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(54) **LIFTING SYSTEM FOR A REFUSE COLLECTION VEHICLE**

(57) The invention relates to a lifting system (100) for a refuse collection vehicle, having a first and second lift device. The first lift device (10) comprises: a first lift member (12), a first lift base (11), a first lift mechanism (13) for raising and lowering the first lift member with respect to the first lift base, and a first gripper (14) configured to carry a main refuse bin (200). The second lift device (20) comprises: a second lift base (21), a second gripper (24) configured to carry an insert refuse bin (250), and a second lift mechanism (23) configured for raising and lowering the second gripper with respect to the second lift base. The first lift member is the second lift base of the second lift device which is configured such that the first lift member and second lift device are raised and lowered together as one unit when the first lift member is raised respectively lowered by the first lift mechanism.

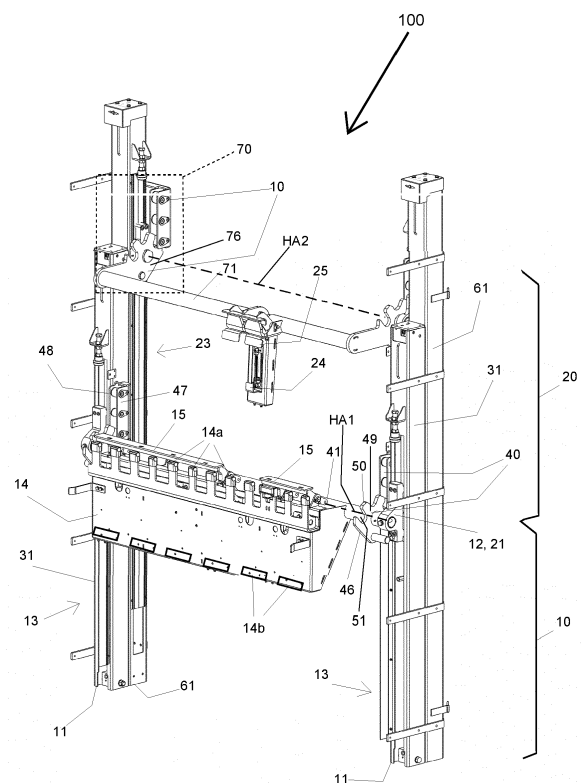


FIG. 4

Description

[0001] The present invention relates to a lifting system for a refuse collection vehicle. In particular, the invention relates to lifting systems for refuse collection vehicles, comprising a first lift device and a second lift device.

[0002] Refuse collection vehicles comprising a first lift device and a second lift device can be employed to collect collection bins having a removable insert bin. Such collection bins are often employed for separation of waste, e.g. in households, in which the main bin may then contain a different type of waste from the insert bin. The collection bins are often brought up onto the street for emptying and/or collection. Upon collection by a refuse collection vehicle, both the main bin and the insert bin are usually to be lifted and emptied separately into said refuse collection vehicle, particularly into separate compartments of a refuse collection vehicle.

[0003] A lifting system for lifting such collection bins having an insert bin is known from EP 14 914 64. This lifting system is designed such that both a first and a secondary lifting yoke can rotate relative to a collection body in the refuse collection vehicle, with the secondary lifting yoke rotating above the primary lifting yoke. In this known solution the primary lifting yoke is rotatable about a horizontal rotation axis supported on the vehicle, in particular the collection body of the vehicle. The gripping means of the primary lifting yoke can engage the main bin and rotate the main bin from a first, lower position to a higher position in which the main bin can be emptied into a compartment of the refuse collection vehicle. The secondary lifting yoke is also rotatably supported on the vehicle (collection bin) by means of a horizontal rotation axis. The horizontal rotation axis of the primary lifting yoke and the horizontal rotation axis of the secondary lifting yoke are mutually parallel and arranged at a distance from each other. In addition, the secondary lifting yoke is supported on the primary lifting yoke by a bar or regulating unit (28) which mechanically combines the lever arms (18 and 24) of the primary and secondary lifting yoke so that the lifting system of EP 14 914 64 requires only one jack device (27) for movement of both the primary lifting yoke and the secondary lifting yoke - EP 14 914 64 A column 4 line 51 to column 5 line 4.

[0004] It is a disadvantage of this known solution that in their swivelling rotation the lifting yokes of EP 14 914 64 require synchronisation of the respective rotation arcs described by the lifting yokes so as to be able to engage the insert in a first position in which it still is in the main bin, and to be able to lift the insert out of said main bin. As confirmed by EP 3 020 657 - see its [0002]-[0003] - this leads to a quite complex and expensive system. Further the lifting system of EP 14 914 64 is inefficient as well.

[0005] An object of the invention is to provide an alternative lifting system for a refuse collection vehicle.

[0006] This object is achieved by a lifting system for a refuse collection vehicle, comprising a first lift device and a second lift device, wherein the first lift device comprises:

- a first lift member,
- a first lift base,
- a first lift mechanism configured to raise and lower the first lift member with respect to the first lift base - for example, between a first low position and a first high position -, and
- a first gripper which is:
 - configured to carry a main bin for refuse,
 - mounted to and carried by the first lift member to be raised and lowered together with the raising and lowering of the first lift member, and
 - rotatable, with respect to the first lift base and/or first lift member, around a first horizontal rotation axis to rotate the main bin between a first upright position and a first tilted position;

wherein, in the first upright position, a bottom side of the main bin is arranged lower than a top side of the main bin, and wherein, in the first tilted position, the bottom side of the main bin is arranged higher than the top side of the main bin;

wherein the second lift device comprises:

- a second lift base,
- a second gripper which is:
 - configured to carry an insert bin for refuse, and
 - rotatable, with respect to the second lift base, around a second horizontal rotation axis to rotate the insert bin between a second upright position and a second tilted position,
- a second lift mechanism configured to raise and lower the second gripper with respect to the second lift base, for example, between a second low position and a second high position;

wherein, in the second upright position, a bottom side of the insert bin is arranged lower than a top side of the insert bin, and wherein, in the second tilted position, the bottom side of the insert bin is arranged higher than the top side of the insert bin; and wherein the first lift member is the second lift base of the second lift device, which second lift device is configured such that the first lift member and second lift device are raised and lowered together as one unit over the same distance when the first lift member is raised respectively lowered by the first lift mechanism.

[0007] The 'first lift member being the second lift base' means that the second lift device is from mechanical perspective configured in series with the first lift member by supporting and mounting the second lift base (on) to the first lift member. That is, the first lift member and second

lift device will be subjected to the same movement, i.e. when the first lift member moves a distance x with respect to the fixed world, the second lift device will move exactly the same distance x with respect to the fixed world. In the lifting system according to the invention, with the first lift member being the base of the second lift device, the second lift device is superposed on the first lift device and as such may act as an extension thereof. According to a further embodiment, the second lift device may - viewed in the lifting direction - be placed on top of the first lift device. For example a plunger of a cylinder-piston-unit as second lift device may be placed on top of the cylinder of a cylinder-piston-unit as first lift device. According to another further embodiment, the second lift device may - viewed transverse to the lifting direction - be arranged partly parallel to the first lift device (but from mechanical perspective the second lift device is still configured in series with the first lift member). For example a plunger of a cylinder-piston-unit as second lift device may be extend partly parallel and alongside the cylinder of a cylinder-piston-unit as first lift device.

[0008] Similar to the first lifting device, the second lifting device may, according to an embodiment of the invention, comprise a second lift member and a second lift mechanism configured to raise and lower the second gripper with respect to the second lift base, wherein the second gripper is mounted to and carried by the second lift member so that the second gripper is raised and lowered together with raising and lowering of the second lift member.

[0009] According to the invention, the second lift device is so to say a lift placed on or in the first lift device. The first lift device lifts not only its first lift member provided with the first gripper for the main bin, but also lifts the second lift device over the same distance as it lifts the first lift member. The second lift device being carried by the first lift member, allows the second lift device to perform its own lifting motion independent of any movement or any position of the first lift member. This leads to a lifting system in which the movement of the second lift device does not require synchronisation with respect to the movement of the first lift device. Further, the lifting system according to the invention allows a substantially uninterrupted, continuous lifting motions for both of the first lift device and the second lift device. This leads to a timeefficient lifting system. Whilst a fully continuous lifting motion may be optimal from the perspective of time efficiency, the lifting motion may also be intermittent for example for safety reasons.

[0010] It is noted that raising and lowering the first lift member, with respect to the first lift base, by the first lift mechanism may be done between distinct positions, e.g. a first low position and a first high position. It is further noted that raising and lowering the second gripper with respect to the second lift base may be done between distinct positions, e.g. a second low position and second high position. The second high position may be different from the first high position, e.g. higher. Then, in raising

and lowering the second gripper (or second lift member carrying the second gripper) with respect to the second lift base (i.e. the first lift member), the second lift device effects a change in the distance between the second gripper (or second lift member carrying the second gripper) and the first lift member so as to accommodate said height difference.

[0011] The first lift device may perform a rotational lifting movement or a translational lifting movement. For the rotational movement, in raising or lowering the first lift member rotates with respect to, i.e. around, the first lift base. For the translational lifting movement, in raising or lowering the first lift member translates substantially vertically with respect to the first lift base. The path described by the translational lifting movement may be rectilinear or curvilinear.

[0012] The second lift device may perform a rotational lifting movement or a translational lifting movement. For the rotational movement, in raising or lowering the second gripper rotates with respect to, i.e. around, the second lift base. For the translational lifting movement, in raising or lowering the second gripper translates substantially vertically with respect to the second lift base. The path described by the translational lifting movement may be rectilinear or curvilinear.

[0013] The first and second lift devices may perform sequential lifting movements.

[0014] In use, the lifting system may raise the main bin and the insert bin from their respective lower positions to their respective higher positions, such that the main bin and the insert bin can empty the refuse they contain into the collection body, or hopper, of the refuse collection vehicle. Subsequently, the lifting system may lower the main bin and the insert bin from their respective higher positions to the respective lower positions. The lower positions may be 'pick-up positions'. The higher positions may be 'emptying positions'.

[0015] The refuse collected by a refuse collection vehicle that is to be emptied into the collection body may e.g. be household waste, recyclable waste such as plastics, green waste, glass, or old paper that is collected in bins of different sizes and comprising a plurality of wheels, typically two, three or four. A refuse bin with four wheels is sometimes referred to as a refuse container. Refuse bins - in practice called 'bins' - up to about 400 litres - such as a 60 litres, a 80 litres, a 140 litres, a 240 litres, and a 360 litres refuse bin - have in general two wheels, two corners of the bottom each having one wheel. Refuse bins - in practice in general called containers - from about 500 litres to about 1300 litres - such as 660 litres, 770 litres, and 1100 litres refuse bins - have in general 4 wheels, one at each corner of the bottom. These bins are in practice standardised, at least per region. Insert bins typically form 'inner bins' that separate the inside of a bin ('main bin') into compartments: e.g. a compartment being the remaining inner space of the bin, and another compartment being the inner space of the insert bin. As a result different types of waste may be

collected in those separate compartments. Such bins having inserts are in practice standardised, at least per region. The inserts are typically removable. Upon collection by a refuse collection vehicle, both the main bin and the removable insert bin are typically to be lifted and emptied separately into separate compartments of a refuse collection vehicle.

[0016] Referring to the above paragraph, it is noted that the term 'bin' as used in this application comprises containers as well, in other words the term 'bin' of this application comprises the term 'bin' as used in practise as well as the term 'container' as used in practise.

[0017] In a first 'emptying' position the main bin can be emptied into its corresponding compartment in the collection body of the refuse vehicle. This may be achieved by rotating the main bin between a first upright position and a first tilted position; wherein, in the first upright position, a bottom side of the main bin is arranged lower than a top side of the main bin, and wherein, in the tilted position, the bottom side of the main bin is arranged higher than the top side of the main bin. As such the contents of the main bin can easily, induced by gravity, be emptied into the collection body, when the main bin is in the first tilted position.

[0018] In a second 'emptying' position the insert bin can be emptied into its corresponding compartment in the collection body of the refuse vehicle. This may be achieved by rotating the insert bin between a second upright position and a second tilted position; wherein, in the second upright position, a bottom side of the insert bin is arranged lower than a top side of the insert bin, and wherein, in the second tilted position, the bottom side of the insert bin is arranged higher than the top side of the insert bin. As such the contents of the insert bin can easily, induced by gravity, be emptied into the collection body, when the insert bin is in the second tilted position.

[0019] Due to the second lift device carried by the first lift member being allowed to perform its own lifting motion independent of any movement and any position of the first lift member, the raising and lowering of the main bin and the insert bin by the first and second lift devices, respectively, may comprise a part in which the main bin and insert bin are subjected to a simultaneous movement of same speed (i.e. the main bin and insert bin have a position relative to each other which is fixed), and/or a part in which the main bin as well as the insert bin simultaneously move with a different speed (i.e. the main bin and insert bin have a relative position to each other which varies), and/or a part in which the main bin has a fixed position whilst the insert bin moves with respect to the main bin (i.e. the first lift device is inactive whilst the second lift device is active). For example, the raising may start out as a simultaneous movement of both the first lift base and second gripper at a same speed by only activating the first lift device for a lifting action whilst keeping the second lift device inactive, followed by a simultaneous movement at a different speed in which not only the first lift device is still activated for a lifting action but also

the second lift device is activated for a lifting action to move the second gripper with respect to the first lift member, i.e. the base of the second lift device. But it is also conceivable that the raising may start out as a simultaneous movement of both the main bin and insert bin at a different speed, in which the first lift device is activated to raise both the main bin and insert bin and in which the second lift device is activated to raise the insert bin with respect to the main bin. Further it is conceivable that the raising may start out with activating the second lift device to raise the insert bin with respect to the main bin whilst the first lift device is inactive, followed by a simultaneous movement of both the first lift base and second gripper at a same speed by only activating the first lift device for a lifting action whilst keeping the second lift device inactive. Also other combinations of activating the first and second lift device and/or keeping inactive the first and second lift device are conceivable. Similar applies vice versa for lowering the main bin and insert bin after having them emptied into the collection body or hopper of the collection vehicle. By activating the second lift device for a lifting action, the distance between the first gripper and second gripper, i.e. the distance between the main bin and insert bin, can be increased during raising or decreased during lowering so that the insert bin can be emptied into the collection body or hopper of the collection vehicle at a position higher than the position where the main bin is emptied into the collection body or hopper of the collection vehicle.

