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(54) Handling device for objects to be moved in space

(57) A handling device (1) for objects to be moved in space, comprising a balancing actuator (11) connected between a supporting base (2) and an arm (5) and designed to balance the weight at least of a loading portion (8) connected to the arm (5) in such a way as to keep the loading portion (8) suspended in space.

The handling device (1) also comprises movement aid means (14) acting on the mechanical arm (5) and designed to move the mechanical arm (5) relative to the base along a line of movement (6). Said handling device (1) also comprises a control unit (16) which can be operated by the operator and is operatively connected to the movement aid means (14) for operating said movement aid means (14) on command.

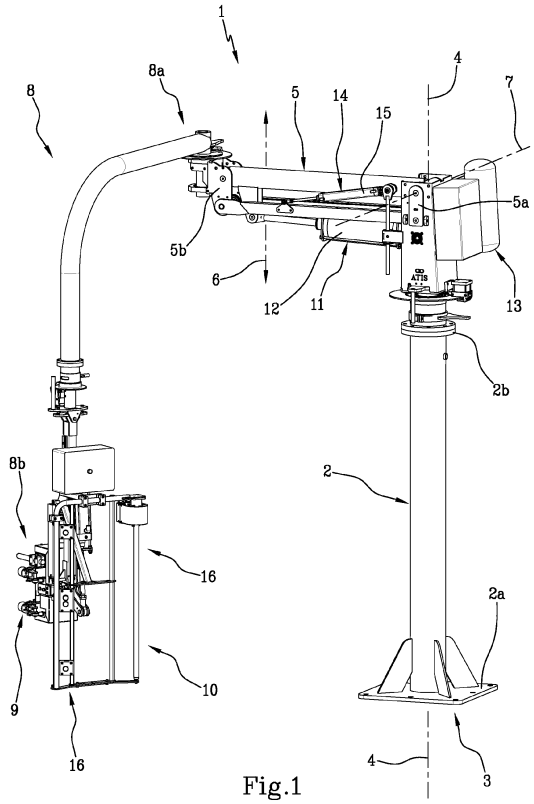


Fig.1

EP 2 762 436 A1

Description

[0001] This invention relates to a handling device for objects to be moved in space. Preferably, said handling device is of the pneumatic type.

[0002] In general, handling devices help an operator to manually move objects (usually weighing between around 5 kg and 500 kg) in space while avoiding effort by the operator. In particular, handling devices allow the movement of offset loads, in any direction without constraints and with extreme freedom.

[0003] According to the prior art a handling device comprises a supporting base, preferably having the shape of a column, connectable to a reference point which may be stationary (e.g.: the ground, ceiling, etc.) or movable (e.g.: a rail, etc.) and at least one arm whose first end is rotatably mounted on said supporting base. Moreover, a handling device comprises a loading portion rotatably connected to a second end (opposite to the first end) of the arm and designed to support an object to be shifted. In detail, the loading portion is shifted manually by the user.

[0004] Moreover, a handling device usually comprises at least one balancing actuator (preferably pneumatic) connected between the supporting base and the arm and designed to balance the weight at least of the loading portion along a line of movement in such a way as to keep the loading portion suspended in space.

[0005] Preferably, the line of movement substantially coincides with a vertical line along which the second end of the arm moves. In other words, the second end of the arm moves along the vertical line to raise or lower the object loaded relative to the ground or to the ceiling.

[0006] Moreover, the loading portion comprises a holding unit which can be grasped by an operator for shifting the loading portion in space. In use, the operator, having positioned the object on the loading portion, manually moves said loading portion in space to shift the object, depending on requirements, without having to manually hold the offset load.

[0007] The handling device may have loaded balancing in which the actuator balances both the weight of the loading portion and the weight of the object loaded, or empty balancing in which the actuator balances only the weight of the loading portion. In both cases, to move the object loaded (for example along the vertical line) on the loading portion the operator must apply an additional force on the latter in such a way as to oppose the force determined by the inertia of the load to be shifted and to begin lifting or lowering the object. It is estimated that said additional force in upward/downward movements is between 1.5 kg and 7 kg depending on the weight of the object loaded.

[0008] However, sometimes said additional force requires the operator to make an effort which, if continued for long periods, may tire out the operator over the course of a day.

[0009] Therefore, to solve that problem a second known technique is used.

[0010] That second known technique consists of inserting in the holding unit a pneumatic control connected to the balancing actuator. Said control allows the static condition of the actuator to be varied and promotes the initial movement of the object loaded.

[0011] However, this second prior art technique also has several disadvantages.

[0012] In fact, given the large size of the balancing actuator, there are often unforeseeable delays in the movement in the desired direction. Such unforeseeable delays may harm the operator who does not expect the movement to occur at a predetermined delayed moment. Moreover, for the same reasons the movement is often imprecise.

[0013] In addition, the continuous variation of the balancing conditions may result in subsequent imprecision in restoring the initial balancing conditions.

[0014] In this situation, the aim of this invention is to provide a handling device for objects to be moved in space which overcomes the above-mentioned disadvantages.

[0015] In particular, this invention has for an aim to provide a handling device which allows objects to be shifted in space in a precise way and without additional effort by the operator.

[0016] It is also the aim of the invention to provide a handling device which allows an increase in the responsiveness of the handling device to the movements performed by the operator.

[0017] The above mentioned aims are substantially achieved by a handling device for objects to be moved in space as described in the appended claims.

[0018] Further features and the advantages of this invention are more apparent from the detailed description which follows of a preferred but non-limiting embodiment of a handling device for objects to be moved in space as illustrated in the accompanying drawings, in which:

- Figure 1 is an axonometric view of a handling device for objects to be moved in space according to this invention;
- Figure 2 is an axonometric view of an enlargement of a first detail of the handling device of Figure 1 with some parts removed;
- Figure 3 is an axonometric front view of the enlargement of the first detail of Figure 2 in a first operating configuration;
- Figure 4 is an axonometric front view of the enlargement of the first detail of Figure 2 in a second operating configuration;
- Figure 5 is an axonometric view of the enlargement of the first detail of Figure 2 in a third operating configuration;
- Figure 6 is a cross-section of the enlargement of the first detail of Figure 2;
- Figure 7 is an axonometric view of an enlargement of a second detail of the handling device of Figure 1

with some parts removed; and

- Figure 8 is an axonometric view of an enlargement of a third detail of the handling device of Figure 1 with some parts removed.

[0019] With reference to said figures, the reference numeral 1 denotes in its entirety a handling device for objects to be moved in space according to this invention.

[0020] In particular, the handling device 1 comprises a supporting base 2 connectable to a reference point 3. Preferably, said reference point 3 may be stationary (e.g.: the ground, the ceiling, a lateral wall, etc.) or movable (e.g.: a rail, etc.). Moreover, said supporting base 2 extends away from said reference point 3. In other words, the supporting base 2 extends between its own fixing portion 2a fixed to the reference point 3 and its own connecting portion 2b distanced from the fixing portion 2a.

