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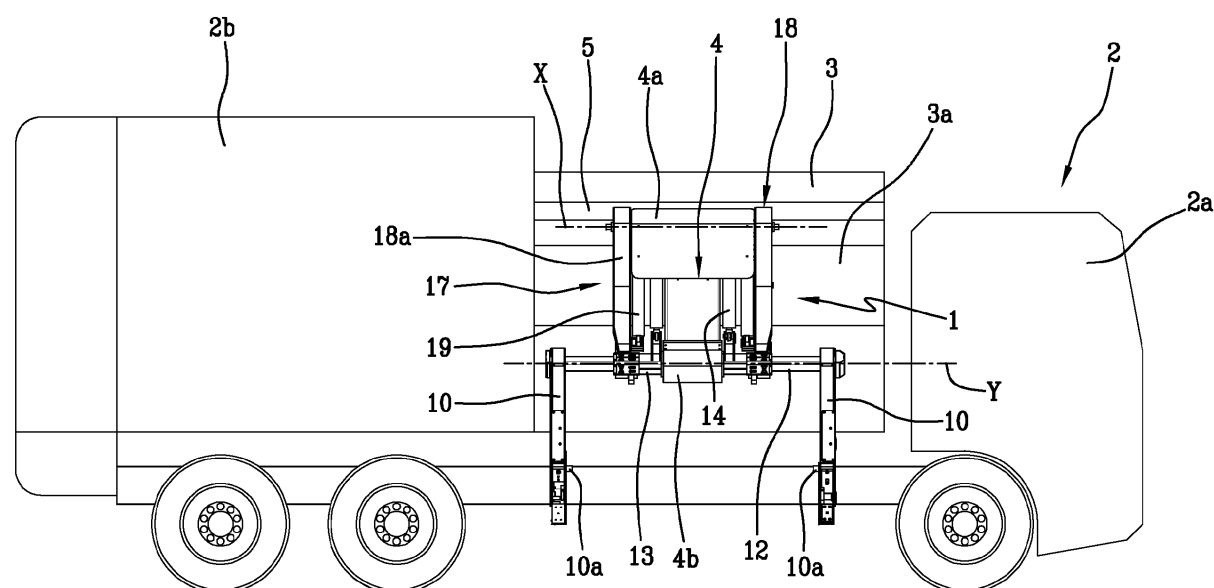
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(54) **Apparatus for gripping, lifting and emptying street refuse bins**

(57) An extendable frame (4) is hinged near an access sill (5) located above a loading hopper (3) that is carried by the vehicle, and rotationally supports a pair of lifting arms (10) operatively engageable with a bin (11). A support structure (18) rotationally constrained near the access sill (5) operates on the extendable frame (4) to rotate the latter from a stand-by position against a side

wall (3a) of the hopper (3) to a gripping position in which the lifting arms (10) are moved away from the side wall (3a). At least one tilting actuator (20) operates between the support structure (18) and the extendable frame (4) to rotate the latter between a rest position in which it develops below said access sill (5) and a tilting position in which it is raised with respect to the access sill (5).

**Fig.1**



## Description

**[0001]** The present invention relates to an apparatus for gripping, lifting, and emptying street refuse bins into a vehicle for refuse collection.

**[0002]** More specifically, the apparatus of the invention is of the type usually mounted on the side of a vehicle, to empty bins designed for refuse collection in a completely automated way.

**[0003]** As is known, one of the common methods for refuse collection in urban areas involves placing refuse in bins which are advantageously located along the pavement or along the sides of roads. The bins are designed to be periodically emptied into appropriately equipped vehicles, which transport the refuse to places for disposal or recycling.

**[0004]** These vehicles usually have apparatus that is suitable for lifting the bin up off the ground to raise it above a loading hopper and to tip it to empty the refuse into the vehicle. Once emptying is complete, the apparatus also repositions the bin back on the ground.

**[0005]** A known type of apparatus, which is described in document EP 1454848, comprises a pair of lifting arms rotationally supported by a carriage which is mobile along an extendable guide structure. The guide structure comprises a first frame with an upper end horizontally hinged near the loading sill of the hopper, and a second frame which slides longitudinally with respect to the first frame. In a rest condition, the guide structure is longitudinally retracted and positioned vertically against the side wall of the hopper, with its lifting arms extending vertically downwards relative to the carriage, which is positioned about halfway from the extension of the framework.

**[0006]** The operating cycle comprises angularly rotating the gripping arms so they adopt a horizontal orientation and, by extending the extendable frame and sliding the carriage along the second portion of the frame, lowering them to the level of the bin container to engage it at the respective gripping elements. An actuator operating on the first frame of the extendable guide structure can be operated to tilt the latter, with respect to the side of the vehicle, until it reaches the bin, which is located at a certain distance from the vehicle. This distance varies each time according to the stop position of the vehicle.

**[0007]** Once engaged, the extendable guide structure is contracted by retracting the first frame into the second frame, and the carriage brings the gripping arms back into the raised position up to the upper end of the guide structure. A rotation of the gripping arms around their horizontal hinging axis results in the tilting of the bin and the emptying of the contents into the hopper.

**[0008]** An inverse operating cycle as compared to the one described above results in the repositioning of the bin back on the ground, and the apparatus is returned to the rest condition.

**[0009]** The document EP 1389591 proposes an apparatus that is conceptually similar to the one described above where, unlike the latter, the tilting/overturning of

the bin is performed by tilting the extendable guide structure around its hinging axis near the loading sill of the hopper. A pair of fluid dynamic actuators that can be simultaneously operated, operate between the side of the vehicle and the guide structure to tilt it until the gripping arms reach the bin. The bin, which is engaged by the gripping arms, is lifted following the contraction of the extendable guide structure and the translation of the carriage towards the upper part of the structure.

**[0010]** When the bin has passed the loading sill of the hopper, the aforesaid fluid dynamic actuators are again operated to overturn the bin following a tilting operation of the extendable guide structure around its hinging axis.

**[0011]** The main aim of the present invention is substantially to improve the known apparatus, so as to reduce the time required to complete the cycle for gripping, emptying and repositioning the bin while at the same time ensuring the precise repositioning of the bin in the exact position from where it was picked up for the purpose of being emptied.

**[0012]** This and other aims, which are apparent in this description, are substantially achieved by an apparatus for gripping, lifting, and emptying street refuse bins for refuse collection, according to claim 1 and/or to one or more of the subsequent claims.

**[0013]** Further features and advantages of the invention are more apparent in the detailed description below, with reference to a preferred, non-limiting, embodiment of an apparatus for gripping, lifting, and emptying street refuse bins for refuse collection, according to the present invention.