[0020] In an example, for collection bins brought up onto the street for emptying, for which the main bin and the insert bin are to be lifted and emptied separately into separate lower and upper compartments of a refuse collection vehicle, the lifting system, in use, may be described to have the following phases whilst handling said main bin and insert bin:

- a gripping phase, in which the collection bin is usually at street level, and wherein the first gripper and/or the second gripper engage the main bin and/or insert bin, respectively;
- a simultaneous raising phase, or paired raising phase, of the first lift device and second lift device, in which the first lift member is raised by the first lift mechanism, thereby also raising the second lift device, as the first lift member and second lift device are raised and lowered together as one unit;
- a diverging raising phase, wherein the first lift device and the second lift device yield diverging movements towards the respective lower and upper emptying positions, i.e. as it raises with respect to the second lift base, the second lift device effects a mutual distance with regards to the first lift member so as to lift the insert bin out of the main bin;
- a tipping phase, in which the main bin and/or insert bin are tipped such that the main bin and/or insert bin can be emptied into the respective lower respectively upper compartments;

- a converging lowering phase, wherein the first lift device and the second lift device yield converging movements towards the respective first and second lower positions, i.e. the second lift device reduces the mutual distance with regards to the first lift member so as to lower the insert bin back into or towards the main bin;
- a simultaneous lowering phase, or paired lowering phase, of the first lift device and second lift device, in which the first lift member is lowered by the first lift mechanism to return the collection bin back to a position at street level, thereby also lowering the second lift device, as the first lift member and second lift device are raised and lowered together as one unit.

[0021] In an example, the first gripper may have a bin rim locking mechanism to engage in locking manner with the main bin at a rim thereof, so as to prevent the main bin from falling from its gripper, e.g. when rotating the main bin between the first upright position and the first tilted position. The first gripper may further have a pushing plate - also known as pushing pad - mounted to it, which pushing plate is adapted to support the rotation of the main bin between the first upright position and the first tilted position.

[0022] The second gripper may have an insert bin rim locking mechanism to engage in locking manner with the insert bin, for example at a rim thereof, so as to prevent the insert bin from falling from its gripper, e.g. when rotating the insert bin between the second upright position and the second tilted position.

[0023] The lifting system according to the invention may further conveniently allow the lifting system to be movable between a lowered operational position and a raised transport position. In the lowered operational position the first lift base is positioned such that a main bin positioned at street level can be engaged by the first gripper. In the raised transport position the first lift base is raised with respect to the lowered operational position, such that the lowest point of the lifting system is at a sufficient distance from the ground; i.e. that the lifting system cannot hit potential bumps in the road as encountered when driving a refuse collection vehicle.

[0024] For a given position of the lifting system, e.g. the lowered operational or raised transport position, the first lift base may be considered a fixed point of reference, or fixed frame of reference, with respect to which the first lift device can raise or lower the first lift member. The second lift base may be considered a moving point of reference, or frame of reference, that is determined by the position of the first lift member. It is with respect to this moving point of reference, or frame of reference, that the second lift device, when active, raises or lowers the second gripper.

[0025] In an embodiment the first lift mechanism comprises a first vertically oriented linear actuator, wherein the first lift base is associated to a lower part of the first

linear actuator and the first lift member is associated to an upper part of the first linear actuator so that the first lift member can be raised or lowered with respect to the first lift base by actuating the first linear actuator. In use, the first vertically oriented linear actuator defines a translational movement raising or lowering the first lift member with respect to the first lift base. That is, the first lift member is raised by actuating the first linear actuator in a first direction, and is lowered by actuating the first linear actuator in a second direction opposite the first direction. It is an advantage of this embodiment that it leads to a compact and stable lift mechanism. As the first lift member is the base of the second lift device, the second lift device may be mounted to, or on top of, the upper part of the first linear actuator. The first linear actuator may be a hydraulic or pneumatic actuator or an electromechanical actuator.

[0026] In an embodiment, the second lift mechanism comprises a second vertically oriented linear actuator, wherein the second lift base is associated to a lower part of the second linear actuator and the second gripper (respectively second lift member) is associated to an upper part of the second linear actuator so that the second gripper (respectively second lift member) can be raised or lowered with respect to the second lift base by actuating the second linear actuator. As the first lift member is the second lift base, the raising or lowering of the second gripper (respectively second lift member) is independent of any position and any movement of the first lift member. In use, the second vertically oriented linear actuator defines a translational movement raising or lowering the second gripper (respectively second lift member) with respect to the first lift member (which constitutes the second lift base). That is, the second gripper is raised by actuating the second linear actuator in a first direction, and is lowered by actuating the second linear actuator in a second direction opposite the first direction. This embodiment leads to a compact and stable lift mechanism. This embodiment having a second vertically oriented linear actuator in combination with the embodiment having a first vertically oriented linear actuator leads to an additionally compact lift mechanism requiring considerable less horizontal space behind or beside a refuse collection vehicle than a lifting mechanism based on swiveling lifting yokes as is the case in for example EP 14 914 64. The second linear actuator may be a hydraulic or pneumatic actuator or an electromechanical actuator.

[0027] In a further embodiment, the first linear actuator comprises a telescoping unit of telescoping parts, wherein the first lift base is associated to a lower one of the telescoping parts of the first telescoping unit and the first lift member is associated to an upper one of the telescoping parts of the first telescoping unit so that the first lift member can be raised or lowered with respect to the first lift base by telescoping of the first telescoping unit. The first telescoping unit may for example be a cylinder-piston-unit with a cylinder and piston as the telescoping parts. In another further embodiment the first telescoping

unit may comprise three, four or more telescoping parts - i.e. having a lower telescoping part, an upper telescoping part, and one - in case of in total three telescoping parts -, two - in case of in total four telescoping parts - or more - in case of more than in total four telescoping parts -intermediate telescoping parts. The first telescoping part may according to another further embodiment be a hydraulic telescoping unit.

[0028] In another further embodiment, the first linear actuator may be an electromechanical actuator, comprising an electro-motor and configured to convert the rotary motion of the electro-motor into linear motion. In a further embodiment, the (first) electromechanical actuator may comprise a screw - also called spindle - and be configured to move the screw/spindle to-and-fro in its longitudinal direction, and the first lift member may for example be mounted on the screw/spindle.

[0029] The first linear actuator may be contained in a housing, e.g. a lifting column, that partially or fully encompasses the telescoping unit in its extended and/or retracted state. This lifting column may be a metal construction, e.g. a steel construction. The housing may further comprise outer protection plates, e.g. in addition to the lifting columns.

[0030] In a further embodiment, the first lift device further comprises a first tipping mechanism configured to transform a translational movement of the first linear actuator into a rotary movement of the first gripper with respect to the first lift member around the first rotation axis. That is, the raising and or lowering movement of the first linear actuator is transformed into a rotary movement of the first gripper around the first horizontal rotational axis, i.e. such that the first gripper rotates with respect to the first lift base. The first gripper is configured to carry the main bin. Hence, when the first gripper rotates, the main bin will rotate accordingly.

[0031] In a more specific embodiment the first tipping mechanism comprises:

- a first tipping plate rotatably mounted to the first lift member and having a first sprocket wheel section [with sprockets (also called teeth) separated by indentations], and
- a first gear rack having a number of gear members aligned along the direction of the translational movement and configured to successively engage, when the first tipping plate passes the first gear rack, with the first sprocket wheel section [i.e. in the indentations of the sprocket wheel section] so that the first tipping plate rotates with respect to the first lift member around the first rotation axis; and

wherein the first gripper is mounted to the first tipping plate so that it rotates together with the first tipping plate. The first sprocket wheel section may have sprockets, e.g. teeth, that are separated by indentations. The number of gear members aligned along the first gear rack may

be configured to successively engage, when the first tipping plate passes the first gear rack, in said indentations of the sprocket wheel section. This yields a reliable rotation of the first tipping plate and hence first gripper. Tipping angles of the tipping plate may be up to 45 degrees, e.g. in the range of 30 - 45 degrees, 20-45 degrees, 15-45 degrees etc. There may be an adjustment mechanism to adjust the tipping angles of the tipping mechanism.

[0032] In an embodiment, the first lift mechanism comprises two said first linear actuators and two said first tipping mechanisms, one of the first tipping mechanisms being associated to one of the first linear actuators and another of the first tipping mechanisms being associated to another of the first linear actuators, wherein the first tipping mechanisms define a common said first rotation axis, and wherein, viewed along the common first rotation axis, the first gripper is arranged between the first tipping mechanisms. The common first rotation axis is then the first horizontal rotational axis around which the first gripper is rotatable. Having two said first linear actuators and two said first tipping mechanisms, with the first gripper arranged there between, leads to a powerful and stable lifting system. The first gripper in this embodiment may e.g. be arranged on a horizontal lift member that is lifted by the first lift mechanism. This horizontal lift member may be a crossbar connecting the two telescoping units.

[0033] In a practical embodiment, the second lift base is supported on the upper part of the first linear actuator at a position below the upper end of the first linear actuator. This leads to a compact lifting system.

[0034] In a further embodiment, the second linear actuator comprises a telescoping unit of telescoping parts, wherein the second lift base is associated to a lower one of the telescoping parts of the second telescoping unit whilst the second gripper (or second lift member) being associated to an upper one of the telescoping parts of the second telescoping unit so that the second gripper (or second lift member) can be raised or lowered with respect to the second lift base by telescoping of the second telescoping unit. The second telescoping unit may for example be a cylinder-piston-unit with a cylinder and piston as the telescoping parts. In another further embodiment the second telescoping unit may comprise three, four or more telescoping parts - i.e. having a lower telescoping part, an upper telescoping part, and one - in case of in total three telescoping parts -, two - in case of in total four telescoping parts - or more - in case of more than in total four telescoping parts -intermediate telescoping parts. The second telescoping part may according to another further embodiment be a hydraulic telescoping unit.

[0035] In another further embodiment, the second linear actuator may be an electromechanical actuator, comprising an electro-motor and configured to convert the rotary motion of the electro-motor into linear motion. In a further embodiment, the (second) electromechanical actuator may comprise a screw - also called spindle - and be configured to move the screw/spindle to-and-fro

in its longitudinal direction, and the second lift member may for example be mounted on the screw/spindle.

[0036] The second linear actuator may be contained in a housing, e.g. a lifting column, that partially or fully encompasses the telescoping unit in its extended and/or retracted state. This lifting column may be a metal construction, e.g. a steel construction.

[0037] In an embodiment the second lift device further comprises a second tipping mechanism configured to transform a translational movement of the second linear actuator into a rotary movement of the second gripper with respect to the second lift base around the second rotation axis. That is, the raising and or lowering movement of the second linear actuator is transformed into a rotary movement of the second gripper around the second horizontal rotational axis, i.e. such that the second gripper rotates with respect to the second lift base. The second gripper is configured to carry the insert bin. Hence, when the second gripper rotates, the insert bin will rotate accordingly.

[0038] In a more specific embodiment, the second tipping mechanism comprises:

- a second tipping plate rotatably mounted to the part of the second linear actuator which is movable with respect to the second lift base, the second tipping plate having a second sprocket wheel section [with sprockets (also called teeth) separated by indentations]; and
- a second gear rack having a number of gear members aligned along the direction of the translational movement and configured to successively engage, when the second tipping plate passes the second gear rack, with the second sprocket wheel section [i.e. in the indentations of the sprocket wheel section] so that the second tipping plate rotates with respect to the second linear actuator around the second rotation axis; and

wherein the second gripper is mounted to the second tipping plate so that it rotates together with the second tipping plate. The second sprocket wheel section may have sprockets, e.g. teeth, that are separated by indentations. The number of gear members aligned along the second gear rack may be configured to successively engage, when the second tipping plate passes the second gear rack, in said indentations of the sprocket wheel section. This yields a reliable rotation of the second tipping plate and hence the second gripper. Tipping angles of the tipping plate may be up to 45 degrees, e.g. in the range of 30 - 45 degrees, 20-45 degrees, 15-45 degrees etc. There may be an adjustment mechanism to adjust the tipping angles of the tipping mechanism.

[0039] In an embodiment, the second lift mechanism comprises two said second linear actuators and two said second tipping mechanisms, one of the second tipping mechanisms being associated to one of the second linear actuators and another of the second tipping mechanisms

being associated to another of the second linear actuators,

wherein the second tipping mechanisms define a common said second rotation axis, and wherein, viewed along the common second rotation axis, the second gripper is arranged between the second tipping mechanisms. The common second rotation axis is then the second horizontal rotational axis around which the second gripper is rotatable. Having two said second linear actuators and two said second tipping mechanisms, with the second gripper arranged there between, leads to a powerful and stable lifting system. The second gripper in this embodiment may be arranged on a second lift member, e.g. a horizontal lift member that is lifted by the second lift mechanism. This horizontal lift member may comprise a crossbar connecting the two second telescoping units.

[0040] A refuse collection vehicle according to the invention comprises:

- a chassis,
- a driver's cab provided on the chassis,
- a collection body for collecting refuse, provided on the chassis, behind the driver's cab, and
- a lifting system according to the invention for raising refuse bins from a pick-up position, emptying the refuse bins into the collection body, and lowering the refuse bins to return to the pick-up position.

