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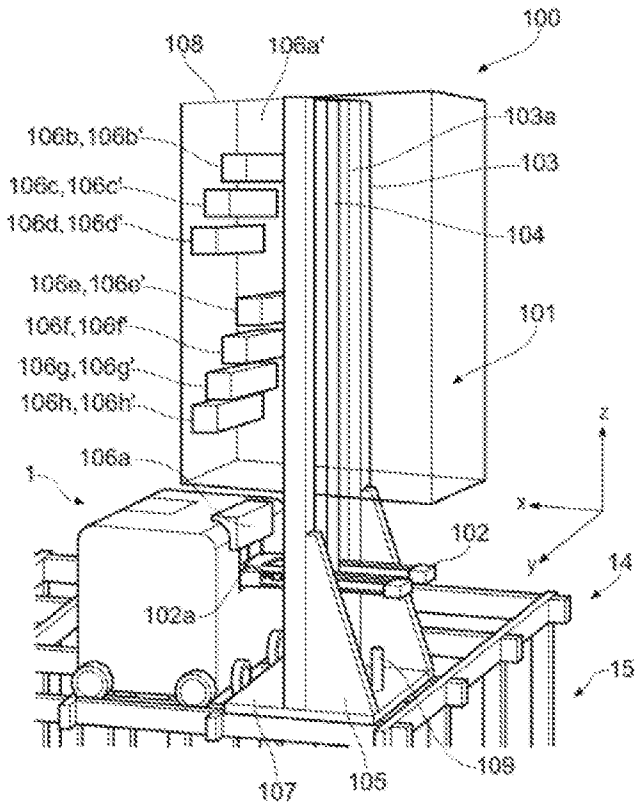
(73)	Proprietor	Autostore Technology AS, Stokkastrandvegen 85, 5578 NEDRE VATS, Norge
(72)	Inventor	Ingvar Hognaland, Stokkastrandvegen 334, 5578 NEDRE VATS, Norge Ivar Fjeldheim, Bjørnebærveien 9, 5533 HAUGESUND, Norge Børge Bekken, Johan Falkbergets gate 2, 5538 HAUGESUND, Norge Trond Austrheim, Nedre Teigen 12, 5590 ETNE, Norge
(74)	Agent or Attorney	ONSAGERS AS, Postboks 1813, Vika, 0123 OSLO, Norge

(54) Title **Storage system comprising a charging station assembly and method of replacing the power source of a remotely operated vehicle**

(56) References Cited: US 2012068664 A1, US 2013343842 A1, US 2011106294 A1, US 2010071979 A1, US 4983903 A, EP 0902521 A2

(57) Abstract

The invention concerns a charging station assembly for charging a plurality of power sources and a method thereof. The charging station assembly comprises a charging station support for fixing the charging station assembly to a base, a plurality of charging stations, each charging station comprising charging means for charging the plurality of power sources and a power source transport device enabling relocation of the power source between an operational position on a remotely operated vehicle and a charging position in or at any one of the plurality of charging stations.



Technical Field:

The present invention relates to a charging station for charging a plurality of power sources as defined in the preamble of claim 1 and a method thereof.

Background and prior art:

A charging station for charging remotely operated vehicles is known. A detailed description of a relevant prior art storage system is presented in WO 2015/104263 A1, and details of a prior art vehicle relevant for use of such charging stations is disclosed in Norwegian patent NO317366. The prior art vehicle is configure to pick up and store storage bins within a three dimensional storage grid. The bins are stacked on top of each other up to a certain height. The storage grid is normally constructed as columns interconnected by top rails onto which remotely operated vehicles, or robots, are arranged to move laterally. Each robot is equipped with a rechargeable battery providing electrical effect to an integrated motor. The robot typically communicates with a control system via a wireless link and is recharged at a charging station when needed, typically at night.

An example of a prior art storage system is illustrated in figure 1. The storage system 3 includes a plurality of robots 1 configured to move on dedicated supporting rails 13 and to receive a storage bin 2 from a storage column 8 within a bin storing grid 15. The prior art storage system 3 may also include a dedicated bin lift device 50, the latter being arranged to receive a storage bin 2 from the robot 1 at the top level of the storage system 3 and to convey the storage bin 2 down in a vertical direction to a delivery station, or port 60.

An example of prior art charging system is illustrated in figure 2 comprising a robot 1 with a battery 6 operated on a base 14 of rails 13 above a bin storing grid 15 and a plurality of charging stations 20,20' for charging the battery 6. The charging stations 20,20' are fixed to the base 14 in positions that are accessible for the part of robot 1 which includes the battery 6. Fig. 2 shows a particular situation where the robot 1 is approaching the charging station 20 in order to transfer an almost discharged battery 6 to a battery vacant charging station 20. After a successful transfer, the robot 1 is moved to another charging station 20' by aid of an auxiliary power source. The other charging station 20' is typically the closest charging station 20' that contains a battery 6' being charged to a fully operational level.

A system for replacing a battery of a ground transportation vehicle, particularly of an unmanned heavy-duty transportation vehicle for ISO containers is disclosed in US 2012068664 A1. The system includes storage spaces for batteries, at least one

ground transportation vehicle having a receiving space for a replaceable battery, and at least one loading and unloading device for transporting batteries between the storage spaces and the receiving space of the transport vehicle in a replacement area. The storage space and the receiving space may include respective centering elements such that the battery is aligned relative to the storage space or the receiving space in response to the loading motion of the loading and unloading device.

Figure 3 (a) and (b) shows an example of a prior art robot 1 viewed from two different angles. The prior art robot 1 comprises a rectangular vehicle body or framework 4 displaying a cavity centrally arranged there within, a top cover 7 covering the top part of the body 4, and two sets of wheels 10,11 oriented perpendicular to each other. A vehicle lifting device 9 for lifting storage bins 2 are seen located within the cavity. The general configuration of the prior art robot 1 is to maximise the cavity size. Motors for the wheels 10,11 may for example be located adjacent to, or within, the respective wheels 10,11.

The additional step of moving the robot 1 from one charging station 20 to another 20' is time consuming. Moreover, this additional step necessitates a built-in auxiliary power source that results in an undesired increase in the minimum robot size and/or decrease in the maximum robot cavity size into which storage bins 2 are situated. This is particularly important when using a compact designed robot such as the robot illustrated in figure 3.

It is thus an object of the present invention to provide a solution that enables a high overall operational cycle and a high number of simultaneously operating vehicles during handling of storage bins within a storage grid. In a more general object is to provide a more efficient way of effectively charging a multiple number of batteries within a smallest possible area.

Summary of the invention:

The present invention is set forth and characterized in the main claims, while the dependent claims describe other characteristics of the invention.