[0021] In the preferred embodiment illustrated, for example, in Figure 1, the supporting base 2 extends along a first axis 4. Preferably, said first axis 4 is substantially vertical. Even more preferably, the supporting base 2 is connected to the ground and extends upwards along the first axis 4. Moreover, the handling device 1 comprises an arm 5 extending between its own first part 5a and its own second part 5b. Said first part 5a is movably connected to the supporting base 2 in such a way that said second part 5b is movable relative to the supporting base 2 along a line of movement 6.

[0022] Preferably, the arm 5 is rotatably coupled to the supporting base 2. In detail, the arm 5 is rotatable relative to the supporting base 2 according to two axes of rotation which are orthogonal to one another. Figure 1 shows how the arm 5 is rotatable about the first axis 4 (vertical) and about a second axis 7. Preferably, said second axis 7 is substantially horizontal. The line of movement 6 of the second part 5b of the arm 5 is defined by the movement of the arm 5 according to only one of the two axes. Preferably, the line of movement 6 of the second part 5b of the arm 5 is defined by the movement of the arm 5 according to the second axis 7 (horizontal). In other words, the line of movement 6 is substantially vertical in such a way as to move the second part 5b of the arm 5 away from or towards the reference point 3.

[0023] Advantageously, the arm 5 is freely movable relative to the supporting base 2. That is to say, there are no motor-driven means for moving the arm 5 relative to the supporting base 2.

[0024] Moreover, the handling device 1 comprises a loading portion 8 for loading the object to be moved, said portion extending away from the second part 5b of the arm 5 and mechanically connected to said second part 5b of the arm 5. Preferably, the loading portion 8 extends between its own connecting end 8a which is connected to the second part 5b of the arm 5 and its own loading end 8b where, in use, the object to be shifted is mounted. In practice, the loading portion 8 extends close to the reference point 3.

[0025] In addition, the connecting end 8a of the loading portion 8 is rotatably mounted on the second part 5b of the arm 5 in such a way that it is rotatable relative to the latter. In the preferred embodiment, the loading portion 8 is rotatable relative to the arm 5 according to a substantially vertical axis.

[0026] Figure 1 shows how, while the supporting base 2 extends away from the ground, the loading portion 8 extends towards the ground.

[0027] It should be noticed that the object to be loaded is positioned on the loading end 8b. Advantageously, the loading end 8b has a predetermined shape depending on the object to be supported. In a first embodiment, the loading end 8b has the shape of a shelf on which the object to be shifted can be loaded. In a second embodiment, the handling device 1 comprises a pickup unit 9 for the object, mounted on the loading portion 8 at the loading end 8b and configurable between a position for picking up the object and a position for releasing the object. In other words, said pickup unit 9 may be a gripper or a set of suction cups designed to grip the object to be shifted, as described in more detail below.

[0028] In addition, the loading portion 8 comprises a holding unit 10 (also described in more detail below) which can be grasped by an operator for shifting the loading portion 8 in space.

[0029] Moreover, the handling device 1 comprises a balancing actuator 11 connected between the supporting base 2 and the arm 5 and designed to balance the weight at least of the loading portion 8 along the line of movement 6 in such a way as to keep the loading portion 8 suspended in space. Preferably, said balancing actuator 11 comprises a pneumatic cylinder 12 and a cylinder internal pressure control assembly 13 so that in use the arm 5 is held stationary in a predetermined position relative to the supporting base 2. As already indicated, the handling device 1 may have loaded balancing in which the actuator balances both the weight of the loading portion 8 and the weight of the object loaded, or empty balancing in which the actuator balances only the weight of the loading portion 8. Depending on the type of balancing, the handling device 1 is designed to keep the loading portion 8 suspended in space without the object or with the object loaded.

[0030] Advantageously, the actuator extends and operates along a line which is angled relative to the line of movement 6 in such a way as to be able to move the second part 5b of the arm 5 along the line of movement 6. According to this invention, the handling device 1 comprises movement aid means 14 acting on the mechanical arm 5 and designed to move the mechanical arm 5 relative to the base along the line of movement 6. In other words, the aid means 14 determine a force along the line of movement 6 which aids the user during the operation for shifting the loading portion 8. In particular, at least during the initial step of shifting the loading portion 8 so as to overcome the inertia. Preferably, the movement aid means 14 comprise an auxiliary actuator 15 which is separate from the balancing actuator 11 and connected be-

tween the supporting base 2 and the arm 5 for moving the arm 5 along the line of movement 6. In particular, the auxiliary actuator 15 extends and operates along a line which is angled relative to the line of movement 6 in such a way as to be able to move the arm 5 relative to the supporting base 2.

[0031] In addition, the handling device 1 comprises a control unit 16 which can be operated by the operator and is operatively connected to the movement aid means 14 for operating said movement aid means 14 on command. In other words, the control unit 16 is operatively connected to the movement aid means 14 for controlling them. In detail, the control unit 16 is designed to activate or deactivate the aid means 14. In the embodiment illustrated in the accompanying drawings, the control unit 16 is mounted on the loading portion 8 at the loading end 8b.

[0032] In detail, the control unit 16 comprises a part 17 fixed to the loading portion 8 and a handle 18 which is slidable relative to the fixed part 17. In more detail, the handle 18 is movable along a line of shifting 19 corresponding to the line along which the loading portion 8 is to be moved. For example, in Figures 3 and 4, the handle 18 is shown in two respective operating positions. A first operating position (Figure 3) corresponding to raising of the loading portion 8 relative to the ground. And a second operating position (Figure 4) corresponding to lowering of the loading portion 8 relative to the ground.

[0033] Advantageously, the movement of the handle 18 along the line of shifting 19 corresponds to the movement that the operator intends to make the loading portion 8 perform, so as to make the command instinctive for the user. In other words, if the user wants to raise the loading portion 8 he must move the handle 18 upwards. In contrast, if he wants to lower the loading portion 8 he must move the handle 18 downwards.

[0034] In addition, the handle 18 is designed to operate the movement aid means 14 along the line of movement 6 corresponding to the line of shifting 19 of the handle 18. In detail, the handle 18 is designed to move the movement aid means 14 along the line of movement 6 in the direction corresponding to the movement performed by the handle 18.

[0035] Precisely, the handle 18 is movable along the line of shifting 19 between a first operating position, a home position, and a second operating position. The control unit 16 is designed to activate the movement aid means 14 in a first direction of the line of the line of movement 6 when the handle 18 is brought from the home position to the first operating position and to activate the movement aid means 14 in a second direction, opposite to the first, of the line of movement 6 when the handle 18 is brought from the home position to the second operating position.

[0036] It should be noticed that the aid means 14 act on the arm 5 for the time interval corresponding to the time during which the handle 18 is held by the operator in the first operating position or in the second operating position.

[0037] In the preferred embodiment illustrated in the accompanying drawings, the line of movement 6 and the line of shifting 19 are substantially parallel with a vertical line.

[0038] In addition, as can be seen in Figures 2 to 6, the fixed part 17 of the control unit 16 comprises a bar 20 and two pierced plates 21 through which the bar 20 extends. Even more particularly, the pierced plates 21 are spaced from one another along the bar 20 in such a way as to form, between them, a manoeuvring space for the handle 18. The bar 20 extends along the line of shifting 19.