[0041] The lifting system may be provided at the rear side of the refuse collection vehicle. This is otherwise known as a 'rear-loader'. Similarly the lifting system may be provided at a lateral side of the refuse collection vehicle, which may commonly be known as a 'side-loader'.

[0042] In an embodiment, the refuse collection vehicle comprises a plurality of lifting systems according to invention, wherein the plurality of lifting systems are arranged in parallel, such that they can be operated in parallel. The plurality of lifting systems may e.g. be arranged side-by-side on a single side (e.g. rear side or lateral side) of the refuse collection vehicle, or on different sides of said vehicle. This allows for the simultaneous handling of a plurality of collection bins. Alternatively, the plurality of lifting systems may perform a paired lifting movement so as to lift a larger bin, e.g. a four-wheeled container, that cannot be lifted by a single lifting system.

[0043] The invention will be explained further with reference to the drawings, in which like reference symbols designate like parts. In these drawings:

Figures 1A - 1C illustrate a highly schematically representation of a lifting system according to the invention in three different states of operation; Figures 2A -2B illustrate a highly schematically representation of a lifting system according to the invention in two different states of operation; Figures 3A-3B illustrate a highly schematically representation of a lifting system according to the invention in two different states of operation;

Figure 4 shows a view in perspective of a lifting system according to the invention;

Figures 5A - 5C show a view in perspective of the lifting system of Figure 4 carrying a main bin and an insert bin in three different states of operation;

Figures 6A-6B shows a view in perspective of a telescoping unit for the lifting system of Figure 4 in different states of operation;

Figure 7A - 7C schematically shows, as a detail 70 of figure 4, the tipping mechanism of the second lifting system of Figure 4 in three different states of operation;

Figure 8 shows a view in perspective of a rear section of a refuse collection vehicle according to the invention.

[0044] Figs. 1-3 all are highly schematically and telescoping units in these figures are telescoping units with two telescoping parts in the form of cylinder-piston-units, but may equally well be telescoping units with three or more telescoping parts.

[0045] In Figs. 1A - 1C is shown a lifting system 1 for a refuse collection vehicle, comprising a first lift device 10 and a second lift device 20. The lifting system 1 being mounted on a side of the refuse collection vehicle.

[0046] The first lift device 10 comprises: a first lift member 12, a first lift base 11, a first lift mechanism 13 configured to raise and lower the first lift member 12 with respect to the first lift base 11, and a first gripper 14. The first gripper 14 is configured to carry a main bin 200 for refuse, is mounted to and carried by the first lift member 12 to be raised and lowered together with the raising and lowering of the first lift member 12. Further, the first gripper 14 is rotatable, with respect to the first lift base 11 and/or first lift member, around a first horizontal rotation axis HA1 to rotate the main bin 200 between a first upright position (shown in figures 1A and 1B) and a first tilted position (shown in figure 1C). In the first upright position of Fig. 1A and 1B, a bottom side of the main bin is arranged lower than a top side of the main bin, and, in the first tilted position of Fig. 1C, the bottom side of the main bin is arranged higher than the top side of the main bin. In Figs. 1A, 1B and 1C the main bin 200 is shown as an U, with the top side of the bin being the open upper side of the U and the bottom side of the bin being the closed lower side of the U.

[0047] The raising and lowering of the first lift member 12, with respect to the first lift base 11, by the first lift mechanism 13 may be done between distinct positions, e.g. a first low position as shown in Fig. 1A, and a first high position as shown in Fig. 1C. In Fig. 1C the first lift member 12 has travelled a distance df2 with respect to the first lift base 11.

[0048] The second lift device 20 comprises a second lift base 21, a second lift member 22, a second gripper 24, and a second lift mechanism 23. The second lift mechanism 23 is configured to raise and lower the second gripper 24 with respect to the second lift base 21.

The second gripper 24 is carried by the second lift member 22, is configured to carry an insert bin 250 for refuse, and is rotatable, with respect to the second lift base 21, around a second horizontal rotation axis HA2 to rotate the insert bin 250 between a second upright position (shown in Figs. 1A and 1B) and a second tilted position (shown in Fig. 1C). In the second upright position of Figs. 1A and 1B, a bottom side of the insert bin 250 is arranged lower than a top side of the insert bin 250, and, in the first tilted position of Fig. 1C, the bottom side of the insert bin 250 is arranged higher than the top side of the insert bin 250. In Figs. 1A, 1B and 1C the insert bin 250 is shown as an U, with the top side of the bin being the open upper side of the U and the bottom side of the bin being the closed lower side of the U.

[0049] The raising and lowering of the second gripper 24 with respect to the second lift base 21 may be done between distinct positions, e.g. a second low position as shown in Fig. 1A and in Fig. 1B, and a second high position as shown in Fig. 1C. In Figs. 1A and 1B, the distance between the second lift member 22 (/ the second gripper 24) and the second lift base 21 (/ the first lift member 12) is ds1. In Fig. 1C the second lift base 22 (/ second gripper 24) has travelled a distance ds2 with respect to the second lift base 21 (/the first lift member 12).

[0050] The first lift member 12 is the base 21 of the second lift device 20 which is configured such that the first lift member 12 and second lift device 20 are raised and lowered together as one unit when the first lift member 12 is raised respectively lowered by the first lift mechanism 13. This is shown in Figs. 1B and 1C. Going from the state shown in figure 1A to the state shown in figure 1B, the first lift mechanism 13 is active and the second lift mechanism is inactive, which results in raising the first lift member 12 and the second lift device 20 as one unit over the distance df1. In this example in which the grippers 14 and 24 are not rotated between the state of Fig. 1A and the state of Fig. 1B, this effectively means that the distance between the first gripper 14 and the first lift base 11, on the one hand, and the distance between the second gripper 24 and the first lift base, on the other hand, are both increased with a same distance df1.

[0051] The state of operation as shown in Fig. 1A may be considered an 'start position' and/or an 'end position' for a lifting system 1 according to the invention. That is, both the first lift device 10 and the second lift device 20 are in a position that allows for picking up a main bin and an insert bin, or for returning said main bin and insert bin.

[0052] The state of operation as shown in Fig. 1B may be considered an 'intermediate position' for a lifting system 1 according to the invention. That is, the first lift device 10 has been raised by a distance df1 with respect to the first lift base 11, with the second lift device 20 having been raised simultaneously over the same distance. In case - as is the case in the transition from Fig. 1A to Fig. 1B - the second lift device is inactive when raising the first lift device, the second lift member 22 will be raised simultaneously over the same distance df1 as the first lift

member 12 is raised.

[0053] The state of operation shown in Fig. 1C may be considered an 'high position' for a lifting system 1 according to the invention. That is, the first lift device 10 has been raised by a distance df_2 with respect to the first lift base 11, and the second lift device 20 has been raised by a distance ds_2 with respect to the first lift member 12, i.e. the second lift base 21. In other words, the second lift device 20 has effected a mutual distance between the second gripper 24, on the one hand, and the first lift member 12 and the first gripper 14 mounted thereto, on the other hand. When the first gripper 14 is carrying a main bin 200, and the second gripper 24 is carrying an insert bin 250, this means that the second gripper 24 has lifted the insert bin 250 out of the main bin 200. In this 'high position' the main bin and insert bin are ready for being emptied simultaneously or the one after the other, into separate compartments of a refuse collection vehicle. This has been visualized in Fig. 1C as well by showing the main bin 200 and insert bin 250 with their bottom sides facing upwards.

[0054] As can be seen in the Figs. 1B and 1C, the second lift base 21, being the first lift member 12, may be considered a moving point of reference, or frame of reference, that depends on the position of said first lift member 12. It is with respect to this moving point of reference, or frame of reference, that the second lift device 20 can raise or lower the second gripper 24.

[0055] In relation to the main bin 200 and insert bin 250, Fig. 1A shows these bins in the start position with the insert bin 250 at a distance above the main bin 200. This is however shown in this manner for sake of clarity of the schematic representation. As its name already suggests, the insert bin 250 will, in practise, be inserted in the main bin when in the start position of Fig. 1A. In practise, the second gripper 24 of the second lift device 20 will grab the insert bin 250 and, in the lift cycle following, the insert bin 250 will be lifted out of the main bin 200. For this purpose the insert bin may be provided with a support, which, in the start position, rests on the upper edge of the main bin and may project a little outside the main bin in order to facilitate easy grabbing by the second gripper 24. The same applies for the embodiments of figures 2 and 3.

[0056] Figs. 2A and 2B show as a further embodiment of the lifting system 1 of Fig. 1 a further lifting system 2, which like lifting system 1 also comprises a first lift device 10 and a second lift device 20. Like the lifting system 1 of Fig. 1, the lifting system 2 is mounted on a side of a refuse collection vehicle 4 - e.g. a rear side, left side or right side - which vehicle has a top side 4a and a lower side 4b.

[0057] The difference between the embodiment of Fig. 1 and Fig. 2 is, that the in the embodiment of Fig. 2 the first lift mechanism 13 has been further elaborated as a (first) cylinder-piston-unit 30, which may for example be oriented vertically (in other words about exactly vertical) or vertical with a slant with respect to the vertical (in other

words not exactly vertical but with a angle with respect to the vertical of less than for example 45° or less than 30°). For similar parts, same references have been used as in the embodiment of Fig. 1.

[0058] In the embodiment of Fig. 2, the first lift base 11 is associated to the piston 30b of the first cylinder-piston-unit 30, whilst the cylinder 30a of the first cylinder-piston-unit 30 is part of the first lift member 12 so that the first lift member 12 can be raised or lowered with respect to the first lift base 11 by moving the piston 30b of the first cylinder-piston-unit 30 with respect to the cylinder 30a of the first cylinder-piston-unit 30. It is noted that this embodiment is an example, and that alternatively the first lift base 11 may be associated to the cylinder 30a of the first cylinder-piston-unit 30, whilst the first lift member 12 being associated to piston 30b of the first cylinder-piston-unit 30.

[0059] As the first lift member 12 functions as the base of the second lift device 20, the second lift device 20 may be mounted to, or on top of, the cylinder 30a (or in case of the alternative the piston 30b) of the first cylinder-piston unit 30.

[0060] In Fig. 2A the first cylinder-piston-unit is shown in a retracted state, and in Fig. 2B the first cylinder-piston-unit is shown in an extended state. That is, the first lift member 12 is raised by moving the piston 30b out of the cylinder-piston-unit 30 and is lowered by moving the piston 30b into the cylinder-piston-unit 30. This embodiment with a first cylinder-piston-unit 30 allows a compact and stable lifting system.

[0061] Raising the first lift member 12 yields a lifting movement - called raising - towards the top end 4a of the refuse vehicle 4. Lowering the first lift member 12 yields a lifting movement - called lowering - towards the lower end 4b of the refuse vehicle 4.

[0062] Considering Fig. 2A to be the start position of the lifting system 1, both the first lift device 10 and the second lift device 20 are in a position - with respect to the refuse vehicle 4 and street level, respectively - that allows for picking up a main bin with an insert bin suspended in the main bin. Considering Fig. 2A to be the end position of the lifting system 1, both the first lift device 10 and the second lift device 20 are in a position - with respect to the refuse vehicle 4 and street level, respectively - that allows for putting down on the street a main bin with an insert bin suspended in the main bin. In the state as shown in Fig. 2A, the first lift device 10 is in its (first) lower position, and the second lift device 20 is in its (second) lower position.

[0063] In the 'intermediate' position shown in Fig. 2B, the first lift device 10 has been raised by its maximum distance df_2 with respect to the first lift base 11 and the refuse vehicle 4 - i.e. the first lift device is in its (first) high position -, and the second lift device 20 has been raised a corresponding distance df_2 with respect to the first lift base, without the second gripper 24 having been raised yet with respect to the first lift member - i.e. the second gripper 24 still is in its (second) low position. Raising the

second gripper 24 with respect to the first lift member 12 may follow in a subsequent step of the lifting cycle. It is however also possible that, when the first lift device arrives at its (first) high position - at maximum raised distance df_2 -, the second gripper 24 simultaneously arrives at its (second) high position - at maximum raised distance ds_2 (Fig. 1C) - or already has arrived at its (second) high position.

[0064] As can be seen in Figs. 2A and 2B, the first lift base 11 has remained stationary with respect to refuse vehicle 4 between both positions. The first lift base 11, for a given position of lifting system 2 with respect to vehicle 4, can hence be considered a fixed point of reference, or frame of reference, for said lifting system 2.

[0065] Figs. 3A and 3B show as a further embodiment of the lifting system 1 of Fig. 1 and of the lifting system 2 of Fig. 2 a further lifting system 3, which like lifting system 1 and lifting system 2 also comprises a first lift device 10 and a second lift device 20. Like the lifting system 1 of Fig. 1 and the lifting system 2 of Fig. 2, the lifting system 3 is mounted on a side of a refuse collection vehicle - e. g. a rear side, left side or right side -.

[0066] The difference between the embodiments of Fig. 1 and Fig. 2, on the one hand, and the embodiment of Fig. 3, on the other hand, is, that, in the embodiment of Fig. 3:

- the first lift mechanism 13 has been further elaborated as having two (first) cylinder-piston-units 30,
- similar to the first lift mechanism 13 - the second lift mechanism 23 has been further elaborated as having two (second) cylinder piston units,
- a first tipping mechanism 40 is shown schematically, and
- a second tipping mechanism 70 is shown schematically.

[0067] These four differences between the embodiments of Fig. 1 and Fig. 2, on the one hand, and Fig. 3 on the other hand may be applied, in a lifting system according to the invention, separate (independent) from each other as well as in any combination. Like in the embodiment of Fig. 2, the first cylinder-piston units 30 may for example be oriented vertically (in other words about exactly vertical) or vertical with a slant with respect to the vertical (in other words not exactly vertical but with a angle with respect to the vertical of less than for example 45° or less than 30°). Similarly, the second cylinder-piston units 60 may for example be oriented vertically (in other words about exactly vertical) or vertical with a slant with respect to the vertical (in other words not exactly vertical but with a angle with respect to the vertical of less than for example 45° or less than 30°). For similar parts, same references have been used as in the embodiments of Fig. 1 and Fig. 2.