In a first aspect, the invention concerns a storage system comprising a bin storing grid, a base of rails arranged above the bin storing grid, a remotely operated vehicle arranged on the rails and a charging station assembly, wherein the charging station assembly is for charging a plurality of power sources and comprises

- a charging station support fixing the charging station assembly to a base,

wherein the charging station assembly further comprises

- a plurality of charging stations, each charging station arranged at different vertical positions and comprising charging means for charging one of the plurality of power sources and
- a power source transport device enabling relocation of the power source between an operational position on a remotely operated vehicle and a charging position in or at any one of the plurality of charging stations, the power source transport device comprises a power source lift vertically movable between
    - a first vertical position in line with, or near in line with, a power source position on the remotely operated vehicle when the remotely operated vehicle is situated on the base and
    - a second vertical position in line with, or near in line with, any one of the plurality of charging stations;

the first vertical position at a lower level than the second vertical position, and

- the power source lift comprises power source connection means and a horizontally movable frame, and the power source connection means is horizontally moveable on the vertically movable frame for reversibly disconnecting the power source from its operational position on the remotely operated vehicle during use; and

the plurality of charging stations are surrounded by a charging station framework into which the power source lift may enter from below and move within, wherein a lowermost level of the charging station framework is higher than an uppermost level of the remotely operated vehicle.

The charging station assembly may also be suitable for reversibly disconnecting the power sources from remotely operated vehicles. Each of the power sources is in a preferred embodiment configured to provide power to driving mechanisms within a corresponding remotely operated vehicle.

In yet another advantageous embodiment the power source connection means comprises a horizontally movable support and at least one connecting pin fixed to the horizontally movable support for releasably disconnecting the power source from its operational position on the remotely operated vehicle during use. Note that the term ‘connection pin’ should be interpreted as any means, such as mechanical and/or electro-magnetical, that may remove/replace the power source from/to its operational position.

In yet another advantageous embodiment the power source transport device further comprises a vertical directed drive shaft drivingly connected to the power source lift and a remotely operated motor for driving the drive shaft.

In yet another advantageous embodiment the power source transport device further comprises at least one, preferably at least two, vertical directed, or near vertical directed,

column fixed at one longitudinal end to the charging station support and extending at least to the uppermost charging stations, wherein the power source lift is vertically slidable along the column by aid of the remotely operated motor. If at least two columns, these should preferably be situated symmetrically around the drive shaft.

In yet another advantageous embodiment the power source lift further comprises at least one horizontally extending protrusion, and the at least one column displays at least one protrusion receiving recess extending along the at least one column, wherein the power source lift and the at least one column is configured such that the at least one protrusion is sliding within the at least one recess during the vertical movement of the power source lift.

In yet another advantageous embodiment the charging station assembly further comprising a control system for controlling charging of the power sources arranged in a charging position within the charging stations, the control system comprising monitoring means for monitoring a state of charge of the power sources and signal communication means for communicating the state of charge of the power sources to at least one receiver at the power source transport device.

In a second aspect, the invention also concerns a method for charging a plurality of power sources by a charging station assembly according to the first aspect. The inventive method comprises the following sequential steps:

- driving a remotely operated vehicle with a power source to be charged to a remotely controlled charging station assembly comprising a power source lift,
- lowering the power source lift to a vertical position, or keeping the power source lift in a lowered vertical position, corresponding to the vertical position making the next step possible,
- horizontally positioning a power source connection means of the power source lift to a position in which the power source may be disconnected from the remotely operated vehicle and
- disconnecting the power source from the remotely operated vehicle.

The above mentioned vertical position of the power source lift may for example be in line with, immediately below, or immediately above the vertical position of the power source

In another advantageous embodiment the method further comprises the step:

- retracting the power source connection means to the above mentioned vertical position.

In yet another advantageous embodiment the method further comprises the step:

- lifting the power source lift with the power source to a charging station configured to receive and charge the power source, the charging station being one of a plurality of charging stations.

In yet another advantageous embodiment the method further comprises the step:

- horizontally positioning the power source connection means of the power source lift to a position in which the power source is changeably connected in, or may be changeably connected to, the charging station.

The above described method operates a charging station assembly which is in accordance with any one of the above-mentioned embodiments.

In the following description, numerous specific details are introduced to provide a thorough understanding of embodiments of the claimed charging station assembly and corresponding method. One skilled in the relevant art, however, will recognize that these embodiments can be practiced without one or more of the specific details, or with other components, systems, etc. In other instances, well-known structures or operations are not shown, or are not described in detail, to avoid obscuring aspects of the disclosed embodiments.

Brief description of the drawings:

Fig. 1 is a perspective view of a prior art storage system;

Fig. 2 is a perspective side view of part of a prior art storage system including a bin storing grid, a base, a robot and a plurality of charging stations;

Figs. 3 (a) and (b) are perspective views of a prior art remotely operated vehicle, observed from two different angles;

Fig. 4 is a perspective view of a storage system with a remotely operated vehicle and a charging station for multiple power sources in accordance with the invention;

Fig. 5 is a perspective view showing further details of the interconnection between the power source of the remotely operated vehicle and the charging station illustrated in figure 4; and

Fig. 6 (a)-(j) are perspective views of the storage systems at various stages of an exchange of a discharged power source on a remotely operated vehicle with a fully charged power source picked from a charging station assembly.

Detailed description of the invention

Figs. 1 and 2 give perspective views of prior art storage systems as described in further details above.

Fig. 3 gives perspective views in two different angles of a robot 1 that may be used as part of the inventive charging station. This particular robot 1 comprises a rectangular vehicle body or framework 4 displaying a cavity 7 centrally arranged there within, a top lid 72 covering the top part of the body 4, a first set of four wheels 10 mounted inside the cavity 7 and a second set of four wheels 11 mounted at the exterior walls of the body 4. The first and second set of wheels 10,11 are oriented perpendicular to each other.

Fig. 4 shows a part of a storage system 14,15 where the robot 1 is positioned near a multiple charging station 100 in accordance with the invention. The multiple charging station 100 includes a transport device 101 for transporting a battery 106a-h from an operational position on or within the robot 1 to a charging position in one of a plurality of charging stations 106a'-h' located within a cuboid enclosure 108 which partly encloses the transport device 101. The enclosure 108 is open at least at its lower end for enabling a battery lift 102 of the transport device 101 to move freely between a lower position intended for removing a battery 106a from its operational position and an upper position intended for placing the battery 106a into its the charging position within any available/void charging station 106a'.

For the sake of clarity a Cartesian coordinate system is shown with its X, Y and Z axes aligned along the principal directions of the storage system 14,15. Any direction within the X,Y plane is referred to as a horizontal direction and any direction along the z-direction is referred to as a vertical direction.

In the particular embodiment shown in fig. 4, the battery lift 102 may be moved in a vertical direction (z-direction) via a drive shaft 104 connected to a remotely operated motor 109. To ensure stability of the charging station 100 as a whole, as well as to ensure predictable movements of the battery lift 102 during operation, the transport device 101 also includes two vertical support columns 103 situated symmetrically on each side of the battery lift 102 along the y-direction. The support columns 103 has guiding tracks 103a, into which protrusions 102d extending on both sides of the battery lift 102 towards the columns 103 are inserted in order enable stable vertical movements. Each protrusion 102d is preferably shaped as a mushroom, where the horizontal widths of the mushroom head and the mushroom trunk in the x-direction are larger and smaller, respectively, than the corresponding horizontal width of the guiding tracks 103a.

