(19) DANMARK

(10) **DK/EP 3426576 T3**

Patent- og
Varemærkestyrelsen

(12) Oversættelse af
europæisk patentskrift

(51) Int.Cl.: ***B 65 G 1/04 (2006.01)***

(45) Oversættelsen bekendtgjort den: **2020-11-16**

(80) Dato for Den Europæiske Patentmyndigheds
bekendtgørelse om meddelelse af patentet: **2020-11-04**

(86) Europæisk ansøgning nr.: **17710519.4**

(86) Europæisk indleveringsdag: **2017-03-10**

(87) Den europæiske ansøgnings publiceringsdag: **2019-01-16**

(86) International ansøgning nr.: **EP2017055697**

(87) Internationalt publikationsnr.: **WO2017153583**

(30) Prioritet: **2016-03-10 GB 201604100**

(84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

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(54) Benævnelse: **Fremgangsmåde og indretning til hentning af enheder fra et lagersystem**

(56) Fremdragne publikationer:
WO-A1-2015/019055
WO-A1-2015/193278

DESCRIPTION

[0001] The present invention relates to a load handling device, to an apparatus for retrieving units form a storage system. In particular, but not exclusively, the invention relates to robotic devices for handling storage containers or bins in a store comprising a grid of stacked units.

[0002] This application claims priority from UK Patent Application No. GB1604100.6 filed on 10th March 2016.

[0003] Some commercial and industrial activities require systems that enable the storage and retrieval of a large number of different products. One known system for the storage and retrieval of items in multiple product lines involves arranging storage bins or containers on rows of shelves arranged in aisles. Each bin or container holds a plurality of products of one product type. The aisles provide access between the rows of shelves, so that the required products can be retrieved by operatives or robots that circulate in the aisles. It will be appreciated, however, that the need to provide aisle space to access the products means that the storage density of such systems is relatively low. In other words, the amount of space actually used for the storage of products is relatively small compared to the amount of space required for the storage system as a whole.

[0004] In an alternative approach, which offers a significant improvement in storage density, containers are stacked on top of one another and the stacks are arranged in rows. The containers are accessed from above, removing the need for aisles between the rows and allowing more containers to be stored in a given space.

[0005] Methods of handling containers stacked in rows have been well known for decades. In some such systems, for example as described in US 2,701,065, free-standing stacks of containers are arranged in rows in order to reduce the storage volume associated with storing such containers while still providing access to a specific container if required. Access to a given container is made possible by providing relatively complicated hoisting mechanisms which can be used to stack containers and to remove given containers from stacks. The cost of such systems are, however, impractical in many situations and they have mainly been commercialised for the storage and handling of large shipping containers.

[0006] The concept of using freestanding stacks of containers and providing a mechanism to retrieve and store specific containers has been developed further, for example as described in EP 0 767 113 B (Cimcorp). Cimcorp discloses a mechanism for removing a plurality of stacked containers using a robotic load handler in the form of a rectangular tube which is lowered around the stack of containers, and which is configured to be able to grip a container at any level in the stack. In this way, several containers can be lifted at once from a stack. The movable tube can be used to move several containers from the top of one stack to the top of another stack, or to move containers from a stack to an external location and vice versa. Such systems can be particularly useful where all of the containers in a single stack contain the

same product (known as a single-product stack). The load handler can be used to move containers between single-product stacks, for example to add a plurality of containers containing a single type of product to the store, and to pick up one or more containers from two or more single-product stacks to create a multi-product output stack. An example of this is the picking of vegetable crates in a central warehouse to create a multi-product order for delivery to retail stores.

[0007] In the system described in Cimcorp, the height of the tube has to be as least as high as the height of the largest stack of containers, so that that the highest stack of containers can be extracted in a single operation. Accordingly, when used in an enclosed space such as a warehouse, the maximum height of the stacks is restricted by the need to accommodate the tube of the load handler. Furthermore, the system is not well adapted for the selection of a single container from a multi-product stack.

[0008] Online retail businesses selling multiple product lines, such as online grocers and supermarkets, require systems that are able to store tens or even hundreds of thousands of different product lines. The use of single-product stacks in such cases can be impractical, since a very large floor area would be required to accommodate all of the stacks required. Furthermore, it can be desirable only to store small quantities of some items, such as perishables or infrequently-ordered goods, making single-product stacks an inefficient solution.

[0009] Accordingly, for some applications, the use of multi-product stacks, in which the containers making up each stack may hold different products, is favoured in order to maximise the storage density of the system. The stored items must remain accessible reasonably quickly and easily, so that a plurality of different items required to fulfil a customer order can be picked from the storage system in an efficient way, even if some of the items required are stored in a lower level of a stack, underneath several other containers.

[0010] International patent application WO 2015/019055 A1, cited during prosecution of this application, describes a storage system and in particular a load handling device for lifting and moving containers stacked in the storage system according to the preamble of claim 1.

[0011] International patent application WO 98/049075A (Autostore), describes a system in which multi-product stacks of containers are arranged within a frame structure. A system of this type is illustrated schematically in Figures 1 to 4 of the accompanying drawings.

[0012] As shown in Figures 1 and 2, stackable containers, known as bins 10, are stacked on top of one another to form stacks 12. The stacks 12 are arranged in a grid frame structure 14 in a warehousing or manufacturing environment. Figure 1 is a schematic perspective view of the frame structure 14, and Figure 2 is a top-down view showing a stack 12 of bins 10 arranged within the frame structure 14. Each bin 10 typically holds a plurality of product items (not shown), and the product items within a bin 10 may be identical, or may be of different product types depending on the application.

[0013] The frame structure 14 comprises a plurality of upright members 16 that support horizontal members 18, 20. A first set of parallel horizontal members 18 is arranged perpendicularly to a second set of parallel horizontal members 20 to form a plurality of horizontal grid structures supported by the upright members 16. The members 16, 18, 20 are typically manufactured from metal. The bins 10 are stacked between the members 16, 18, 20 of the frame structure 14, so that the frame structure 14 guards against horizontal movement of the stacks 12 of bins 10, and guides vertical movement of the bins 10.

[0014] The top level of the frame structure 14 includes rails 22 arranged in a grid pattern across the top of the stacks 12. Referring additionally to Figures 3 and 4, the rails 22 support a plurality of robotic load handling devices 30. A first set 22a of parallel rails 22 guide movement of the load handling devices 30 in a first direction (X) across the top of the frame structure 14, and a second set 22b of parallel rails 22, arranged perpendicular to the first set 22a, guide movement of the load handling devices 30 in a second direction (Y), perpendicular to the first direction. In this way, the rails 22 allow movement of the load handling devices 30 laterally in two dimensions in the horizontal X-Y plane, so that a load handling device 30 can be moved into position above any of the stacks 12.

[0015] The load handling devices 30 are further described in Norwegian patent number 317066. Figure 3(a) and 3(b) are schematic perspective views of a load handling device 30 from the rear and front, respectively, and Figure 3(c) is a schematic front perspective view of a load handling device 30 lifting a bin 10.

[0016] Each load handling device 30 comprises a vehicle 32 which is arranged to travel in the X and Y directions on the rails 22 of the frame structure 14, above the stacks 12. A first set of wheels 34, consisting of a pair of wheels 34 on the front of the vehicle 32 and a pair of wheels 34 on the back of the vehicle 32, is arranged to engage with two adjacent rails of the first set 22a of rails 22. Similarly, a second set of wheels 36, consisting of a pair of wheels 36 on each side of the vehicle 32, is arranged to engage with two adjacent rails of the second set 22b of rails 22. Each set of wheels 34, 36 can be lifted and lowered, so that either the first set of wheels 34 or the second set of wheels 36 is engaged with the respective set of rails 22a, 22b at any one time.

[0017] When the first set of wheels 34 is engaged with the first set of rails 22a and the second set of wheels 36 is lifted clear from the rails 22, the wheels 34 can be driven, by way of a drive mechanism (not shown) housed in the vehicle 32, to move the load handling device 30 in the X direction. To move the load handling device 30 in the Y direction, the first set of wheels 34 is lifted clear of the rails 22, and the second set of wheels 36 is lowered into engagement with the second set of rails 22a. The drive mechanism can then be used to drive the second set of wheels 36 to achieve movement in the Y direction.

[0018] The load handling device 30 is equipped with a crane device 40. The crane device 40 comprises a cantilever arm 42 that extends laterally from the top of the vehicle 32. A gripper plate 44 is suspended from the cantilever arm 42 by four cables 46. The cables 46 are

connected to a winding mechanism (not shown) housed within the vehicle 32. The cables 46 can be spooled in or out from the cantilever arm 42, so that the position of the gripper plate 44 with respect to the vehicle 32 can be adjusted in the Z direction.

[0019] The gripper plate 44 is adapted to engage with the top of a bin 10. For example, the gripper plate 44 may include pins (not shown) that mate with corresponding holes (not shown) in the rim that forms the top surface of the bin 10, and sliding clips (not shown) that are engageable with the rim to grip the bin 10. The clips are driven to engage with the bin 10 by a suitable drive mechanism housed within the gripper plate 44, which is powered and controlled by signals carried through the cables 46 themselves or through a separate control cable (not shown).

[0020] To remove a bin 10 from the top of a stack 12, the load handling device 30 is moved as necessary in the X and Y directions so that the gripper plate 44 is positioned above the stack 12. The gripper plate 44 is then lowered vertically in the Z direction to engage with the bin 10 on the top of the stack 12, as shown in Figure 3(c). The gripper plate 44 grips the bin 10, and is then pulled upwards on the cables 46, with the bin 10 attached. At the top of its vertical travel, the bin 10 is accommodated beneath the cantilever arm 42 and is held above the level of the rails 22. In this way, the load handling device 30 can be moved to a different position in the X-Y plane, carrying the bin 10 along with it, to transport the bin 10 to another location. The cables 46 are long enough to allow the load handling device 30 to retrieve and place bins from any level of a stack 12, including the floor level. The vehicle 32 is sufficiently heavy to counterbalance the weight of the bin 10 and to remain stable during the lifting process. The weight of the vehicle 32 may be comprised in part of batteries that are used to power the drive mechanism for the wheels 34, 36.

[0021] As shown in Figure 4, a plurality of identical load handling devices 30 are provided, so that each load handling device 30 can operate simultaneously to increase the throughput of the system. The system illustrated in Figure 4 includes two specific locations, known as ports 24, at which bins 10 can be transferred into or out of the system. An additional conveyor system (not shown) is associated with each port 24, so that bins 10 transported to a port 24 by a load handling device 30 can be transferred to another location by the conveyor system, for example to a picking station (not shown). Similarly, bins 10 can be moved by the conveyor system to a port 24 from an external location, for example to a bin-filling station (not shown), and transported to a stack 12 by the load handling devices 30 to replenish the stock in the system.

[0022] Each load handling device 30 can lift and move one bin 10 at a time. If it is necessary to retrieve a bin 10 ("target bin") that is not located on the top of a stack 12, then the overlying bins 10 ("non-target bins") must first be moved to allow access to the target bin 10.

[0023] Each of the load handling devices 30 is under the control of a central computer. Each individual bin 10 in the system is tracked, so that the appropriate bins 10 can be retrieved, transported and replaced as necessary.

[0024] The system described with reference to Figures 1 to 4 has many advantages and is suitable for a wide range of storage and retrieval operations. In particular, it allows very dense storage of product, and it provides a very economical way of storing a huge range of different items in the bins 10, while allowing reasonably economical access to all of the bins 10 when required for picking.

[0025] For high-volume systems in which speed of operation is critical, it is important to maximise the performance of each of the load handing devices, in terms of speed of operation, battery life, reliability, lifting capacity, stability and so on. It may therefore be desirable to provide load-handling devices that offer improved performance in one or more of these areas.