[0068] The first lift device 10 may additionally comprise one or more first tipping mechanisms. In the example of Fig. 3, two of these first tipping mechanisms are shown

schematically with reference no. 40. These two tipping mechanisms 40 have a common tipping shaft 41, which extends along and is rotatable around rotational axis HA1. The first tipping mechanisms 40 are configured to transform a translational movement of the first cylinder-piston-units 30 into a rotary movement of the first gripper 14 with respect to the first lift member 12. That is, the raising and or lowering movement of the first cylinder-piston-unit(s) 30 is transformed by the first tipping mechanism(s) into a rotary movement of the gripper 14 around the first horizontal rotational axis HA1, i.e. such that the first gripper 14 rotates with respect to the first lift base. The first gripper 14 is configured to carry the main bin 200. Hence, when the first gripper 14 rotates, the main bin 200 rotates accordingly. Fig. 3A schematically shows the first tipping mechanism(s) and first gripper 14 carrying a main bin 200 in their positions corresponding to the 'first upright position' of the main bin, in which the bottom side of the main bin faces downward and is arranged lower than the top side of the main bin. Fig. 3B schematically shows the first tipping mechanism(s) and first gripper 14 carrying a main bin 200 in their positions corresponding to the 'first tilted position' of the main bin, in which the bottom side of the main bin faces upward and is arranged higher than the top side of the main bin.

[0069] Like in the first lift device, the second lift mechanism 23 of the second lift device 20 may comprise one or more (second) cylinder-piston-units. Similar as in Fig. 2 for the first lift device 10, this may for example be one second cylinder-piston unit 60 or two second cylinder-piston-units 60 as is shown in Fig. 3. The second lift base 21 is associated to the piston 60b of the second cylinder-piston-unit 60, whilst the cylinder 60a of the second cylinder-piston-unit 60 is part of the second lift member 22 carrying the second gripper 24 so that the second lift member 22 and second gripper 24 can be raised or lowered with respect to the second lift base 21 by moving the piston 60b of the second cylinder-piston-unit 60 with respect to the cylinder 60a of the second cylinder-piston-unit 60. Taking into account that according to the invention the first lift member 12 constitutes the second lift base 21 of the second lift device 20, the piston 60b is in turn associated to or part of the first lift member 21. Because - see discussion in relation to Fig. 2 -, in case of the first lift mechanism 13 comprising a first cylinder piston-unit 30, the cylinder 30a (or alternatively the piston 30b) of the first cylinder-piston-unit 30 is part of the first lift member 12, the piston 60b of the second cylinder-piston unit 60 may be arranged in a series configuration (series configuration being considered the mechanical equivalent of an electrical series connection) with respect to the first cylinder-piston-unit 30. In the example of Fig. 3, the piston 60b of the second cylinder-piston-unit is supported on the cylinder 30a of the first cylinder-piston-unit 30. It is noted that this embodiment is an example, and that alternatively the second lift base 21 may be associated to the cylinder 60a of the first cylinder-piston-unit 60, whilst the second lift member 22 being associated

to piston 60b of the first cylinder-piston-unit 60.

[0070] Like the first lift device, the second lift device 20 may additionally comprise one or more second tipping mechanism. In the example of Fig. 3, two of these second tipping mechanisms are shown schematically with reference no.60. These two tipping mechanisms 60 have a common tipping shaft 71, which extends along and is rotatable around rotational axis HA2. The second tipping mechanisms 70 are configured to transform a translational movement of the second lifting mechanism 23 into a rotary movement of the second gripper 24 with respect to the first lift member 12 (which first lift member 12 serves as (second) lift base 22 of the second lift device 20. That is, the raising and or lowering movement of the lifting mechanism 23 - in this embodiment elaborated as the second cylinder-piston-unit(s) 60, is transformed by the second tipping mechanism(s) into a rotary movement of the gripper 24 around the second horizontal rotational axis HA2, i.e. such that the gripper 24 rotates with respect to the second lift base 21. The second gripper 24 is configured to carry the insert bin. Hence, when the second gripper 24 rotates, the insert bin would rotate accordingly.

[0071] Figures 4-8 show a more detailed embodiment of a lifting system 100 according to the invention. This lifting system 100 for a refuse collection vehicle, comprises a first lift device 10 and a second lift device 20. For similar parts, same references have been used as in the embodiments of Fig 1, Fig. 2 and Fig. 3.

[0072] The first lift device 10 comprises: a first lift member 12, a first lift base 11, a first lift mechanism 13 configured to raise and lower the first lift member 12 with respect to the first lift base 11, and a first gripper 14. The first gripper 14 is configured to carry a main bin 200 for refuse, is mounted to and carried by the first lift member 12 to be raised and lowered together with the raising and lowering of the first lift member 12, and is rotatable, with respect to the first lift base 11, around a first horizontal rotation axis to rotate the main bin 200 between a first upright position (Figs. 5A and 5B) and a first tilted position (Fig. 5C). In this embodiment said rotational axis coincides with the horizontal shaft 41.

[0073] The first gripper 14 shown in Fig. 4, which may also be called a lifting chair, has upper gripping elements 14a and lower gripping elements 14b to engage with the main bin 200, so as to carry it. The upper gripping elements 14a may - as is known from prior art - be upwardly directed fingers to be inserted from below into the hollow rim 203 - see Fig. 5 - at the upper side of a main bin 200. The lower gripping elements 14b may - as is known from the prior art - be pushing pads to support the main bin 200 amongst others during tilting of the main bin from the upright to the tilted position. Such a gripper 14 is known as such and is typically in correspondence with the 'standardised' bins used in a region of interest.

[0074] The first gripper 14 of Fig. 4 further has a bin rim lock 15 - as is known from prior art - to engage in locking manner the rim of the main bin between the gripper element(s) 14 and the bin rim lock 15, so as to prevent

the main bin 200 from falling from its gripper 14, e.g. when rotating the main bin between the first upright position and the first tilted position. The bin rim lock 15 may be actuated by a spring mechanism, e.g. gas springs, operated with pneumatic cylinders to effect said locking engagement.

[0075] The first lift mechanism 13 in Figures 4-8 comprises two vertically oriented first telescoping units 30 - see Fig. 6 - which are contained in a housing 31 and have in this embodiment each three telescoping parts 30a, 30b, 30c. These housings, or lifting columns, 31 fully encompass the telescoping units 30 in their respective extended and/or retracted states (shown in Figs. 6B respectively 6A). The lifting column may be a metal construction, e.g. a steel construction. The housing/lifting column 31 may further be shielded by protection plates 32 (shown in Fig. 8), which partially or fully shield the lifting columns 31 shown in Fig. 4 to provide extra protection of the lifting system 100.

[0076] The first lift base 11 is associated to the lower one 30c of telescoping parts of the first telescoping units 30, whilst the first lift member 12 is associated to the upper one 30a of the telescoping parts of the first telescoping units 30, so that the first lift member 12 can be raised or lowered with respect to the first lift base 11 by telescoping (= telescopically moving) the telescoping parts of the first telescoping units 30 with respect to each other.

[0077] A full stroke FS1 of the first telescoping units 30, i.e. the extension and retraction length, may e.g. be in the order of 1250 mm - 1700 mm.

[0078] The first lift device 10 further comprises two first tipping mechanisms 40, configured to transform a translational movement of the first telescoping units 30 into a rotary movement of the first gripper 14 with respect to the first lift base 11. One first tipping mechanism 40 for each of the first telescoping units 30.

[0079] The first tipping mechanisms 40 are provided at opposing ends of a common first tipping shaft 41. The first tipping mechanisms 40 define a common first rotation axis, which rotation axis extends parallel to the length axis of the tipping shaft 41 and may coincide with this length axis or may extend along the tipping shaft 41 at some distance transverse to the tipping shaft 41. The first gripper 14 is mounted on the tipping shaft 41 between the first tipping mechanisms 40.

[0080] The first tipping mechanisms in Figs. 4-8 each comprise: a first tipping plate 46 rotatably mounted to the first lift member 12 and having a first sprocket wheel section 49, and a first gear rack 47 having a number of gear members 48 aligned along the direction of the translational movement of the first lift device 10 and configured to successively engage, when the first tipping plate 46 passes the first gear rack 47, with the first sprocket wheel section 49 so that the first tipping plate rotates with respect to the first lift member 12.

[0081] The first gripper 14 is mounted to the first tipping shaft 41, which in turn is mounted between the two first

tipping plates 46, so that the gripper 14 rotates together with the first tipping plates 46 around a common first rotation axis. The first sprocket wheel section 49 has sprockets 50, e.g. teeth, that are separated by indentations 51. The number of gear members 48 aligned along the first gear rack 47 is configured to successively engage, when the first tipping plate 46 passes the first gear rack 47, in said indentations 50 of the sprocket wheel section 49. This yields a reliable rotation of the first tipping plate 46 and first tipping shaft 41 (which has its length axis coinciding with the first rotation axis HA1) and hence rotation of the first gripper 14 around the common first rotation axis HA1.

[0082] The working principle of such a first tipping mechanism 40 as shown in Figs. 4 and 5, will be further explained below - with reference to FIG. 7 - on the basis of the second tipping mechanism 70 to be introduced. The working principles of the first tipping mechanism(s) 40 and second tipping mechanism(s) 70 are basically the same.

[0083] The second lift device 20 in Figs. 4-8 comprises a second lift base 21 and a second gripper 24. The second gripper 24 is configured to carry one or more insert bins 250 for refuse, and is rotatable, with respect to the second lift base 21, around a second horizontal rotation axis to rotate the insert bin between a second upright position and a second tilted position. The gripper 24 in Fig. 4 is mounted on a horizontal second tipping shaft 71. In this embodiment the second rotation axis coincides with the horizontal second tipping shaft 71.

[0084] The second lift device 20 further comprises a second lift mechanism 23 configured to raise and lower the second gripper 24 with respect to the second lift base 21, which according to the invention is the first lift member 12. The second lift mechanism 23 comprises two vertically oriented telescoping units 60 (of which only one can be seen in the perspective view of Figure 4). The telescoping units 60 are each contained in a housing 61 (see Fig. 4) and have in this embodiment each three telescoping parts 60a, 60b, 60c. These housings, or lifting columns, 61 fully encompass the telescoping units 60 in their respective extended and/or retracted states (shown in Figs. 6B respectively 6A). The lifting column 61 may be a metal construction, e.g. a steel construction. The housing/lifting column 61 may further be shielded by protection plates 32 (shown in Fig. 8), which partially or fully wrap shield the lifting columns 61 shown in Fig. 4 to provide extra protection of the lifting system.

[0085] The second lift base 21 is associated to the lower one(s) 60c of the telescoping parts of the second telescoping units 60, whilst the second gripper 24 is associated to the upper one 60a of the telescoping parts of the second telescoping units 60 so that the second gripper 24 can be raised or lowered with respect to the second lift base 21 by telescoping (=telescopically moving) the telescoping parts 60a, 60b, 60c of the second telescoping units 60 with respect to each other.

[0086] A full stroke FS2 of the second telescoping units

60, i.e. the extension and retraction length, may e.g. be in the order of 600 mm - 1100 mm.

[0087] The second gripper 24 of Fig. 4-8 further has an insert bin rim lock 25 to engage in locking manner the projecting part 253 of the insert bin 250 between the gripper 24 and the lock 25, so as to prevent the insert bin 250 from falling from the gripper 24, e.g. when rotating the insert bin between the second upright position and the second tilted position. The bin rim lock 25 may be actuated by a spring mechanism, e.g. by gas springs, to effect said locking engagement.

[0088] The second lift device 20 further comprises two second tipping mechanisms 70, of which only one is shown in detail in Fig. 7. These second tipping mechanisms 70 are configured to transform a translational movement of the second telescoping units 60 into a rotary movement of the second gripper 24 with respect to the second lift base 21/first lift member 12. One of the second tipping mechanisms 70 for each of the second telescoping units 60.

[0089] The second tipping mechanisms 70 are provided at opposing ends of a common second tipping shaft 71. The second tipping mechanisms 70 define a common second rotation axis, which rotation axis extends parallel to the length axis of the second tipping shaft 71 and may coincide with this length axis or may extend along the tipping shaft 71 at some distance transverse to the tipping shaft 71. The second gripper 24 is mounted on the tipping shaft 71, between the second tipping mechanisms 70.

[0090] The second tipping mechanisms 70 of Figs. 4-8 each comprise, shown in detail in Fig. 7: a second tipping plate 76 rotatably mounted to the second lift member 22 and having a second sprocket wheel section 79, and a second gear rack 77 having a number of gear members 78a, 78b, 78c aligned along the direction of the translational movement of the second lift device 20 and configured to successively engage, when the second tipping plate 76 passes the second gear rack 77, with the second sprocket wheel section 79 so that the second tipping plate 76 rotates with respect to the second lift member 22.

[0091] The second gripper 24 is mounted to the second tipping shaft 71, which in turn is mounted between the two second tipping plates 76, so that the gripper 24 rotates together with the second tipping plates 76 around a common second rotation axis HA2. The length axis of the second tipping shaft extends parallel to the second rotation axis HA2, and a distance from the second rotation axis HA2. The second sprocket wheel section 79 has sprockets 80, e.g. teeth, that are separated by indentations 81a, 81b, 81c. The number of gear members 78a, 78b, 78c aligned along the second gear rack 77 may be configured to successively engage, when the second tipping plate 76 passes the second gear rack 77, in said indentations 81a, 81b, 81c of the sprocket wheel section 79. This yields a reliable rotation of the second tipping plate 76 and second tipping shaft 71 and hence rotation of the second gripper 24 around the common second rotation axis.