Fig. 5 shows in further details the mechanism 102a,b for inserting / removing the battery 106a-h to/from the operation position on the robot 1, the mechanism 102a,c for horizontal movements towards/from the operational position and the mechanism 102d,103a for guiding the battery lift 102 in the vertical direction along the support columns. For inserting / removing of the battery 106a the particular embodiment utilizes connecting pins 102b fixed at one end to a support plate 102a. The pins 102b are vertically guided into corresponding cavities (not shown) situated at the lower face of the battery 106a by raising the battery lift 102 until the battery 106a is abutting, or near abutting, the support plate 102a. Furthermore, the support plate 102a may be horizontally adjusted on a vertically movable frame 102c. The horizontal movement may for example be achieved using the same principles as for the vertical movement, i.e. using a drive shaft in the x-direction rotationally connected to the motor 109. However, any drive mechanism known in the art capable of moving the support plate, or the entire battery lift 102, horizontally may be envisaged. Moreover, any means for connecting / disconnecting a battery 106a from a robot 1 may be envisaged, involving mechanical means, magnetic means or a combination of both.

With reference to figs. 4-6, and in particular fig. 6(a)-(j), the replacement of a discharged, or nearly discharged, battery 106a connected to a robot 1 with a charged battery 106b from the multiple charging station 100 may be achieved in the following manner:

(a) the battery lift 102 is lowered to, or remain in, a vertical position suitable for disconnecting the battery 106a connected to the robot 1 and the robot 1 is instructed to move into a predetermined position near the charging station 100,

(b) when the robot 1 is in position, the support plate 102a with its connecting pins 102b are horizontally adjusted in order to align the pins 102b below the corresponding cavities within the lower part of the battery 106a,

(c) the battery lift 102 is raised to a position where the base of the battery 106a abuts, or near abuts, the upper surface of the support plate 102a,

(d) the support plate 102a with the battery 106a is retracted horizontally to a position where the battery lift 102 may be lifted vertically into the enclosure 108 with the multiple charging stations 106a'-g',

(e) the battery lift 102 with the battery 106a is lifted vertically to an available / void charging station 106a' within the enclosure 108,

(f) the battery lift 102 is horizontally adjusted and placed in a charging position within the charging station 106a',

(g) the battery lift 102 is moved to any one of the other batteries 106b-g in charge within the multiple charging station 100, for example battery 106b within charging station 106b', and the battery lift 102 is subsequently

horizontally aligned in a position where the connecting pins 102b are aligned below the corresponding cavities and then raised and retracted in the same manner as in steps (b) to (d),

(h) the battery lift 102 with the charged battery 106b is lowered to a position below the enclosure 108 and into a vertical *and* horizontal position above the robot's 1 battery holder,

(i) the battery lift 102 is lowered until the battery 106b is in an operational position on the robot 1 and the connecting pins 102b have been released from the battery 106b and

(j) the robot 1 is instructed to continue its task of removing / storing bins 2 within the storage grid 15.

In the particular embodiment shown in figs. 4-6, the movement between the lower and the upper positions involves horizontal and vertical movements separated in time. However, alternative movement paths of the batteries 106a-h are feasible. For example, if the batteries 106a-h are mounted on the top surface of the robot 1 one may envisage purely vertical movements during placement / disconnection of batteries 106a-h from the robot 1. In this alternative embodiment the battery lift 102 is lowered vertically, then grabs the battery 106a using for example hooks or claws, and finally raised, all operation performed by vertical movements. Movement paths involving simultaneous horizontal and vertical movements are also possible. For example, the horizontal movements of the support plate 102a may start before the battery lift 102 has reached its final positions, thereby reducing operational time.

All operations of both the robots 1 and the multiple charging stations 100 may be controlled by wireless communication means and remote-control units. For example, multiple charging stations 100 may be equipped with a control system allowing control of the charging process by monitoring the state of charge of each battery 106a-h during charging and wirelessly communicating the state of charge real-time to the operator and/or to a receiver in the transport device 101. The motor 109 may be programmed accordingly. The communication of the state of charge to the transport device 101 may be achieved directly or via another system.

In the preceding description, various aspects of the charging station assembly and the method according to the invention have been described with reference to the illustrative embodiment. For purposes of explanation, specific numbers, systems and configurations were set forth in order to provide a thorough understanding of the apparatus and its workings. However, this description is not intended to be construed in a limiting sense. Various modifications and variations of the illustrative embodiments, as well as other embodiments of the assembly, which are

apparent to persons skilled in the art to which the disclosed subject matter pertains, are deemed to lie within the scope of the present invention.

List of reference numerals / letters:

1 Remotely operated vehicle / robot
2 Storage bin
3 Storage system
4 Vehicle body / framework
6 Power source / battery for single battery charging station
7 Top cover
8 Storage column
9 Vehicle lifting device
10 First set of wheels
11 Second set of wheels
13 Supporting rail
14 Base
15 Bin storing grid
20 Charging station for a single power source/battery
20' Adjacent charging station for a single power source/battery
50 Bin lift device
60 Delivery station / port
100 Charging station assembly for multiple power sources / multiple charging station
101 Power source transport device / transport device
102 Power source lift / battery lift
102a Horizontally movable support / support plate
102b Connecting pins
102c Vertically movable frame / frame
102d Guiding track protrusion / protrusion
103 Vertical support columns
103a Guiding track
104 Drive shaft for power source lift
105 Stabilizing elements for vertical support columns
106a-g Power source / battery for multiple batteries charging station
106a'-g' Charging stations
107 Support stand for charging station / charging station support
108 Charging station framework with support for power sources / enclosure
109 Drive shaft motor / motor

CLAIMS

1. A storage system comprising a bin storing grid (15), a base (14) of rails (13) arranged above the bin storing grid (15), a remotely operated vehicle (1) arranged on the rails (13) and a charging station assembly (100), wherein the charging station assembly (100) is for charging a plurality of power sources (106a-g) and comprises

- a charging station support (107) fixing the charging station assembly (100) to a base (14),

characterized in that the charging station assembly (100) further comprises

- a plurality of charging stations (106a'-h'), each charging station (106a'-h') arranged at different vertical positions and comprising charging means for charging one of the plurality of power sources (106a-h) and
- a power source transport device (101) enabling relocation of the power source (106a-h) between an operational position on a remotely operated vehicle (1) and a charging position in or at any one of the plurality of charging stations (106a'-h'), the power source transport device (101) comprises a power source lift (102) vertically movable between
    - a first vertical position in line with, or near in line with, a power source position on the remotely operated vehicle (1) when the remotely operated vehicle is situated on the base (14) and
    - a second vertical position in line with, or near in line with, any one of the plurality of charging stations (106a'-h');

      the first vertical position at a lower level than the second vertical position, and
- the power source lift (102) comprises power source connection means (102a,102b) and a horizontally movable frame (102c), and the power source connection means (102a,102b) is horizontally moveable on the vertically movable frame for reversibly disconnecting the power source (106a-h) from its operational position on the remotely operated vehicle (1) during use; and

the plurality of charging stations (106a'-h') are surrounded by a charging station framework (108) into which the power source lift (102) may enter from below and move within, wherein a lowermost level of the charging station framework (108) is higher than an uppermost level of the remotely operated vehicle (1).

