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Storage and Retrieval Device

The invention at hand relates to a storage and retrieval device comprising a storage and retrieval unit and a satellite vehicle according to the preamble of independent patent claim 1 as well as to a channel store comprising a plurality of channels for receiving storage goods, for example pallets.

In the food industry, fully-automatic channel stores, in which the frozen products are stored at temperatures of up to -30°C, are used for intermediately storing frozen products. The channel stores comprise a plurality of channels for receiving pallets, for example, on which the frozen products are stored. To optimally utilize space, the channels of the channel stores are configured for multi-deep storage, i.e. a plurality of pallets can be stored downstream from one another in the same channel. This requires sophisticated logistics with respect to the storage and retrieval according to type and expiration date of the frozen products.

Between the channels, the channel store comprises aisles to ensure access to the individual channels. The storage and retrieval of the pallets from the channel store takes place by means of a storage and retrieval device, which comprises a storage and retrieval unit and a satellite vehicle. The storage and retrieval unit moves in the aisle to the corresponding channel, from which a pallet, for example, is to be removed. The storage and retrieval unit comprises a height-adjustable carrying platform, on which the satellite vehicle is arranged, which moves from the storage and retrieval unit into the corresponding channel and to the first pallet in the channel, lifts the pallet and then traverses the latter back onto the storage and retrieval unit. The storage and retrieval unit can subsequently leave

the aisle and can transfer the pallet at a transfer location.

Known storage and retrieval devices from the prior art comprise a storage and retrieval unit, which communicates with a satellite vehicle via radio or cable. The energy required for traversing the satellite vehicle and for lifting the pallet is either supplied via cables or is stored in lead acid batteries in the satellite vehicle. Cables are disadvantageous, because only very expensive cables can be used for this purpose in the case of low temperatures, because they are additionally subjected to a large wear and must be replaced annually. In the case of these low temperatures, lead acid batteries must be heated. This causes additional waste of energy and is in stark contrast to an energy utilization, which is as economical as possible. Due to the fact that lead acid batteries cannot be charged quickly, replacement batteries must be kept available and exchanged for a three-shift operation.

DE 10 2008 022 323 A1 shows a channel store comprising a satellite vehicle, which, in the rest position, is arranged in a station. The station is manually attached to the respective channel by means of a forklift. The satellite vehicle can subsequently move from the station into the channel, can load a pallet and return back to the station. The station has means for supplying energy to the satellite vehicle and to communicate with it. Super-capacitors, for example, are used as energy storage means for the satellite vehicle.

Due to the fact that the super-capacitors can only store a lifted amount of energy, there is a risk of a failure of the satellite vehicle, which makes it necessary to engage manually.

DE 29 30 569 describes a generic storage and retrieval device.

The invention at hand is thus based on the object of creating a storage and retrieval device, by means of which an energy supply-related failure of the satellite vehicle is avoided by all means.

This object is solved by means of the storage and retrieval device according to the invention, as it is defined in independent patent claim 1. Independent patent claim 13 defines a channel store comprising a storage and retrieval device according to the invention. Advantageous embodiment alternatives follow from the dependent patent claims.

The nature of the invention is that the storage and retrieval device according to the invention comprises a storage and retrieval unit and a satellite vehicle. The satellite vehicle can move from a carrying platform of the storage and retrieval unit into a channel of a channel store and can move out of the latter again onto the carrying platform of the storage and retrieval unit. The satellite vehicle comprises a lifting device for lifting storage goods, for example pallets, a drive for traversing the satellite vehicle, an energy store comprising super-capacitors as storage means and a control device for the lifting device, for the drive and for communicating with the storage and retrieval unit. The control device is in radio contact with the storage and retrieval unit. The energy store has a monitoring device for monitoring the charge state of the storage means and the storage and retrieval unit comprises a charging control device, wherein the monitoring device is in radio contact with the charging control device for transmitting charge state information relating to the control device, and the charging control device is configured for triggering and stopping the charging process of the energy store of the satellite

vehicle from a charge energy source of the storage and retrieval unit.

The monitoring device of the energy store permanently monitors the charge state of the super-capacitors. When falling below a certain charge state, the return to the storage and retrieval unit can be initiated immediately, in order to avoid an energy supply-related failure.

In the case of the storage and retrieval device according to the invention, the storage and retrieval unit and the satellite vehicle preferably have matching charge contacts for the charging process of the energy store of the satellite vehicle. Charge contacts are a simple and safe option for establishing a connection for the energy transfer in a simple and autonomous manner.