[0092] As already said, the working principle of the second tipping mechanisms 70 is basically identical to that of the first tipping mechanisms 40. The working principle of both will now be elucidated on the basis of the second tipping mechanism 70 with reference to Figs. 7A, 7B, and 7C, which show the framed detail 70 of Fig. 4 in three different stages of engagement between the second tipping plate 76 and second gear rack 77.

[0093] In Fig. 7A the second tipping plate 76 engages, during upward motion due to the first lift device 10 and/or due to the second lift device 20, with its first indentation 81a the lower gear member 78a of the second gear rack 77. If the lifting motion of lift device 10 and/or 20 yields a further upward movement, the tipping plate 76 subsequently rotates to the position as shown in Fig. 7B. There the next indentation 81b of the tipping plate 76 starts to engage with the middle gear member 78b of the second gear rack 77. In this position the second tipping plate 76, and hence the second gripper 24, have rotated by a tipping angle α with respect to the position of Fig. 7A. Further upward movement of the lift device 10 and/or 20 then yields the subsequent rotation of the tipping plate 76 as shown in Fig. 7C. There, the tipping plate 76 has now engaged the upper gear member 78c of the second gear rack 77 with its next indentation 81c. In this position the second tipping plate 76, and hence the second gripper 24, have rotated by a tipping angle β with respect to the position of Fig. 7B. When the first lift device and/or second lift device are lowered, the above happens in reverse direction.

[0094] Figs. 6A and 6B show a telescoping assembly 150 for a lifting system 100 according to Figs. 4-8. As that of Figure 4. The telescoping assembly 150 comprises a first telescoping unit 30 and a second telescoping unit 60 which is mounted to said first telescoping unit 30.

[0095] The first and second telescoping units 30, 60 have a lower telescoping part 30c, 60c, an intermediate telescoping part 30b, 60b, and an upper telescoping part 30a, 60a. The second telescoping unit 60 is mounted (partly) parallel to the first telescoping unit 30 in order to allow the second gripper to be lowered to about the same position as the first gripper (which is desired because the main bin and insert bins are to be grabbed at about the same vertical level), but from mechanical perspective the second telescoping unit 60 is configured in series with the first telescoping unit 30 by supporting and mounting the piston 60b of the second telescoping unit onto the cylinder 30a of the first telescoping unit 30. In other words, the lower one 60c of the telescoping parts of the second telescoping unit 60 is supported on the upper one 30a of the telescoping parts of the first telescoping unit 30 in an attachment zone below the upper end 72 of the first telescoping unit 30.

[0096] The telescoping units 30, 60 each have two sliding blocks 91, and 92, respectively 93 and 94 which guide the upper telescoping parts 30a, 60a when moving back and forth in their respective lifting columns/housings 31, 61 (see Fig. 4), without the upper telescoping parts com-

ing into contact with said the respective lifting column/housing.

[0097] The first and second telescoping units 30, 60 may be hydraulic telescoping units. Alternatively, the first and/or second telescoping unit(s) 30, 60 is/are pneumatic telescoping unit(s). The telescoping units as shown in Figs. 6A and 6B each have three telescoping parts, for example three telescoping hollow cylinders or two telescoping hollow cylinders and one telescoping massive cylinder. Three or even more telescoping parts allow increase of the ratio of maximum length versus minimum length increases (= max. length / min. length). The length of stroke thus increases, while the retracted length dimension is maintained compact. The telescoping aspect of the telescoping units 30, 60 in Figs. 6A and 6B is further illustrated by the extension position shown in Fig. 6B.

[0098] In Figs. 5A - 5C is illustrated how a main bin and an insert bin may be lifted by the lifting system of Figs. 4-8.

[0099] In Fig. 5A the lifting system 100 has received a main bin 200 with two insert bins 250. The main bin 200 is grabbed by the first gripper 14 and in a first upright position. The two insert bins 250 are each grabbed by the second gripper 24 and are in a second upright position. In the first upright position, the underside of the bottom 201 of the main bin 200 faces downwards and the bottom 201 of the main bin is arranged lower than the top side 202 of the main bin 200. In the second upright position the underside of the bottom 251 of the insert bin 250 faces downwards and the bottom 251 of the insert bin is arranged lower than a top side 252 of the insert bin 250.

[0100] In Fig. 5B, the main bin 200 has been lifted from the ground. The lift device 10 has lifted the main bin some distance with respect to the first lift base 11. In Fig. 5B, also the insert bins 250 have been lifted. However, the insert bins 250 have been lifted a larger distance than the main bin 200 has. This is because the insert bins 250 not only have been lifted by the first lift device simultaneously with the main bin, but also have been lifted by the second lift device 20, which lifted the insert bins 250 out of the main bin. The second lift device 20 has effected an increase of the distance between the first lift member 12 and the second gripper 24, or in other words the distance between the second gripper 24 and first gripper 14 has been increased. As can be seen in Fig. 5B, the main bin 200 and insert bins 250 still are in the first upright position and second upright position, respectively.

[0101] In Fig. 5C, the main bin 200 and the insert bins 250 have been lifted to their respective higher positions, and have been tilted by their respective tipping mechanisms into the first tilted position and second tilted position, respectively. In other words, the main bin 200 and the insert bins 250 are in their emptying positions. When in the first tilted position, the underside of the bottom 201 of the main bin 200 faces upward and the bottom 201 of the main bin 200 is arranged higher than the top side 202 of the main bin. This allows the refuse to easily fall out

of the main bin 200 and into the collection body, or hopper, of the refuse collection vehicle. Similarly, when in the second tilted position, the underside of the bottom 251 of the insert bin 250 faces upward and the bottom 251 of the insert bin is arranged higher than the top side 252 of the insert bin 250. The tipping angles β (see Fig. 7C) in the first and/or second tilted position may typically be in the order of 120-145 degrees with respect to the upright position. It is noted, however, that The lifting system 100 of Figs. 4-8 may according to a further embodiment be provided with one or more adjustment mechanisms to adjust these tipping angles of the first and second tipping mechanisms 40 and/or 70.

[0102] Figure 8 is a rear view of a refuse collection vehicle 300 according to the invention. The vehicle 300 comprises: a chassis 301, a driver's cab 302 provided on the chassis, a collection body 310 for collecting refuse provided on the chassis, behind the driver's cab, and a lifting system 100 for raising refuse bins from a pick-up position, emptying the refuse bins into the collection body, and lowering the refuse bins to return to the pick-up position. The embodiment shown in Fig. 8 has two upper hoppers 330 - one for each insert bin - and a lower hopper 320. The lifting system 100 can thus empty an insert bin into the upper hopper 330 and a main bin into the lower hopper 320.

[0103] Embodiments and further embodiments of the present invention may be expressed in words as set out in the following clauses:

Clause 1: Lifting system for a refuse collection vehicle, comprising a first lift device and a second lift device,

wherein the first lift device comprises:

- a first lift member,
- a first lift base,
- a first lift mechanism configured to raise and lower the first lift member with respect to the first lift base, and
- a first gripper which is:
 - configured to carry a main bin for refuse,
 - mounted to and carried by the first lift member to be raised and lowered together with the raising and lowering of the first lift member, and
 - rotatable, with respect to the first lift base, around a first horizontal rotation axis to rotate the main bin between a first upright position and a first tilted position;

wherein, in the first upright position, a bottom side of the main bin is arranged lower than a top side of the main bin, and wherein, in the first

tilted position, the bottom side of the main bin is arranged higher than the top side of the main bin; wherein the second lift device comprises:

- a second lift base,
- a second gripper which is:
 - configured to carry an insert bin for refuse, and
 - rotatable, with respect to the second lift base, around a second horizontal rotation axis to rotate the insert bin between a second upright position and a second tilted position,
- a second lift mechanism configured to raise and lower the second gripper with respect to the second lift base;

wherein, in the second upright position, a bottom side of the insert bin is arranged lower than a top side of the insert bin, and wherein, in the second tilted position, the bottom side of the insert bin is arranged higher than the top side of the insert bin;

wherein the first lift member is the second lift base of the second lift device which is configured such that the first lift member and second lift device are raised and lowered together as one unit when the first lift member is raised respectively lowered by the first lift mechanism.

Clause 2: Lifting system according to clause 1, wherein the first lift mechanism comprises a first vertically oriented linear actuator, the first lift base is associated to a lower part of the first linear actuator whilst the first lift member being associated to an upper part of the first linear actuator so that the first lift member can be raised or lowered with respect to the first lift base by actuation of the first linear actuator.

Clause 3: Lifting system according to clause 2, wherein the first lift device further comprises a first tipping mechanism configured to transform a translational movement of the first linear actuator into a rotary movement of the first gripper with respect to the first lift member around the first rotation axis.

Clause 4: Lifting system according to clause 3,

wherein the first tipping mechanism comprises:

- a first tipping plate rotatably mounted to the first lift member and having a first sprocket wheel section, and
- a first gear rack having a number of gear members aligned along the direction of the translational movement and configured to successively engage, when the first tipping

plate passes the first gear rack, with the first sprocket wheel section so that the first tipping plate rotates with respect to the first lift member around the first rotation axis; and

wherein the first gripper is mounted to the first tipping plate so that it rotates together with the first tipping plate.

Clause 5: Lifting system according to one of the clauses 3-4,

wherein the first lift mechanism comprises two said first linear actuators and two said first tipping mechanisms, one of the first tipping mechanisms being associated to one of the linear actuators and another of the first tipping mechanisms being associated to another of the first linear actuators,

wherein the first tipping mechanisms define a common said first rotation axis, and wherein, viewed along the common first rotation axis, the first gripper is arranged between the first tipping mechanisms.

Clause 6: Lifting system according to one of the clauses 2-5,

wherein the second lift base is supported on the upper part of the first linear actuator at a position below the upper end of the first linear actuator.

Clause 7: Lifting system according to one of the clauses 2-6, wherein the first linear actuator comprises a telescoping unit of telescoping parts, wherein the first lift base is associated to a lower one of the telescoping parts of the first telescoping unit whilst the first lift member being associated to an upper one of the telescoping parts of the first telescoping unit so that the first lift member can be raised or lowered with respect to the first lift base by telescoping of the first telescoping unit.

Clause 8: Lifting system according to clause 7, wherein the first telescoping unit is a hydraulic telescoping unit.

Clause 9: Lifting system according to one of the clauses 2-6, wherein the first linear actuator comprises an electromechanical actuator, which has an electro-motor and is configured to convert rotary movement of the electro-motor into linear motion.

Clause 10: Lifting system according to one of the preceding clauses,

wherein the second lift mechanism comprises a second vertically oriented linear actuator, the second lift base being associated to a lower part of the second linear actuator whilst the second gripper being associated to an upper part of the second linear actuator so that the second gripper can be raised or lowered with respect to the second lift base by actuation of the second linear actuator.

Clause 11: Lifting system according to clause 10, wherein the second lift device further comprises a second tipping mechanism configured to transform a translational movement of the second linear actuator into a rotary movement of the second gripper with respect to the second lift base around the second rotation axis.

Clause 12: Lifting system according to clause 11,

wherein the second tipping mechanism comprises:

- a second tipping plate rotatably mounted to the part of the second linear actuator which is movable with respect to the second lift base, the second tipping plate having a second sprocket wheel section, and
- a second gear rack having a number of gear members aligned along the direction of the translational movement and configured to successively engage, when the second tipping plate passes the second gear rack, with the second sprocket wheel so that the second tipping plate rotates with respect to the second linear actuator around the second rotation axis; and

wherein the second gripper is mounted to the second tipping plate so that it rotates together with the second tipping plate.

Clause 13: Lifting system according to one of the clauses 11-12,

wherein the second lift mechanism comprises two said second linear actuators and two said second tipping mechanisms, one of the second tipping mechanisms being associated to one of the second linear actuators and another of the second tipping mechanisms being associated to another of the second linear actuators, wherein the second tipping mechanisms define a common said second rotation axis, and wherein, viewed along the common second rotation axis, the second gripper is arranged between the second tipping mechanisms.

Clause 14: Lifting system according to one of the clauses 10-13, wherein the second linear actuator comprises a telescoping unit of telescoping parts, wherein the second lift base is associated to a lower one of the telescoping parts of the second telescoping unit whilst the second gripper (or second lift member) being associated to an upper one of the telescoping parts of the second telescoping unit so that the second gripper (respectively second lift member) can be raised or lowered with respect to the second lift base by telescoping of the second telescoping

unit.

Clause 15: Lifting system according to clause 14, wherein the second telescoping unit is a hydraulic telescoping unit.

Clause 16: Lifting system according to one of the clauses 10-13, wherein the second linear actuator comprises an electromechanical actuator, which has an electro-motor and is configured to convert rotary movement of the electro-motor into linear motion.

Clause 17: Refuse collection vehicle, wherein the vehicle comprises:

- a chassis,
- a driver's cab provided on the chassis,
- a collection body for collecting refuse, provided on the chassis, behind the driver's cab, and
- a lifting system according to one of the preceding clauses for raising refuse bins from a pick-up position, emptying the refuse bins into the collection body, and lowering the refuse bins to return to the pick-up position.

Clause 18: Refuse collection vehicle, according to clause 17, wherein the vehicle comprises a plurality of lifting systems according to one of the preceding clauses, wherein the plurality of lifting systems are arranged in parallel.

[0104] It is noted that in this particular embodiment the lifting system 100 is provided at the rear of the vehicle 300. This ought to be considered an example. The lifting system 100 may equally be provided at a side of the vehicle 300, e.g. the right side for countries with right-side driving, or the left side for countries with left-side driving.