**[0014]** This description is detailed below with reference to the accompanying drawings, which are only indicative and thus non-limiting, in which:

- figure 1 shows a front view of an apparatus according to the present invention, in the resting position on the side of a vehicle intended for refuse collection;
- figure 2 shows a side view of the apparatus of figure 1, near a bin for refuse collection;
- figure 3 shows a side view of the apparatus in a bin gripping position;
- figure 4 shows a front view of the apparatus in the gripping position of figure 3;
- figure 5 shows a step subsequent to figure 3, in which the bin is raised near the loading threshold of the hopper;
- figure 6 shows a step of tilting the guide structure for the purpose of overturning the bin to empty the contents into the hopper;
- figure 7 shows a step in which the overturning of the bin is completed through a further angular rotation of the lifting arms;
- figure 8 shows a side view of the apparatus in a gripping position of a bin, which is partly below ground level.

**[0015]** With reference to the mentioned drawings, the numeral 1 indicates an apparatus, in its entirety, for gripping, lifting, and emptying street refuse bins for refuse collection according to the present invention.

**[0016]** The apparatus 1 can be installed on a vehicle designed for refuse collection, for example along the side of the vehicle, combined with a loading hopper 3 which is operatively arranged between a driver's cabin 2a and a container 2b for conveying and/or compacting the refuse. The apparatus 1 comprises an extendable frame 4 having an upper end 4a hinged, preferably according to a hinged horizontal geometric axis X, near an access sill 5 above the loading hopper 3.

**[0017]** More specifically, the extendable frame 4 comprises a proximal segment 6 hinged to a side wall 3a of the loading hopper 3, slightly below the access sill 5, and a distal segment 7 slidably engaged with respect to the proximal segment 6.

**[0018]** Preferably, at least one intermediate connection segment 8 is operatively interposed between the proximal segment 6 and the distal segment 7. In a preferred embodiment, the intermediate segment 8 comprises at least one first and one second intermediate portion 8a, 8b, which are slidably engaged with each other.

**[0019]** The proximal segment 6 and the distal segment 7, and also the intermediate segment 8, which preferably has a tubular shape, are telescopic and slide with respect to each other. More specifically, the intermediate segment 8 is slidably fitted onto the proximal segment 6 and the distal segment 7 is slidably fitted onto the intermediate segment 8.

**[0020]** At least one extension actuator, preferably of the linear type, operates between the proximal segment 6 and the distal segment 7 to perform reciprocal sliding actions between the segments and, consequently, a movement which extends and contracts the extendable frame 4 between a maximum contraction condition and a maximum extension condition. The extension actuator, not shown as it is made in a known manner, may comprise at least one hydraulic cylinder, for example of the telescopic type, which is accommodated inside the proximal segment 6, the distal segment 7 and the intermediate segment 8.

**[0021]** Advantageously, making the extendable frame 4 in three or more segments which slide with respect to each other makes it possible to adequately contain the overall longitudinal dimension of the extendable frame 4 in the maximum contraction condition, while in the maximum extension condition, said extendable frame 4 may be as long as or longer than the distance that can be measured in the vertical direction between the hinged geometric axis X and the ground.

**[0022]** The apparatus 1 also comprises one pair of lifting arms 10 rotated with respect to the extendable frame 4 and operatively engageable with a refuse bin 11, which is to be emptied inside the hopper 3.

**[0023]** The lifting arms 10 are rotatably engaged with the distal segment 7 near one lower end 4b of the ex-

tendable frame 4, preferably according to a rotational axis Y with respect to the latter. More specifically, the lifting arms 10 are interconnected to each other by a connection bar 12, which extends perpendicularly to the longitudinal extension of the extendable frame 4, through at least one sleeve 12a rotationally supported by the distal segment 7 at the lower end of the extendable frame.

**[0024]** Preferably, the connection bar 12 is formed by at least two longitudinal portions which reciprocally slide, controlled by a transversal movement actuator 13, to cause the lifting arms 10 to move close to and away from each other.

**[0025]** At least one lifting actuator 14, preferably of the linear type, operates between the extendable frame 4 and the lifting arms 10 to cause a rotation of the arms around their rotational axis Y. This lifting actuator 14 can advantageously comprise a pair of hydraulic cylinders in positions which are laterally opposite to the extendable frame 4, and each operating between the distal segment 7 and a clamp carried by the connection bar 12.

**[0026]** The lifting arms 10 have respective coupling seats 15, for example a notch, on the opposite side relative to the connection bar 12. In a known way, these coupling seats 15 engage the bin 11 at respective gripping elements 16, which are made for example in the shape of pins protruding from respectively opposite side walls of the bin 11.

**[0027]** The apparatus 1 also comprises positioning devices 17 operating on the extendable frame 4 to rotate the latter angularly around its hinged geometric axis X. For this purpose, the positioning devices 17 comprise a support structure 18 rotationally constrained near the access sill 5 and at least one positioning actuator 19 operating between the support structure 18 and the side wall 3a or another fixed part with respect to the hopper 3.

**[0028]** More specifically, the support structure 18, which is preferably constrained to the side wall 3a according to the same hinged geometric axis X of the extendable frame 4, comprises a pair of auxiliary arms 18a arranged on respectively opposite sides of the extendable frame 4, and controlled by a pair of positioning actuators 19, preferably linear, for example each comprising a hydraulic cylinder operating on one of the auxiliary arms 18a.

**[0029]** The extendable frame 4 is also controlled by tilting devices which rotate the frame, together with the lifting arms 10, between a resting position in which it develops below the access sill 5, according to an angle set by the position taken on by the support structure 18, and a tilting position in which it is raised with respect to the access sill 5, as shown in figure 6. The angular range achieved by the extendable frame 4 as it moves from the resting position and the tilting position may be indicatively between 130° and 150°, for example equal to 140°.

**[0030]** The tilting devices comprise at least one tilting actuator 20 operating between the support structure 18 and the extendable frame 4. More specifically, there is preferably a pair of tilting actuators 20, preferably linear,

which each operate between one side of the extendable frame 4 and one of said auxiliary arms 18a. Each tilting actuator 20 may comprise a hydraulic cylinder with one end constrained to one side of the proximal segment 6 of the extendable frame 4, and the opposite end constrained to one of the auxiliary arms 18a; the extendable frame 4 is thus constrained to the support structure 18 to cause an angular rotation of the extendable frame around its own hinged geometric axis X following a corresponding angular rotation of the support structure 18.

**[0031]** More specifically, upon the simultaneous operation of the positioning actuators 19, the extendable frame 4 angularly rotates starting from a stand-by position against the side wall 3a of the loading hopper 3 (shown in figure 2), to a gripping position in which the lifting arms 10 are moved away from the side wall 3a (as shown in figure 3). To reach the gripping position, which can be determined each time as a function of the distance between the bin 11 and the vehicle, the angular range of the extendable frame 4 may indicatively be between 0° and 50°.

**[0032]** The operating cycle of the apparatus 1 is as follows.

**[0033]** While the vehicle 2 is moving, the apparatus 1 is in a resting position, in which the extendable frame 4 is retracted in the minimum length configuration, and is positioned against the side wall 3a of the hopper 3, possibly indicatively tilted between 10° and 15° with respect to a vertical direction. The lifting arms 10 extend vertically downwards, as shown in figures 1 and 2.