[0026] It may also be desirable to increase the number of load handling devices in use at any one time, to allow an increase in the speed with which items can be retrieved from the storage system. For example, the Applicant's co-pending International Patent Application No. PCT/GB2013/051215, describes a storage system in which a plurality of each of two different types of load handling device are provided. One type of load handling device is adapted to lift a plurality of bins from a stack in one operation, to allow a target bin in the stack to be accessed by a single-bin load handling device of the second type. In such cases, it may be desirable to reduce the size of the load handling devices in order to minimise instances in which the optimum movement path for one device is hindered by the presence of other devices.

[0027] It is against this background that the present invention has been devised.

[0028] According to the invention there is provided a load-handling device for lifting and moving containers stacked in stacks in a storage system, according to the appended claim 1.

[0029] From one aspect, the present invention concerns load handling devices for use in storage systems comprising a grid frame containing a plurality of stacks of containers. The load handling devices are arranged above the stacks of containers and are capable of lifting a container from a stack and moving the container laterally to another location. Advantageously, each load handling device occupies only a single grid space in the storage system.

[0030] A load handling device according to the invention includes a container-receiving space into which a container can be lifted. The container-receiving space is arranged beneath a vehicle module, in which components such as power components, control components, drive components and lifting components are housed.

[0031] By arranging the bulky components of the load handling device above the container-receiving space, the footprint of the load handling device is reduced compared to the cantilever designs shown in Figures 3(a) to 3(c) and described in NO317366, in which the bulky components are housed in a vehicle module disposed to one side of the container-receiving space. Advantageously, the load handling device of the invention occupies the space above only one stack of containers in the frame, in contrast to the cantilever design shown in Figures

3(a) to 3(c) which occupies the space above two stacks. This means that, by virtue of the invention, the efficiency of operation of the storage system can be improved, because the reduced footprint allows more load handling devices to be accommodated and reduces the likelihood of one device obstructing the optimum path of another.

[0032] The load handling device includes a set of wheels for supporting the load handling device above the stacks. For example, lateral movement of the load handling device is guided by rails disposed above the frame. The rails are arranged in a grid pattern, allowing two-dimensional movement of the load handling device in the horizontal plane. The wheels engage with the rails. Two sets of wheels are provided, with one set being arranged to engage with a first set of rails to guide movement of the second handling device in a first direction, and another set being arranged to engage with a second set of rails to guide movement of the second handling device in a second direction.

[0033] The wheels are arranged at the periphery of the container-receiving space. In one aspect of the invention, the wheels may be driven by one or more motors housed in the vehicle module and drive may be transferred from the motors in the vehicle module to the wheels by drive transfer means disposed around the container-receiving space. For example, the drive transfer means may comprise a suitable arrangement of pulleys and drive belts.

[0034] One or both set of wheels may be configured to be raised and lowered with respect to the other set of wheels. One or more wheel lift motors or other wheel lift devices may be housed in the vehicle module for this purpose.

[0035] The vehicle module may house a winch or crane device for lifting the container into the container-receiving space. The crane device may include one or more motors for lifting the container, and the or each motor of the crane device may be housed in the vehicle module.

[0036] The crane device includes a gripper device configured to grip a container from above. The gripper device may be suspended from cables that can be extended and retracted from the vehicle to move the gripper device vertically.

[0037] The load handling device is equipped with a lifting device arranged to lift a single container from the stack into the container-receiving space. The lifting device may comprise a pair of lifting arms arranged on either side of the container-receiving space, in which case the lifting device may comprise a gripper device mounted between the ends of the arms and arranged to grip a container from above.

[0038] The lifting device comprises rods or cables arranged to engage with vertical channels formed in the side walls of the containers. The channels may be accessed by apertures in a top face of each container. In such an arrangement, vertically-extending spaces in the storage system are not necessary.

[0039] The rods or cables may carry an anchor mechanism arranged to engage releasably

with a container. For example, the anchor mechanism may comprise one or more laterally-extendable arms for engaging a surface of the container. The anchor mechanism may be operated remotely, for example by a wire that extends through a tubular bore of the rod or cable.

[0040] The load handling device further comprises an upper part, a lower part including a container-receiving space, and winch means for lifting a container into the container-receiving space. The winch means comprises a winch motor which is housed in the upper part, above the container-receiving space. The lower part includes a wheel assembly to facilitate lateral movement of the load handling device with respect to the frame, and the upper part also includes at least one motor for driving one or more wheels of the wheel assembly.

[0041] The lower part may comprise a frame structure for supporting the wheels of the wheel assembly. The frame structure may be arranged around the container-receiving space. For example, the container-receiving space may be bounded on four sides by the frame structure. One or more elements of the frame structure may be moveable to raise and lower a first set of the wheels with respect to a second set of the wheels, thereby to facilitate engagement of either the first set of wheels or the second set of wheels with a first or a second set of rails or tracks, respectively. The moveable elements of the frame structure may be driven by a motor housed in the upper part of the load handling device.

[0042] The load-handling device of the invention is preferably a self-propelled robot vehicle.

[0043] From another aspect, the invention resides in a storage system comprising a frame containing a plurality of stacks of containers, and one or more load handling devices as described above. Each load handling device occupies a single grid space, corresponding to the area occupied by only one stack of containers.

[0044] A storage system may comprise a frame containing a plurality of stacks of containers, a first handling device capable of lifting a plurality of containers from a stack in a single operation, and a second handling device capable of lifting a single container and moving the container laterally. The first and second handling devices are disposed above the frame and are independently moveable to access different stacks. The second handling device is of the type described above, and occupies a space corresponding to only one stack of containers.

[0045] In this aspect, the provision of a first handling device capable of lifting a plurality of containers from a stack in a single operation along with a second handling device capable of lifting a single container and moving the container laterally provides an optimum solution when seeking to retrieve a container which is located in the middle or bottom of a stack. In such a case, only two lifting operations need be carried out to retrieve the target container, which greatly increases the speed and efficiency of the retrieval process compared to prior art arrangements in which only one container can be lifted at a time.

[0046] The storage system may further comprise one or more port locations at which

containers can be removed from and/or added to the storage system. The load handling device of the invention may be capable of transporting a target container from a stack to a port location. The containers may comprise open-topped bins. The containers may be arranged to interlock or engage with one another in the vertical direction when formed in a stack.

[0047] In a typical application, multiple handling devices may be employed so that multiple containers can be lifted and moved simultaneously. The handling devices may be of different types, and may be selected to balance the cost and energy consumption of the system with the speed and flexibility of operation. One benefit of the present invention is that, because the load handling devices occupy the space above only one stack, the efficiency of a multiple-device system can be improved compared to prior art load handling device designs which occupy two or more stack spaces. The gain in efficiency may arise from being able to accommodate more load handling devices in a given system, from optimising the routing of the device using the space gained by the reduced device footprints, or from a combination of these factors.

Figure 1 is a schematic perspective view of a frame structure for housing a plurality of stacks of bins in a known storage system;

Figure 2 is a schematic plan view of part of the frame structure of Figure 1;

Figures 3(a) and 3(b) are schematic perspective views, from the rear and front respectively, of a known load handling device for use with the frame structure of Figures 1 and 2, and Figure 3(c) is a schematic perspective view of the known load handling device in use lifting a bin; and

Figure 4 is a schematic perspective view of a known storage system comprising a plurality of load handling devices of the type shown in Figures 3(a), 3(b) and 3(c), installed on the frame structure of Figures 1 and 2.

[0048] Embodiments of the present invention will now be described, by way of example only, with reference to the remainder of the accompanying drawings, in which like reference numerals are used for like features, and in which:

Figure 5 is a schematic perspective view of a load handling device according to an embodiment of the invention;

Figures 6 is a schematic perspective view of the load handling device of Figure 5, showing one possible possible system architecture of the device;

Figure 7 is a schematic perspective cut away view of the load handling device of Figures 5 and 6, the load handling device;

Figure 8 is a schematic perspective view of an embodiment of the invention, the load handling device comprising four displacement motors each motor acting on a set of wheels on one side of the load handling device;

Figure 9 is a schematic perspective view of an embodiment of the invention, the load handling device comprising 4 moveable sides each side comprising displacement mechanisms driven by a motor located within the load handling device;

Figure 10 is a schematic perspective view of a load handling device comprising two sets of wheels, each set of wheels comprising 4 individually driven wheels, each wheel comprising a mechanism for engaging or disengaging the wheel with the tracks;

Figures 11 to 13 show schematic perspective views of an embodiment of the invention, the load handling device comprising four sides, each side comprising two wheels, each side being liftable and lowerable with respect to the other sides by a mechanical solenoid and pin system.

[0049] Figure 5 shows a load handling device 100 according to an embodiment of the invention. The load handling device 100 comprises a vehicle 102 equipped with a winch or crane mechanism to lift a storage container or bin 106, also known as a tote, from above. The crane mechanism includes winch cables and a grabber plate. The grabber plate is configured to grip the top of the container 106 to lift it from a stack of containers 106 in a storage system of the type shown in Figures 1 to 4. It will be appreciated that the ride height of the load handling device changes when the moving means 188 is activated.

[0050] Referring also to Figures 6 and 7, the vehicle 102 comprises an upper part 112 and a lower part 114.

[0051] The lower part 114 is fitted with two sets of wheels 116, 118, which run on rails provided at the top of the frame of the storage system. At least one wheel of each set 116, 118 is driven to enable movement of the vehicle 102 in X- and Y-directions respectively along the rails. As will be explained below, one set of wheels 116 can be moved vertically to lift the set of wheels 116 clear of the respective rails leaving the remaining set of wheels in contact with the rails, thereby allowing the vehicle 102 to change direction.

[0052] The wheels 116, 118 are arranged around the periphery of a cavity or recess 120, known as a container-receiving recess, in the lower part 114. The recess 120 is sized to accommodate the bin 106 when it is lifted by the crane mechanism 104, as shown in Figure 6(a). When in the recess 120, the bin 106 is lifted clear of the rails beneath, so that the vehicle 102 can move laterally to a different location. On reaching the target location, for example another stack, an access point in the storage system or a conveyor belt, the bin 106 can be lowered from the recess 120 (as shown in Figure 6(b)) and released from the grabber plate 110.

[0053] The upper part 112 of the vehicle 102 houses all of the significant bulky components of the load handling device, as shown in Figure 6(c). The upper part 112 houses the battery and associated electronics, controllers and communications devices, motors for driving the wheels 116, 118, motors for driving the crane mechanism 104, and other sensors and systems.

[0054] In this way, the footprint of the vehicle 102 is larger than the size of a bin 106 only enough to accommodate the wheels 116, 118 either side of the recess 120. In other words, the vehicle 102 occupies a single grid space in the storage system. In this way, the vehicle 102 therefore takes up the minimum possible amount of space in the X-Y plane.

[0055] The load handling devices 100 of the invention can also offer improved stability, as the mechanical components displacing the or each set of wheels with respect to each other are located in the lower part 114 of the load handling device.

[0056] As shown in Figures 5 to 7 the first set of wheels 116 can be raised clear of the rails or lowered onto the rails by means of a wheel positioning mechanism. Each wheel 116 is mounted on an arm 180 that is pivotally mounted at its outer end. An inner end of each arm 180 is connected to the lower end of a respective linkage 182. The upper ends of both linkages 182 are connected to the lower end of a common linkage 184. In turn, the upper end of the common linkage 184 is moved by a motor or solenoid or worm gear or lead screw mechanism or any suitable means for drawing the common linkage upwards. By operating the moving means 188 to draw the common linkage 184 upwards, the first set of wheels 116 can be raised so that the second set of wheels 118 alone is engaged with the rails, allowing movement of the vehicle 102 in the Y-direction. By operating the motor 188 to push the common linkage 184 downwards, the first set of wheels 116 move downwards to engage with the rails and to lift the vehicle so that the second set of wheels 118 is lifted clear of the rails, as shown in The vehicle 102 can then move in the X-direction.

[0057] The wheels 118 of the second set are mounted to fixed T-pieces 190 disposed at either end of the lower part 114 of the vehicle 102.