[0105] It is not shown in the figures, but may be easily envisaged therefrom, that the refuse collection vehicle may further comprise a plurality of lifting systems, wherein the plurality of lifting systems are arranged in parallel, e.g. side-by-side at the rear of the vehicle, or side-by-side at the left or right side of the vehicle, or both at the rear and the left and/or right side of the vehicle.

[0106] The embodiments described in this document serve exclusively as examples. It should be appreciated that the invention may also be implemented in other forms. In particular, the mere fact that certain technical measures are specified in different dependent claims still allows the possibility that a combination of these technical measures may advantageously be applied.

Claims

1. Lifting system (100) for a refuse collection vehicle, comprising a first lift device and a second lift device,

wherein the first lift device (10) comprises:

- a first lift member (12),
- a first lift base (11),
- a first lift mechanism (13) configured to raise and lower the first lift member (12) with respect to the first lift base (11), and
- a first gripper (14) which is:

- configured to carry a main bin (200) for refuse,
- mounted to and carried by the first lift member (12) to be raised and lowered together with the raising and lowering of the first lift member (12), and
- rotatable, with respect to the first lift base (11), around a first horizontal rotation axis (HA1) to rotate the main bin (200) between a first upright position and a first tilted position;

wherein, in the first upright position, a bottom side (201) of the main bin (200) is arranged lower than a top side (202) of the main bin (200), and wherein, in the first tilted position, the bottom side (201) of the main bin (200) is arranged higher than the top side (202) of the main bin (200); wherein the second lift device (20) comprises:

- a second lift member (22),
- a second lift base (21),
- a second lift mechanism (23) configured to raise and lower the second lift member (22) with respect to the second lift base (21),
- a second gripper (24) which is:

- configured to carry an insert bin (250) for refuse,
- mounted to and carried by the second lift member (22) to be raised and lowered together with the raising and lowering of the second lift member (22), and
- rotatable, with respect to the second lift base (21), around a second horizontal rotation axis (HA2) to rotate the insert bin (250) between a second upright position and a second tilted position;

wherein, in the second upright position, a bottom side (251) of the insert bin (250) is arranged lower than a top side (252) of the insert bin (250), and wherein, in the second tilted position, the bottom side (251) of the insert bin (250) is arranged higher than the top side (252) of the insert bin (250);

wherein the first lift member (12) is the second lift base (21) of the second lift device (20) which is configured such that the first lift member (12) and second lift device (20) are raised and low-

- ered together as one unit over the same distance when the first lift member (12) is raised respectively lowered by the first lift mechanism (13); wherein the first lift mechanism (13) comprises a first vertically oriented linear actuator (30), wherein the first lift base (11) is associated to a lower part of the first linear actuator (30) and the first lift member (12) is associated to an upper part of the first linear actuator (30) so that the first lift member (12) can be raised or lowered with respect to the first lift base (11) by actuation of the first linear actuator (30); wherein the second lift mechanism comprises a second vertically oriented linear actuator (60); and wherein the second lift base (21) is associated to a lower part of the second linear actuator (60) and the second lift member (22) is associated to an upper part of the second linear actuator (60) so that the second lift member (22) can be raised or lowered with respect to the second lift base (21) by actuation of the second linear actuator (60).
2. Lifting system (100) according to claim 1, wherein the first lift device (10) further comprises a first tipping mechanism (40) configured to transform a translational movement of the first linear actuator (30) into a rotary movement of the first gripper (14) with respect to the first lift member (12) around the first rotation axis (HA1).
 3. Lifting system (100) according to claim 2, wherein the first tipping mechanism (40) comprises:
 - a first tipping plate (46) rotatably mounted to the first lift member (12) and having a first sprocket wheel section (49), and
 - a first gear rack (47) having a number of gear members (48) aligned along the direction of the translational movement and configured to successively engage, when the first tipping plate (46) passes the first gear rack (47), with the first sprocket wheel section (49) so that the first tipping plate (46) rotates with respect to the first lift member (12) around the first rotation axis (HA1); and
 wherein the first gripper (14) is mounted to the first tipping plate (46) so that it rotates together with the first tipping plate (46).
 4. Lifting system (100) according to one of the claims 2-3, wherein the first lift mechanism (13) comprises
 - two said first linear actuators (30) and two said first tipping mechanisms (40), one of the first tipping mechanisms being associated to one of the linear actuators and another of the first tipping mechanisms being associated to another of the first linear actuators, wherein the first tipping mechanisms (40) define a common said first rotation axis (HA1), and wherein, viewed along the common first rotation axis (HA1), the first gripper (14) is arranged between the first tipping mechanisms (40).
 5. Lifting system (100) according to one of the claims 1-4, wherein the second lift base (21) is supported on the upper part of the first linear actuator (30) at a position below the upper end of the first linear actuator (30).
 6. Lifting system (100) according to one of the claims 1-5, wherein the first linear actuator (30) comprises a telescoping unit of telescoping parts, and wherein the first lift base (11) is associated to a lower one of the telescoping parts of the first telescoping unit and the first lift member (12) is associated to an upper one of the telescoping parts of the first telescoping unit so that the first lift member (12) can be raised or lowered with respect to the first lift base (11) by telescoping of the first telescoping unit.
 7. Lifting system (100) according to claim 6, wherein the first telescoping unit is a hydraulic telescoping unit.
 8. Lifting system (100) according to one of the claims 1-5, wherein the first linear actuator comprises an electromechanical actuator, which has an electro-motor and is configured to convert rotary movement of the electro-motor into linear motion.
 9. Lifting system (100) according to one of the claims 1-8, wherein the second lift device (20) further comprises a second tipping mechanism (70) configured to transform a translational movement of the second linear actuator (60) into a rotary movement of the second gripper (24) with respect to the second lift member (22) around the second rotation axis (HA2).
 10. Lifting system (100) according to claim 9, wherein the second tipping mechanism (70) comprises:
 - a second tipping plate (76) rotatably mounted to the second lift member (22) and having a second sprocket wheel section (79), and

- a second gear rack (77) having a number of gear members (78a, 78b, 78c) aligned along the direction of the translational movement and configured to successively engage, when the second tipping plate (76) passes the second gear rack (77), with the second sprocket wheel section (79) so that the second tipping plate (76) rotates with respect to the second lift member (22) around the second rotation axis (HA2); and

wherein the second gripper (24) is mounted to the second tipping plate (76) so that it rotates together with the second tipping plate (76).

11. Lifting system (100) according to one of the claims 9-10,

wherein the second lift mechanism (23) comprises two said second linear actuators (60) and two said second tipping mechanisms (70), one of the second tipping mechanisms being associated to one of the second linear actuators and another of the second tipping mechanisms being associated to another of the second linear actuators, wherein the second tipping mechanisms (70) define a common said second rotation axis (HA2), and wherein, viewed along the common second rotation axis (HA2), the second gripper (24) is arranged between the second tipping mechanisms (70).

12. Lifting system (100) according to one of the claims 1-11,

wherein the second linear actuator (60) comprises a telescoping unit of telescoping parts, and wherein the second lift base (21) is associated to a lower one of the telescoping parts of the second telescoping unit and the second lift member (22) is associated to an upper one of the telescoping parts of the second telescoping unit so that the second lift member (22) can be raised or lowered with respect to the second lift base (21) by telescoping of the second telescoping unit.

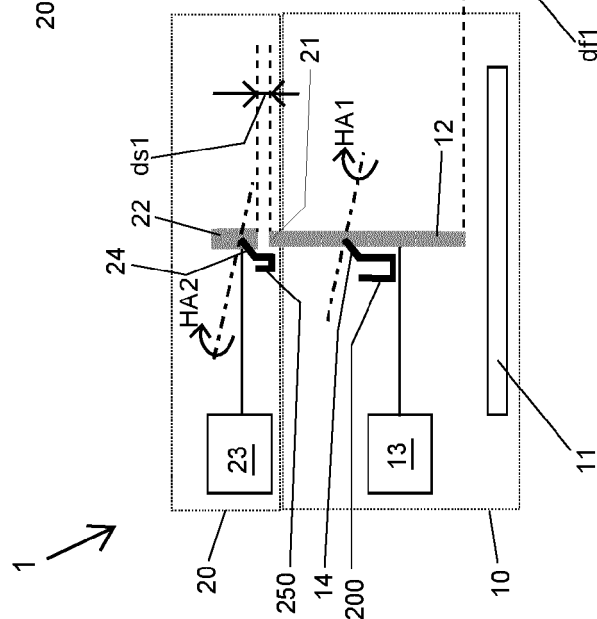
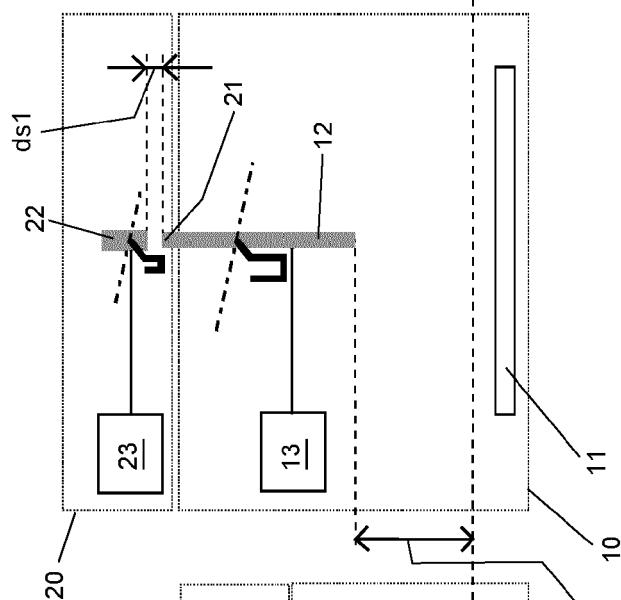
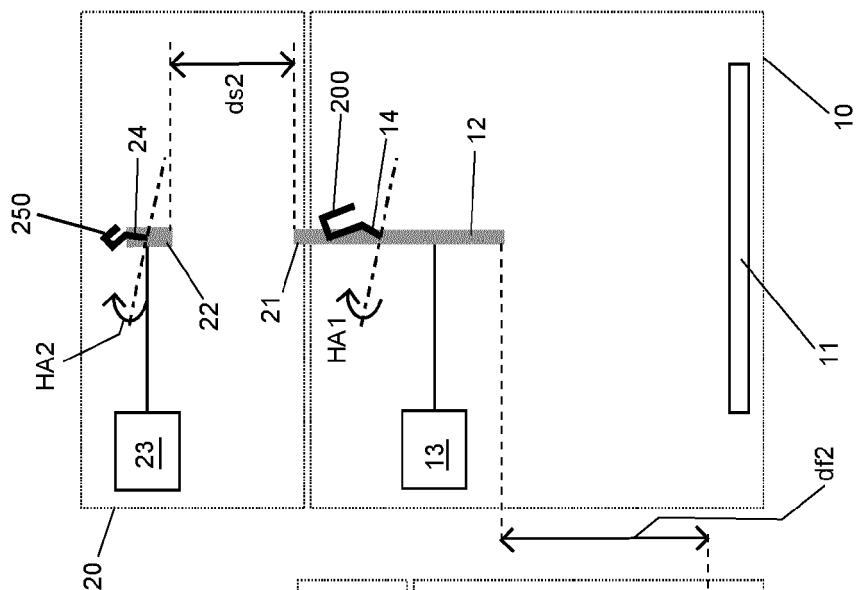
13. Lifting system (100) according to claim 12, wherein the second telescoping unit is a hydraulic telescoping unit.

14. Lifting system (100) according to one of the claims 1-11, wherein the second linear actuator (60) comprises an electromechanical actuator, which has an electro-motor and is configured to convert rotary movement of the electro-motor into linear motion.

15. Refuse collection vehicle, wherein the vehicle com-

prises:

- a chassis (301),
- a driver's cab (302) provided on the chassis (301),
- a collection body (310) for collecting refuse, provided on the chassis (301), behind the driver's cab (302), and
- a lifting system (100) according to one of the preceding claims for raising refuse bins from a pick-up position, emptying the refuse bins into the collection body, and lowering the refuse bins to return to the pick-up position.