[0039] Moreover, the handle 18 comprises a hollow annular body 22 slidably movable on the outside of the bar 20. The hollow annular body 22 extends inside the manoeuvring space. In detail the annular body 22 comprises two disks 23 positioned orthogonally along the handle 18 and spaced from one another. Said disks 23 are positioned between the plates 21 of the fixed part 17.

[0040] In particular, the control unit 16 comprises first elastic return means 24 interposed between the fixed part 17 and the handle 18 for promoting handle 18 return to the home position. Even more particularly, the first elastic return means 24 are connected between the fixed part 17 and a disk 23 of the handle.

[0041] Moreover, the control unit 16 comprises a stop 25 extending inside the annular body 22 and operating by interfering with the bar 20. In detail, the bar 20 comprises a seat 26 substantially shaped to match the stop 25 and positioned at the home position in such a way as to facilitate identification of the home position.

[0042] It should be noticed that the stop 25 is movable along a line orthogonal to the line of shifting 19 and comprises a substantially conical head. In addition, the control unit 16 comprises elastic means 27 acting on the stop 25 to keep it abutted against the bar 20.

[0043] In use, since the seat 26 of the bar 20 is substantially shaped to match the stop 25, sliding is defined between the conical head and the seat 26 towards the home position. It should be noticed that the home position corresponds to the position in which the conical head is completely coupled with the seat 26.

[0044] Moreover, the control unit 16 comprises end of stroke means acting on the handle 18 to define the end of stroke of the latter along the line of shifting 19. Said end of stroke means comprise a pin 28 passing through the handle 18 transversally to the line of shifting 19 and passing through the bar 20 positioned inside the handle 18. Precisely, the bar 20 comprises a through opening 29 with an elongate shape along the line of shifting 19. The pin 28 is inserted in that opening. In that way, the movement of the pin 28 (driven by the handle 18) is limited by the dimensions of the through opening 29 of the bar 20.

[0045] In addition to what is described above, the handle 18 is rotatable (Figure 5) about its own axis of rotation between a first rotation position and a second rotation position. Preferably, the axis of rotation is defined by the line of shifting 19.

[0046] The control unit 16 is designed to control the pickup unit 9 (according to the second embodiment of the loading portion 8 described above) so that it moves to the pickup position when the handle 18 is rotated towards the first rotation position, and to control the pickup unit 9 so that it moves to the releasing position when the handle 18 is rotated towards the second rotation position.

[0047] Moreover, the control unit 16 comprises second elastic return means 30 connected between the handle 18 and the fixed part 17 of the control unit 16 for promoting handle 18 return from the first rotation position or from the second rotation position to an intermediate position. Precisely, the second elastic return means 30 comprise two springs, each connected between the handle 18 and a respective anchoring point on the fixed part 17. It should be noticed that the anchoring points of each spring are spaced from one another around the axis of rotation of the handle 18. Moreover, the control unit 16 comprises at least one detection unit 31 for detecting the position of the handle 18. Said detection unit 31 is designed to detect the position of the handle 18 and to activate the aid means 14 and/or the pickup unit 9 depending on the position detected.

[0048] It should be noticed that the control unit 16 is formed by a frame 32 comprising a plurality bars 33 arranged side by side which the operator can grab in order to move the pickup portion. The handle 18 is one of said bars 33. Preferably, the handle 18 is a lateral bar 33 so that it is positioned at one of the hands of the operator.

[0049] Moreover, the control unit 16 comprises a push-button panel 34 (Figure 7) positioned at a lateral bar 33 opposite to the handle 18 in such a way that it is positioned at the other hand of the operator. In particular, the push-button panel 34 is designed to enable the commands received from the handle 18 before they reach the movement aid means 14 and the pickup unit 9. Advantageously, said configuration allows the operator to keep both hands busy for moving the loading unit, thereby guaranteeing operator safety during the movements of the handling device 1.

[0050] This invention also relates to a method for operating the handling device 1 for objects to be moved in space. In particular, said methods comprises a first operating step of preparing the balancing actuator, of the type described above, which operates on the loading portion 8 of the handling device 1 for balancing said loading portion 8 in such a way as to keep it suspended in space.

[0051] Moreover, the method comprises preparing the control unit 16 connected to the loading portion 8 of the handling device 1. Said control unit 16 comprises the handle 18 movable along the line of shifting 19 corresponding to the line along which the object is to be moved.

[0052] Finally, the method comprises a step of activating the movement aid means 14 operating on the loading portion 8 for moving it along the line of shifting 19, after movement of the handle 18 along the self-same line of shifting 19.

[0053] Operation of this invention derives directly from what is described above.

[0054] In particular, when moving the handle 18 along the line of shifting 19 the operator generates a command (generated by the control unit 16) for activating the auxiliary actuator 15 along the corresponding line of movement 6 in such a way as to receive help in overcoming the initial inertia for shifting the loading portion 8. In particular, that occurs for shifting along a vertical line.

[0055] This invention achieves the preset aims.

[0056] In particular, the handling device allows objects to be shifted in space in a precise way and without additional effort by the operator. In fact, the movement aid means act on the arm independently of the balancing actuator in such a way as to move the arm without acting on the balancing actuator. Therefore, the movement of the loading portion is more precise and has a real-time response.

[0057] Moreover, this invention allows an increase in the responsiveness of the handling device to movements performed by the operator, since the movement aid means act on the arm in the same way in which the operator acts. In other words, to shift the loading portion along the line of shifting the force applied on the loading portion is given by the sum of the force applied by the operator and the force applied by the aid means.

[0058] In that way, the effort of the operator for performing the shifting operations is less than in the prior art.

[0059] Finally, this invention makes the command by the operator for the auxiliary means instinctive, since the movement of the handle along the line of shifting corresponds to the movement that the operator intends to make the loading portion perform.

[0060] It should also be noticed that this invention is relatively easy to produce and that even the cost connected with implementing the invention is not very high.

Claims

1. A handling device (1) for objects to be moved in space, comprising:

   a supporting base (2) which can be connected to a reference point (3);

   an arm (5) extending between its own first part (5a) and its own second part (5b); said first part (5a) being movably connected to the supporting base (2) in such a way that the second part (5b) is movable relative to the supporting base (2) along a line of movement (6);

   a loading portion (8) for the object to be moved, mechanically connected to the second part (5b) of the arm (5);

   a balancing actuator (11) connected between the supporting base (2) and the arm (5) and designed to balance the weight at least of the loading portion (8) along the line of movement (6) in such a way as to keep the loading portion (8)

suspended in space; said loading portion (8) comprising a holding unit (10) which can be grasped by an operator for shifting the loading portion (8) in space; said balancing actuator (11) also being designed to move the second part (5b) of the arm (5) along the line of movement (6) as a result of the application of a basic force applied by an operator on the loading portion (8) in such a way as to move the loading portion (8); **characterised in that** it comprises movement aid means (14), separate from the balancing actuator (11), acting on the mechanical arm (5) and designed to move the mechanical arm (5) relative to the base along the line of movement (6) in such a way as to apply an additional force, relative to the basic force, on the loading portion (8) designed to oppose the initial inertia of the loading portion (8); said handling device (1) comprising a control unit (16) which can be operated by the operator and is operatively connected to the movement aid means (14) for operating said movement aid means (14) on command.