[0058] According to the invention, as shown in Figure 7, it will be appreciated that two motors 118 are required, one to move two of the wheels of the set 116 of wheels and one to move the remaining two of the wheels of the set 116 disposed on the opposite side of the load handling device. In this way, one displacement motor acts to lift half a set of wheels only. It will be appreciated that the motors 188 may operate independently, each one lifting or lowering half a set of wheels at any time. However in order to efficiently change direction the motors 188 operate independently but at the same time to lift the wheels clear of the tracks.

[0059] It will be appreciated that in this embodiment of the invention the mechanism for displacing the wheels is disposed in the lower part of the vehicle body. In this way, additional weight is disposed lower down in the vehicle body thereby improving the stability of the load handling device.

[0060] Figure 8 shows an embodiment of the invention in which the wheels disposed on each side of the load handling device each comprise the mechanism only associated with one set of wheels in the previous embodiment described with reference to Figures 5 to 7. In this embodiment it will be appreciated that each side of the load handling device will therefore

require a displacement motor and a linkage mechanism as described with reference to Figures 5 to 7. It will be appreciated that this provides additional stability to the load handling device as each side comprises the same mechanism and motor means, the weight being evenly distributed. The embodiment of Figure 8 shows a load handling device in which 4 motor means are provided each acting on half a set of wheels 116, 118.

[0061] Figure 9 shows another embodiment of the invention in which the two wheels disposed on each side of the load handling device are rotatably attached to moveable side panels that comprise the sides of the load handling device. Two wheels 200 mounted in a frame structure 210 of a load handling device according to another embodiment of the invention. As in the previous embodiments, in this embodiment the load handling device comprises a vehicle with an upper part 112 that houses the major components of the device and a lower part having a recess 120 for accommodating a bin, with the wheels 200 being arranged on four sides of the recess.

[0062] In this case, the frame structure of the load handling device comprises two parallel panels that accommodate the wheels 200 there between. Drive means is provided to transfer drive to the wheels 200 from a motor housed in the upper part 112 of the vehicle. It will be appreciated that the drive means provided in the upper part of the load handling device may act on two wheels 200 on one side of the load handling device at any one time. In this way, a single motor means located above the cavity may act on half a set of wheels 116 or two motors may be provided each motor acting on half a set of wheels 116.

[0063] Referring additionally to Figure 10, each wheel 200 may be provided with displacement means to enable each wheel 200 to be independently lifted or lowered and engaged or disengaged with the track as required. In this embodiment the wheels 200 each comprise drive means and displacement means. Again, in using mechanisms and components positioned in the lower part of the load handling device the stability of the device is improved.

[0064] Referring to Figures 11 to 13, an embodiment of displacement means for the wheels 200 or sets of wheels 116 and 118 is described. Figure 11 shows a two wheels disposed on each side of the load handling device, attached to moveable side panels that comprise the sides of the load handling device. As can be seen in Figures 12 and 13, the panels further comprise a pin and track mechanism, the pins locating in the tracks when the panels are in situ on the sides of the load handling devices.

[0065] The panels further comprise a motor or solenoid that moves the pin laterally in the track, the shape of the track in the inside of the panels and the movement of the pins in the tacks causing the side panels to be displaced upwardly or downwardly depending on the direction of travel of the pin in the track. This movement in the panel causing the wheels associated with each panel to lift off the track or engage the track accordingly.

[0066] In this way, the wheels 200 in this embodiment can be raised and lowered by moving the panels independently at the same time or opposing panels being connected so as to move

together, relative to the upper part 112 of the vehicle. The panels are mounted to a body 230 of the upper part 112 of the vehicle by way of rails 232. The rails 232 are fixed to the body 230, and pin is slidably mounted to the rails 232.

[0067] Although in some of the Figures only one side of the load handling device is shown, it will be appreciated that an identical structure would be provided on the opposite side of the vehicle. Both structures may be raised and lowered by a common motor, so the four wheels 200 can be lifted and lowered in unison to control engagement of this first set of wheels 200 with rails extending in a first direction across the frame. It will be appreciated that two opposing panels may be raised and lowered by a single motor, the other two opposing panels being raised and lowered by a further motor. Furthermore, each of the four panels may be provided with a motor to independently raise and lower each panel.

REFERENCES CITED IN THE DESCRIPTION

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- NO317366 **[0031]**

Patentkrav

1. Lasthåndteringsindretning (100) til at løfte og bevæge containerne (106), der er stablet i stabler i et lagersystem, hvor systemet omfatter en flerhed af skinner eller spor, der er anbragt i gittermønster over stablerne af containere, hvor gittermønsteret omfatter en flerhed af gitterrum, hvor hver stabel er placeret inden for et areal af kun et enkelt gitterrum, hvor lasthåndteringsindretningen er udformet til at bevæge sig sideværts på skinnerne eller sporene oven over stablerne, hvor lasthåndteringsindretningen yderligere omfatter en løftemekanisme (104), hvilken løftemekanisme omfatter en gribeindretning (110), hvilken gribeindretning (110) er udformet til at gribe en container (106) ovenfra, hvor lasthåndteringsindretningen (100) omfatter:

et køretøj (102) omfattende et legeme, der har en øvre del (112) og en nedre del (114):

hvor den øvre del (112) er til at rumme komponenter såsom effektkomponenter og/eller styrekomponenter og/eller drivkomponenter og/eller løftekomponenter;

hvor den nedre del (114) er anbragt direkte under den øvre del (112), hvor den nedre del (114) omfatter et hulrum (120) til at optage en container (106) og en hjulenhed, hvilken hjulenhed omfatter et første sæt hjul (116) til at gå i indgreb med et første sæt skinner eller spor til føring af indretningens bevægelse i en første retning og et andet sæt hjul (118) til at gå i indgreb med et andet sæt skinner eller spor til føring af indretningens (100) bevægelse i en anden retning, hvor den anden retning er på tværs af den første retning; og

hvor løftemekanismen (104) er udformet til at hæve og sænke gribeindretningen (110) i forhold til hulrummet (120), hvor løftemekanismen (104) er placeret over hulrummet (120),

hvor hjulenheden endvidere omfatter en hjulpositioneringsmekanisme, hvor hjulpositioneringsmekanismen omfatter midler til selektivt at lade enten det første sæt hjul gå i indgreb med det første sæt skinner eller spor eller lade det andet sæt hjul gå i indgreb med det andet sæt skinner eller spor, hvorved det gøres muligt for lasthåndteringsindretningen selektivt at bevæge sig i enten den første eller anden retning hen over gitteret,

kendetegnet ved, at hjulpositioneringsmekanismen omfatter to motorer (188), henholdsvis en første motor til at bevæge to af hjulene af det første eller andet sæt (116) hjul og en anden motor til at bevæge de resterende to af hjulene af det første eller andet sæt (116), anbragt på den modsatte side af lasthåndteringsindretningen, således at en motor (188) er udformet til at virke således, at den kun løfter halvdelen af et sæt hjul.

2. Lasthåndteringsindretning (100) ifølge krav 1, hvor hjulpositioneringsmekanismen endvidere omfatter et element, der er drejeligt monteret ved sin udvendige ende på hvert af hjulene, hvor mekanismen endvidere omfatter to forbindelsesled, hvor den indvendige ende af hver arm er forbundet med et forbindelsesled (182), hvor de øvre ender af begge forbindelsesled (182) er forbundet med den nedre ende af et fælles forbindelsesled (184).

3. Lasthåndteringsindretning (100) ifølge krav 2, hvori motorerne (188) er indrettet til at virke på respektive fælles forbindelsesled (184) for at trække de fælles forbindelsesled (184) opad.

4. Lasthåndteringsindretning (100) ifølge krav 1, hvori motorerne (188) kan arbejde uafhængigt, hvor hver motor er tilpasset til at løfte eller sænke halvdelen af et sæt hjul (116, 118) når som helst.

5. Lasthåndteringsindretning (100) ifølge krav 4, hvori motorerne (188) hver arbejder uafhængigt af den anden og endvidere omfatter midler til at løfte hjulene (116, 118) væk fra sporene eller skinnerne.

6. Lasthåndteringsindretning (100) ifølge krav 1, hvor hjulpositioneringsmekanismen omfatter bevægelige sidepaneler på hver side af lasthåndteringsindretningen (100), hvor hjulene, der er anbragt på hver side af lasthåndteringsindretningen (100), er roterbart fastgjort til de bevægelige sidepaneler.

7. Lasthåndteringsindretning (100) ifølge krav 6, hvor de bevægelige sidepaneler på hver side af lasthåndteringsindretningen udgør en del af en rammestruktur (210) af lasthåndteringsindretningen (100).

8. Lasthåndteringsindretning (100) ifølge krav 7, hvor rammestrukturen (210) er anbragt omkring hulrummet (120).

9. Lasthåndteringsindretning (100) ifølge krav 7, hvor hulrummet (120) er defineret i rammestrukturen (210).

10. Lasthåndteringsindretning (100) ifølge krav 8 eller 9, hvor hulrummet (120) er afgrænset på fire sider af rammestrukturen (210).

11. Lasthåndteringsindretning (100) ifølge et hvilket som helst af de foregående krav, hvor hjulenheden omfatter et eller flere af hjulene, der drives af en motor, som er integreret i hjulet eller anbragt ved siden af hjulet.

12. Lasthåndteringsindretning (100) ifølge et hvilket som helst af de foregående krav, hvor et eller flere af hjulene omfatter en hjulnavsmotor (256).

13. Lasthåndteringsindretning (100) ifølge et hvilket som helst af de foregående krav, hvor et eller flere af hjulene drives af en eller flere motorer, der er anbragt over hulrummet (120).

14. Lasthåndteringsindretning (100) ifølge krav 13, endvidere omfattende drivoverføringsmidler, der er anbragt omkring hulrummet (120) til overføring af drivkraft fra motoren eller hver motor til hjulet eller hvert hjul.

15. Lasthåndteringsindretning (100) ifølge krav 14, hvor drivoverføringsmidlet omfatter en anordning af remskiver og drivremme.

16. Lasthåndteringsindretning (100) ifølge et hvilket som helst af de foregående krav, hvor et eller flere af hjulene indbefatter en kanal, der samvirker med

en drivrem til at drive hjulet.

17. Lasthåndteringsindretning (100) ifølge krav 1, hvor hjulene, der er anbragt på hver side af lasthåndteringsindretningen (100), er roterbart fastgjort til bevægelige sidepaneler, der omfatter siderne af lasthåndteringsindretningen, hvor de bevægelige sidepaneler endvidere omfatter en stift-og-spor-mekanisme, hvor stifterne er anbragt i sporene, når panelerne er på plads på siderne af lasthåndteringsindretningerne.

18. Lasthåndteringsindretning (100) ifølge krav 17, hvor sidepanelerne endvidere omfatter en motor eller solenoide, der bevæger stiften sideværts i sporet, hvor formen af sporet i indersiden af panelerne og bevægelsen af stifterne i sporene bevirker, at sidepanelerne forskydes opad eller nedad afhængigt af stiftens bevægelsesretning i sporet, således at bevægelse i panelet bevirker, at de hjul, der er associeret med hvert panel, følgelig løftes fri af sporet eller skinnerne eller går i indgreb med sporet eller skinnerne.

19. Lasthåndteringsindretning (100) ifølge krav 18, hvori sidepanelerne er monteret på et legeme (230) af en øvre del (112) af køretøjet ved hjælp af skinner (232), hvor skinnerne (232) er fastgjort til legemet (230), og stiften er glidbart monteret på skinnerne (232).

20. Lagersystem omfattende mindst en af lasthåndteringsindretningerne (100) ifølge et hvilket som helst af de foregående krav.

21. Fremgangsmåde til at bevæge mindst en lasthåndteringsindretning (100) ifølge et hvilket som helst af de foregående krav omkring sporene eller skinnerne over et lagersystem, omfattende trinnet selektivt at lade et første sæt hjul gå i indgreb med et første sæt skinner eller spor eller lade et andet sæt hjul gå i indgreb med et andet sæt skinner eller spor, således at lasthåndteringsindretningen afhængigt af valget bevæger sig i en første eller anden retning.