In the case of the storage and retrieval device according to the invention, the storage and retrieval unit and the satellite vehicle alternatively comprise means for a non-body-bound energy transfer, in particular an inductive energy transfer, for the charging process of the energy store of the satellite vehicle. An inductive energy transfer has the advantage that wear cannot occur at mechanical connecting elements, e.g. at charge contacts.

More preferably, in the case of the storage and retrieval device according to the invention, the storage and retrieval unit and the satellite vehicle comprise means, e.g. laser distance meters, light sensors or incremental encoders, for determining the position of the satellite vehicle. Together with the monitoring device, the currently consumed energy for each distance travelled can be determined. The exact position determination also makes it possible to determine, whether the satellite vehicle is located on the storage and retrieval unit and whether the position for the charging process has already been reached.

In the case of the storage and retrieval device according to the invention, the energy store preferably comprises an emergency battery for the supply of emergency power to the satellite vehicle. The emergency battery makes it possible to operate the satellite vehicle for a certain time period, even if the super-capacitors are empty. The energy supply-related failures are further reduced in this respect. Even a slow return to the storage and retrieval unit is possible under certain conditions.

In the case of the storage and retrieval device according to the invention, the monitoring device is preferably configured for monitoring the charge state in addition to monitoring the temperature of the super-capacitors and of the emergency battery. The monitoring of the temperatures can point to a malfunction during operation or during the charging process. By measuring the temperature, the monitoring device is able to report the proper operation or to report an interference to the charging control device, in order to immediately interrupt the charging process.

More preferably, the emergency battery can be charged with the charging process of the super-capacitors in the case of the storage and retrieval device according to the invention. The emergency battery can thus be charged easily.

Again preferably, the control device in the case of the storage and retrieval device according to the invention is configured such that when a switch-over to the emergency battery occurs, an emergency program is automatically executed. The emergency program immediately turns off energy consumers, which are not absolutely necessary, analyzes whether a return to the storage and retrieval unit with or without loaded pallet is possible on the basis of the available amount of energy in the emergency battery and

the determined distance from the storage and retrieval unit, offloads a loaded pallet, if necessary, and returns to the storage and retrieval unit while conserving as much energy as possible.

In the case of the storage and retrieval device according to the invention, the storage and retrieval unit and the satellite vehicle can preferably be connected via an emergency charge cable. In the case of an energy supply-related failure, the energy store can be charged again by means of an emergency charge cable. This avoids having to recover the satellite vehicle by means of a cable winch in the case of an energy supply-related failure.

In the case of the storage and retrieval device according to the invention, the lifting device of the satellite vehicle preferably comprises a lifting motor and a spindle lift gear for lifting the pallet. The spindle lift gear lifts the upper side of the satellite vehicle and thus makes it possible to lift the pallet off the storage or retrieval unit or off the channel of the channel store.

In the case of the storage or retrieval device according to the invention, the satellite vehicle even more preferably comprises a drive motor, which is configured such that, for a braking operation of the drive motor, energy is recovered and can be stored in the energy store. This provides for an additional charging of the super-capacitors.

In the case of the storage and retrieval device according to the invention, the satellite vehicle as the main satellite vehicle can preferably be mechanically and electrically coupled to a further satellite vehicle as an ancillary satellite vehicle such that the control device of the main satellite vehicle also controls the ancillary satellite vehicle. The coupled satellite vehicles can lift and traverse two pallets at the same time, the possible

throughput in the channel store is thus increased. The control device of the ancillary satellite vehicle can be forgone and costs can thus be saved.

A further aspect of the invention relates to a channel store comprising a plurality of channels for receiving storage goods, for example pallets, wherein the channel store comprises an above-described storage and retrieval device.

The storage and retrieval device according to the invention will be described in more detail below by referring to the enclosed drawing, by means of an exemplary embodiment.

Fig. 1 shows an exemplary embodiment of a storage and retrieval device according to the invention comprising a storage and retrieval unit and a satellite vehicle in a schematic view,

Fig. 2 shows the satellite vehicle of Fig. 1 in an angular view,

Fig. 3 shows a block diagram of the functional components of the storage and retrieval device of Fig. 1,

Fig. 4 shows two satellite vehicles of Fig. in a coupled state in an angular view, and

Fig. 5 shows the two satellite vehicles of Fig. 4 on a carrying platform of the storage and retrieval unit of Fig. 1.

Fig. 1 shows an exemplary embodiment of a storage and retrieval device 1 according to the invention in a fully-automatic cannel store 9, in which frozen products 901, e.g., are stored at temperatures of up to -30°C. The

channel store 9 comprises a plurality of channels 90 for receiving pallets 900, for example, on which the frozen products 901 are stored. To optimally utilize space, the channels 90 of the channel store 9 are configured for multi-deep storage, i.e. a plurality of pallets 900 can be stored downstream from one another in the same channel 90.