2. The storage system in accordance with claim 1,

characterized in that the power source transport device (101) further comprises

- a vertical directed drive shaft (104) drivingly connected to the power source lift (102) and
- a remotely operated motor (109) for driving the drive shaft (104).

3. The storage system in accordance with claim 1 or 2,
characterized in that the power source transport device (101) further comprises
- a remotely operated motor (109) and
- at least one vertical directed, or near vertical directed, column (103) fixed at one longitudinal end to the charging station support (107) and extending at least to the uppermost charging stations (106h'),

wherein the power source lift (102) is vertically slidable along the column (103) by aid of the remotely operated motor (109).

4. The storage system in accordance with any one of claims 1-3,
characterized in that the power source transport device (101) further comprises
- a vertical directed drive shaft (104) drivingly connected to the power source lift (102),
- a remotely operated motor (109) for driving the drive shaft (104) and
- at least two vertical directed, or near vertical directed, columns (103) situated symmetrically on each side of the drive shaft (104),

wherein each column is fixed at one longitudinal end to the charging station support (107) and extending at least beyond the uppermost charging stations (106h').

5. The storage system in accordance with claim 3 or 4,
characterized in that the power source lift (102) further comprises
at least one horizontally extending protrusion, and
the at least one column (103) displays
at least one protrusion receiving recess (103a) extending along the at least one column (103),
wherein the power source lift (102) and the at least one column (103) is configured such that the at least one protrusion is sliding within the at least one recess (103a) during the vertical movement of the power source lift (102).

6. The storage system in accordance with any one of the preceding claims,
characterized in that the charging station assembly (100) further comprises a control system for controlling charging of the power sources (106a-h) arranged in a charging position within the charging stations (106a'-h'), the control system comprising
- monitoring means for monitoring a state of charge of the power sources (106a-h) and
- signal communication means for communicating the state of charge of the power sources (106a-h) to at least one receiver at the power source transport device (101) or a remote operator or a combination thereof.

7. A method of replacing the power source of a remotely operated vehicle (1) in a storage system according to any of the preceding claims, comprising the steps of:
    a. driving the remotely operated vehicle (1) into a predetermined position below the plurality of charging stations (106a'-h');
    b. lowering the power source lift (102) to the first position;
    c. horizontally positioning the power source connection means (102a,102b) to a position in which the power source may be disconnected from the remotely operated vehicle;
    d. disconnecting the power source from the remotely operated vehicle; and
    e. lifting the power source lift (102) to the second position;

    wherein steps b and c are performed before, after or simultaneous to step a.

8. A method according to claim 14, comprising the step of:
    f. horizontally positioning the power source connection means to a position in which the power source is connected in a charging position in a charging station.

KRAV

1. Et lagersystem omfattende et kasselagringsgitter (15), et fundament (14) med skinner (13) anordnet over kasselagringsgitteret (15), et fjernstyrt kjøretøy (1) anordnet på skinnene (13) og en ladestasjonssammenstilling (100), hvor ladestasjonssammenstillingen (100) er for ladning av flere kraftkilder (106a-g) og omfatter

- en ladestasjonsstøtte (107) som fester ladestasjonssammenstillingen (100) til fundamentet (14),

karakterisert ved at ladestasjonssammenstillingen (100) videre omfatter

- flere ladestasjoner (106a'-h'), hver ladestasjon (106a'-h') anordnet ved forskjellige vertikale posisjoner og omfattende lademidler for å lade en av de flere kraftkildene (106a-h) og
- en kraftkildetransportanordning (101) som muliggjør flytting av kraftkilden (106a-h) mellom en operativ posisjon på et fjernstyrt kjøretøy (1) og en ladeposisjon i eller ved hvilken som helst av de flere ladestasjonene (106a'-h'), kraftkildetransportanordningen (101) omfatter en kraftkildeheis (102) som er vertikalt bevegelig mellom
    - en første vertikal posisjon på linje med, eller nær på linje med, en kraftkildeposisjon på det fjernstyrte kjøretøyet (1) når det fjernstyrte kjøretøyet er plassert på fundamentet (14) og
    - en andre vertikal posisjon på linje med, eller nær på linje med, hvilken som helst av de flere ladestasjonene (106a'-h');
      den første vertikale posisjonen er ved et lavere nivå enn den andre vertikale posisjonen, og
- kraftkildeheisen (102) omfatter kraftkildetilkoblingsmidler (102a,102b) og en horisontalt bevegelig ramme (102c), og kraftkildetilkoblingsmidlene (102a,102b) er horisontalt bevegelige på den vertikalt bevegelige rammen for å reversibelt frakoble kraftkilden (106a-h) fra dens operasjonelle posisjon på det fjernstyrte kjøretøyet (1) ved bruk; og

de flere ladestasjonene (106a'-h') er omgitt av et ladestasjonsrammeverk (108) inn i hvilket kraftkildeheisen (102) kan gå inn i fra undersiden og bevege seg inne i, hvor et laveste nivå til ladestasjonsrammeverket (108) er høyere enn et øverste nivå til det fjernstyrte kjøretøyet (1).

2. Lagersystemet ifølge krav 1,
karakterisert ved at kraftkildetransportanordningen (101) videre omfatter

- en vertikalt rettet drivaksling (104) drivbart koblet til kraftkildeheisen (102) og
- en fjernstyrt motor (109) for å drive drivakslingen (104).

3. Lagersystemet ifølge krav 1 eller 2,

karakterisert ved at kraftkildetransportanordningen (101) videre omfatter
- en fjernstyrt motor (109) og
- minst en vertikalt rettet, eller nær vertikalt rettet, kolonne (103) festet ved en ende til ladestasjonsstøtten (107) og som minst strekker seg til de øverste ladestasjonene (106h'),

hvor kraftkildeheisen (102) er vertikalt glidbar langs med kolonnen (103) ved hjelp av den fjernstyrte motoren (109).

4. Lagersystemet ifølge hvilket som helst av kravene 1-3,
karakterisert ved at kraftkildetransportanordningen (101) videre omfatter
- en vertikalt rettet drivaksling (104) drivbart koblet til kraftkildeheisen (102),
- en fjernstyrt motor (109) egnet for å drive drivakslingen (104) og
- minst to vertikalt rettede, eller nær vertikalt rettede, kolonner (103) anordnet symmetrisk på hver side av drivakslingen (104),

hvor hver kolonne er festet ved en ende til ladestasjonsstøtten (107) og strekker seg minst forbi de øverste ladestasjonene (106h').