**[0034]** The vehicle 2 stops beside the bin 11, which is located on a pavement or at the side of the road, with the gripping elements 16 aligned parallel to the direction of forward movement.

**[0035]** Suitable known reference systems, for example of optical type and/or with the aid of video cameras or other devices, facilitate stopping the vehicle so that the apparatus 1 is in a substantially centred position with respect to the longitudinal centre line of the bin 11. Once the vehicle has stopped, the apparatus 1 must be brought into an operating position which is suitable for picking up the bin 11 off the ground. For this purpose, the extension actuator, which extends the extendable frame 4, and the lifting actuator(s) 14, which commands the rotation of the lifting arms 10 by moving them away from the side wall 3a towards the bin 11, are simultaneously operated. At the same time, the positioning actuators 19 are operated, moving the entire extendable frame 4, together with the lifting arms 10, away from side wall 3a of the hopper 3, when required. The operation of the extension actuator is interrupted when the extendable frame 4 has reached a predetermined length, for example corresponding to a desired height off the ground of the connection bar 12 of the arms, or when optical thresholds or other reference means associated with the bin 11 are reached. More specifically, the operation of the actuator is preferably interrupted when the rotational axis Y reaches a level which is substantially coplanar or below the plane of the gripping

elements 16 of the bin 11. The operation of the positioning actuators 19 may in turn be stopped when a predetermined distance is reached between the connection bar 12 and a front wall of the bin 11, which is facing the vehicle 2. This distance may be measured in a known way, for example through ultrasound sensors or sensors of another type, which are positioned on the side of the vehicle.

**[0036]** The operation of the lifting actuators 14 may be stopped when a predetermined angle of the lifting arms 10 with respect to the extendable frame 4 is reached, minus the tilting angle set for the frame by the positioning devices 17, so that the lifting arms take on a predetermined orientation relative to the ground, for example substantially horizontal.

**[0037]** At the same time as the gripping position is reached, the lifting arms 10 are brought closer to each other and are stopped at the side walls of the bin 11.

**[0038]** A further rotation of the lifting arms 10 is then determined, to cause the insertion of the gripping elements 16 into the respective coupling seats 15 and the lifting of the bin 11 off the ground. Given that the rotational axis Y is positioned at a height which is equal to or less than the height of the gripping elements 16, the bin 11 is also brought closer to the side of the vehicle in this step and therefore, the bin is moved away from any obstacles or back walls. Appropriate sensors may detect the insertion of the gripping elements 16 into the respective connection seats and consequently command the operation of the extension actuator to cause the contraction of the extendable frame 4. When required, the lifting arms 10 may continue rotating until a predetermined angle is reached, which is indicatively between 30° and 35° relative to a horizontal plane, such as to cause the resting of the bin 11, for example with its front wall or a box-type portion 16a present near each gripping element 16, against suitable stopping elements 10a protruding from the inner sides of the lifting arms 10. This determines a rotational constraint of the bin 11 with respect to the lifting arms 10, so that each additional upwards angular rotation of the arms corresponds to an identical angular rotation of the bin 11 starting from a substantially vertical orientation, referring to a longitudinal symmetry plane containing the axes of the gripping elements 16, presented by the bin when resting on the ground.

**[0039]** Following the contraction of the extendable frame 4, the bin 11 is lifted close to the access sill 5 of the hopper 3 while substantially maintaining its orientation.

**[0040]** When the extendable frame 4 is brought back to the minimum length condition and the bin 11 has reached the access sill 5 as shown in figure 5, the tilting actuators 20 rotate the entire extendable frame 4, together with the lifting arms 10 and the bin 11, around the hinged geometric axis X. Thus the bin 11 is overturned above the hopper 3, past the access sill 5, as shown in figure 6. The overall angular range achieved by the bin 11 at the end of this step may reach a value between 130° and 150°, for example equal to 140°.

**[0041]** When required, a further rotation of the lifting arms 10 may further increase the tilting of the bin 11, up to an overall range of about 180°, to ensure all the refuse is emptied without having to use shaking operations, as shown in figure 7.

**[0042]** Appropriate levers 21, which are known in themselves, may be associated with the lifting arms 10 to open the lid of the bin 11, simultaneously to the tilting operation. Once emptying is complete, the bin 11 is placed on the ground and the apparatus 1 is repositioned in the resting position, with a movement cycle which is inverse to the one described above.

**[0043]** During the entire cycle of lifting, overturning and repositioning the bin 11 back on the ground, the auxiliary arms 18a maintain a fixed position. This ensures the proper positioning of the bin 11 in the exact position where it was picked up from.

**[0044]** The rotation of the lifting arms 10 may advantageously occur at the same time as the translation of the extendable frame 4 between the maximum contraction condition and the maximum extension condition, and/or of the rotation of the frame by the tilting actuators 20 to significantly reduce the time required to complete the cycle of emptying and/or repositioning the bin 11 back on the ground.

**[0045]** The sum of the angular ranges achieved by the lifting arms 10 and by the extendable frame 4 ensures a high angular range for the purpose of tilting the bin 11, thus favouring its emptying without having to shake it, which in the known art is performed through a repeated back-and-forth operation of the actuators which is intended to overturn the bin 11.

**[0046]** With respect to the known systems requiring this shaking operation, this advantageously results in limited noise, mechanical stress and wear and tear of the components, in addition to a limited cycle time.

**[0047]** The positioning of the lifting arms 10, which are rotationally supported at one lower end of the extendable frame 4, makes it possible to eliminate rigid parts of the apparatus 1 below the rotational axis of the arms. Therefore it is possible to bring the lifting arms 10 to ground level without causing mechanical interference between the ground and other rigid parts of the apparatus 1, thus taking advantage of the maximum extension condition of the extendable frame 4, as shown in figure 8.

**[0048]** This makes it possible to pick up bins located in a semi-underground position, using lifting pins which are also below ground level.

## Claims

1. An apparatus for gripping, lifting, and emptying street refuse bins (2) for refuse collection, comprising:

an extendable frame (4) having an upper end (4a) hinged near the access sill (5) located above a loading hopper (3) that is carried by said

vehicle;

a pair of lifting arms (10) rotated with respect to the extendable frame (4) and operationally engageable with gripping elements (16) attached to respectively opposite side walls of a bin (11); positioning devices (17) operating on the extendable frame (4) to rotate the latter from a stand-by position against a side wall (3a) presenting said access sill (5) to a gripping position in which the lifting arms (10) are moved away from said side wall (3a);

tilting devices (20) operating on the extendable frame (4) to rotate the latter from a resting position in which it develops below said access sill (5) to a tilting position in which it is raised with respect to the access sill (5);

in which said positioning devices (17) comprise:

a support structure (18) rotationally constrained near the access sill (5) and at least one positioning actuator (19) operating between the support structure (18) and a fixed part with respect to the hopper (3);

in which said tilting devices comprise at least one tilting actuator (20) operating between the support structure (18) and the extendable frame (4).