DRAWINGS

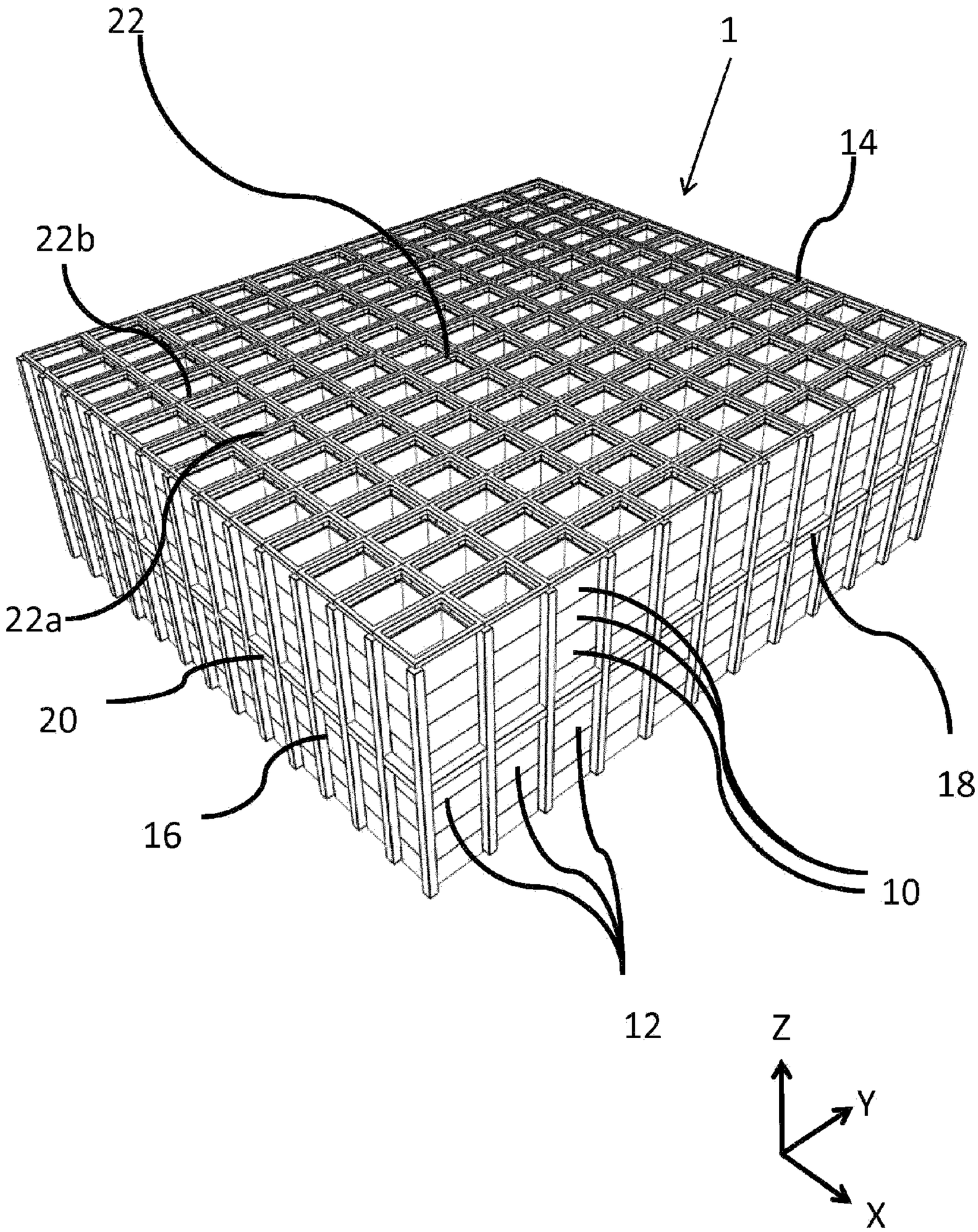


Figure 1

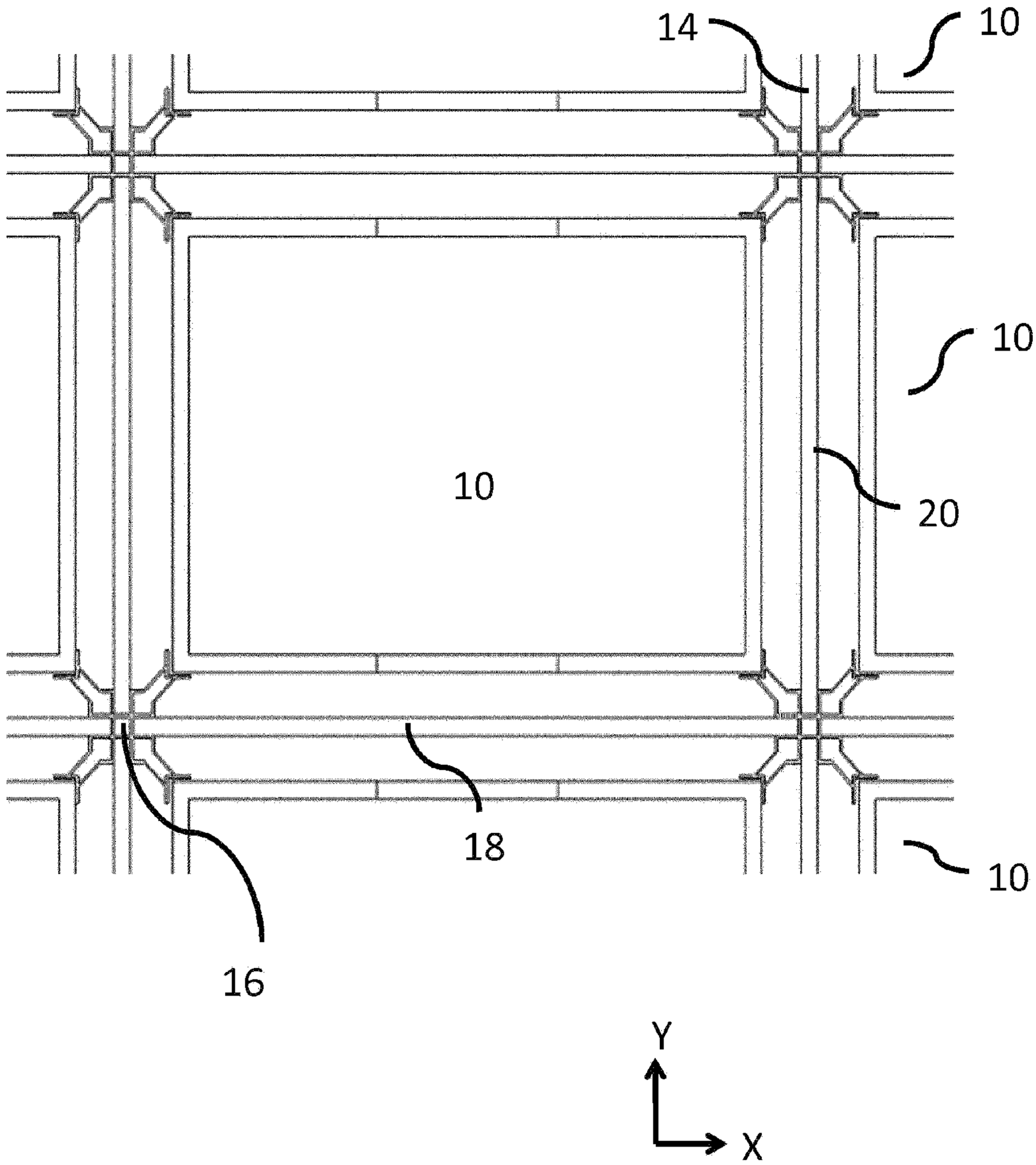


Figure 2

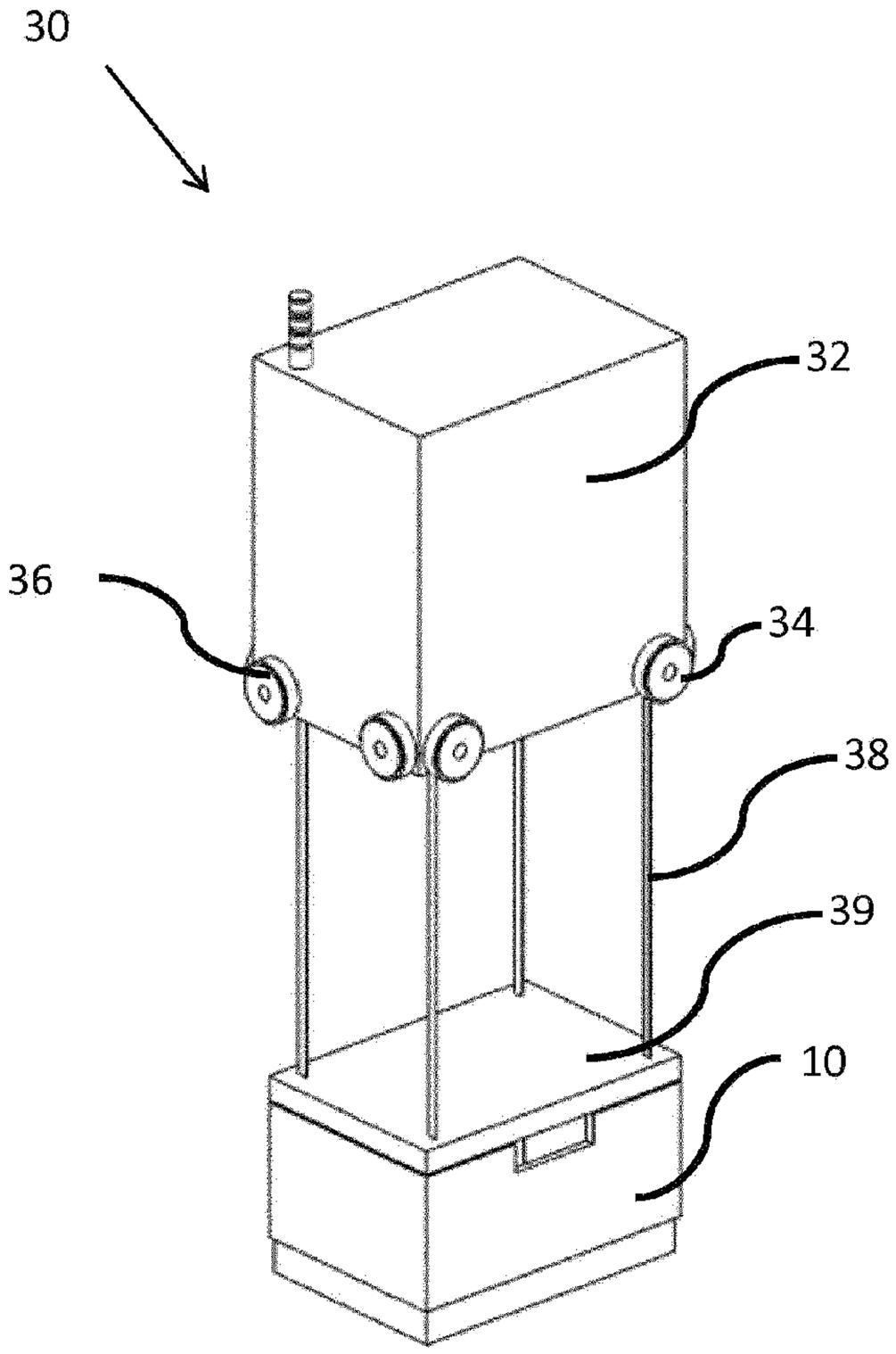
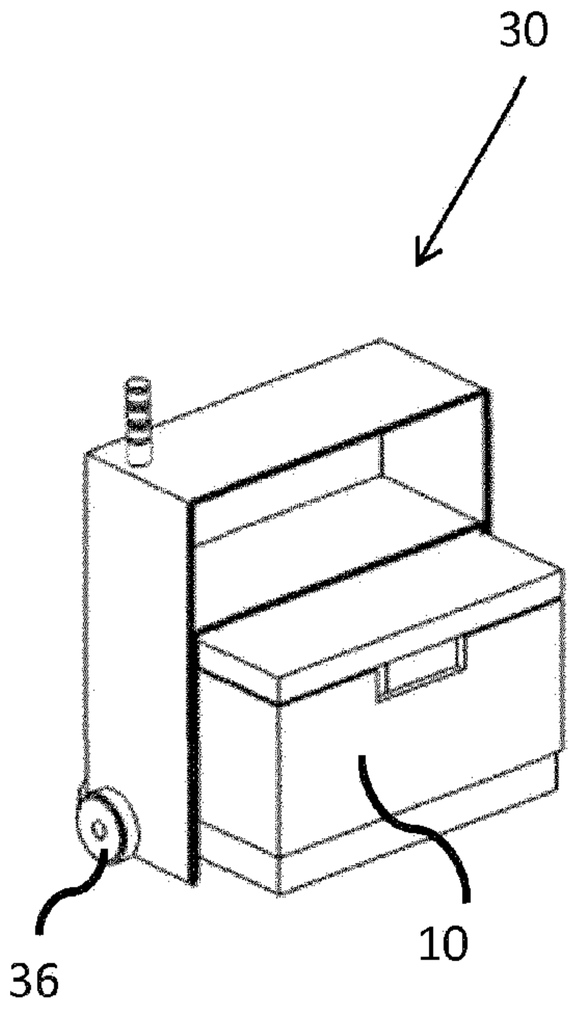