Between the channels 90, the channel store 9 comprises aisles to ensure access to the individual channels 90. The storage and retrieval of the pallets 900 from the channel store 9 takes place by means of the storage and retrieval device 1, which comprises a storage and retrieval unit 2 and a satellite vehicle 3. The storage and retrieval unit 2 moves in the aisle to the corresponding channel 90, from which a pallet 900, for example, is to be removed. The storage and retrieval unit 2 comprises a height-adjustable carrying platform 20, on which the satellite vehicle 3 is arranged, which moves from the storage and retrieval unit 2 into the corresponding channel 90 and to the first pallet 900 in the channel 90, lifts the pallet 900 and then traverses the latter back onto the storage and retrieval unit 2. The storage and retrieval unit 2 can subsequently leave the aisle and can transfer the pallet 900 at a transfer location. This corresponds to the prior art described in DE 10 2008 022 323 A1 ,e.g., so that the person of skill in the art does not require more in-depth explanations.

The following provision applies for the entire further description. If a figure includes reference numerals for the purpose of graphic clarity, but which are not explained in the immediately corresponding description text, reference shall be made to the mention thereof in the preceding figure descriptions.

Fig. 2 shows the satellite vehicle 3, which comprises a lifting device comprising a lifting motor 30 and four

spindle lift gears 31 for lifting stored products, for example the pallet 900, a drive comprising a drive motor 32 and wheels 33 for traversing the satellite vehicle 3 as well as an energy store 34 and charge contacts 36.

In a block diagram, Fig. 3 shows functional blocks of the storage and retrieval device 1 comprising the storage and retrieval unit 2 and the satellite vehicle 3. The storage and retrieval unit 2 comprises a charging control device 21 and a charge energy source 22. The satellite vehicle 3 comprises the energy store 34 comprising super-capacitors 340 and an emergency battery 341 as storage means and a control device 35 for the lifting motor 30, for the drive motor 32 and for communicating with the storage and retrieval unit 2 via radio 300, wherein the charging control device 21 and the control device 35 in each case have a radio module 210, 350, preferably a Bluetooth radio module in each case. The energy store 34 further comprises a monitoring device 345 for monitoring the charge state of the storage means, which are connected to the control device 35 for transmitting charge state information.

To store a pallet 900 in the channel store 9, the storage and retrieval unit picks up the respective pallet 900 at a transfer location. The storage and retrieval unit subsequently moves to the corresponding channel 90 and lifts the carrying platform 20 into the height, which corresponds to the respective channel 90, so that the satellite vehicle 3 can move into the channel 90.

For the energy supply of the satellite vehicle, the super-capacitors 340 and the emergency battery 341 of the energy store 34 of the satellite vehicle 3 must be charged. This takes place via charge contacts 36 on the carrying platform 20 and the satellite vehicle 3. For this purpose, the position of the satellite vehicle 3 is permanently checked by means of a laser distance measurement, by means of light

sensors 23 (see Fig. 5) and by means of incremental encoders. By means of the laser distance measurement, the satellite vehicle 3 checks the exact distance from the storage and retrieval unit via a mirror reflector, which is installed on the storage and retrieval unit 2. Light sensors 23 on the storage and retrieval unit 2 monitor the position of the pallet(s) 900 on the storage and retrieval unit 2. The satellite vehicle 3 comprises light sensors, which sense downwards, in order to detect whether the position for the charging process has been reached on the storage and retrieval unit 2. The storage and retrieval unit 2 comprises light sensors to the top, for being able to detect the presence of the satellite vehicle 3 on the storage and retrieval unit 2. The incremental encoders are coupled to drive shafts of the drive wheels 33, in order to obtain an additional path measurement parallel to the laser distance measurement.

If the position of the charge contacts 36 of the satellite vehicle 3 corresponds to the charge contacts 36 on the carrying platform 20, the charging process can be triggered. For this purpose, the charging control device 21 is connected to the control device 35 as described above via radio 300 for triggering and stopping the charging process of the energy store 34 from the charging energy source 22 of the storage and retrieval unit 2. Following the charging process, the super-capacitors are fully charged within a few seconds, preferably 5 to 15 seconds, preferably approximately 10 seconds by means of an average charging current of preferably 100 to 200 Ampere, preferably approximately 150 Ampere, at a voltage of preferably 20 to 40 VDC, preferably at a voltage of approximately 30 VDC. The super-capacitors have a capacity of preferably 1500 to 2500 Farad, preferably of 2000 Farad, and can preferably store an amount of energy of 20 to 30 Watt hours (Wh), preferably an amount of energy of approximately 23 Wh. An outward journey and return journey

including lifting and lowering the pallet 900 uses approximately 10 Wh. The satellite vehicle thus has a reserve for slightly more than one additional outward and return journey. This relatively large reserve is advantageous, because the use takes place at very low temperatures, a largely autonomous operation must be ensured and a certain aging of the component must also be accepted. The emergency battery is simultaneously also charged with the charging process of the super-capacitors.