2. An apparatus according to claim 1, in which the lifting arms (10) are rotated near one lower end of the extendable frame (4).
3. An apparatus according to one or more of the foregoing claims in which the lifting arms (10) are rotated around a fixed rotational axis (Y) with respect to one lower end of the extendable frame (4).
4. An apparatus according to one or more of the foregoing claims, in which the support structure (18) is rotationally constrained around a hinged geometric axis (X) of the extendable frame (4).
5. An apparatus according to one or more of the foregoing claims, in which said at least one tilting actuator (20) constrains the extendable frame (4) to the support structure (18) to create an angular rotation of the extendable frame (4) around its own hinged geometric axis (X), following a corresponding angular rotation of the support structure (18).
6. An apparatus according to one or more of the foregoing claims, in which the support structure (18) comprises a pair of auxiliary arms (18a) arranged along the respective opposite sides of the extendable frame (4).
7. An apparatus according to the foregoing claim in which said positioning devices (17) comprise a pair

of positioning actuators (19), preferably linear, that each operate on one of said auxiliary arms (18a).

8. An apparatus according to one or more of claims 6 and 7, in which the tilting devices comprise a pair of tilting actuators (20), preferably linear, that each operate between one side of the extendable frame (4) and one of said auxiliary arms (18a). 5
9. An apparatus according to one or more of the foregoing claims, in which the extendable frame (4) comprises a proximal segment (6) hinged to the loading hopper (3), and a distal segment (7) supporting said lifting arms (10). 10  
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10. An apparatus according to the foregoing claim, in which said proximal segment (6) and said distal segment (7) have a tubular shape.
11. An apparatus according to claim 9 or 10, in which said proximal segment (6) and said distal segment (7) are telescopic and slide with respect to each other. 20
12. An apparatus according to one or more of the foregoing claims from 9 to 11, in which the extendable frame (4) also comprises at least one intermediate connection segment (8) operatively interposed between the proximal segment (6) and the distal segment (7). 25  
30
13. An apparatus according to the foregoing claim in which the intermediate segment (8) is slidingly connected to the proximal segment (6) and the distal segment (7) is slidingly connected to the intermediate segment (8). 35
14. An apparatus according to one or more of the foregoing claims in which the extendable frame (4) is mobile between a minimum length condition and a maximum length condition, substantially equal to or greater than the distance that can be measured between said hinged geometric axis (X) and the ground in a vertical direction. 40  
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Fig.1

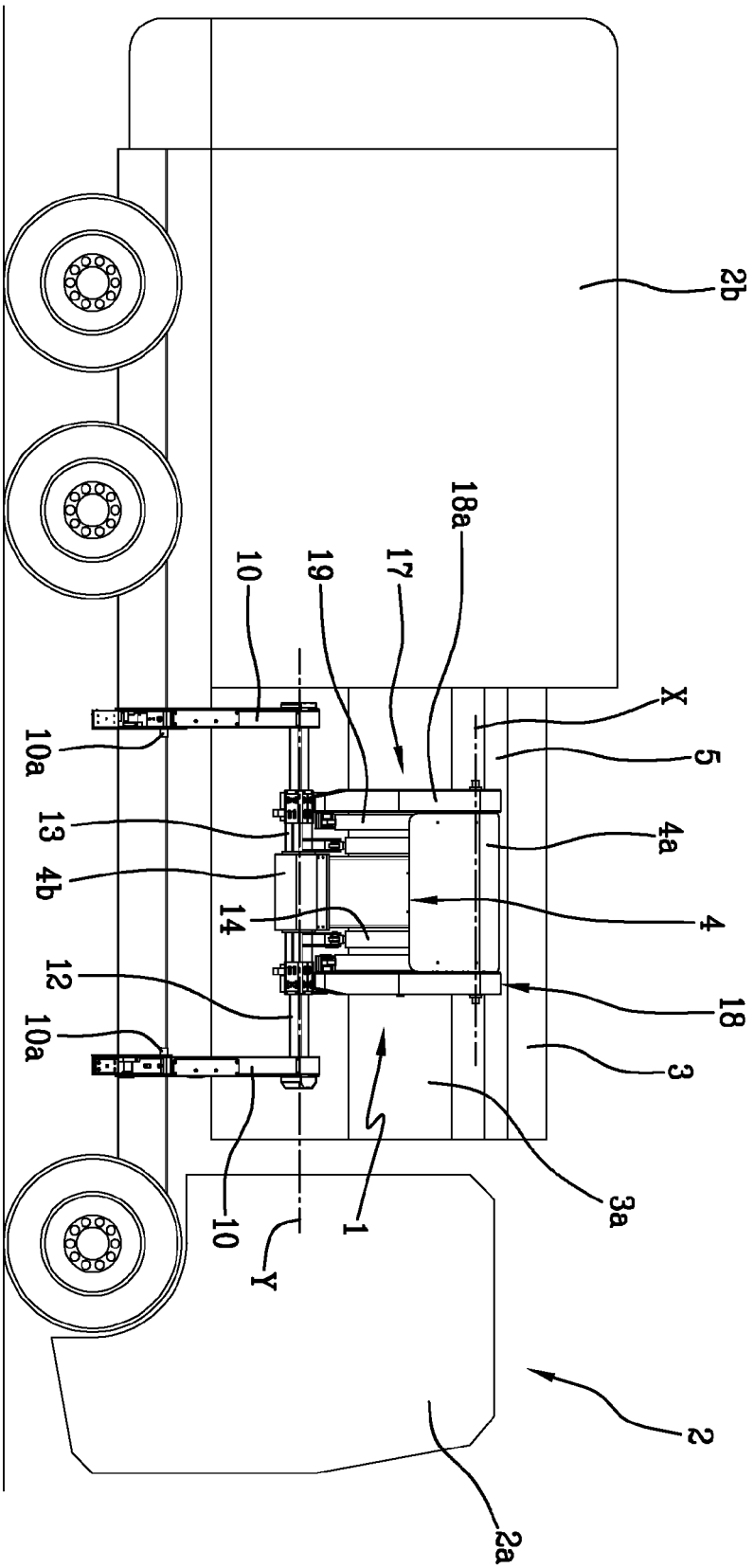
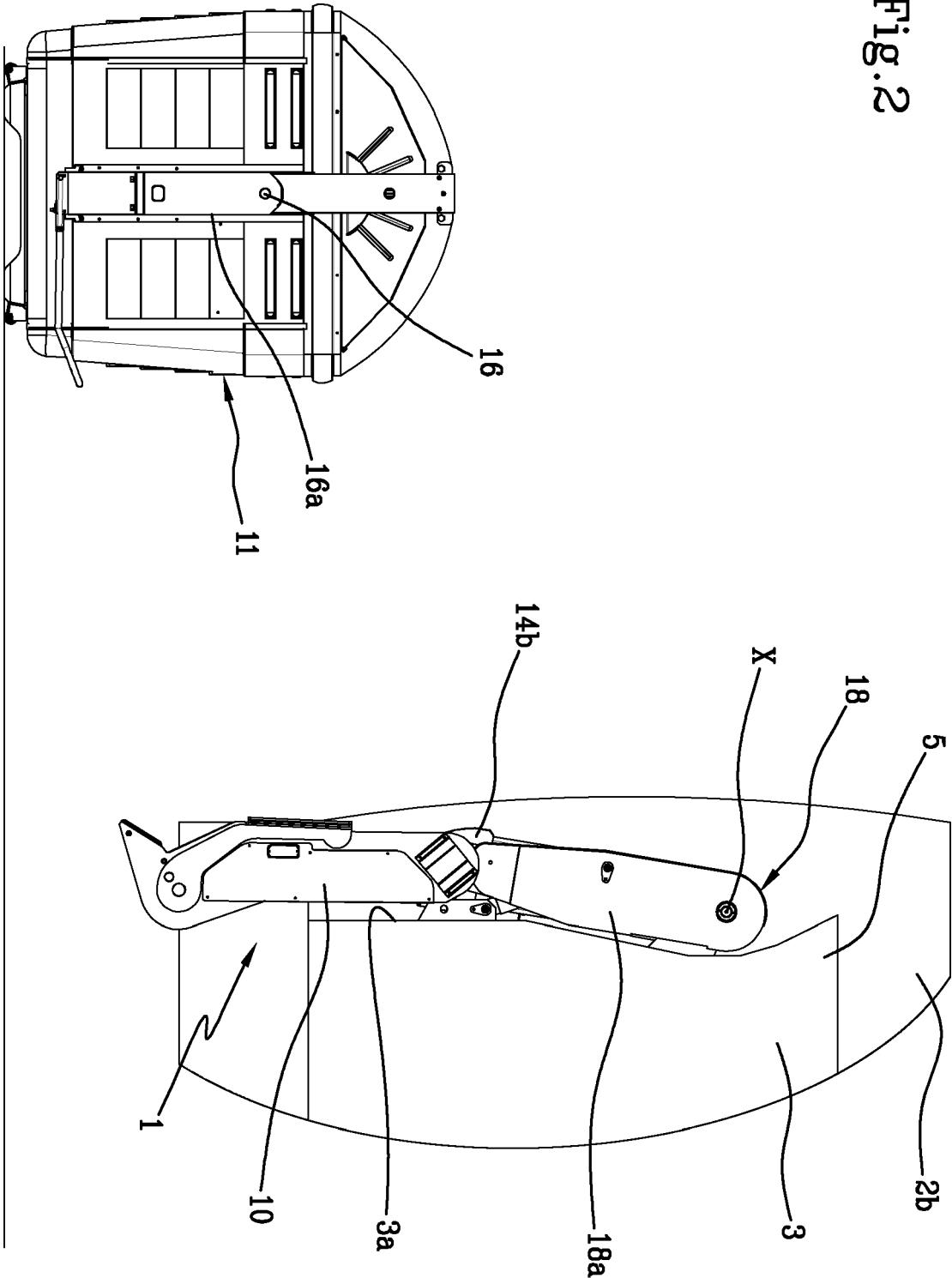