Figure 3a



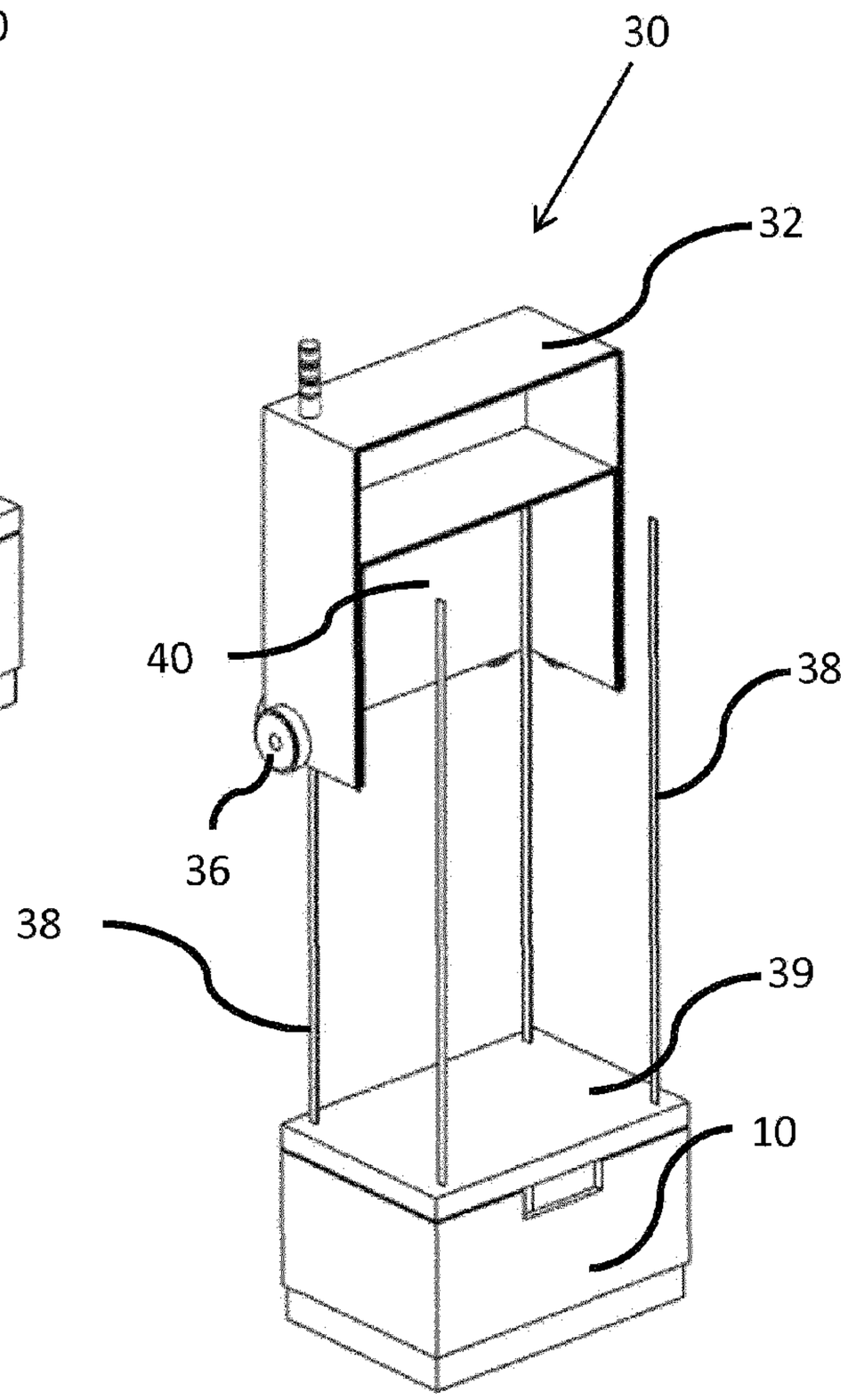


Figure 3b and 3c

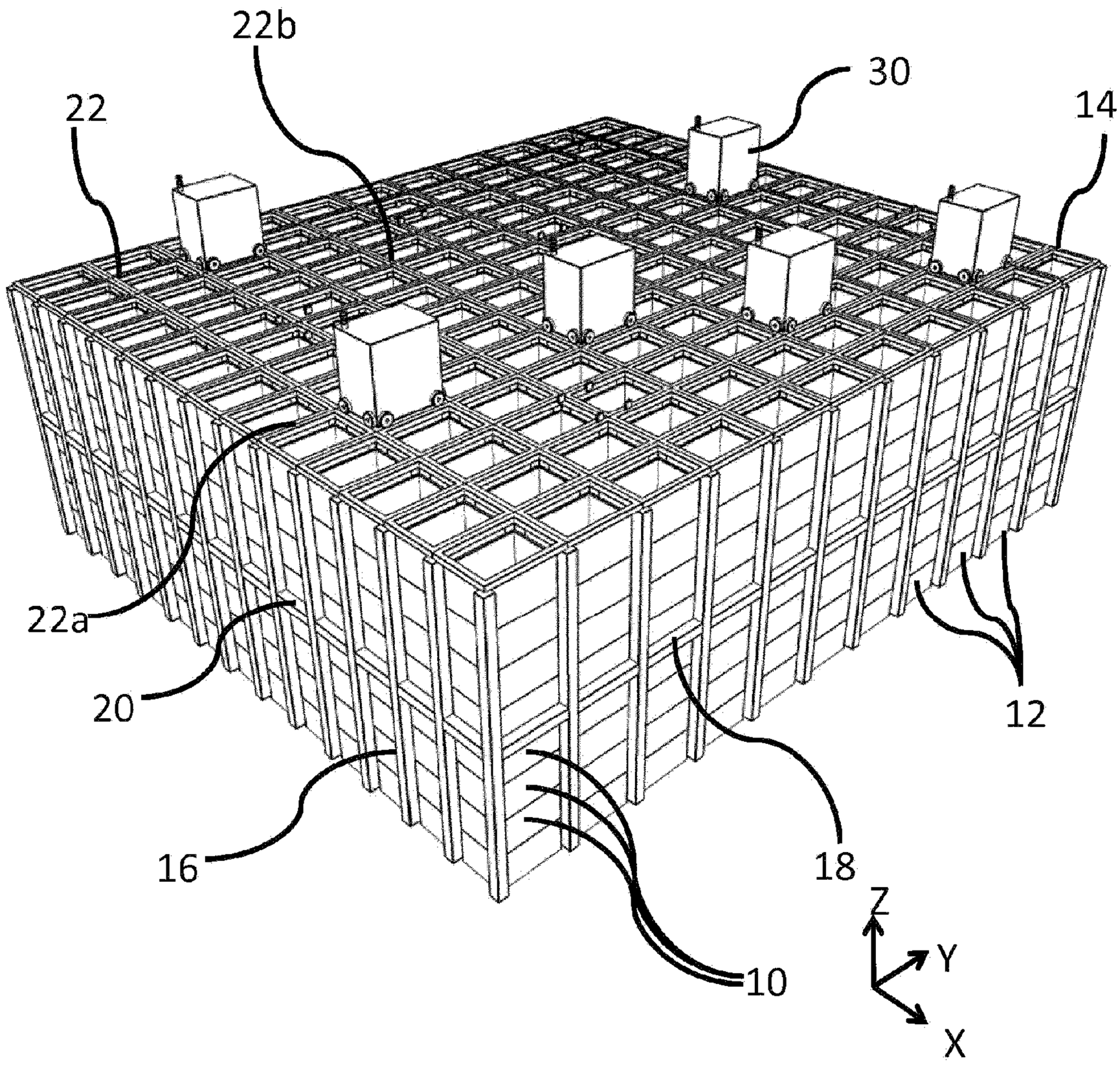


Figure 4

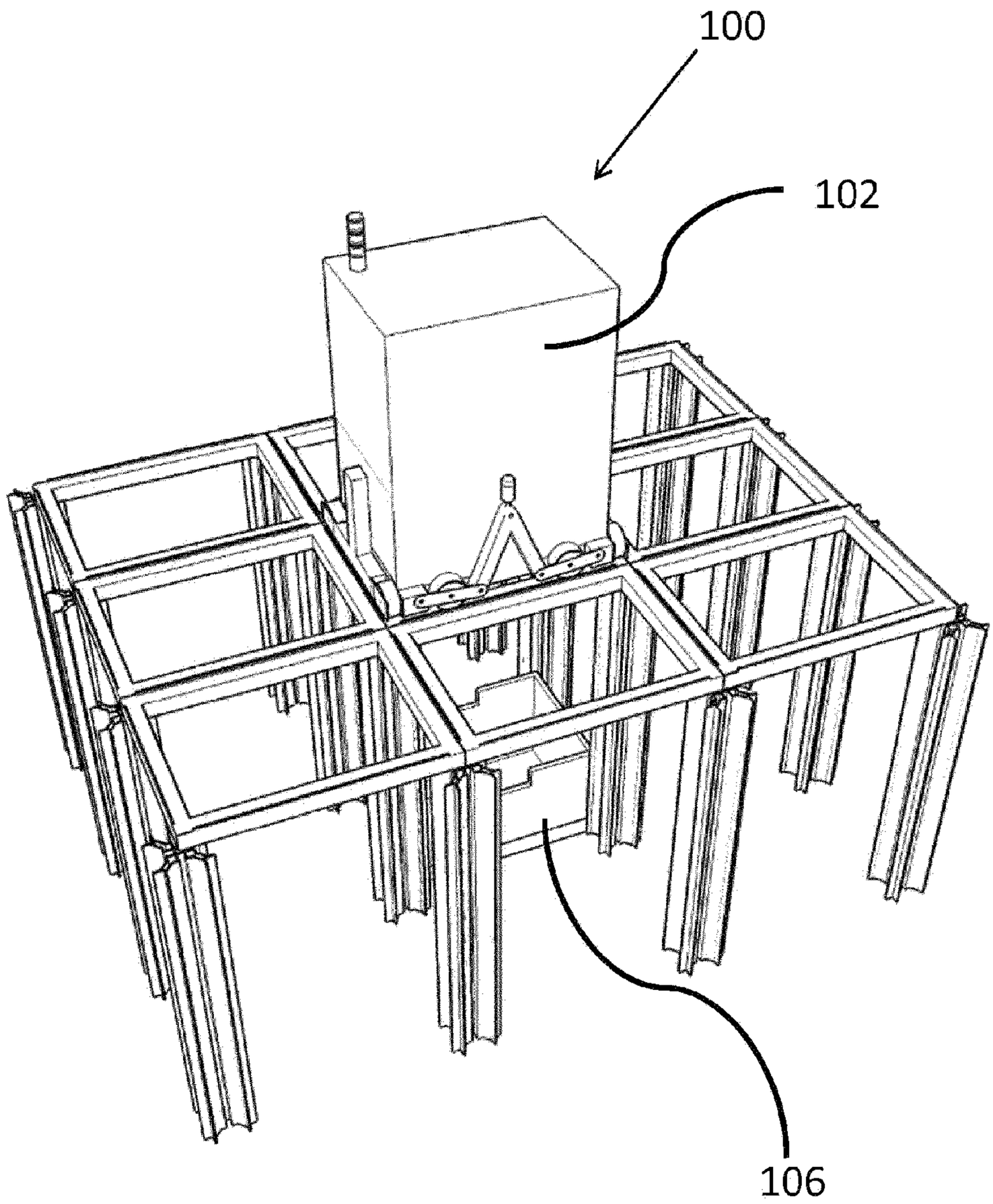