2. The handling device (1) according to claim 1, **characterised in that** the movement aid means (14) comprise an auxiliary actuator (15) which is separate from the balancing actuator (11) and connected between the supporting base (2) and the arm (5) for moving the arm (5) along the line of movement (6).

3. The handling device (1) according to claim 1 or 2, **characterised in that** the control unit (16) comprises a handle (18) movable along a line of shifting (19) corresponding to the line along which the loading portion (8) is to be shifted; said handle (18) being designed to operate the movement aid means (14) along the line of movement (6) corresponding to the line of shifting (19) of the handle (18).

4. The handling device (1) according to claim 3, **characterised in that** the handle (18) is movable along the line of shifting (19) between a first operating position, a home position, and a second operating position; the control unit (16) being designed to activate the movement aid means (14) in a first direction of the line of movement (6) when the handle (18) is brought from the home position to the first operating position and to activate the movement aid means (14) in a second direction, opposite to the first, of the line of movement (6) when the handle (18) is brought from the home position to the second operating position.

5. The handling device (1) according to claim 4, **characterised in that** the control unit (16) comprises a part (17) fixed to the loading portion (8) and said handle (18) which is slidable relative to the fixed part (17); the control unit (16) comprising first elastic return means (24) interposed between the fixed part (17) and the handle (18) for promoting handle (18) return to the home position.

6. The handling device (1) according to claim 5, **characterised in that** the fixed part (17) comprises a bar (20) and the handle (18) comprises a hollow annular body (22) slidably movable on the outside of the bar (20);

7. The handling device (1) according to claim 6, **characterised in that** the control unit (16) comprises a stop (25) extending inside the annular body (22) and operating by interfering with the bar (20); said bar (20) comprising a seat (26) substantially shaped to match the stop (25) and positioned at the home position in such a way as to facilitate identification of the home position.

8. The handling device (1) according to claim 7, **characterised in that** the stop (25) is movable along a line transversal to the line of shifting (19) and comprises a substantially conical head; the control unit (16) comprising elastic means (27) acting on the stop (25) to keep it abutted against the bar (20).

9. The handling device (1) according to any one of the claims from 3 to 8, **characterised in that** it comprises a pickup unit (9) for the object, mounted on the loading portion (8) and which can be configured between a position for picking up the object and a position for releasing the object; the handle (18) being able to rotate about its own axis of rotation between a first rotation position and a second rotation position; the control unit (16) being designed to control the pickup unit (9) so that it moves to the pickup position when the handle (18) is rotated towards the first rotation position, and to control the pickup unit (9) so that it moves to the releasing position when the handle (18) is rotated towards the second rotation position.

10. The handling device (1) according to any one of the claims from 2 to 9, **characterised in that** the balancing actuator (11) and the auxiliary actuator (15) are of the pneumatic type.

11. The handling device (1) according to claim 10, **characterised in that** the balancing actuator (11) comprises a pneumatic cylinder (12) and a cylinder internal pressure control assembly (13) so that in use the arm (5) is held stationary in a predetermined position relative to the supporting base (2).

12. The handling device (1) according to any one of the preceding claims, **characterised in that** it comprises loaded balancing in which the balancing actuator

(11) is designed to balance both the weight of the loading portion (8) and the weight of an object loaded on it.

13. The handling device (1) according to any one of the claims from 1 to 11, **characterised in that** it comprises empty balancing in which the balancing actuator (11) is designed to balance only the weight of the loading portion (8).

14. The handling device (1) according to any one of the preceding claims, **characterised in that** the line of movement (6) and the line of shifting (19) are substantially parallel with a vertical line.

15. A method for operating a handling device (1) for objects to be moved in space, comprising the following operating steps:

preparing a balancing actuator operating on a loading portion (8) of the handling device (1) for balancing the loading portion (8) in such a way as to keep it suspended in space; said balancing actuator (11) also being designed to move the loading portion (8) along a line of movement (6) as a result of the application of a basic force applied by an operator on the loading portion (8);

characterised in that it comprises the following operating steps:

- preparing a control unit (16) connected to the loading portion (8) of the handling device (1); said control unit (16) comprising a handle (18) movable along a line of shifting (19) corresponding to the line along which the object is to be moved;
- activating movement aid means (14), separate from the balancing actuator (11), operating on the loading portion (8) for moving it along the line of shifting (19), after movement of the handle (18) along said line of shifting (19) in such a way as to apply an additional force, relative to the basic force, on the loading portion (8) designed to oppose the initial inertia of the loading portion (8).