In the alternative, the charging process of the satellite vehicle can also take place inductively, i.e. the charging energy source 22 of the storage and retrieval unit 2 can comprise a transmitter coil 24 and the satellite vehicle 3 can comprise a receiver coil 342 in order to enable an inductive charging 310.

The satellite vehicle lifts the pallet 900 by means of the lifting motor 30 via the four spindle lift gears 31 and away from the carrying platform 20. The satellite vehicle 3 can now move into the channel 90 and up to the predetermined position, at which the satellite vehicle lowers the pallet 900, which now comes to rest on an upper rail of the channel 90. The pallet 900 has thus arrived at its storage location and the satellite vehicle 3 returns back to the carrying platform 20 of the storage and retrieval unit 2. During braking, the brake energy is converted back into electric energy and is stored in the super-capacitors 340. Even though the amount of energy gained in this manner is relatively small, because only approximately 0.3 Wh can be gained in response to a brake process, it is nonetheless of use.

The monitoring device 345 permanently monitors the charging state of the super-capacitors 340 and of the emergency battery 341, in order to immediately reduce the speed in the event of failure, so as to at least make it possible

for the satellite vehicle 3 to return to the storage and retrieval unit 2. Should an amount of energy, which is too small, be present in the super-capacitors 340 in the event of failure, the emergency battery 341 enables an operation of the control device 35 of the satellite vehicle 3, preferably for 2 to 4 hours, preferably for approximately 3 hours, so that at least the communication with the storage and retrieval unit 2 can be maintained. An emergency program is hereby executed automatically and the emergency battery 341 also allows for a very slow return of the satellite vehicle 3 to the storage and retrieval unit 2 under certain conditions, so as to charge the super-capacitors 340 again. If a return of the satellite vehicle 3 not be possible any longer, the satellite vehicle 3 can be connected to the storage and retrieval unit 2 in emergencies, in order to charge the energy store 34 again. The satellite vehicle 3 must be recovered by means of a cable winch only in the case of failure of the drive motor 32. The emergency battery 341 is preferably a lithium-iron-phosphate battery (LiFePO4).

The monitoring device 345 also permanently monitors the temperature of the super-capacitors 340 and of the emergency battery 341, in order to prevent an overheating, which could cause a premature aging or a defect.

The storage and retrieval unit 2 is directly connected to the power supply via a conductor line and is supplied with 400V in three phases.

Fig. 4 finally shows two satellite vehicles, which are coupled to one another and which can transport two pallets 900 at the same time. The two satellite vehicles are hereby permanently connected to one another by means of screws. For cost reasons, certain functions or assembly groups, for example the control device 35, can be combined in a main satellite vehicle 503, which can then be forgone on an

ancillary satellite vehicle 504. In contrast, certain assembly groups, such as the energy store 34, the lifting motor 30 or the drive motor 32, respectively, are present on the main satellite vehicle 503 and on the ancillary satellite vehicle 504.

Fig. 5 shows the carrying platform 20 of the storage and retrieval unit 2, on which a main satellite vehicle 503 and an ancillary satellite vehicle 504 are located. As described above, the main satellite vehicle 503 and the ancillary satellite vehicle 504 are coupled to one another. The carrying platform 20 comprises chain conveyors 24, which serve to move the pallet(s) 900 in and out at the transfer location, and light sensors for detecting the exact position of the pallet(s) 900 on the chain conveyors 24. The chain conveyors 24 are arranged such that the main satellite vehicle 503 and the ancillary satellite vehicle 504 can move underneath the pallet(s) 900 and can then lift the pallet(s) 900.

Further design alternatives can be realized for the above-described storage and retrieval device. In particular, the design of a storage and retrieval device comprising a storage and retrieval unit and a plurality of satellite vehicles is also possible, wherein only one satellite vehicle is in each case transported on the storage and retrieval unit, and the further satellite vehicles in each case wait in a channel, until they are picked up. The satellite vehicles preferably wait at the end of the respective channel, so that they can be charged via an emergency feeding device by the storage and retrieval unit in the case of very long waiting time, should the energy store be empty.