Fig.2



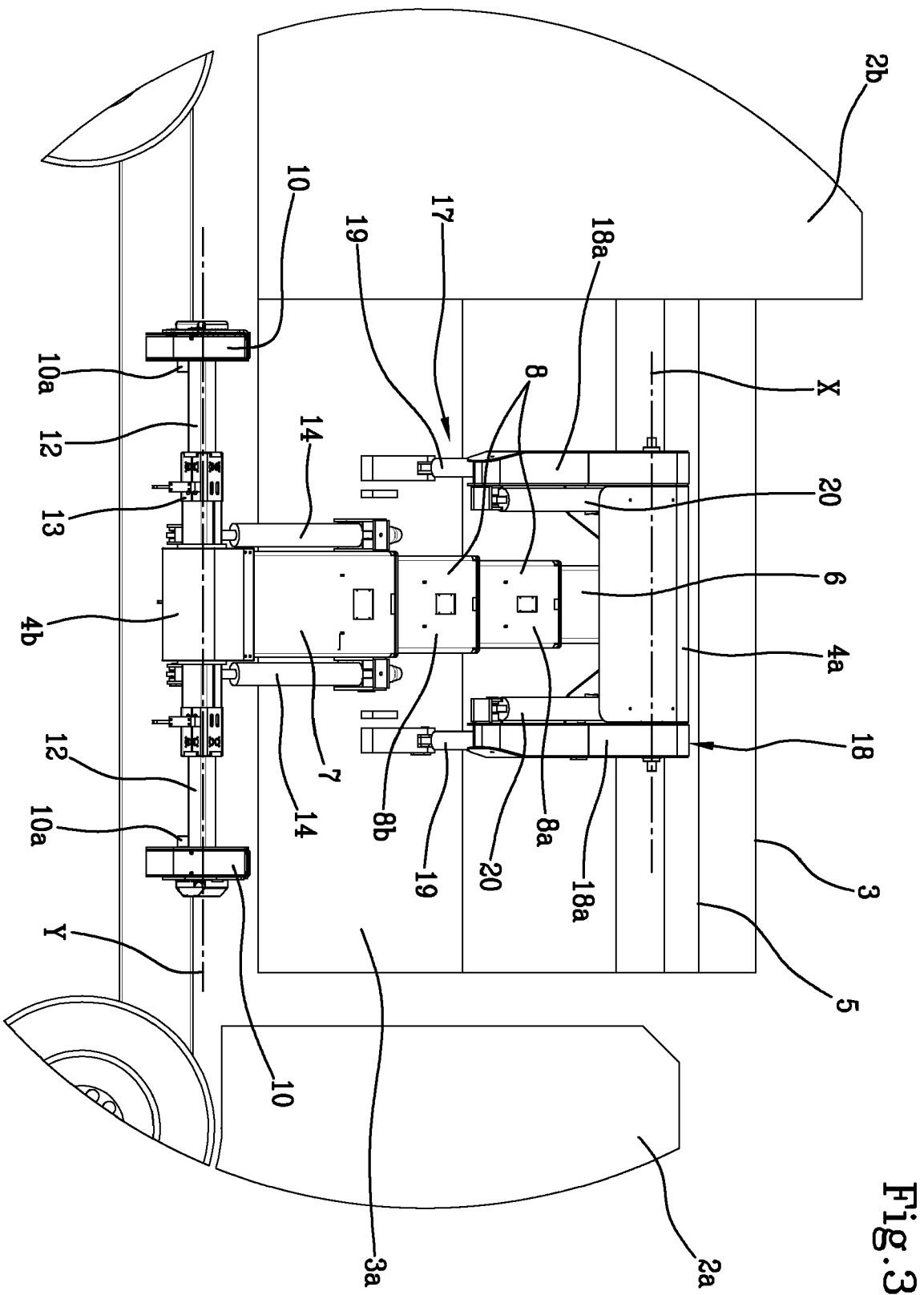


Fig. 4

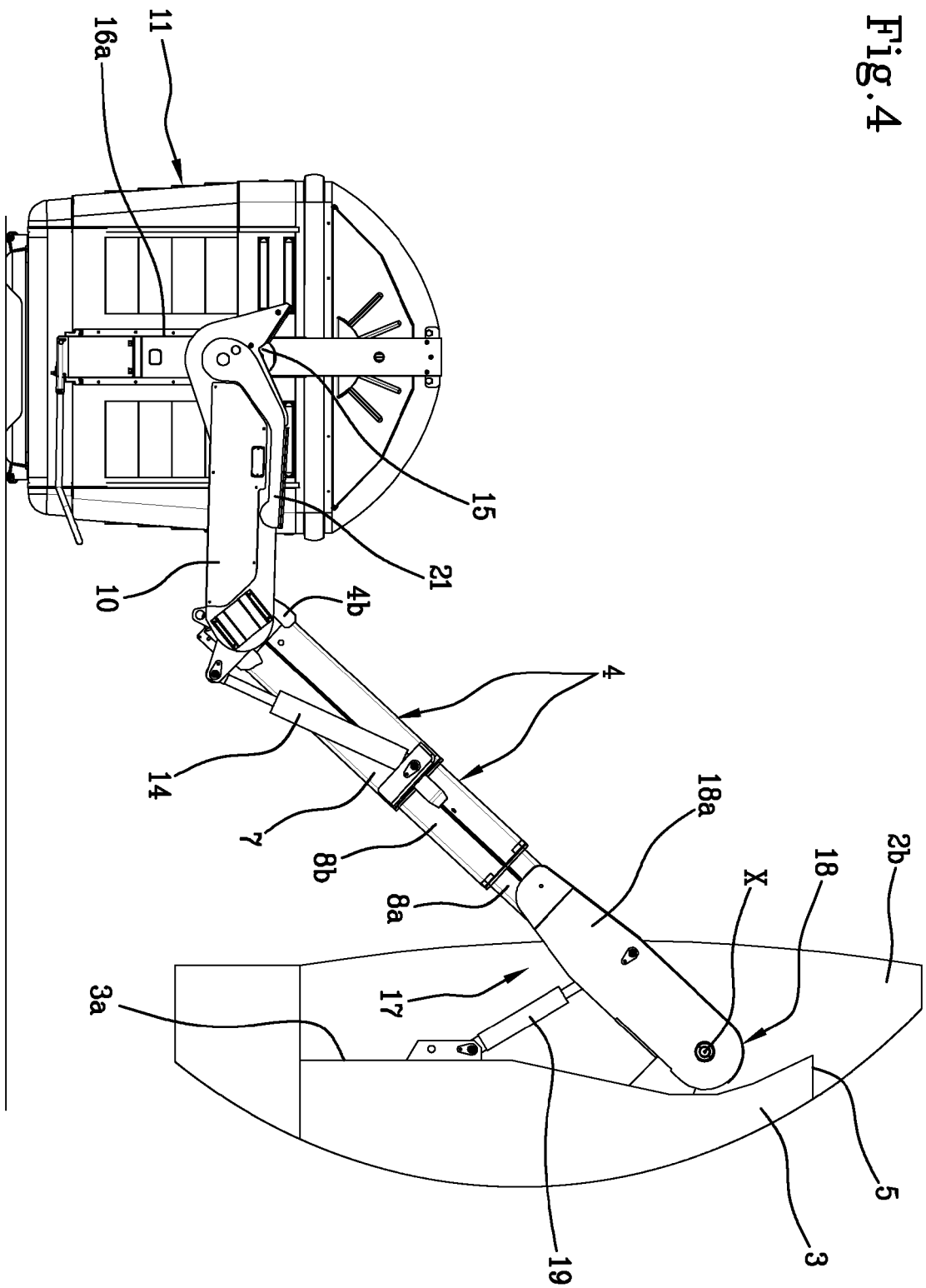


Fig.5

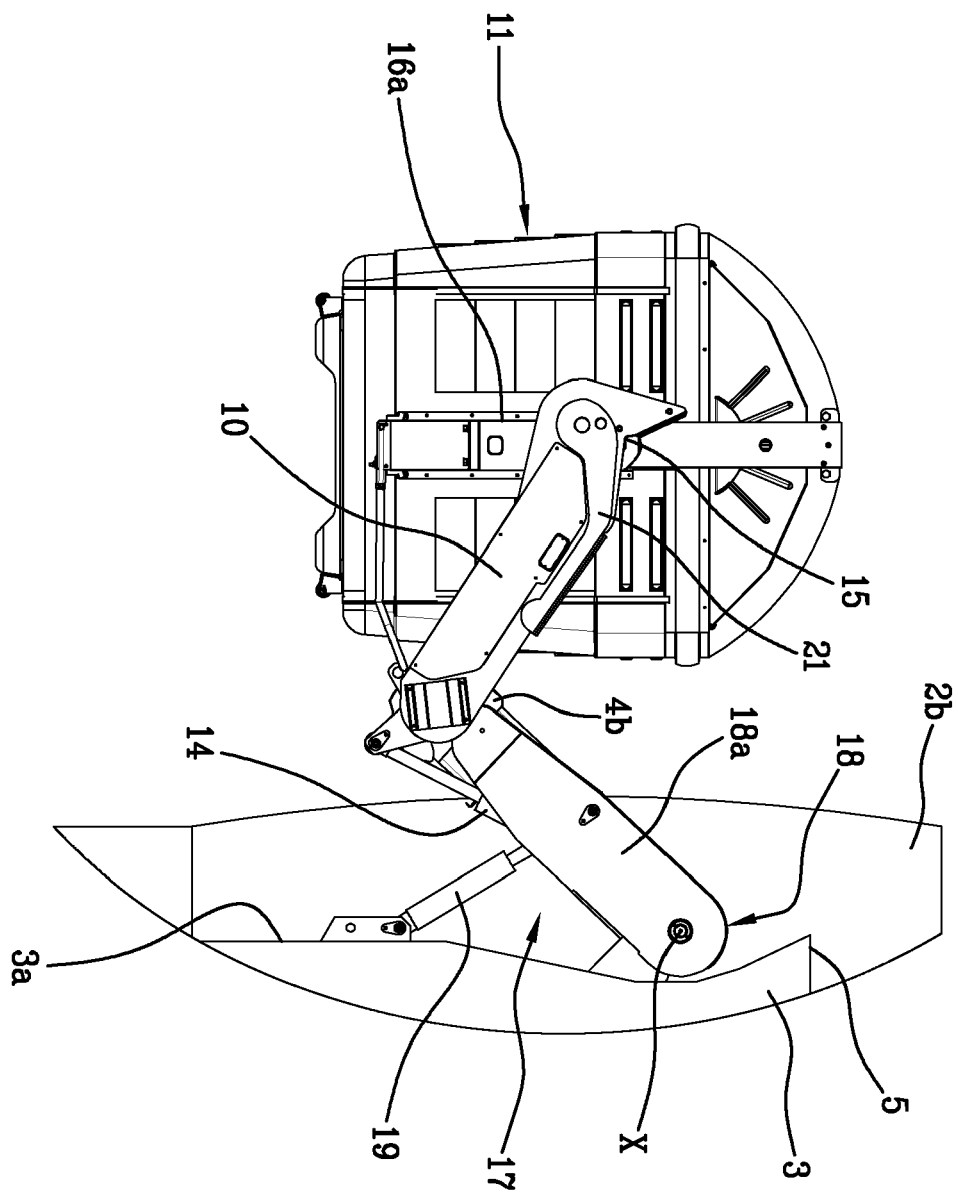


Fig.6

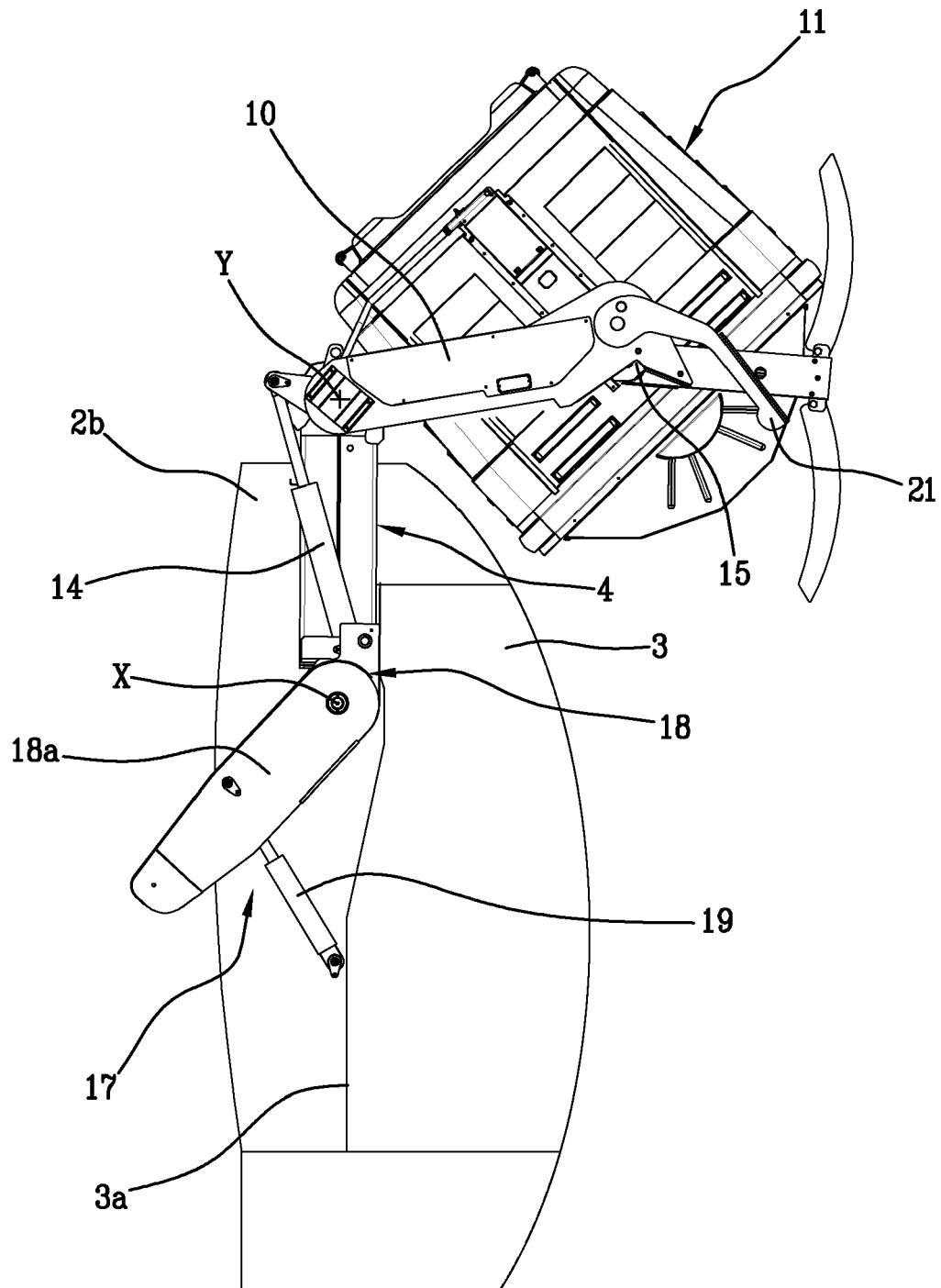


Fig.7

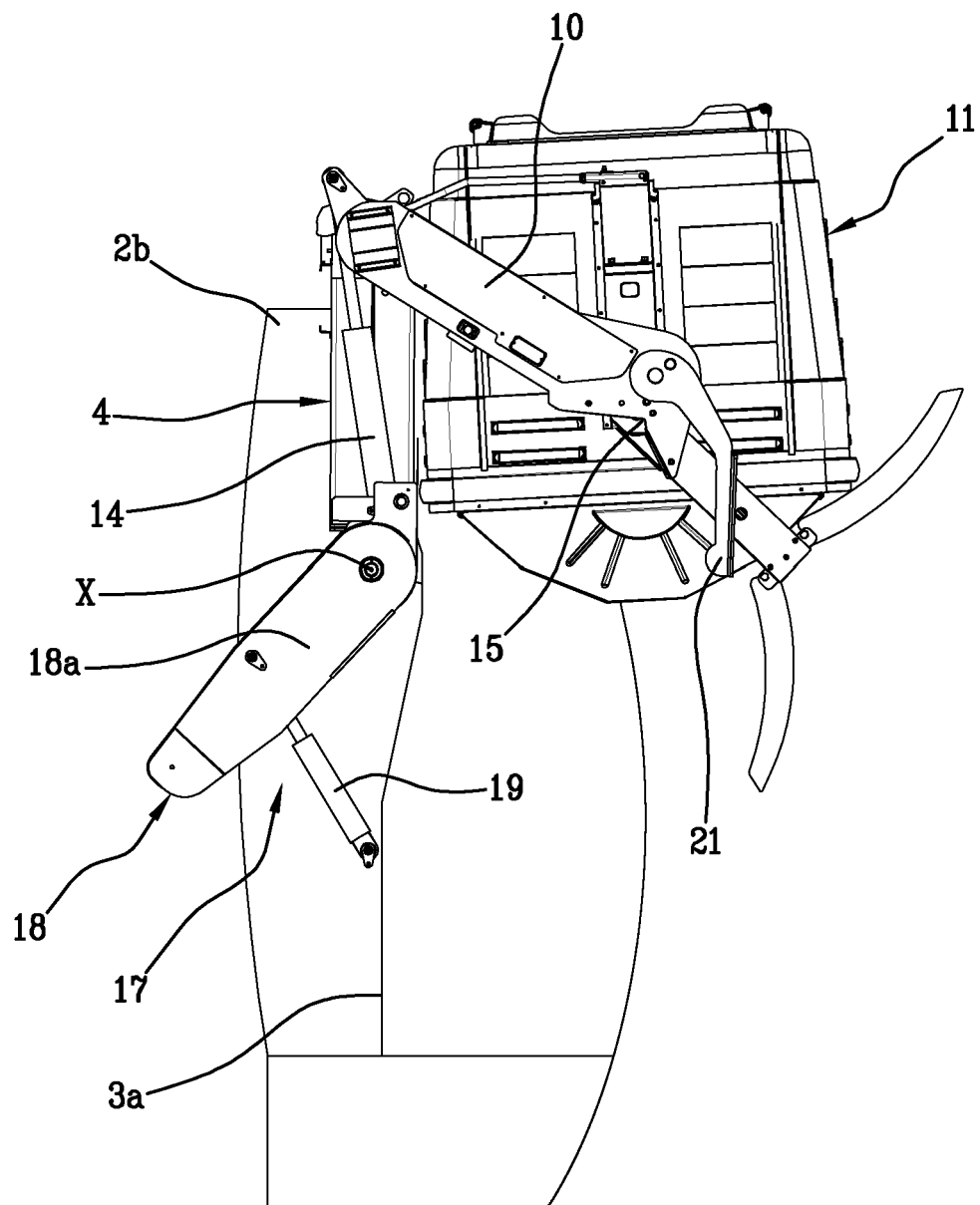
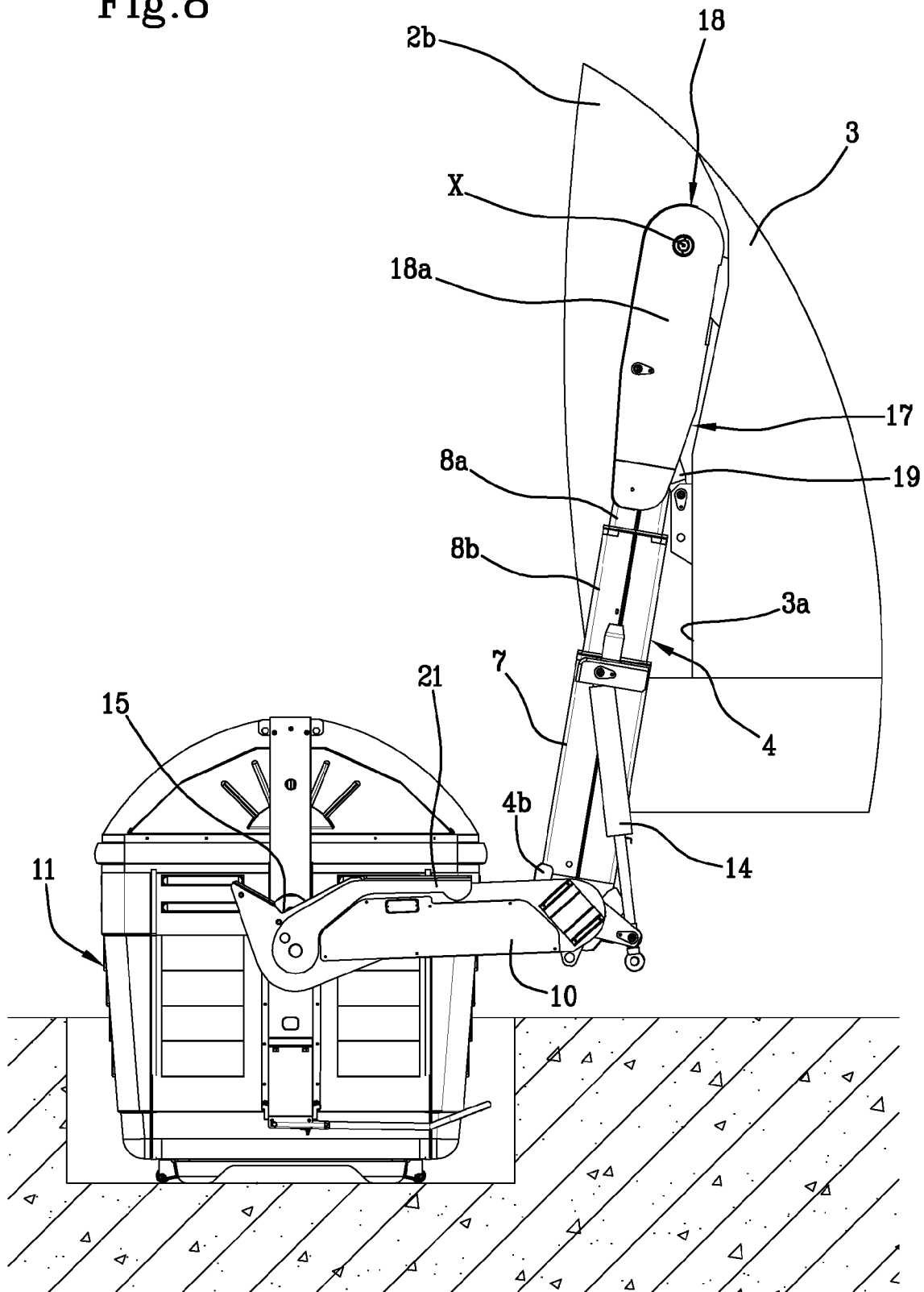


Fig.8





## EUROPEAN SEARCH REPORT

Application Number  
EP 12 16 3869

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                    |                                                                                                                                           |                                                                                                                                                                                                                                                                                       |                                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| Category                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                                             | Relevant to claim                                                                                                                                                                                                                                                                     | CLASSIFICATION OF THE APPLICATION (IPC) |