Figure 5

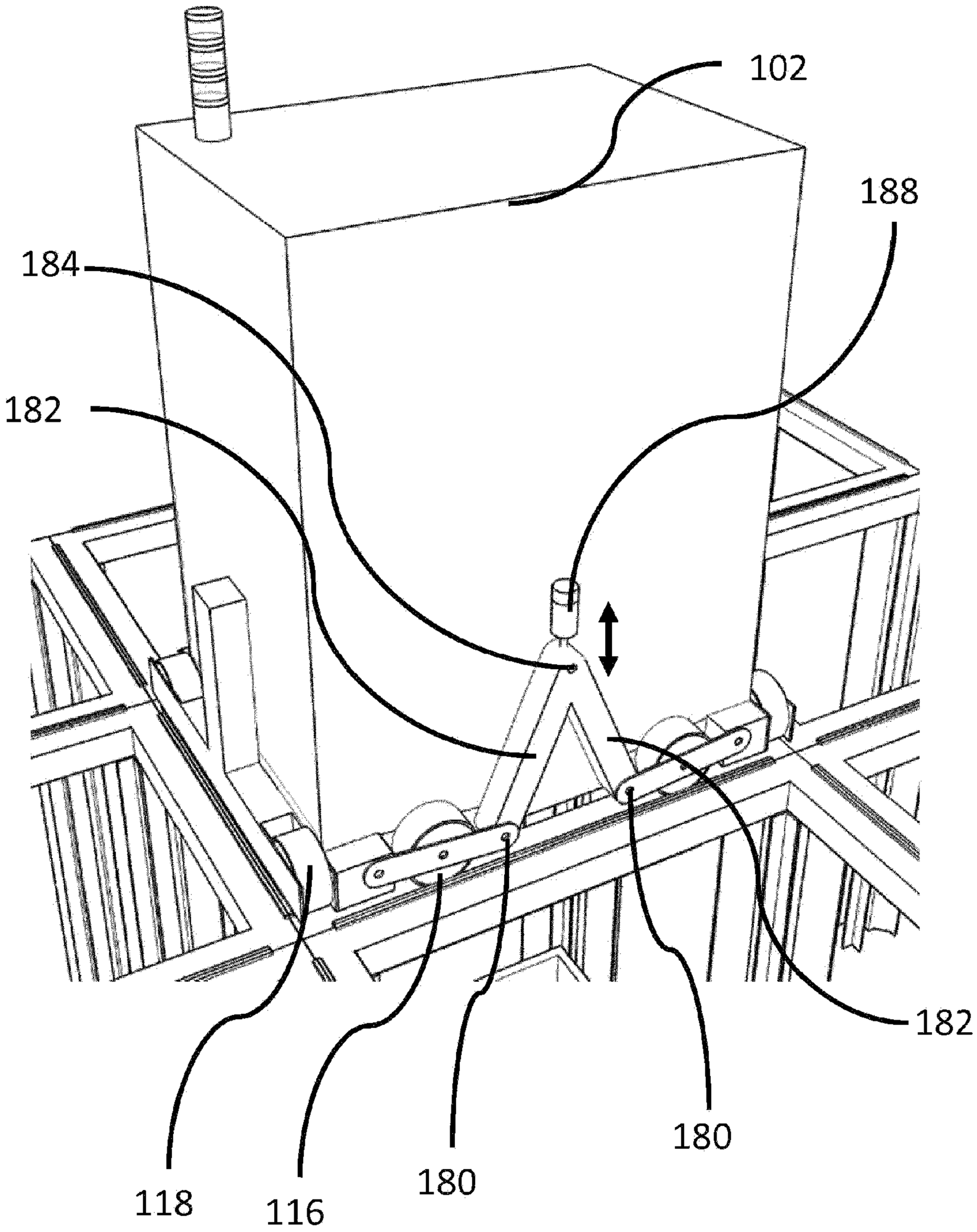


Figure 6

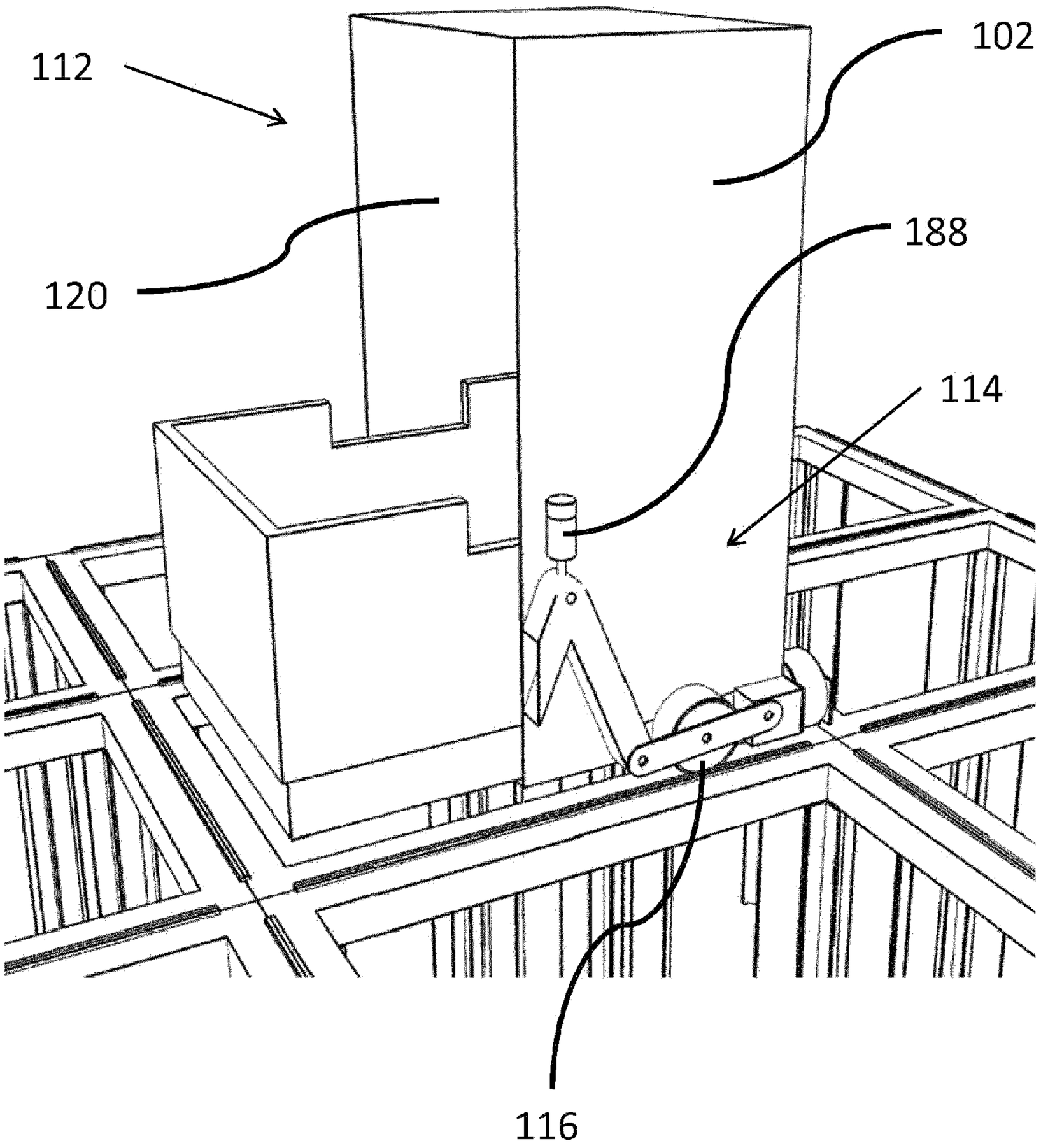


Figure 7

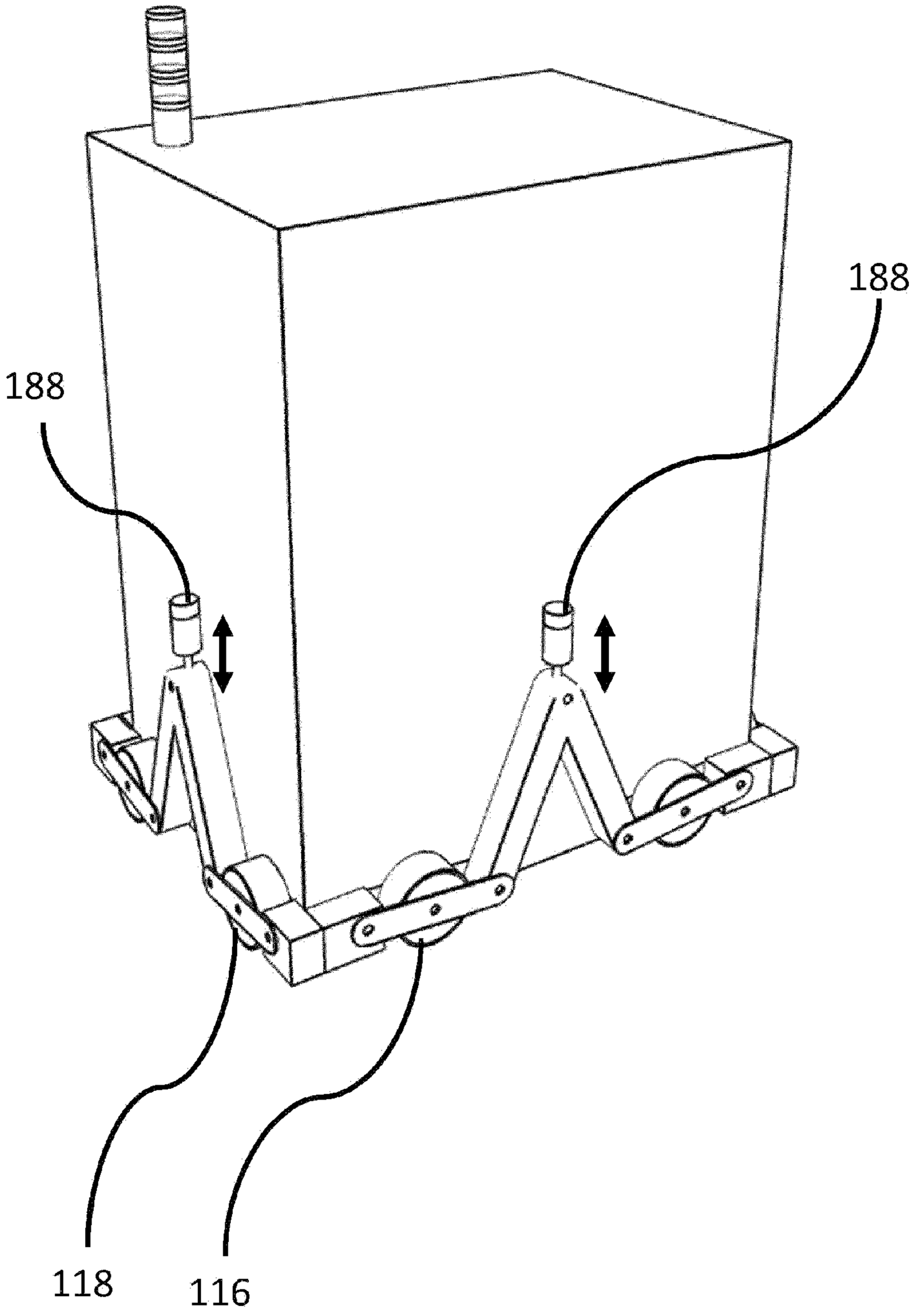