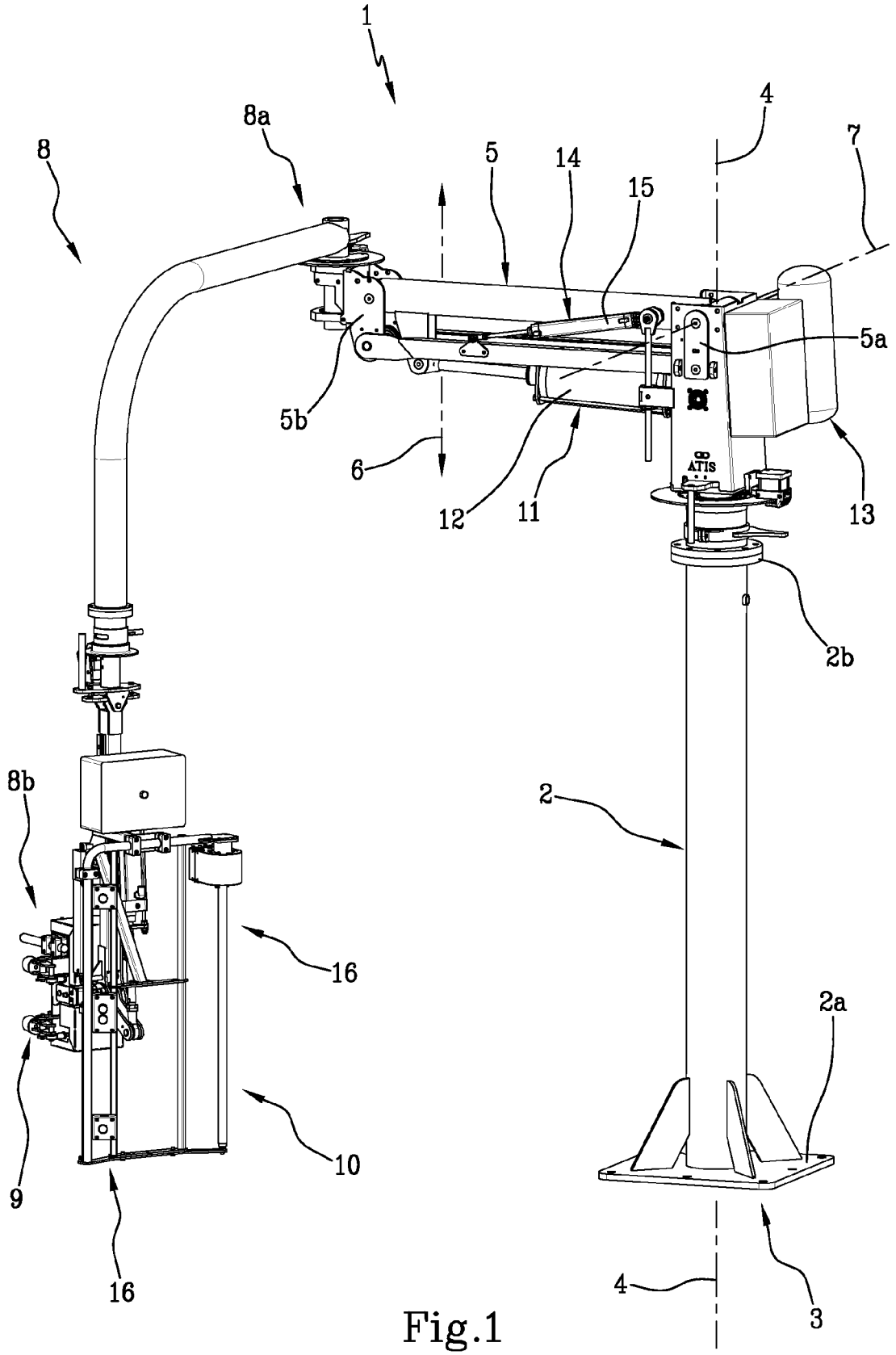


Fig.1

Fig.2

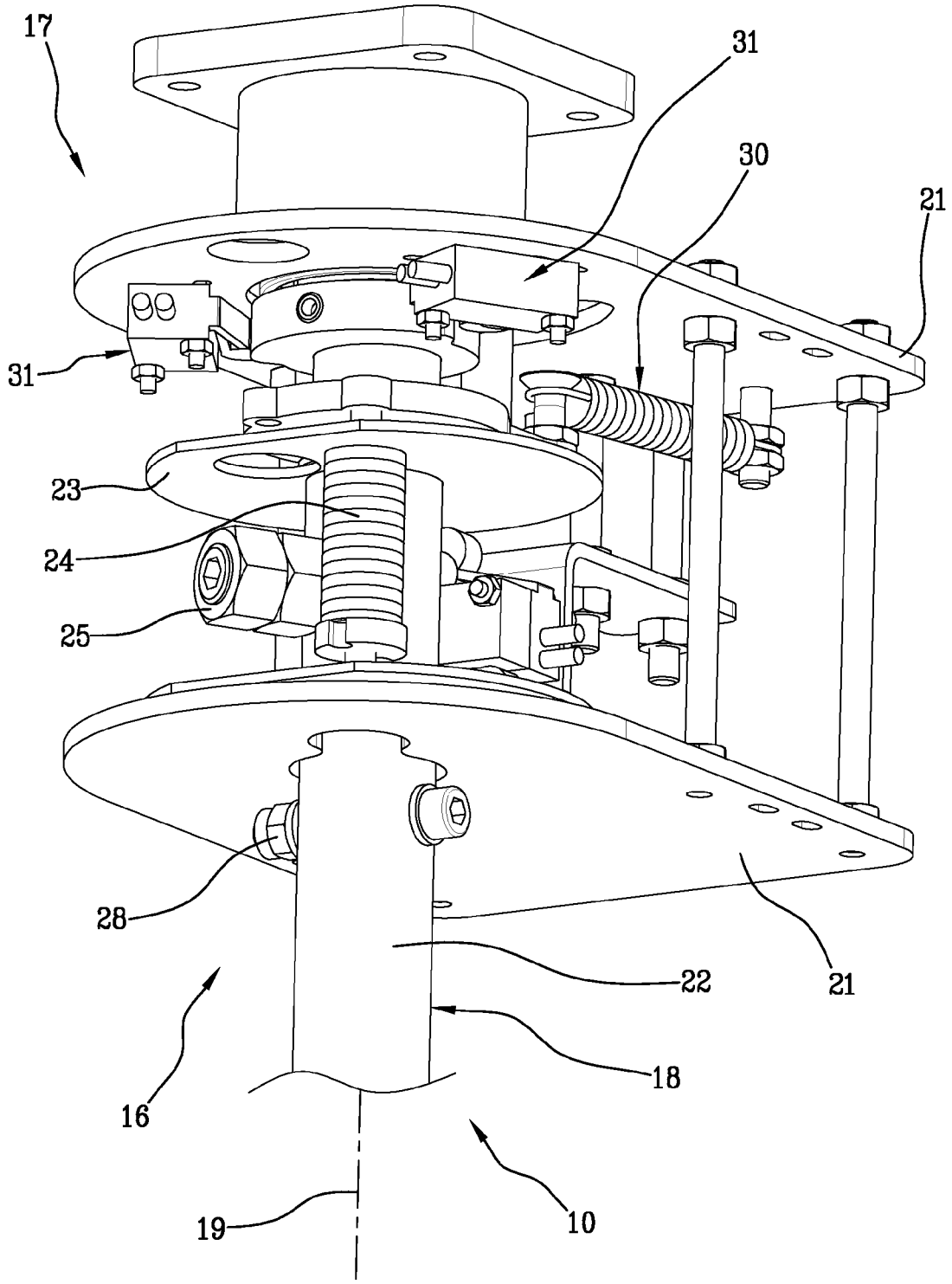


Fig.3