5. Lagersystemet ifølge krav 3 eller 4,
karakterisert ved at kraftkildeheisen (102) videre omfatter
minst et horisontalt utstrakt fremspring, og
den minst ene kolonnen (103) fremviser
minst en fremspringsmottakende utsparing (103a) som strekker seg langs med den minst ene kolonnen (103),
hvor kraftkildeheisen (102) og den minst ene kolonnen (103) er konfigurert slik at det minst ene fremspringet glir inne i den minst ene utsparingen (103a) ved den vertikale bevegelsen til kraftkildeheisen (102).

6. Lagersystemet ifølge hvilket som helst av de forutgående krav,
karakterisert ved at ladestasjonssammenstillingen (100) videre omfatter et kontrollsystem for å kontrollere ladning av kraftkildene (106a-h) anordnet i en ladeposisjon inne i ladestasjonene (106a'-h'), kontrollsystemet omfattende
- overvåkningsmidler for å overvåke kraftkildenes (106a-h) ladetilstand og
- signalkommunikasjonsmidler for å kommunisere kraftkildenes (106a-h) ladetilstand til minst en mottaker ved kraftkildetransportanordningen (101) eller en fjerntliggende operatør eller en kombinasjon derav.

7. En fremgangsmåte for å bytte ut kraftkilden til et fjernstyrt kjøretøy (1) i et lagersystem ifølge hvilket som helst av de forutgående krav, omfattende trinnene:
   a. å kjøre det fjernstyrte kjøretøyet (1) til en forutbestemt posisjon under de flere ladestasjonene (106a'-h');
   b. å senke kraftkildeheisen (102) til den første posisjonen;

c. å horisontalt posisjonere kraftkildetilkoblingsmidlene (102a,102b) til en posisjon hvor kraftkilden kan kobles fra det fjernstyrte kjøretøyet;
d. å frakoble kraftkilden fra det fjernstyrte kjøretøyet; og
e. å løfte kraftkildeheisen (102) til den andre posisjonen;

hvor trinn b og c blir utført før, etter eller samtidig med trinn a.

8. En fremgangsmåte ifølge krav 7, omfattende trinnene:
f. å horisontalt posisjonere kraftkildetilkoblingsmidlene til en posisjon hvor kraftkilden er koblet i en ladeposisjon i en ladestasjon.

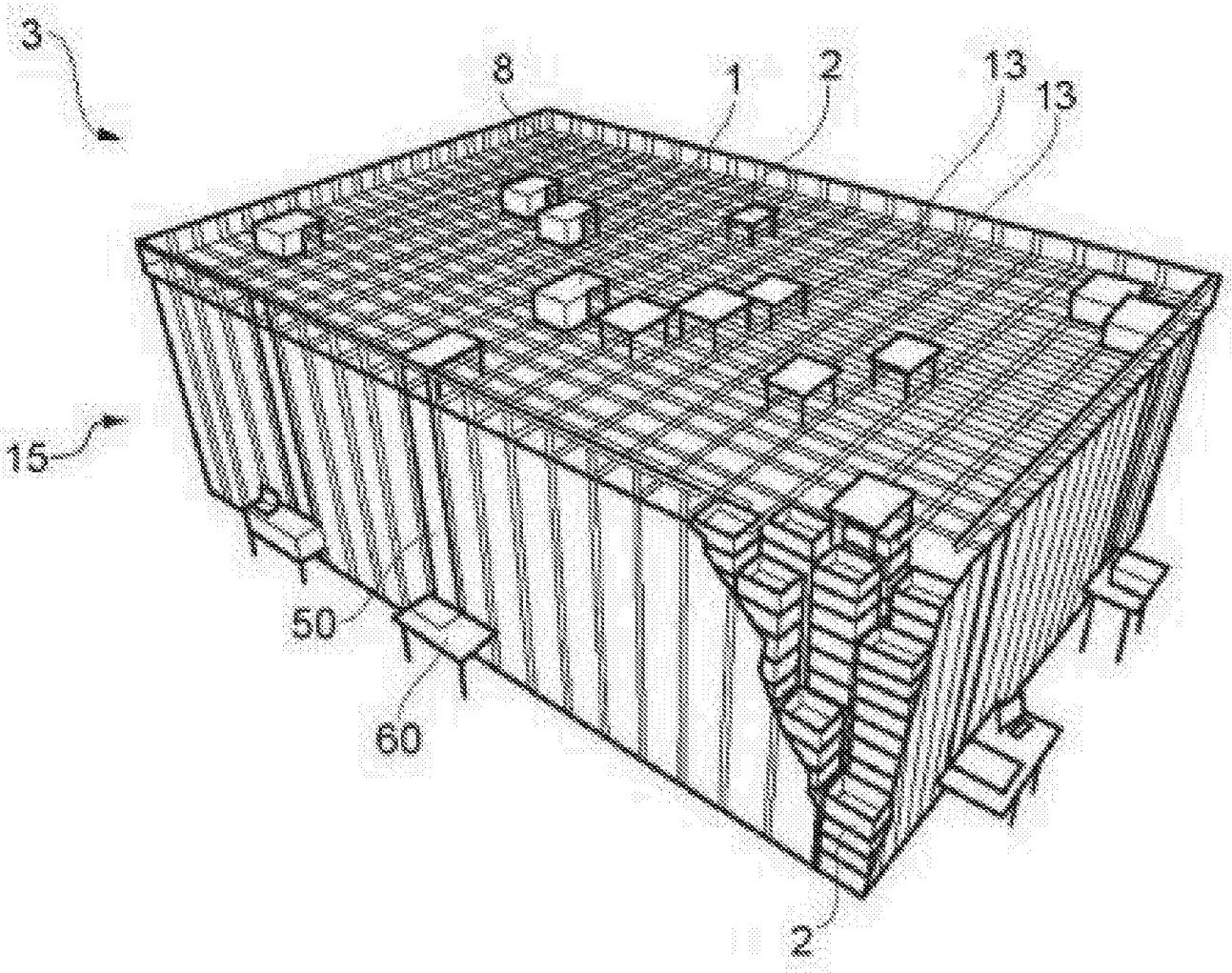


Fig. 1 (Prior Art)