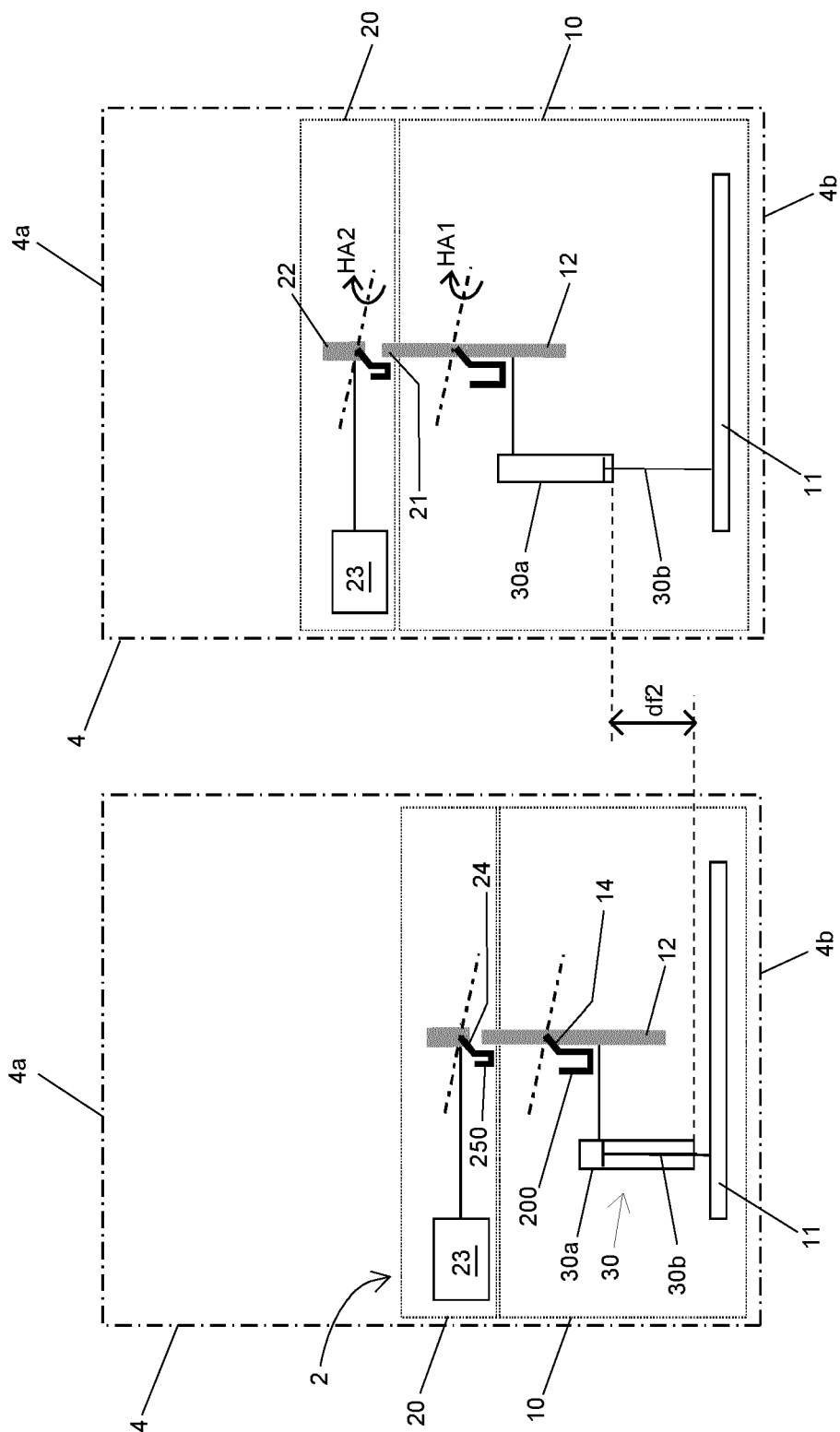
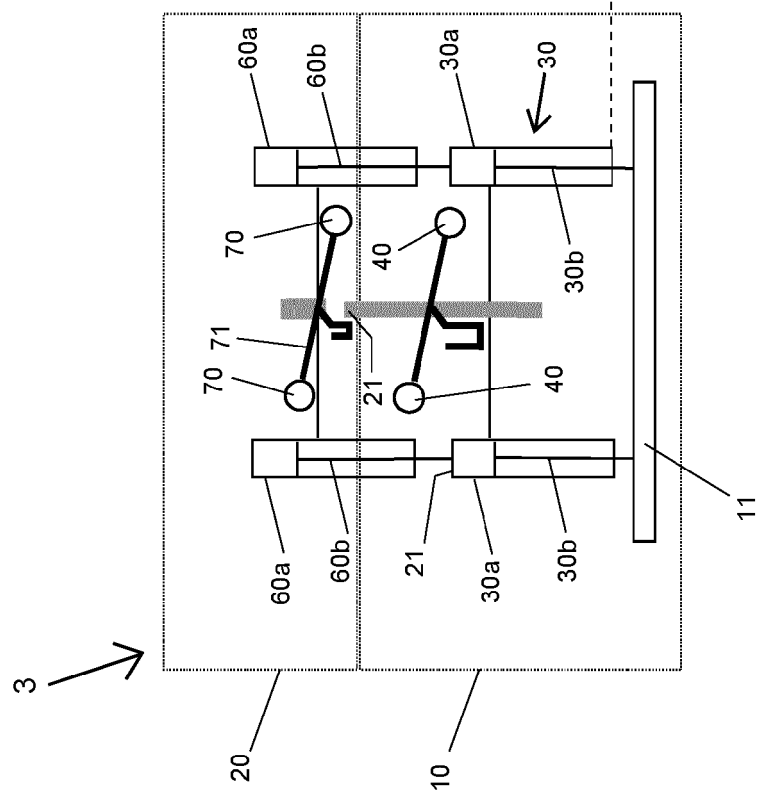
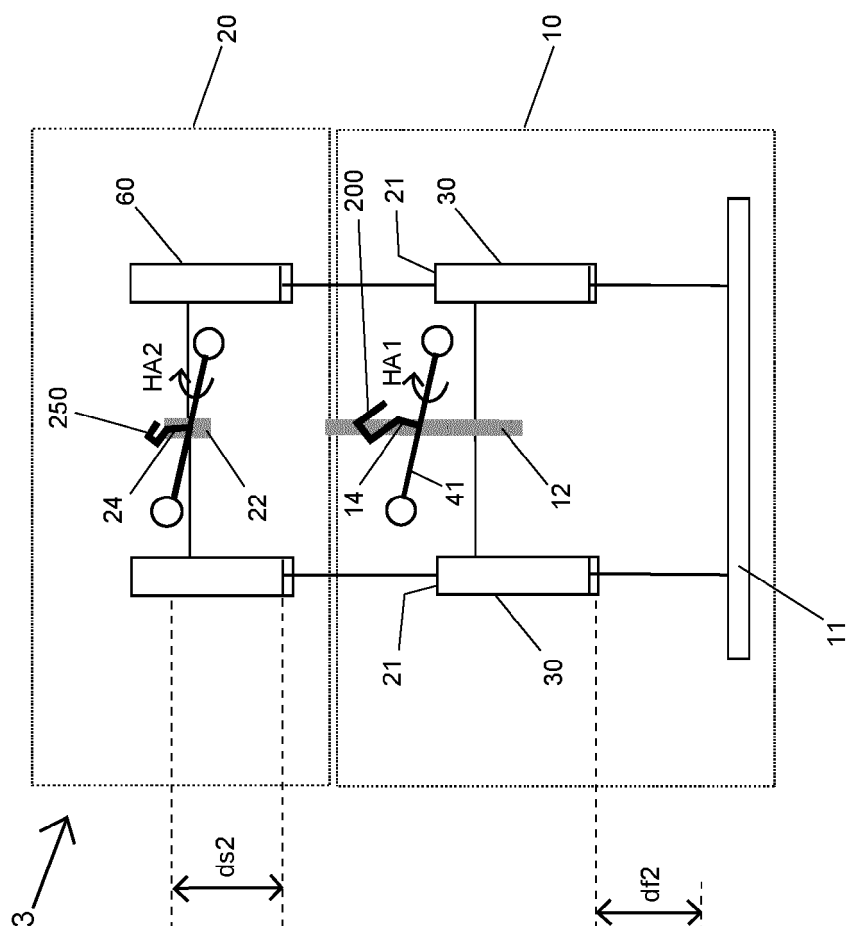