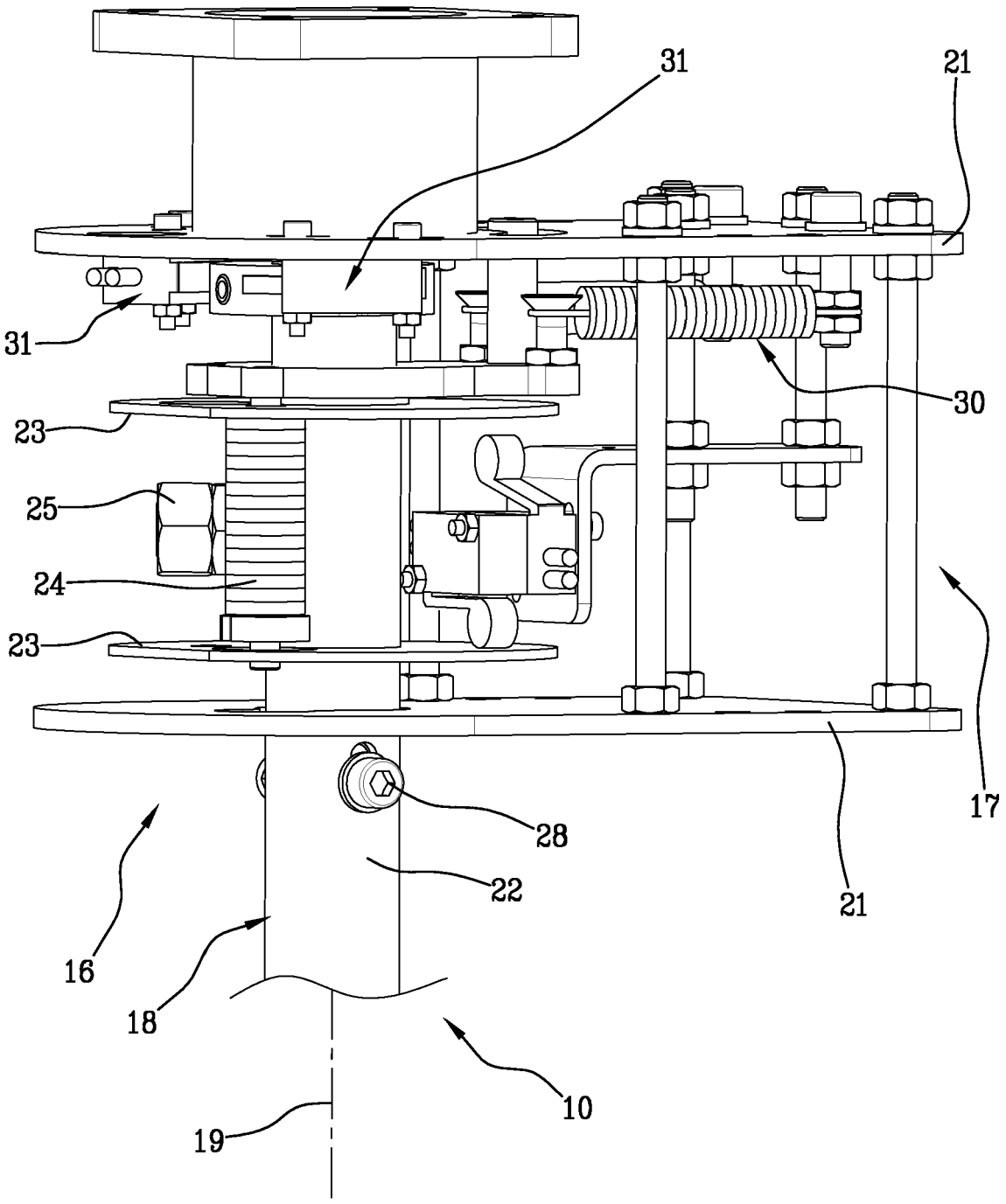


Fig.4

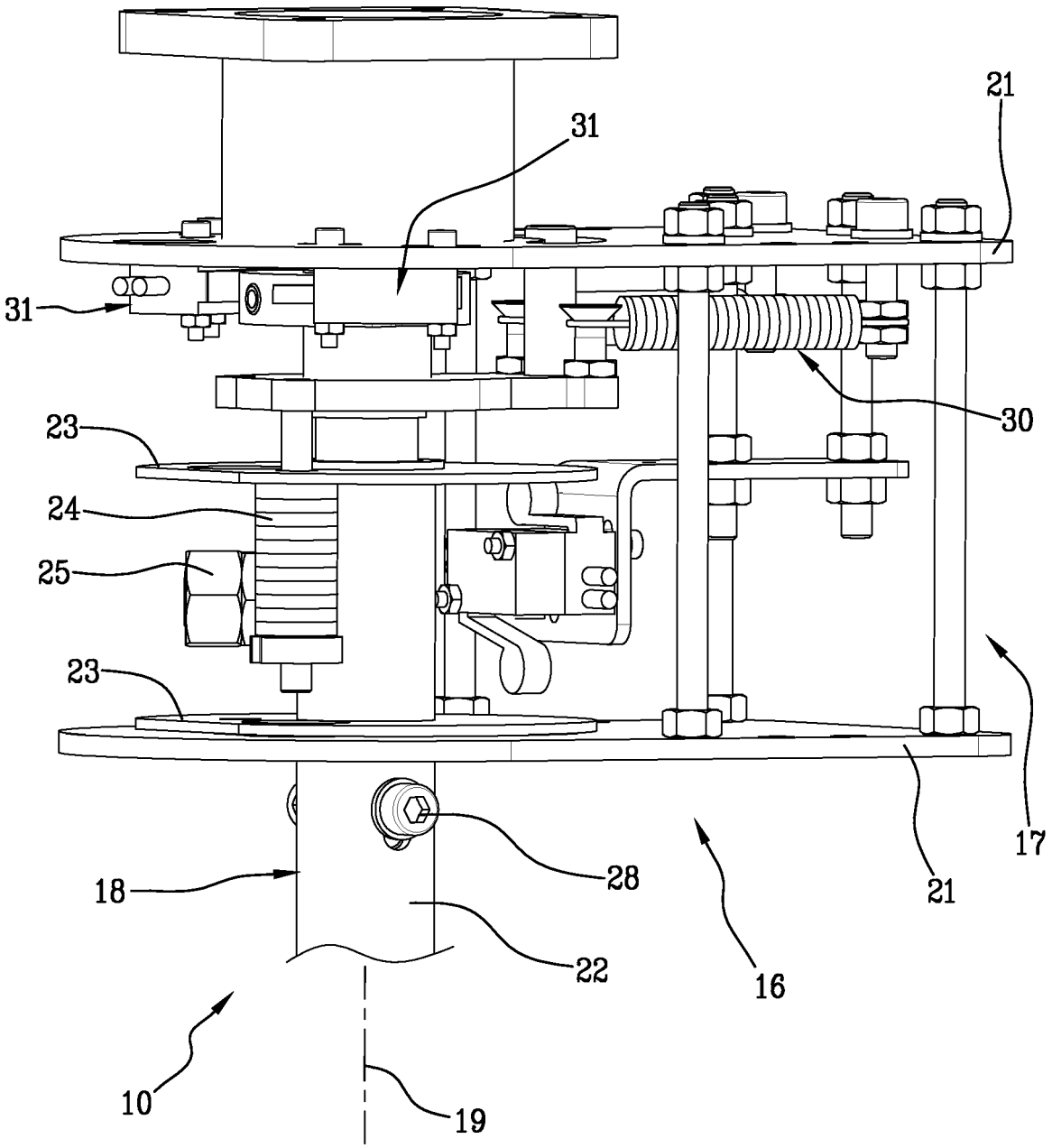


Fig.5