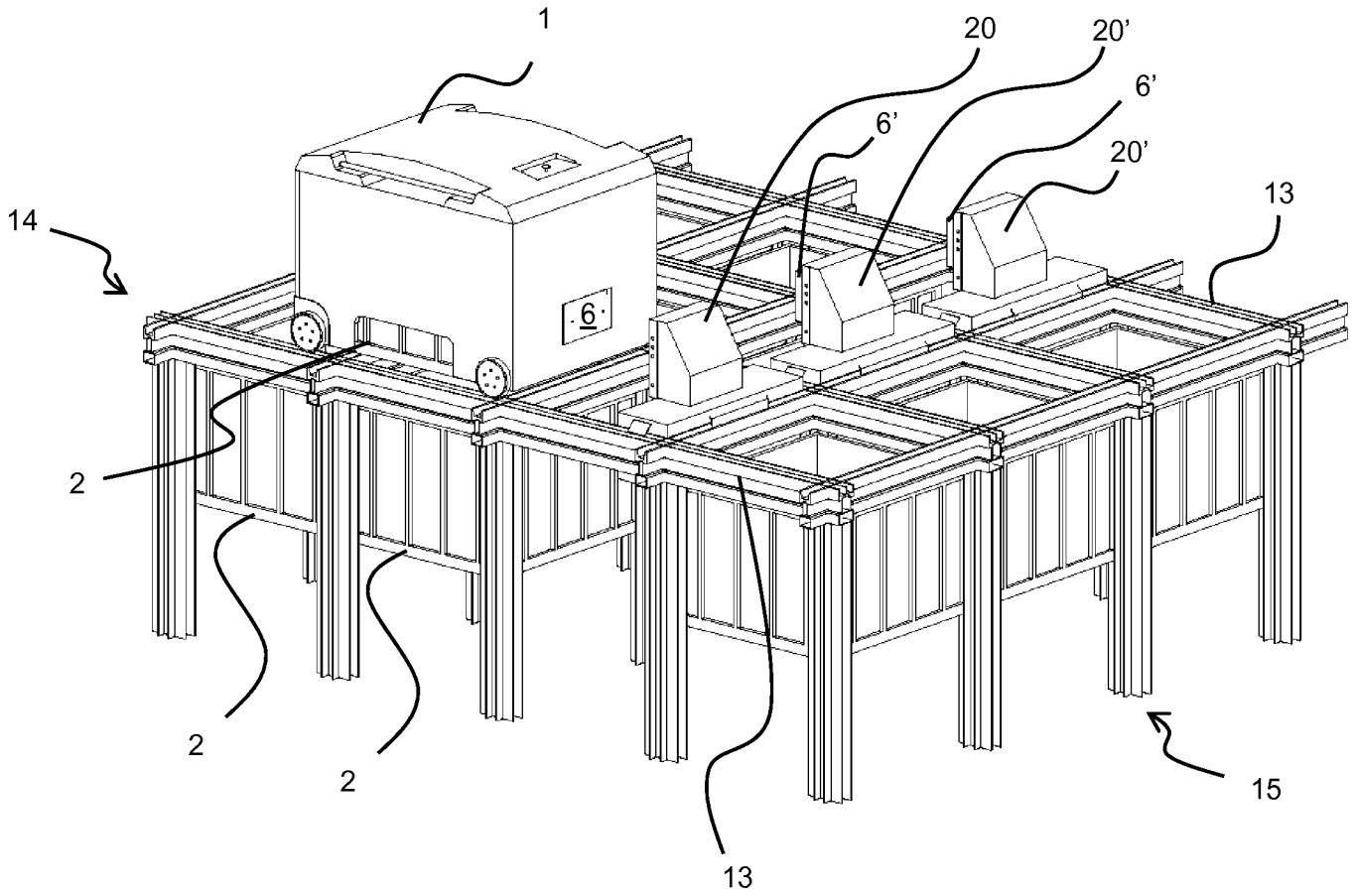


Fig. 2 (Prior Art)

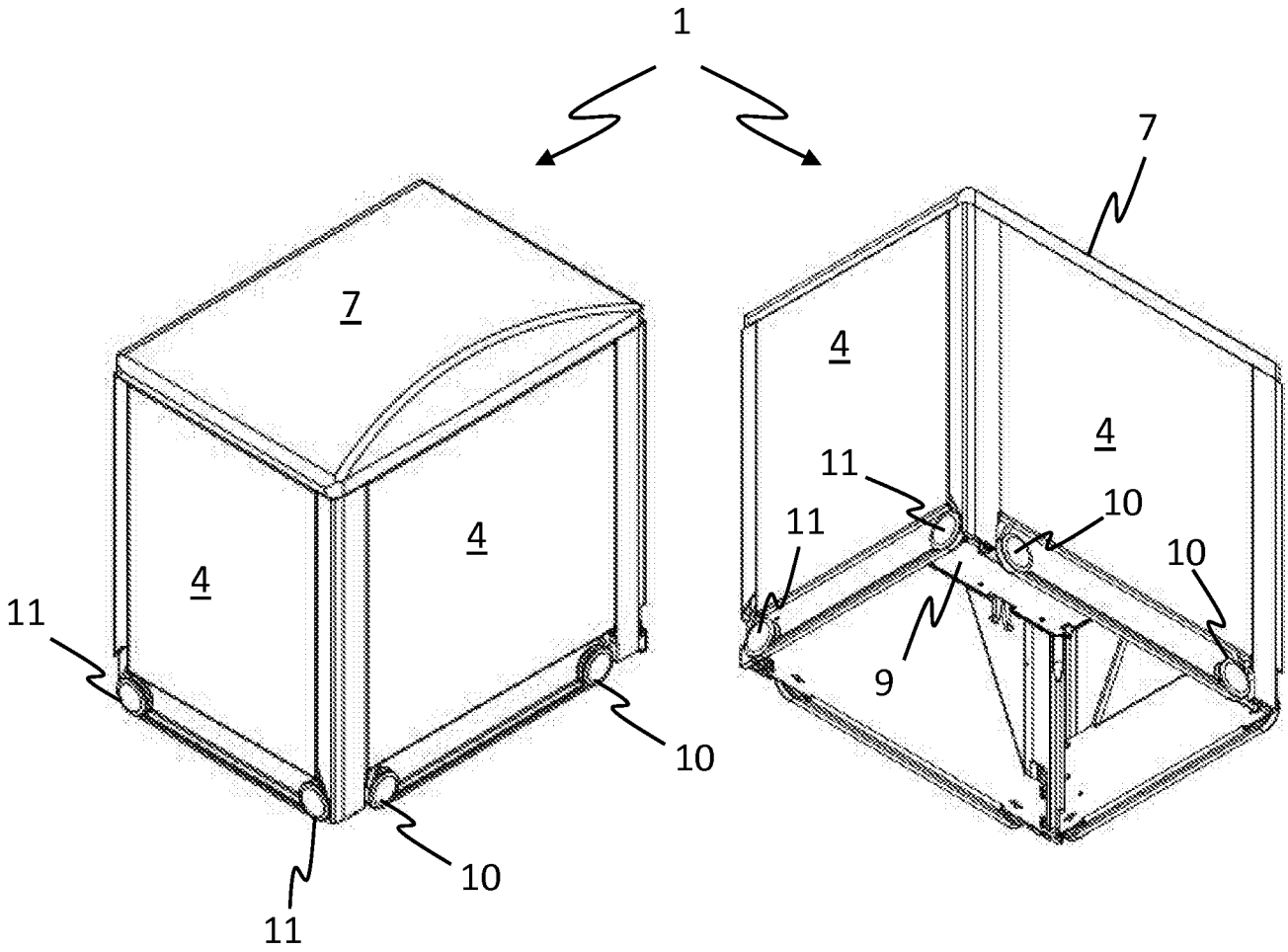


Fig. 3 (Prior Art)

