

ABSTRACT

HIGH DENSITY DYNAMIC STORAGE SYSTEM WITH LIFT

The HDDS system with lift with electronic control and monitoring has several storage bays, each of storage/entry side and retrieval/delivery side provided with lift (2) and metal storage racks (1) being provided on both sides of each bay for storing material in loaded SKUs (7) placed on pallets (12) having own wheels on roller-shelf (6). Transporters (4) move the SKUs placed on pallets (14) for storage and retrieval. Intermediate conveyor (3) is provided for delivery. The system is modular and provided with on-line intelligent electronic monitoring so that whole system monitoring can be done remotely through a master controller for synchronous storage/retrieval. The transporters (4) have wheels, are motorized, draw electrical power continuously from power rails (10.1) or can run on batteries. Transporters are programmed to return to "home" if power fails or battery is discharged.

Separate methods for storing and retrieving material using the invented system are also disclosed.

Fig. 1a



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We claim:

1. A high density dynamic storage (HDDS) system with lift provided with electronic control and monitoring comprises of a plurality of storage bays, a storage or entry side, a retrieval or delivery side, a plurality of metal storage racks (1) being provided on both sides of the bays where material is stored in loaded SKUs (7) on roller-shelf (6), a plurality of transporters (4) for moving the SKUs(7) which are placed on pallets (14) having their own wheels (14.1) for storage and retrieval and at least one lift (2) is operatively connected to the system at the storage side and at the delivery side for storage and retrieval and an intermediate conveyor (3) is located at the delivery side for coordinating with the lift(2) to take away said SKUs.
2. The HDDS system as claimed in claim1, wherein said racks have several tiers or shelves at different heights provided with rollers and the different components of the system are adapted to be configured as modular units.
3. The HDDS system as claimed in claim1, wherein said system is provided with on-line intelligent electronic monitoring so that whole system monitoring can be done remotely from one place.
4. The HDDS system as claimed in claim1, wherein each bay is controlled independently and all bays are controlled by a master controller for synchronous storage/retrieval.
5. The HDDS system as claimed in claim1, wherein said transporters (4) are provided with wheels, are motorized and adapted to draw electrical power continuously from power rails (10.1) provided longitudinally under them, for moving the SKUs (7) placed on pallets (14) with wheels(14.1).
6. The HDDS system as claimed in claims 1 and 5, wherein said transporters (4) are provided with batteries, are adapted to complete a journey cycle and return to the "home" position even in the event of the electric power supply snapping at any intermediate stage of the travel and in the event of the voltage level of the transporter battery dropping below certain set level, the transporter is adapted to complete its current cycle of operation and come automatically to the "home" position for charging purpose.
7. The HDDS system as claimed in claim1, wherein said transporters (4) are provided with a sprocket assembly (12.1) which operationally engages with a guided chain assembly (12.2) located underneath the transporter for ensuring the transporter's travel in a fixed longitudinal path.

8. The HDDS system as claimed in claim1, wherein a common transporter (4) is present which caters to all the shelves of the rack.
9. The HDDS system as claimed in claim1, wherein dedicated transporters (4) are provided along with dedicated lifts (2) for each bay and shelf.
10. The HDDS system as claimed in claim1, wherein each bay has a separate transporter (4) and only two lifts (2) on its delivery side.
11. The HDDS system as claimed in claim1, wherein lifts (2) are provided both on the entry and delivery sides of the system and dedicated transporters (4) are provided for each shelf.
12. The HDDS system as claimed in claim1, wherein lifts (2) are provided on both entry and delivery sides of only the first and the last bay and each bay has a dedicated transporter.
13. The HDDS system as claimed in claim1, wherein one common mobile lift (2) is provided for each of entry and delivery sides, the two lifts being adapted to move between all the bays and each bay has its dedicated transporter.
14. The HDDS system as claimed in claim1, wherein a winch drive is incorporated for the transporter(4) movement.
15. The HDDS system as claimed in claim1, wherein separate pallets (14) having wheels (14.1) are provided at each horizontal level, the SKUs(7) rest on said pallets (14), whose wheels(14.1), are arranged to move along rails on being pushed by a transporter(4) from the rear, along the same track.
16. The HDDS system as claimed in claim 15, wherein a common transporter (4) is provided which is powered through power cable carried in a cable drum (13.1) located in the entry lift (2).
17. A method of storing material implementing the HDDS system as claimed in claims 1 to 16 comprising of the following steps:
 - lifting a first loaded SKU (7) by storage lift (2) to the height of a selected roller shelf (6);
 - placing the first loaded SKU on pallet (14) with wheels (14.1) positioned on said roller shelf;
 - moving the first loaded SKU on said pallet (14) by a transporter (4) towards the retrieval end till the far end of SKU (7) touches mechanical stoppers (11.1) fitted with limit switches positioned at the end of the shelf;
 - stopping the transporter (4) and then reversing it by means of limit switch provided with the stoppers (11.1); and