Figure 8

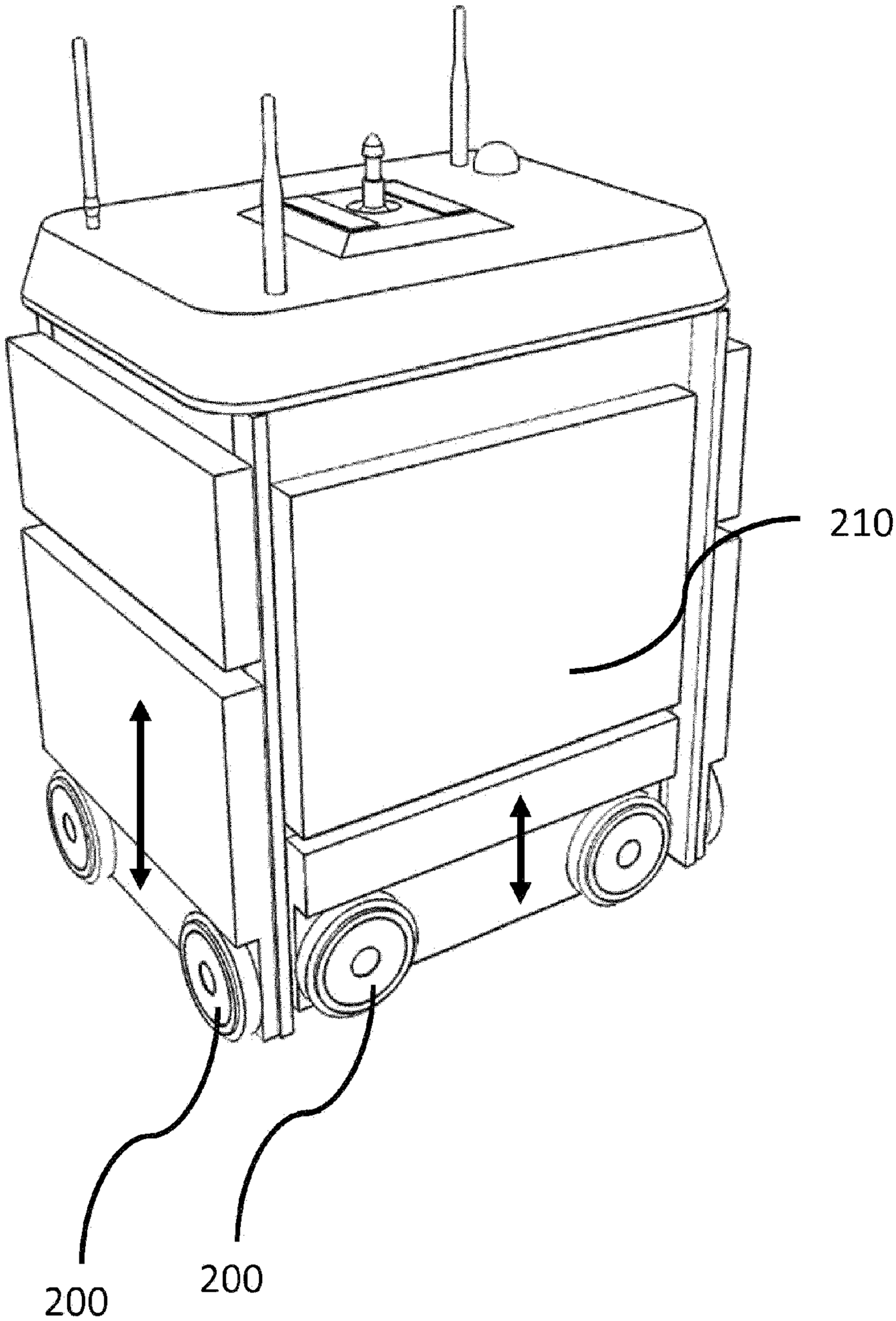


Figure 9

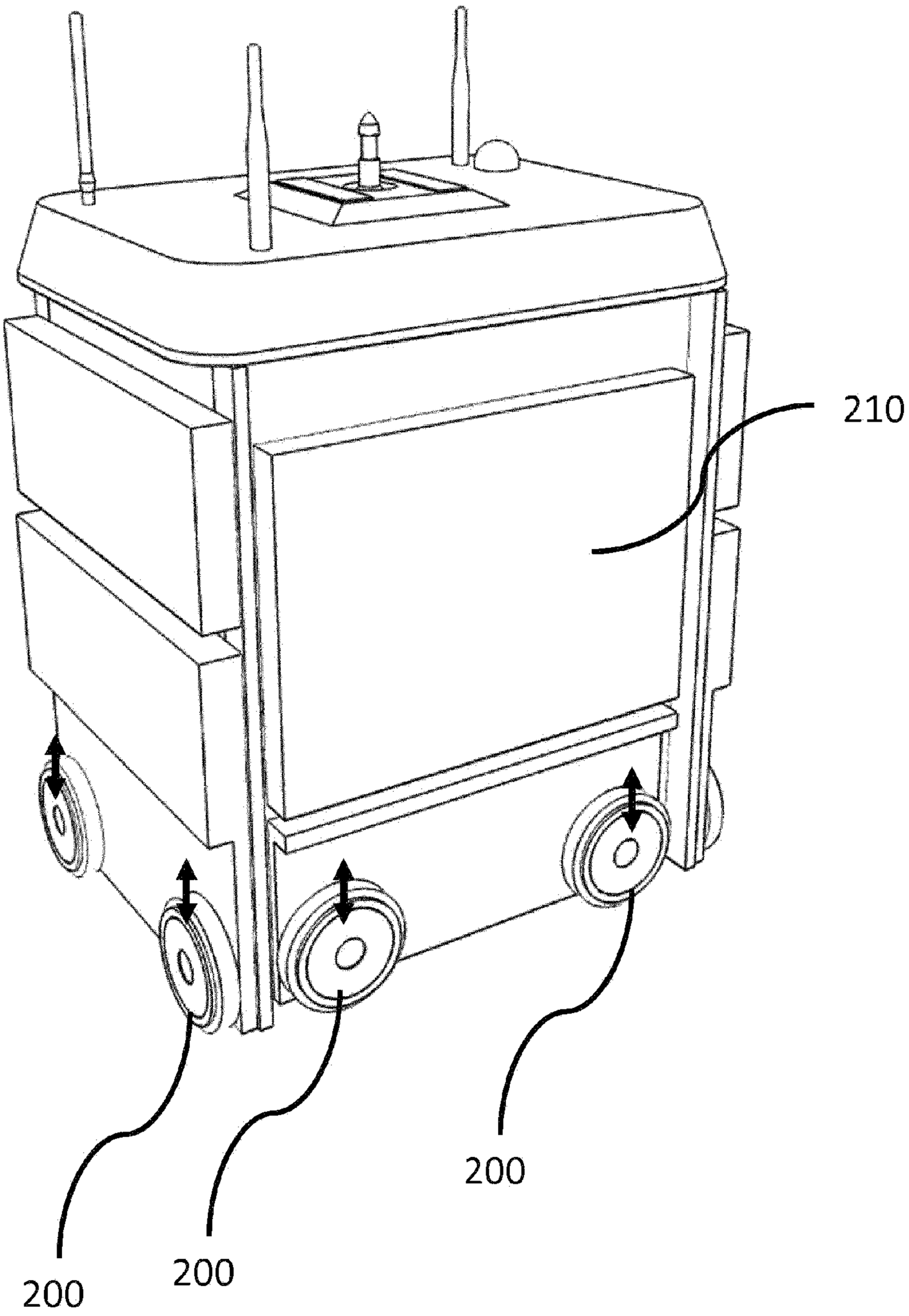


Figure 10

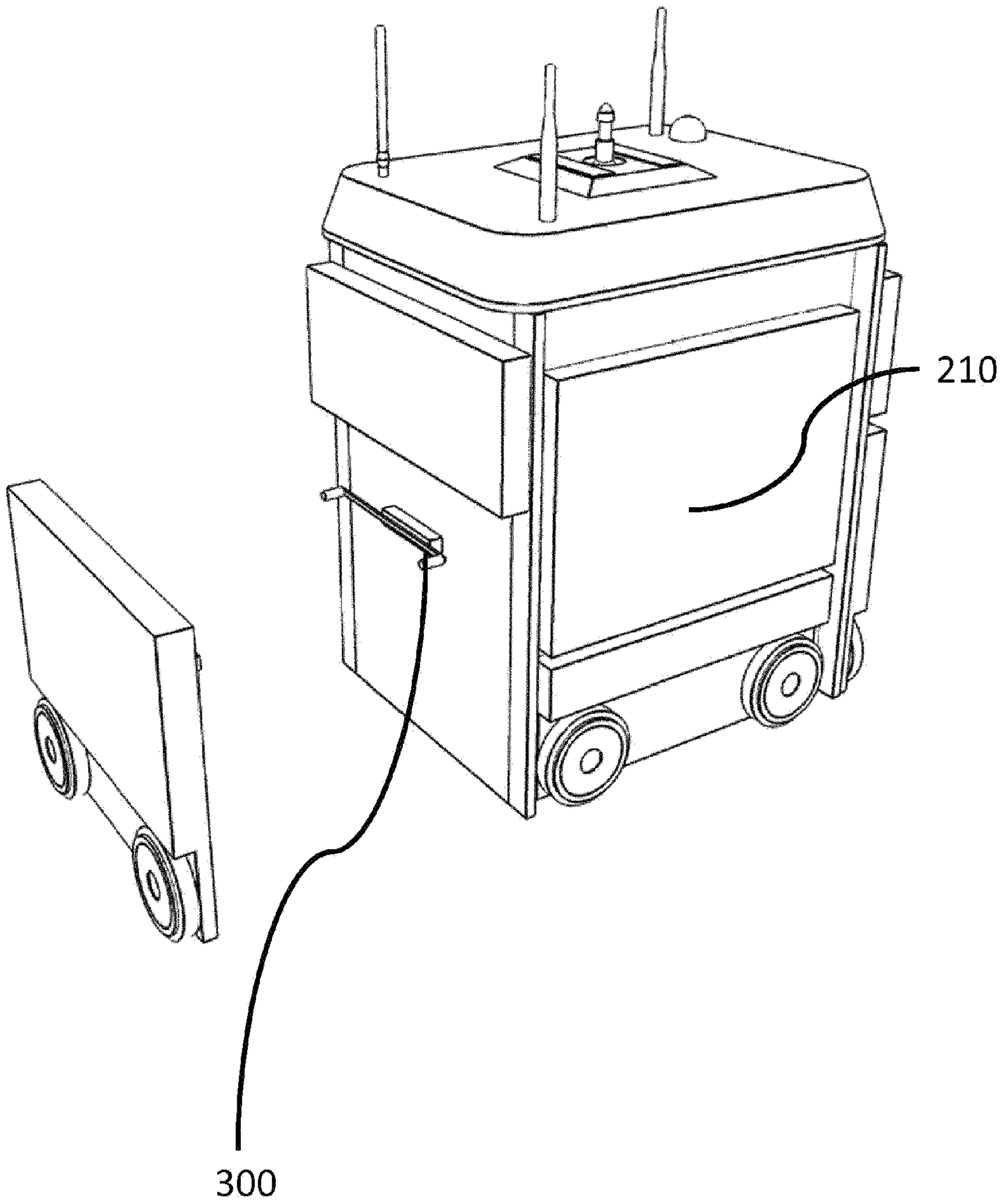


Figure 11

