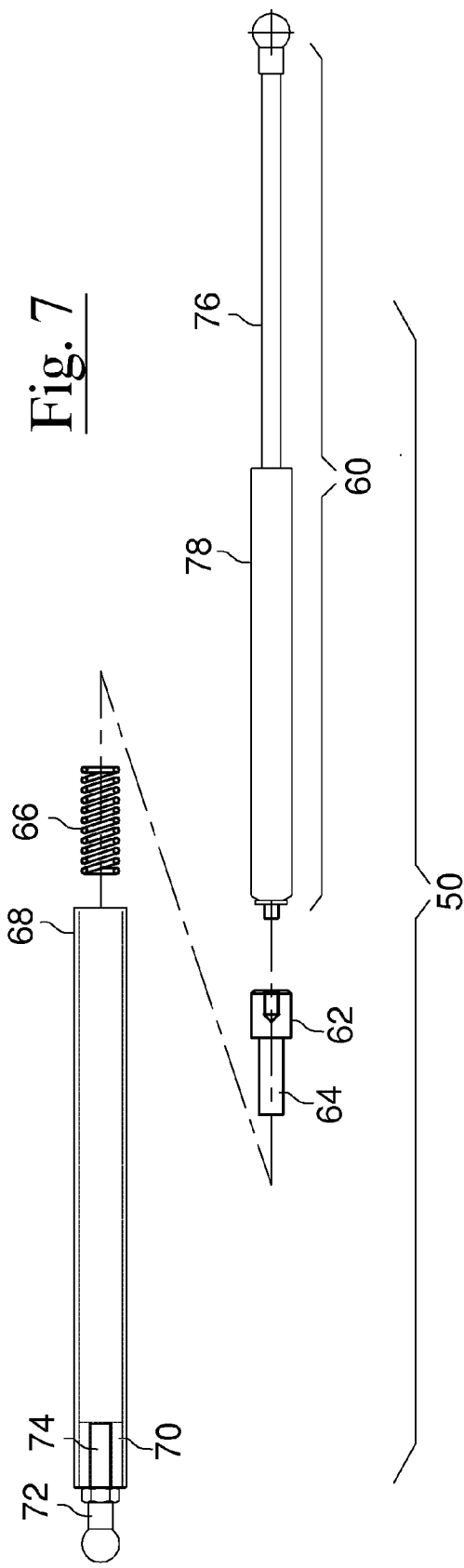
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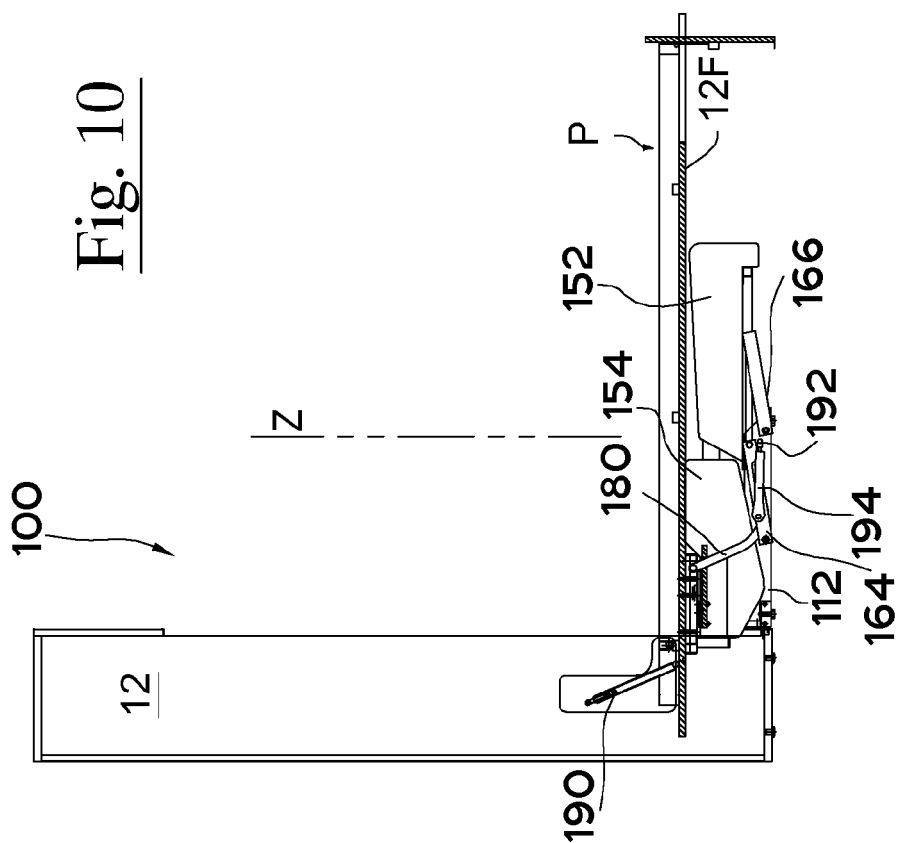


Fig. 9

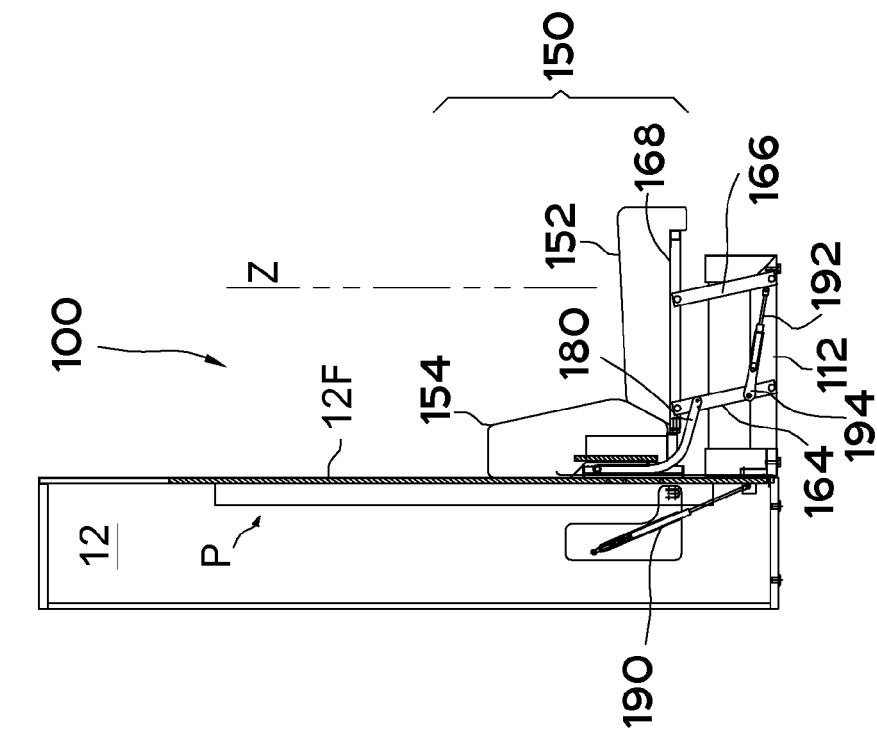


Fig. 10



## EUROPEAN SEARCH REPORT

Application Number  
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