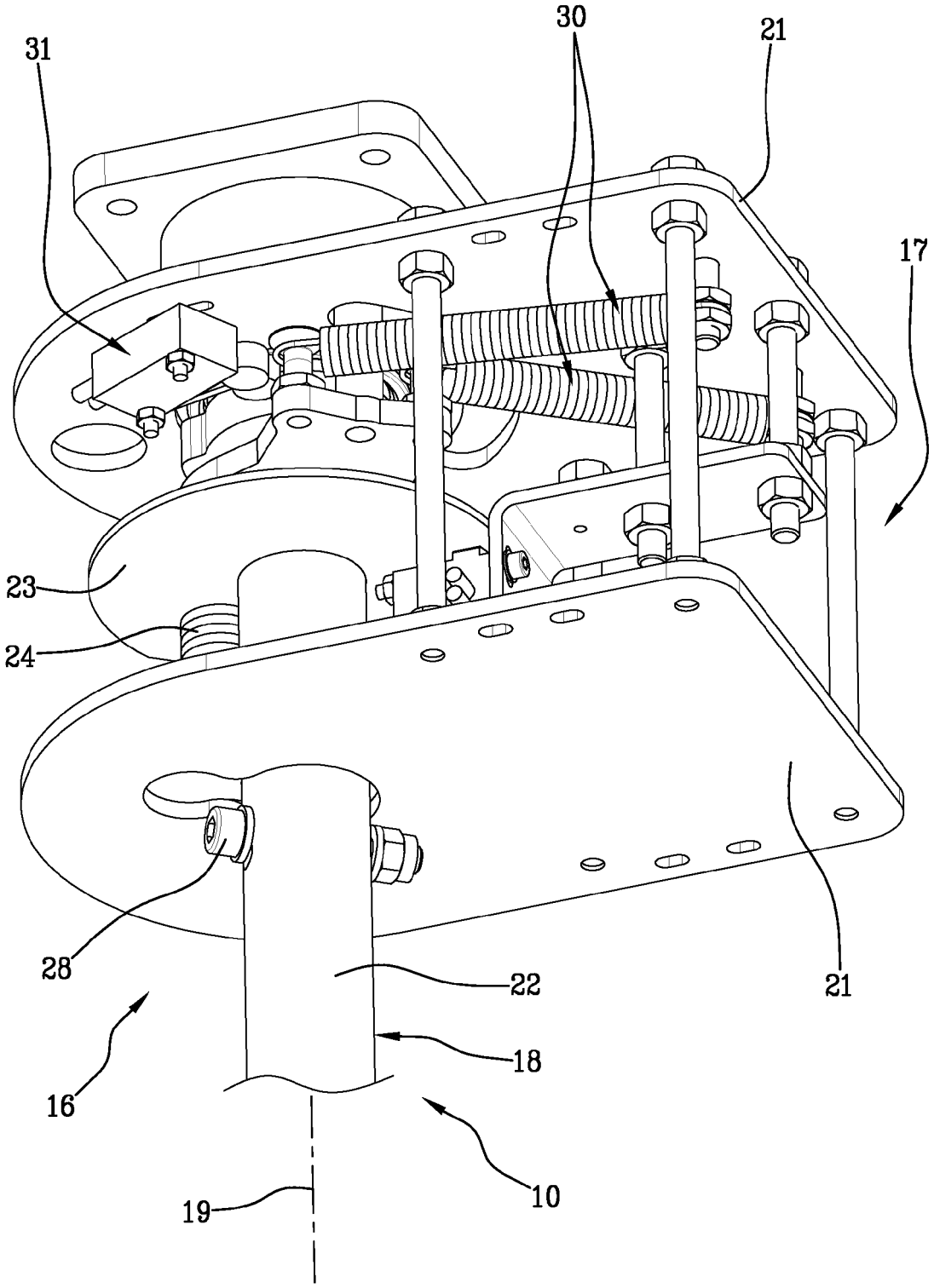


Fig.6

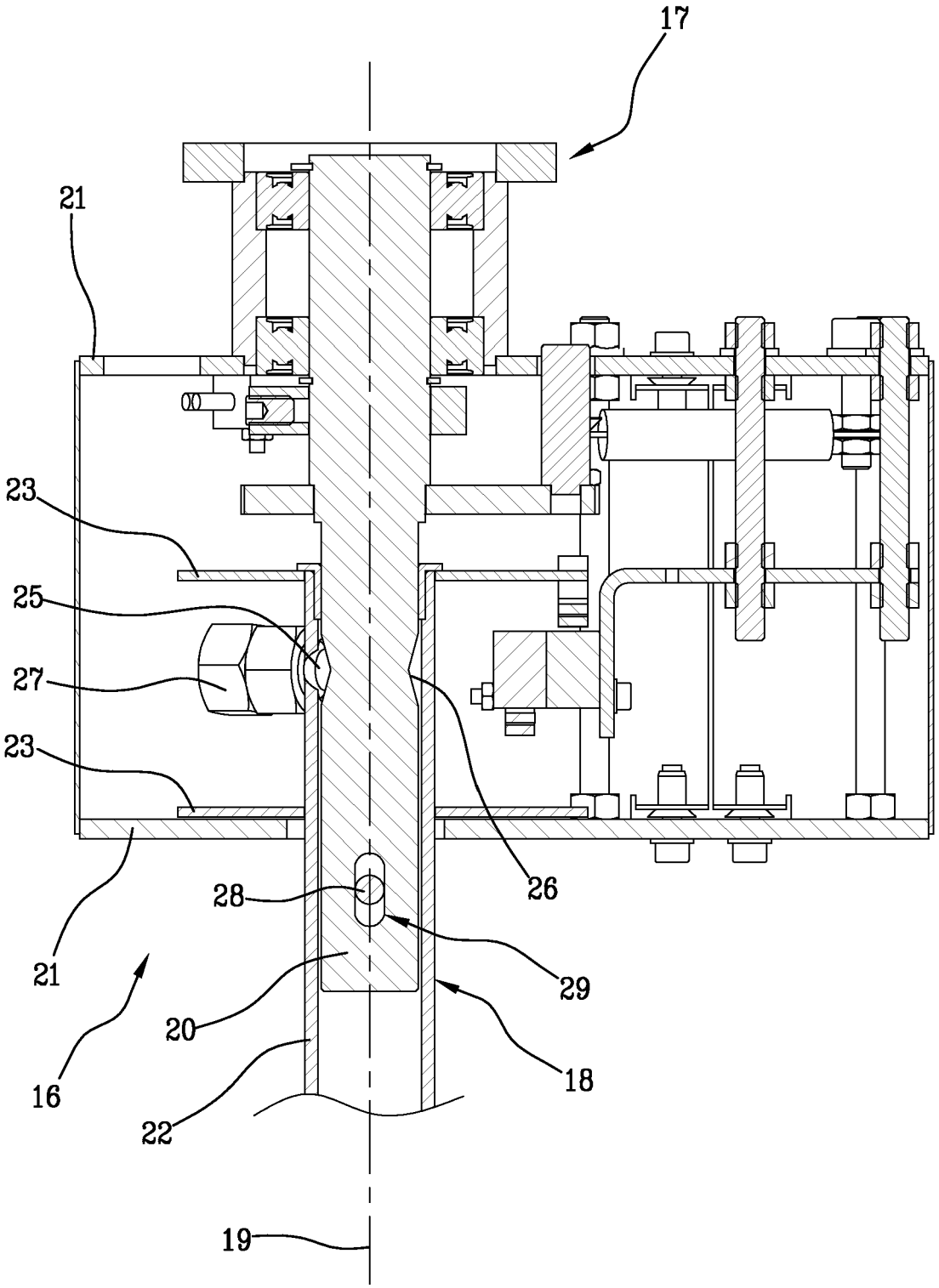
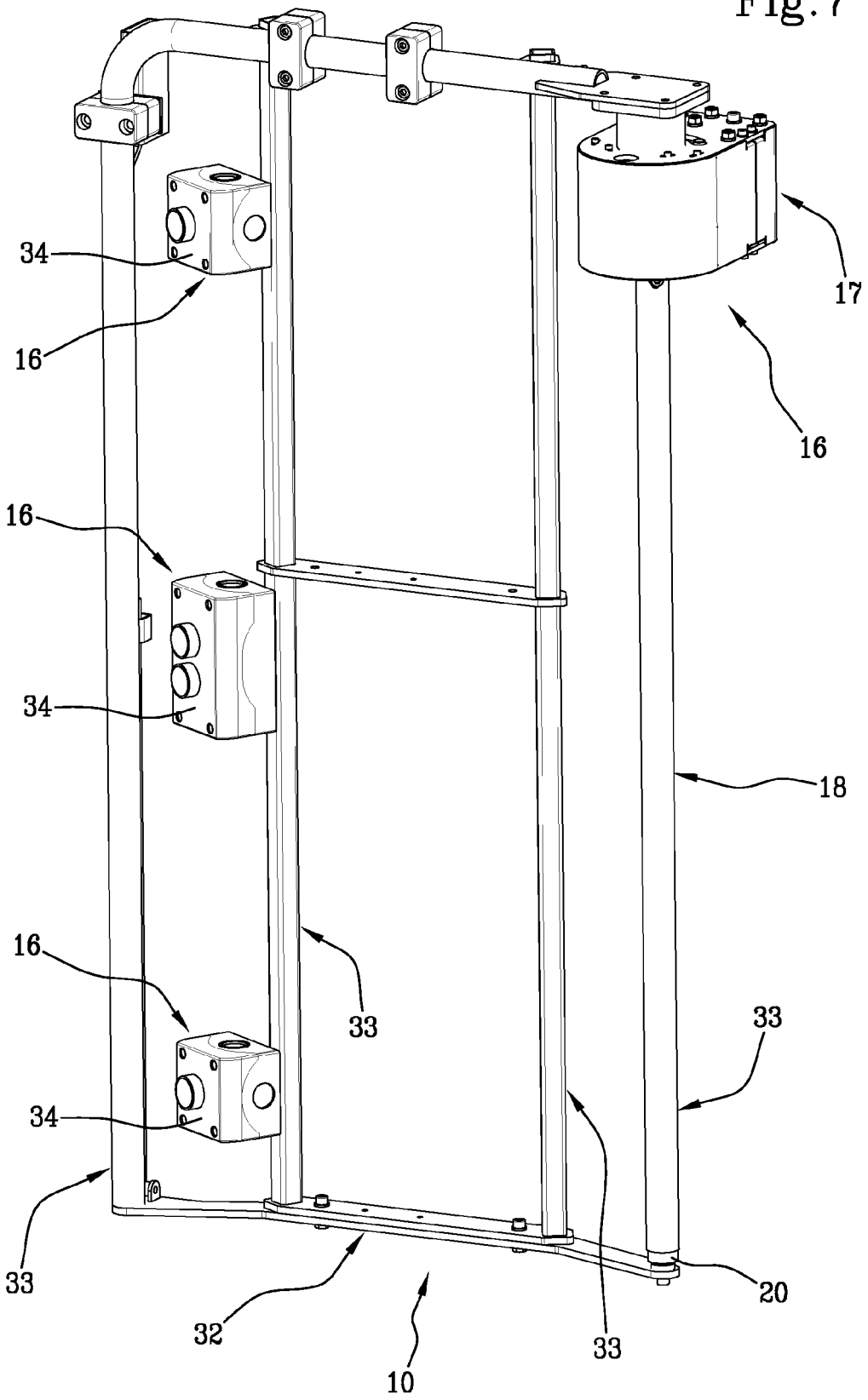