Patentkrav

1. Reolbetjeningsindretning (1) med et reolbetjeningsapparat (2) og et satellitkøretøj (3), som fra én til reolbetjeningsapparatet (2) hørende bæreplatform (20) kan føres ind i én til et kanallager (9) hørende kanal (90) og fra denne igen tilbage til reolbetjeningsapparatets (2) bæreplatform (20),
hvorved satellitkøretøjet (3) omfatter en løfteindretning (30,31) til løftning af lagergods, såsom paller (900), et drev (32,33) til at drive satellitkøretøjet (3), et energilager (34), og en styringsindretning (35) til løfteindretningen (30,31), til drevet (32,33), og til at kommunikere med reolbetjeningsapparatet (2),
hvorved energilageret (34) omfatter en overvågningsindretning (345) til at overvåge akkummuleringsmidlets (34) opladningstilstand, og reolbetjeningsapparatet (2) omfatter en opladningsstyringsindretning (21),
hvorved opladningsstyringsindretningen (21) er indrettet til at starte og stoppe opladningen af satellitkøretøjets (3) energilager (34) fra én til reolbetjeningsapparatet (2) hørende opladningsenergikilde (22),
kendetegnet ved,
at styringsindretningen (35) og reolbetjeningsapparatet (2) er i radiokontakt (300) med hinanden, hvorved overvågningsindretningen (345) er i radiokontakt (300) med opladningsstyringsindretningen (21) for at kommunikere informationer om opladningstilstanden via styringsindretningen (35), og energilageret er udformet med superkondensatorer som akkummuleringsmiddel.

2. Reolbetjeningsindretning (1) ifølge krav 1, hvor reolbetjeningsapparatet (2) og satellitkøretøjet (3) har opladningskontakter (36), der passer sammen, til processen med at oplade satellitkøretøjets (3) energilager (34).

3. Reolbetjeningsindretning (1) ifølge krav 1, hvor reolbetjeningsapparatet (2) og satellitkøretøjet (3) har midler (24,342) til en ikke fysisk forbundet energitransmission, især en induktiv energitransmission (310), til processen med at oplade satellitkøretøjets (3) energilager (34).

4. Reolbetjeningsindretning (1) ifølge krav 1 til 3, hvor reolbetjeningsapparatet (2) og satellitkøretøjet (3) omfatter midler (23) til at bestemme satellitkøretøjets (3) position, f.eks. laserafstandsmålere, lyssensorer eller inkrementelle indkodere.

5. Reolbetjeningsindretning (1) ifølge ethvert af kravene 1 - 4, hvor energilageret (34) omfatter et nødbatteri (341) til at forsyne satellitkøretøjet (3) med nødstrøm.

6. Reolbetjeningsindretning (1) ifølge krav 5, hvor overvågningsindretningen (345) til at overvåge opladningstilstanden er indrettet til yderligere at overvåge temperaturen af superkondensatorerne (340) og nødbatteriet (341).

7. Reolbetjeningsindretning (1) ifølge krav 5 eller 6, hvor nødbatteriet (341) kan oplades ved hjælp af superkondensatorernes (340) opladningsproces.

8. Reolbetjeningsindretning (1) ifølge ethvert af kravene 5 - 7, hvor styringsindretningen (35) er indrettet således, at der ved en omskiftning til nødbatteriet (341) automatisk finder et nødprogram sted.

9. Reolbetjeningsindretning (1) ifølge ethvert af kravene 1 - 8, hvor reolbetjeningsapparatet (2) og satellitkøretøjet (3) kan forbindes med et nødopladningskabel (5) til opladningen af energilageret (34).

10. Reolbetjeningsindretning (1) ifølge ethvert af kravene 1 - 9, hvor satellitkøretøjets (3) løfteindretning omfatter en løftemotor (30) og et spindelløftegear (31) til at løfte pallen (900).

11. Reolbetjeningsindretning (1) ifølge ethvert af kravene 1 - 10, hvor satellitkøretøjet (3) omfatter en drivmotor (32), som er indrettet således, at der ved en bremseoperation af drivmotoren (32) genvindes energi, som kan oplagres i energilageret (34).

12. Reolbetjeningsindretning (1) ifølge ethvert af kravene 1 - 11, hvor satellitkøretøjet (3) som hovedsatellitkøretøj (503) mekanisk og elektrisk kan kobles således sammen med et yderligere satellitkøretøj som sidesattelitkøretøj (504), at hovedsatellitkøretøjets (503) styringsindretning (35) også styrer sidesattelitkøretøjet (504).

13. Kanallager (9) med et antal kanaler (90) til at optage lagergods, f.eks. paller (900), hvorved kanallageret omfatter en reolbetjeningsindretning (1) ifølge ethvert af kravene 1 - 12.