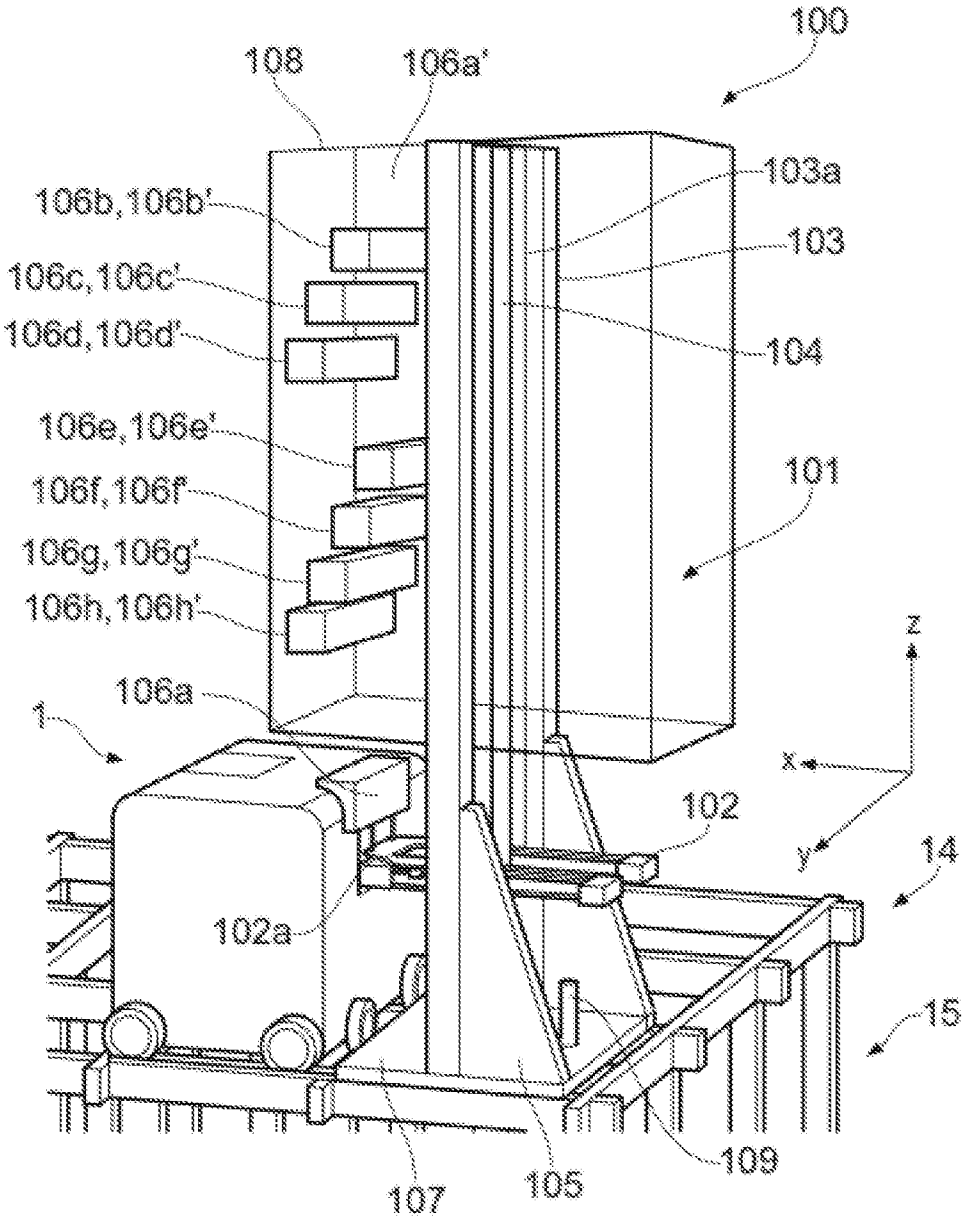

100
108
106a'
103a
106b,106b'
103
106c,106c'
106d,106d'
104
106e,106e'
101
106f,106f'
106g,106g'
106h,106h'
z
106a
1
x
102
y
14
102a
15
109
107
105