Fig.7



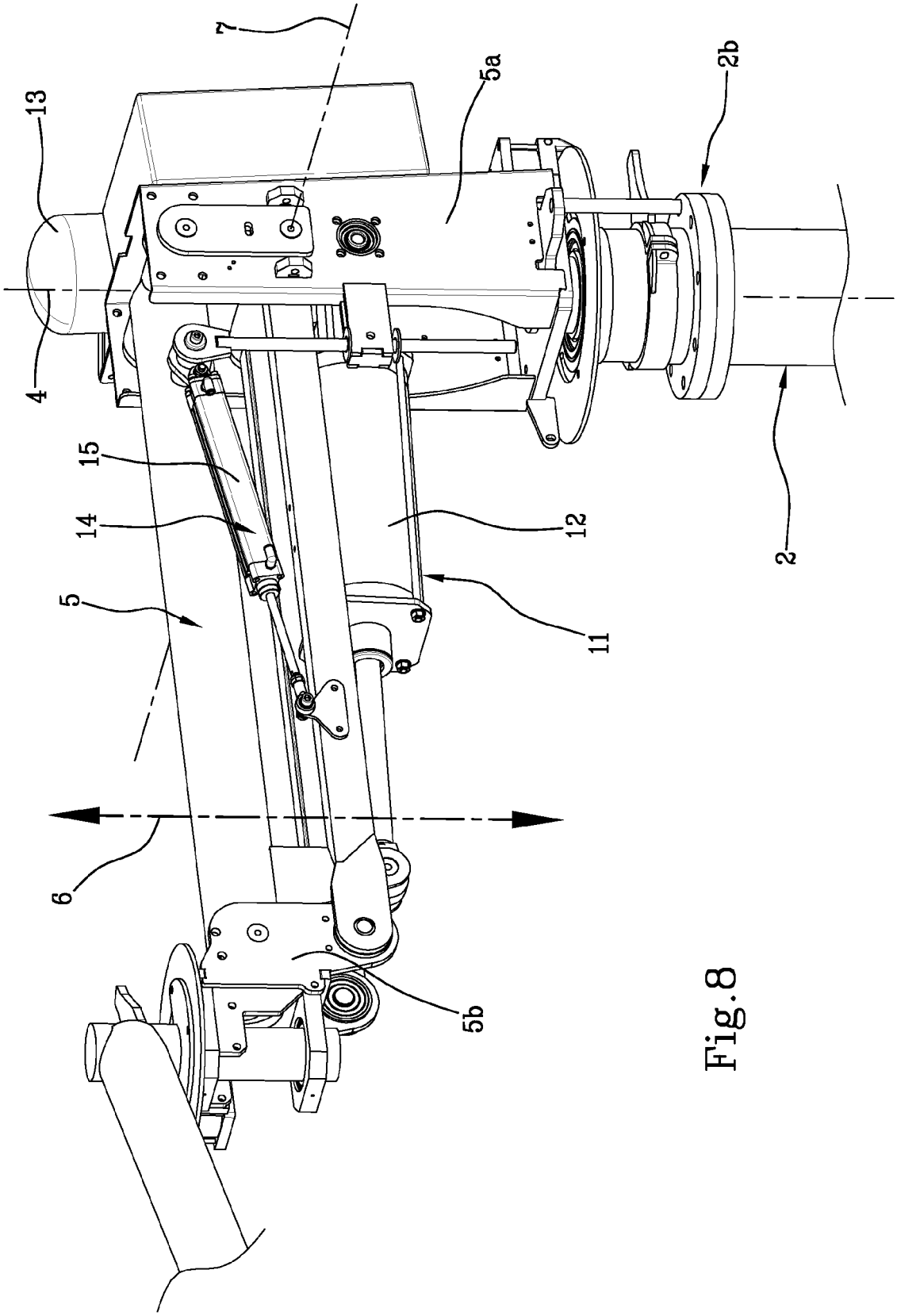


Fig.8

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EUROPEAN SEARCH REPORT

Application Number
EP 14 15 3749

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 April 2014	Rupcic, Zoran

CATEGORY OF CITED DOCUMENTS

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