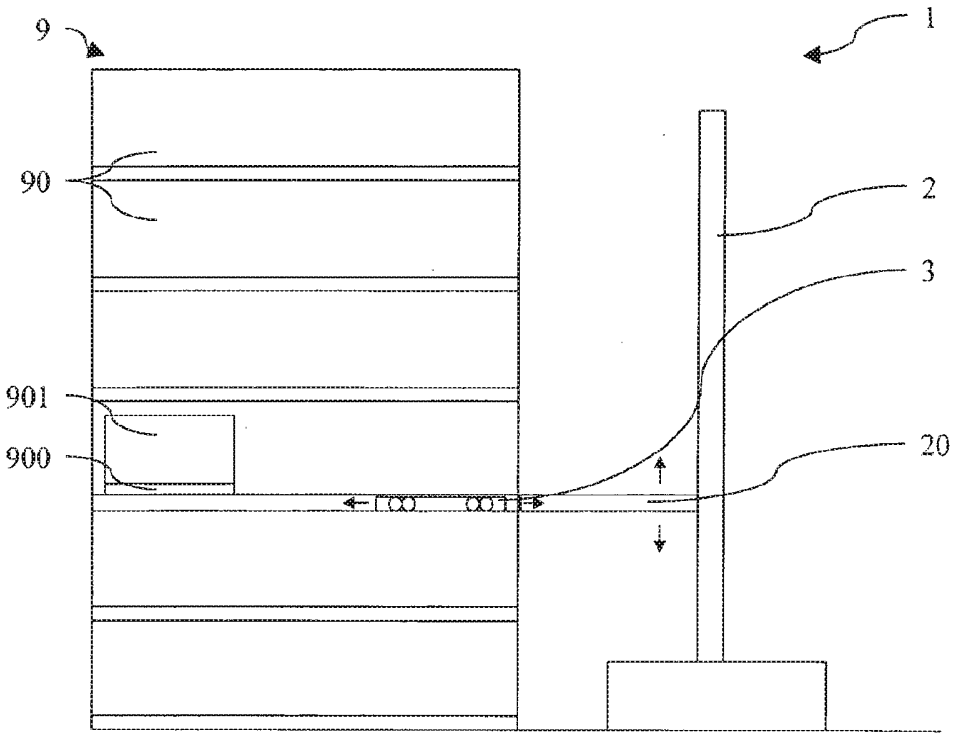


Fig. 1

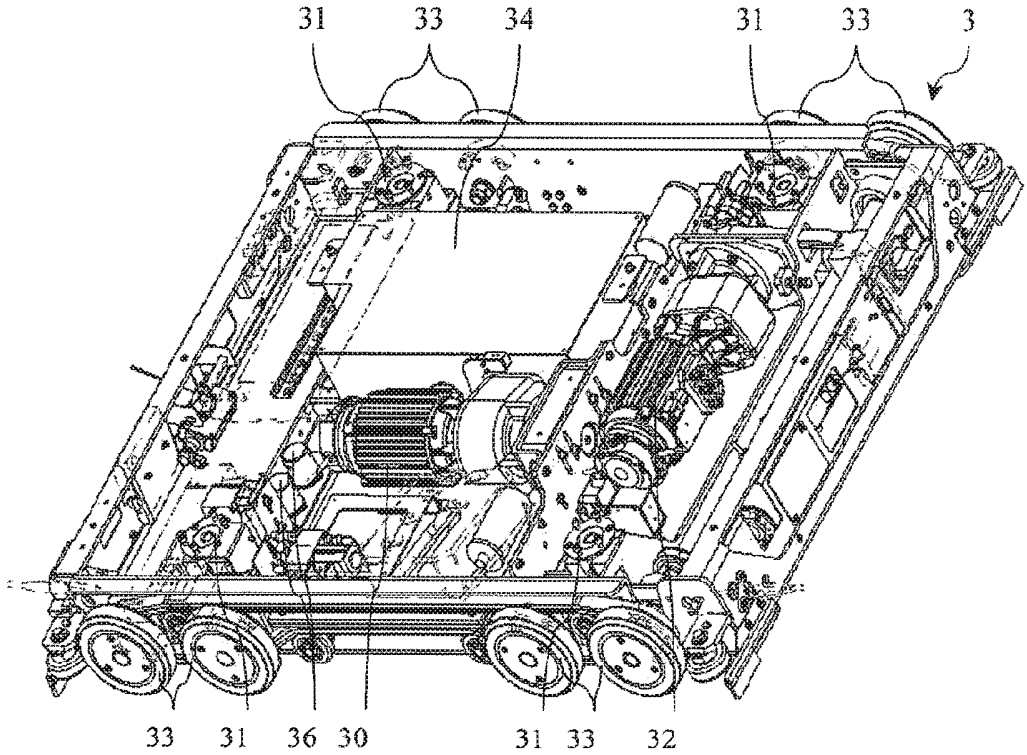
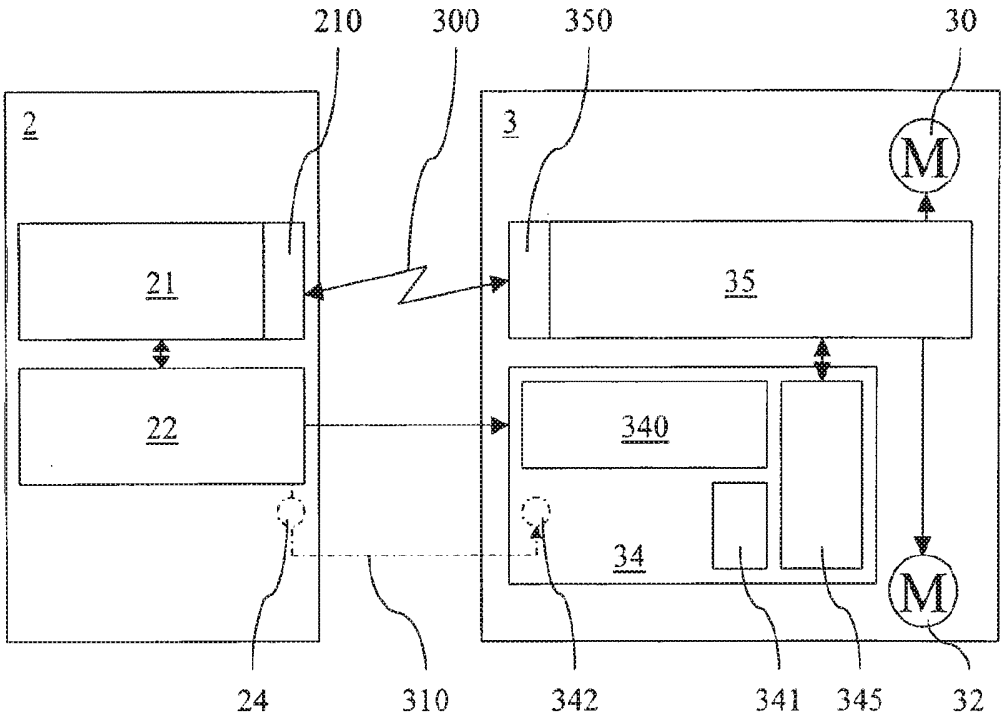


Fig. 2


210
300
350
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21
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22
340
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342
341
345
32