| A                                                                                                                                                                                                                                                      | US 4 401 407 A (D. BRECKENRIDGE)<br>30 August 1983 (1983-08-30)<br>* column 5, line 31 - column 7, line 68 *<br>* figures 1-11 *<br>----- | 1-14                                                                                                                                                                                                                                                                                  | INV.<br>B65F3/04                        |
| A                                                                                                                                                                                                                                                      | IT FI 930 165 A1 (ATTREZZATURE MECCANICHE SPECIALI S.R.L.)<br>19 February 1995 (1995-02-19)<br>* the whole document *<br>-----            | 1-14                                                                                                                                                                                                                                                                                  |                                         |
|                                                                                                                                                                                                                                                        |                                                                                                                                           |                                                                                                                                                                                                                                                                                       | TECHNICAL FIELDS SEARCHED (IPC)         |
|                                                                                                                                                                                                                                                        |                                                                                                                                           |                                                                                                                                                                                                                                                                                       | B65F                                    |
| The present search report has been drawn up for all claims                                                                                                                                                                                             |                                                                                                                                           |                                                                                                                                                                                                                                                                                       |                                         |
| Place of search<br>The Hague                                                                                                                                                                                                                           |                                                                                                                                           | Date of completion of the search<br>2 October 2012                                                                                                                                                                                                                                    | Examiner<br>Smolders, Rob               |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |                                                                                                                                           | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>.....<br>& : member of the same patent family, corresponding document |                                         |

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 12 16 3869

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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02-10-2012

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**REFERENCES CITED IN THE DESCRIPTION**

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