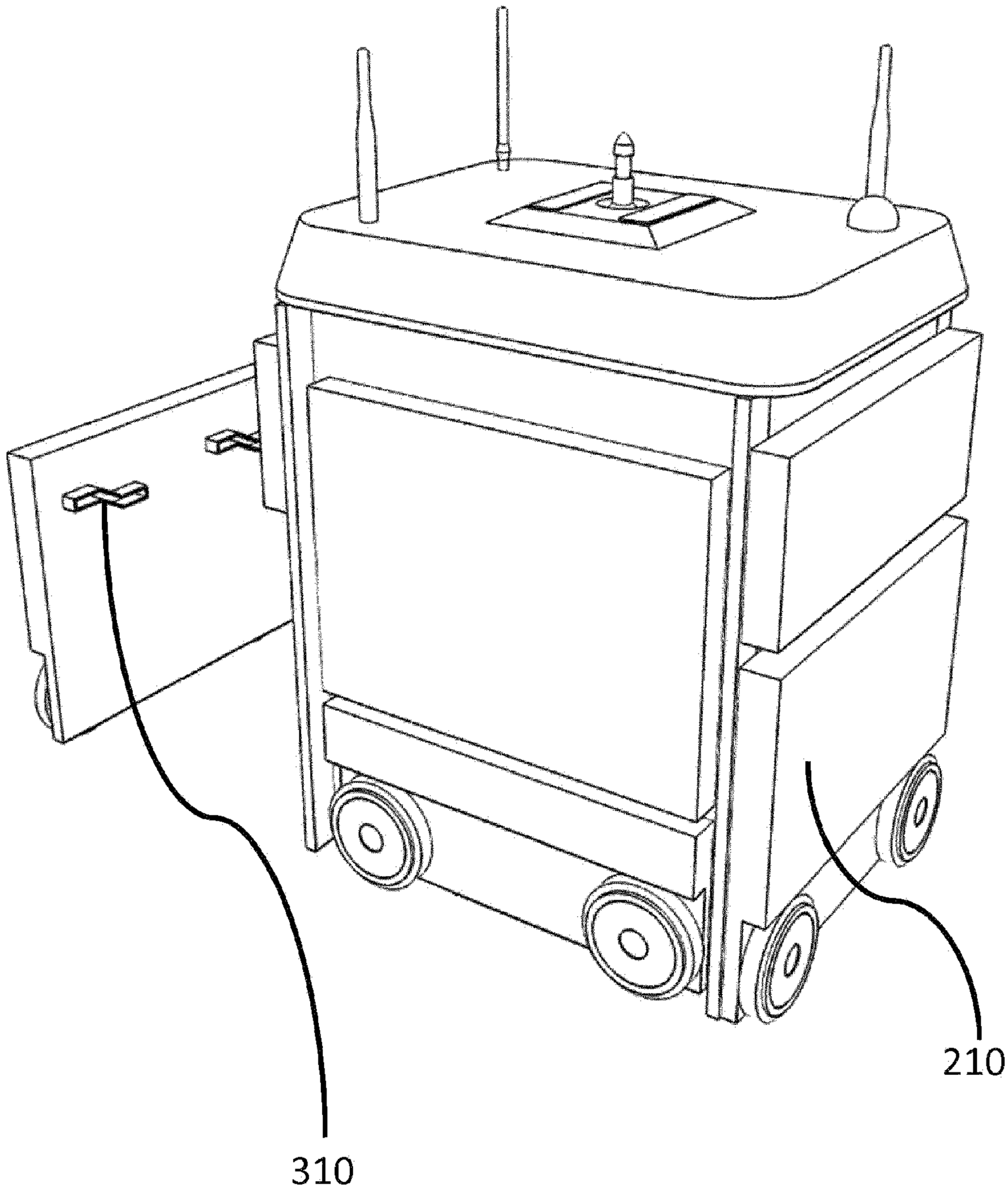


Figure 12

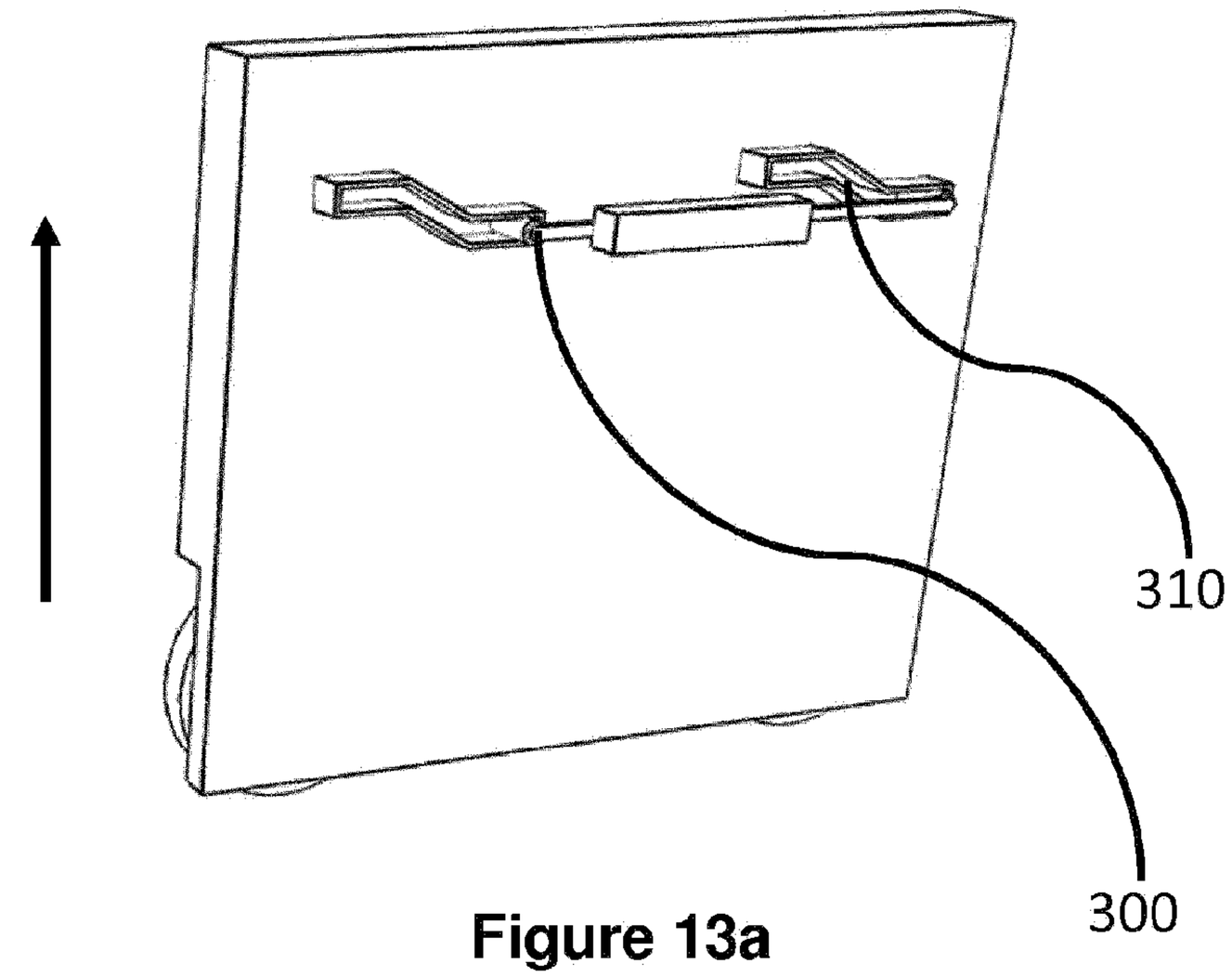


Figure 13a

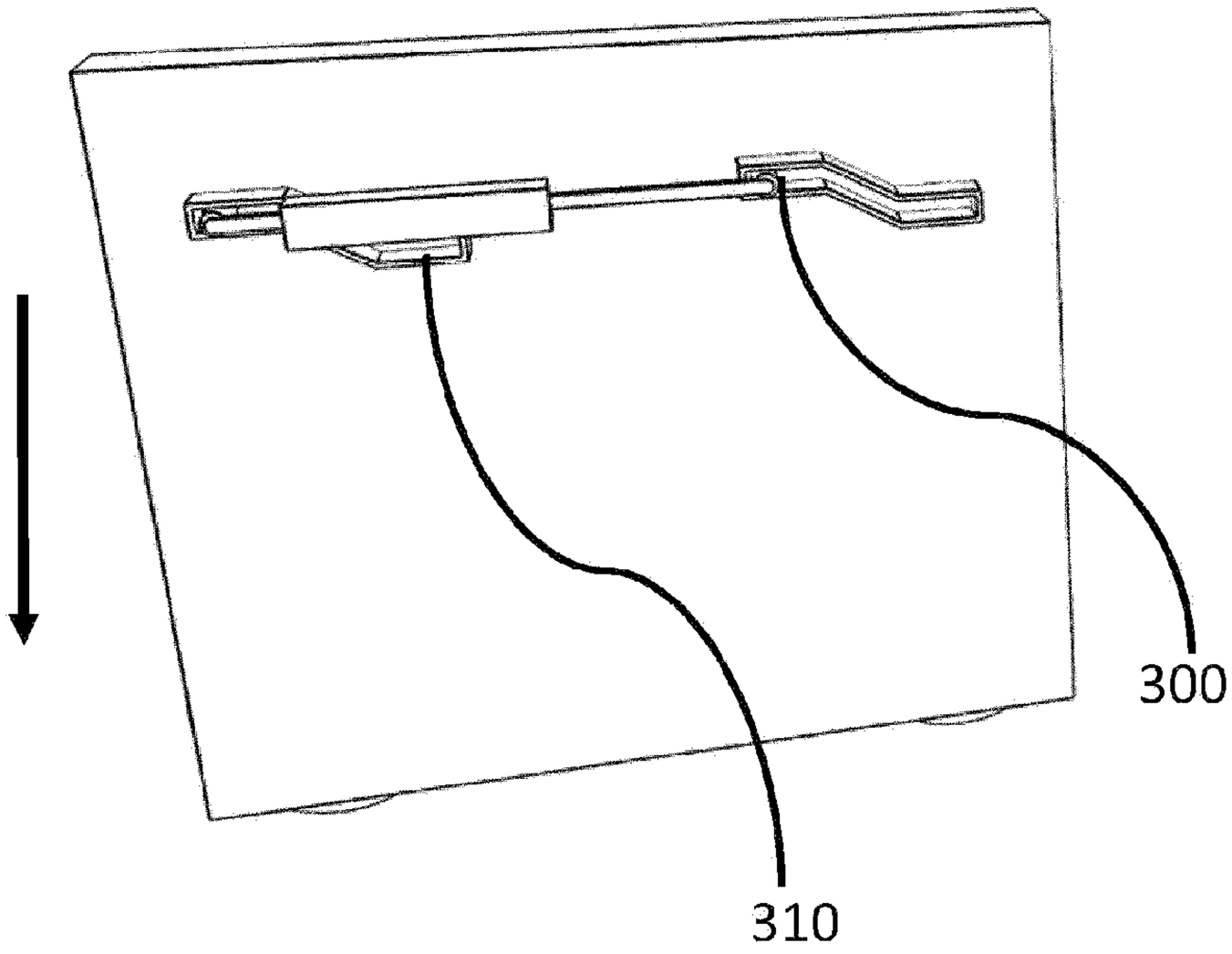


Figure 13b