FIG. 2B

FIG. 2A



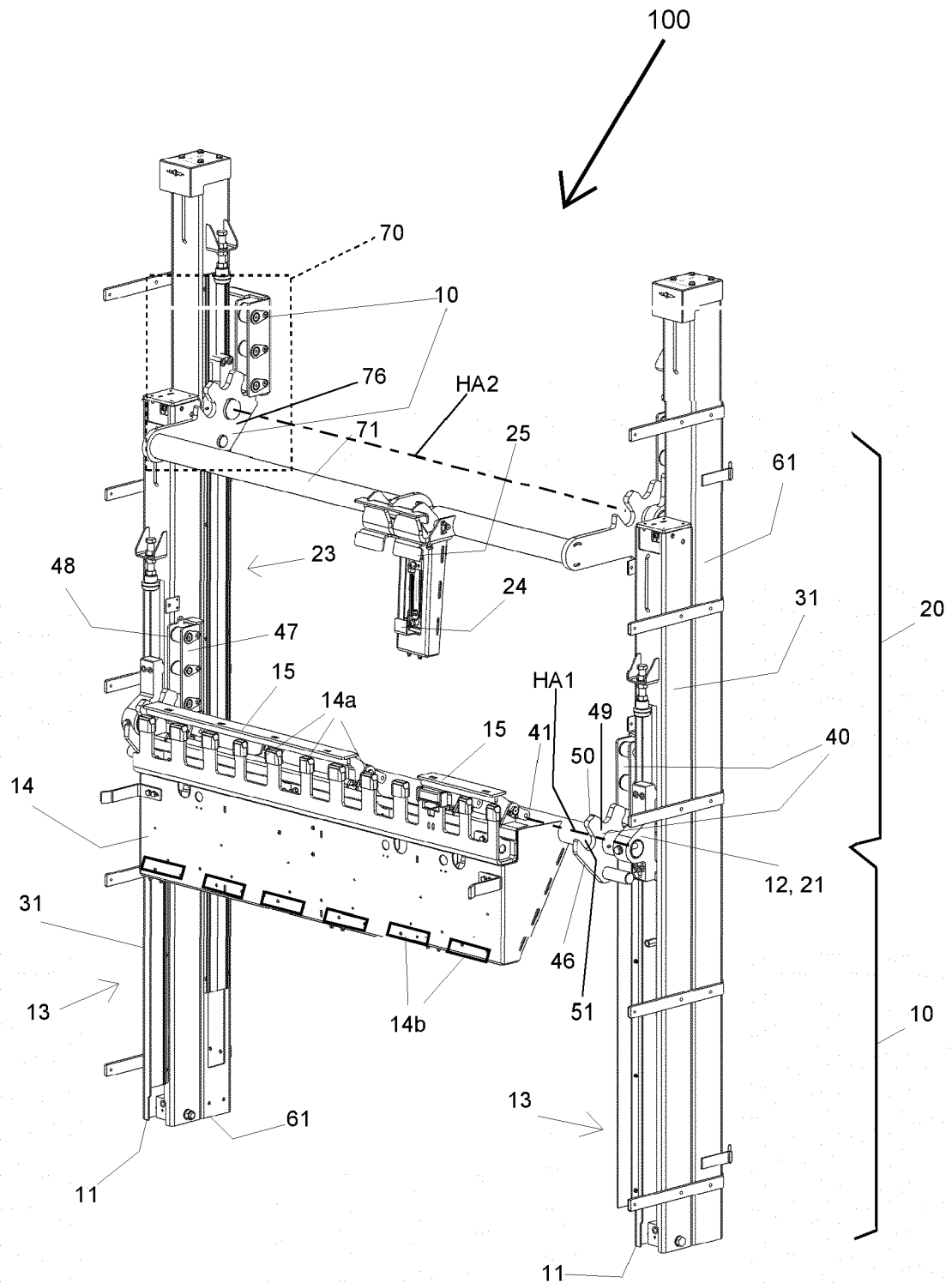


FIG. 4

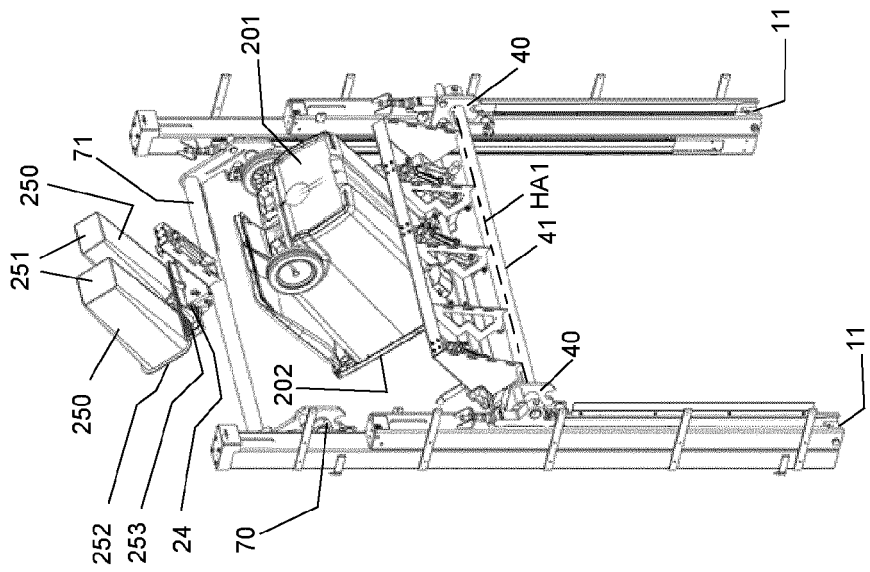


FIG. 5C

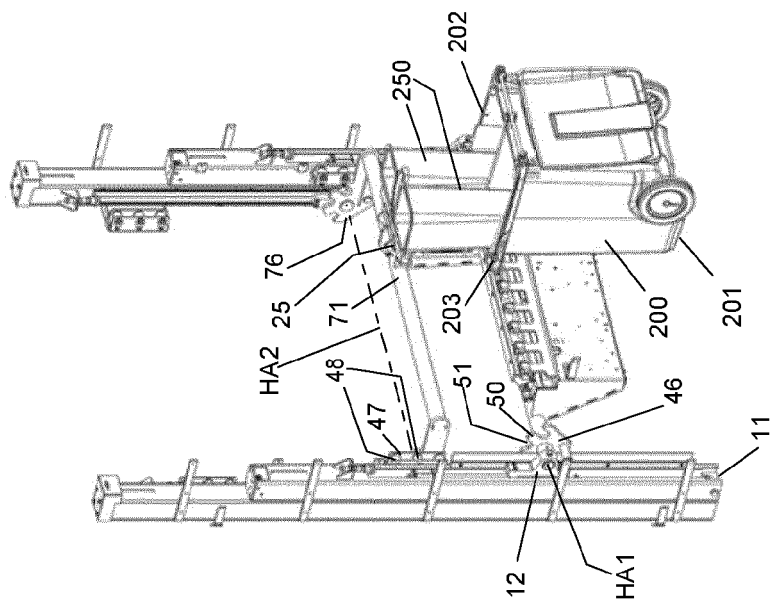


FIG. 5B

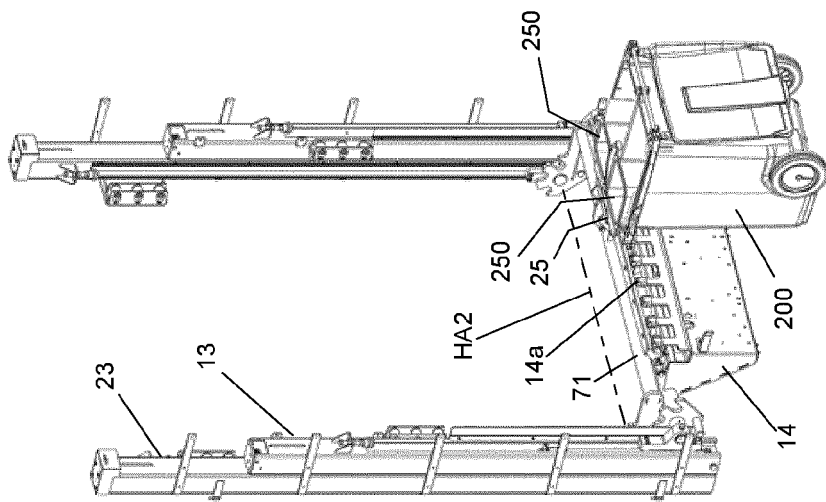


FIG. 5A

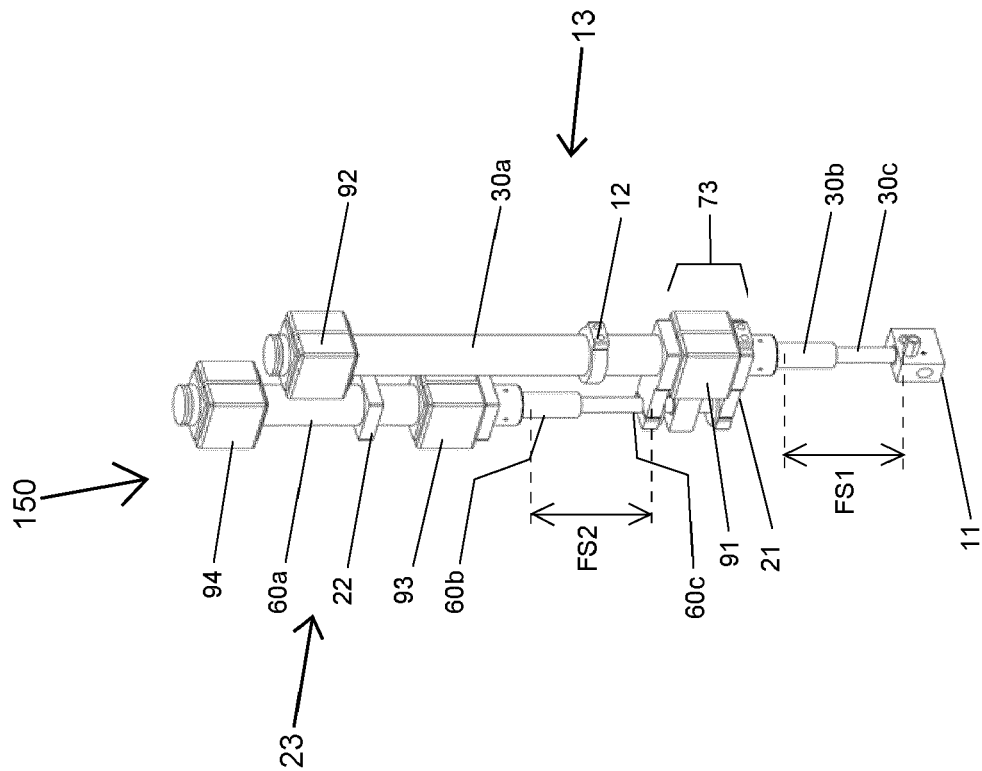


FIG. 6B

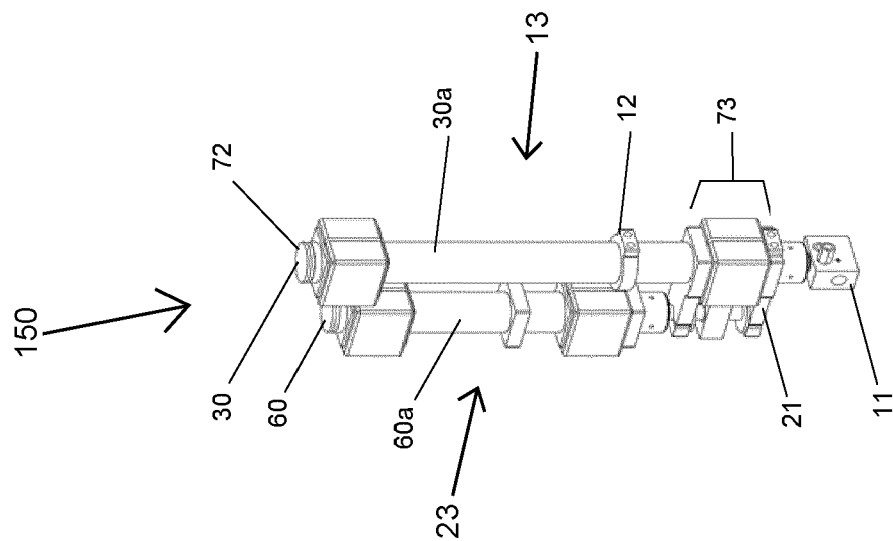


FIG. 6A

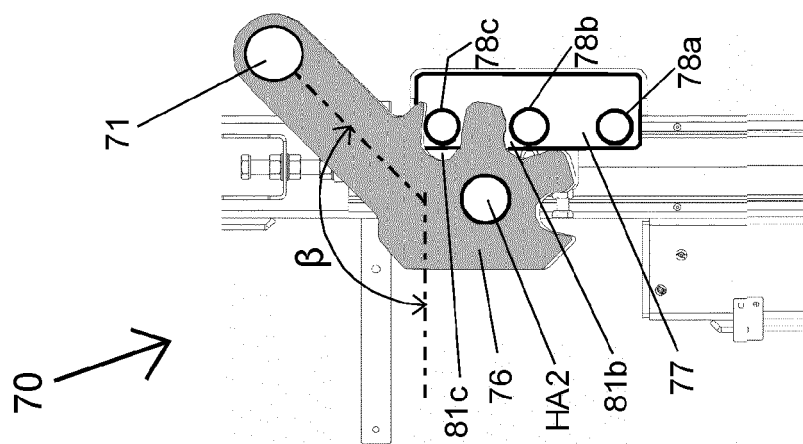


FIG. 7C

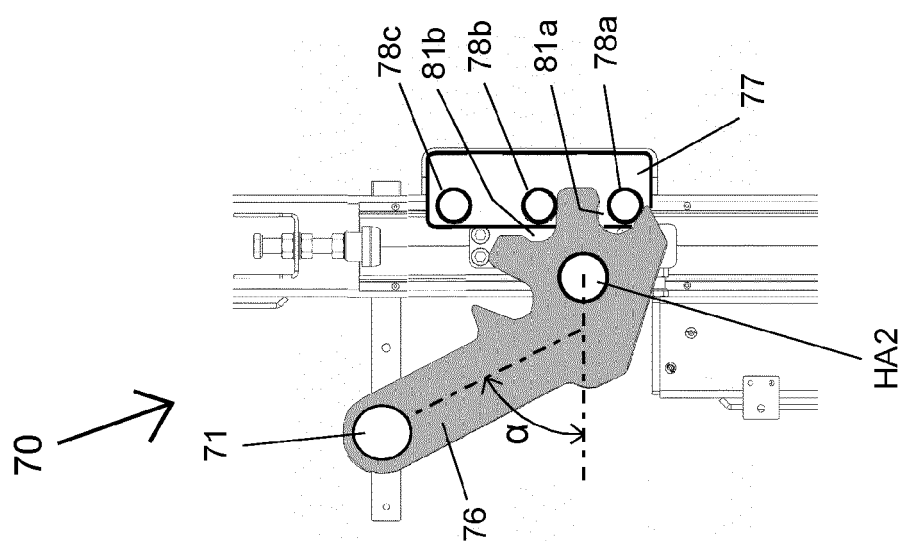


FIG. 7B

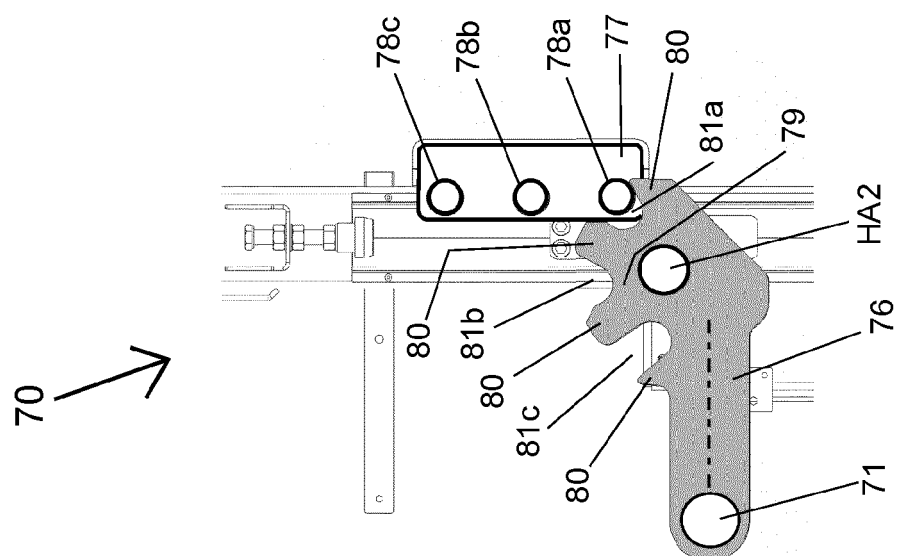
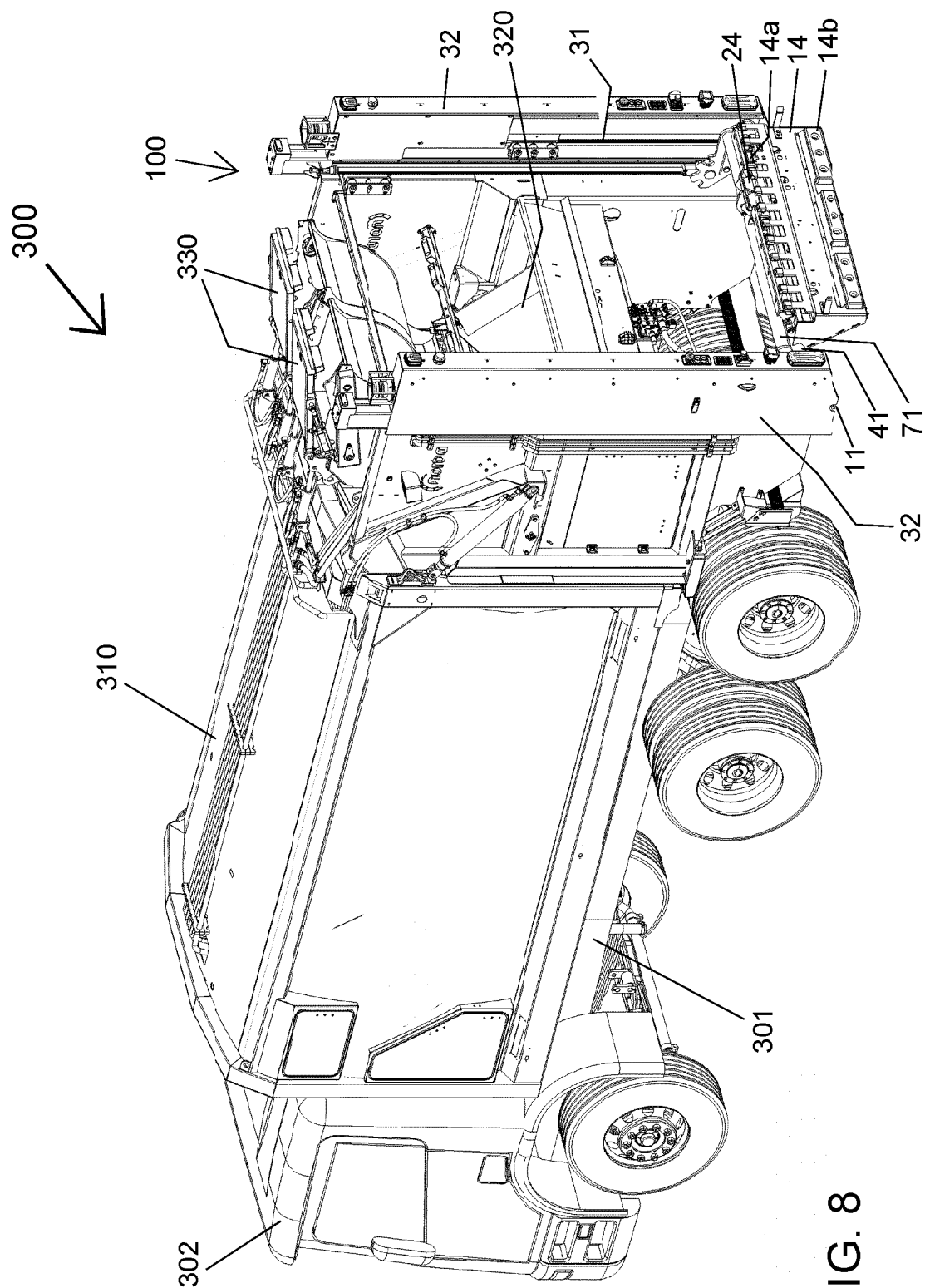


FIG. 7A


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EUROPEAN SEARCH REPORT

Application Number

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 13 June 2022	Examiner Luepke, Erik
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