Fig. 4

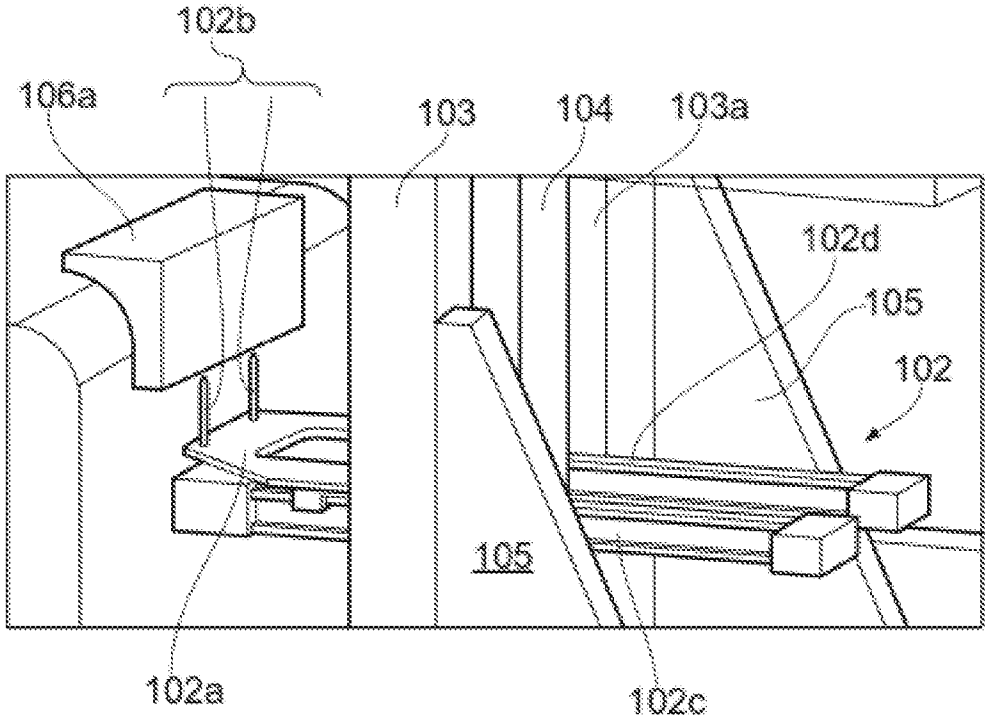


Fig. 5

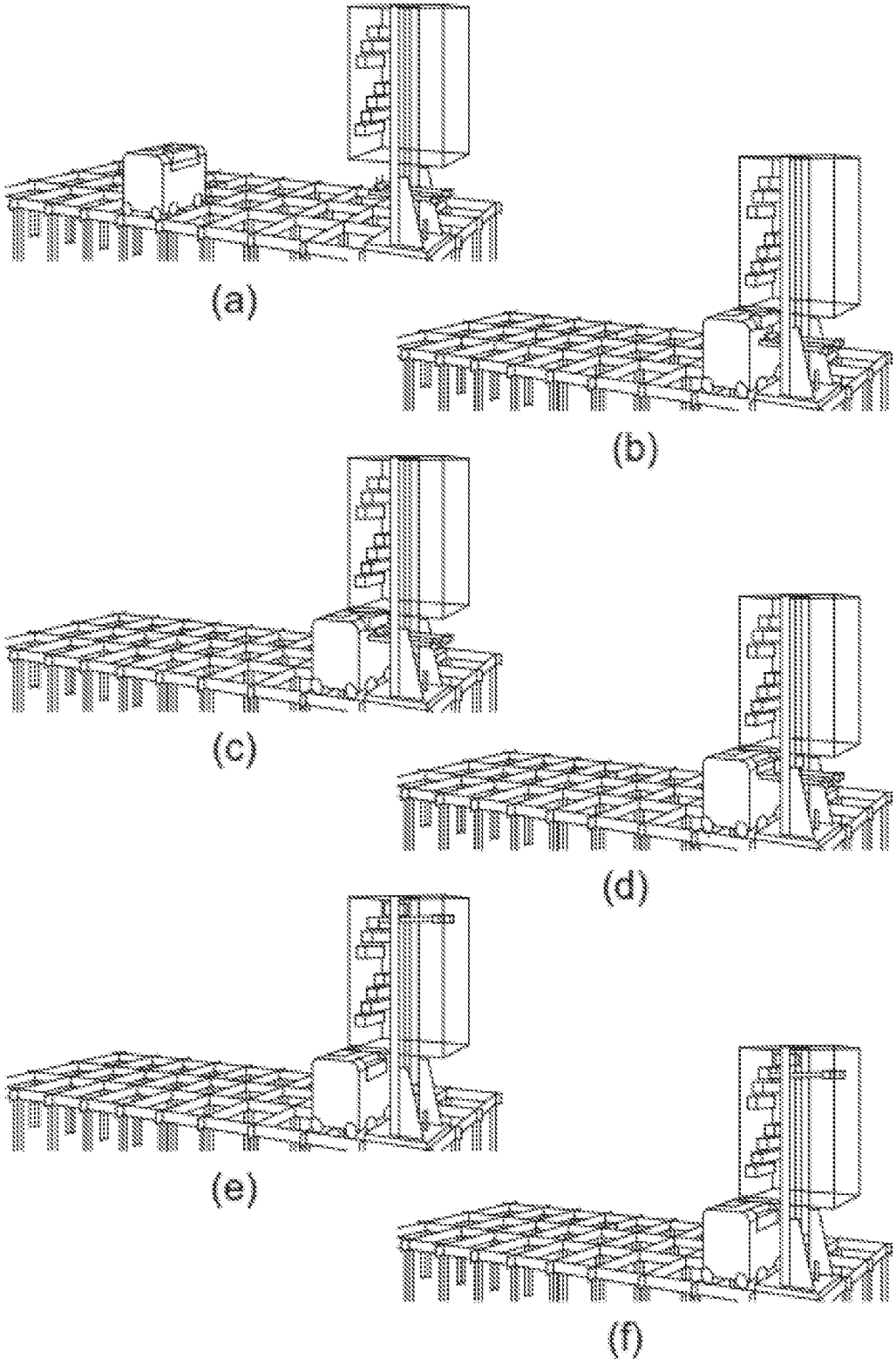


Fig. 6

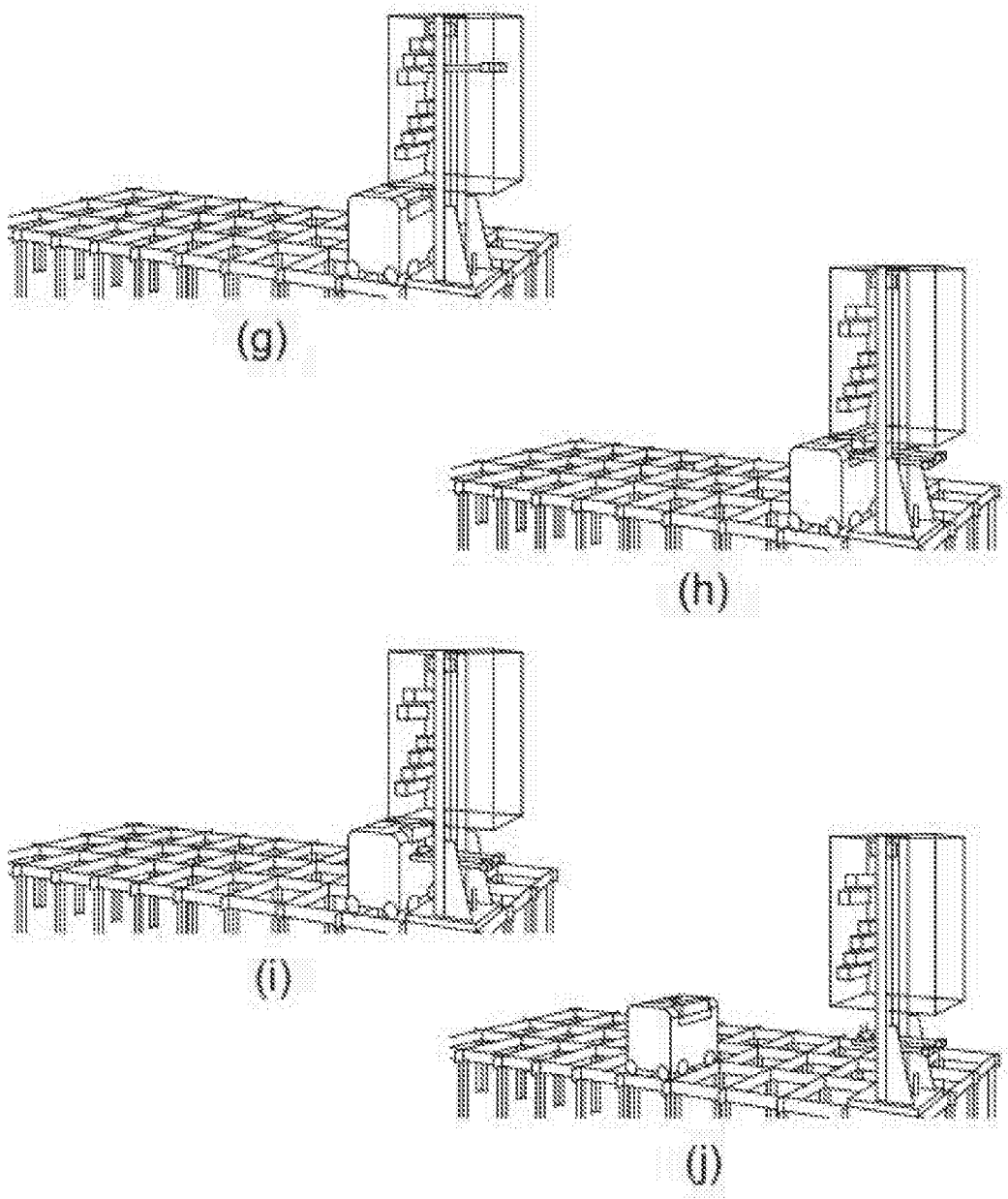


Fig. 6 (cont.)