Fig. 3

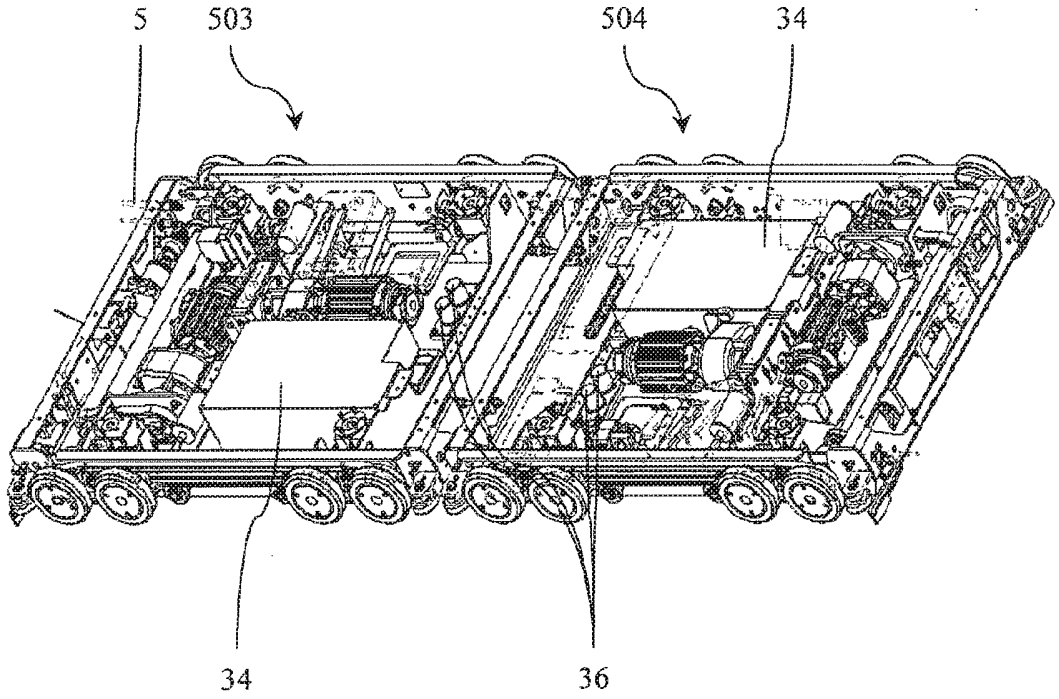
5
503
504
34
34
36

Fig. 4

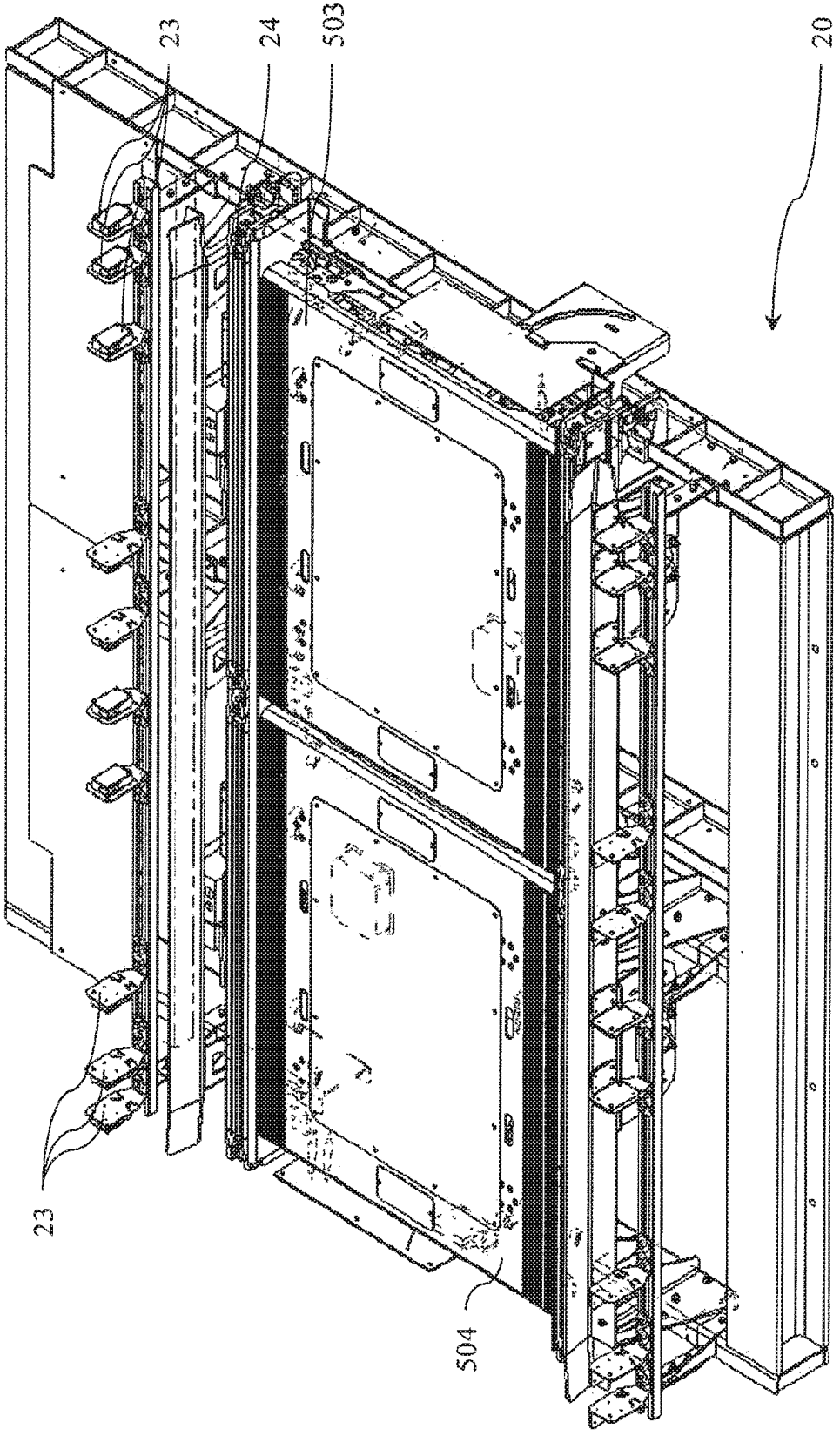

Fig. 5