- repeating the above steps for storing the subsequent loaded SKUs (7) on said pallets(14).
18. A method of retrieving material implementing the HDDS system as claimed in claims 1 to 16 comprising of the following steps:
- selecting the first stored SKU (7) on the electronic control system;
 - causing delivery lift (2) to travel up to the height of the shelf where the selected SKU is stored, the movement of the lift being stopped by a limit switch;
 - actuating briefly the transporter (4) drive and moving the entire row of pallets (14) stored in that particular shelf by the transporter by a predetermined amount;
 - activating the motor of the conveyor of the delivery lift and pulling the SKU on to the lift conveyor fully;
 - lowering delivery lift (2) along with SKU (7) till it hits another limit switch at the lower level and stops;
 - starting the lift conveyor briefly, moving the SKU by a suitable predetermined amount on to the intermediate conveyor (3) till the far end of the SKU hits a limit switch and stops;
 - starting the drive motor of the intermediate conveyor (3) and moving the SKU (7) further into the intermediate conveyor till it reaches its desired position on the intermediate conveyor; and
 - taking the SKU away from the intermediate conveyor (3) by any suitable material handling means.

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NUMBER OF SHEETS-16
SHEET NO.1

ORIGINAL

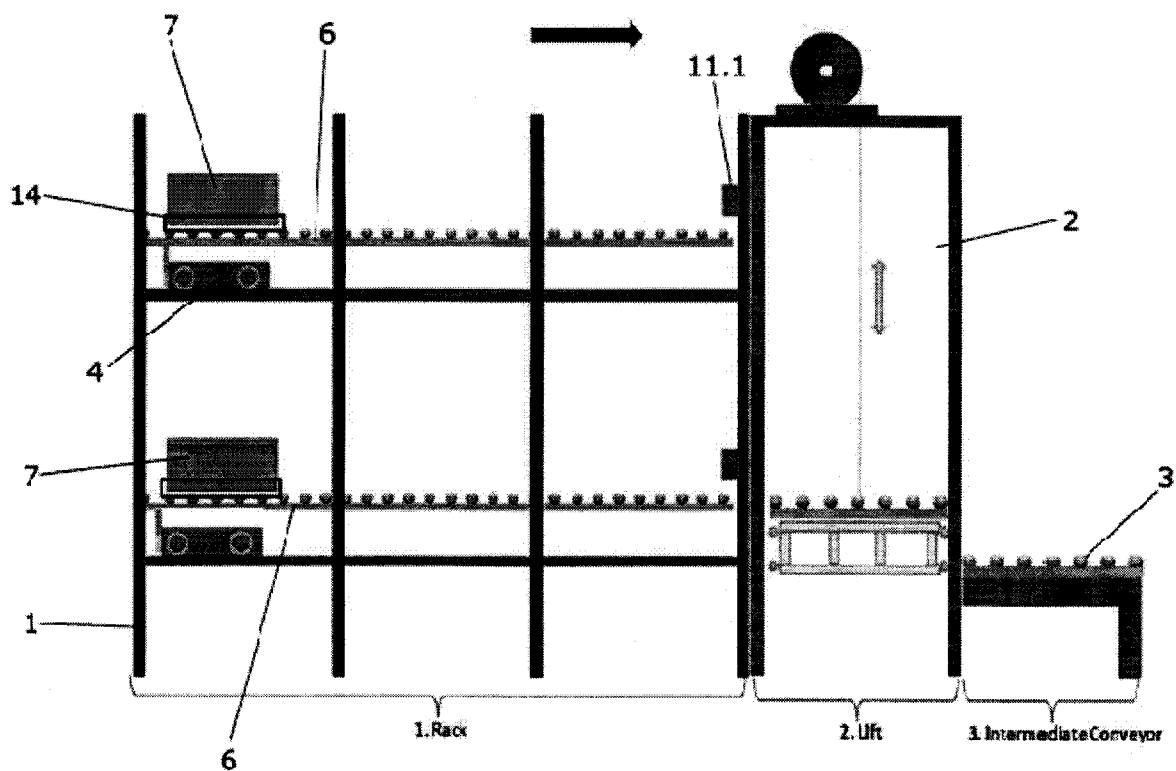


FIG 1a

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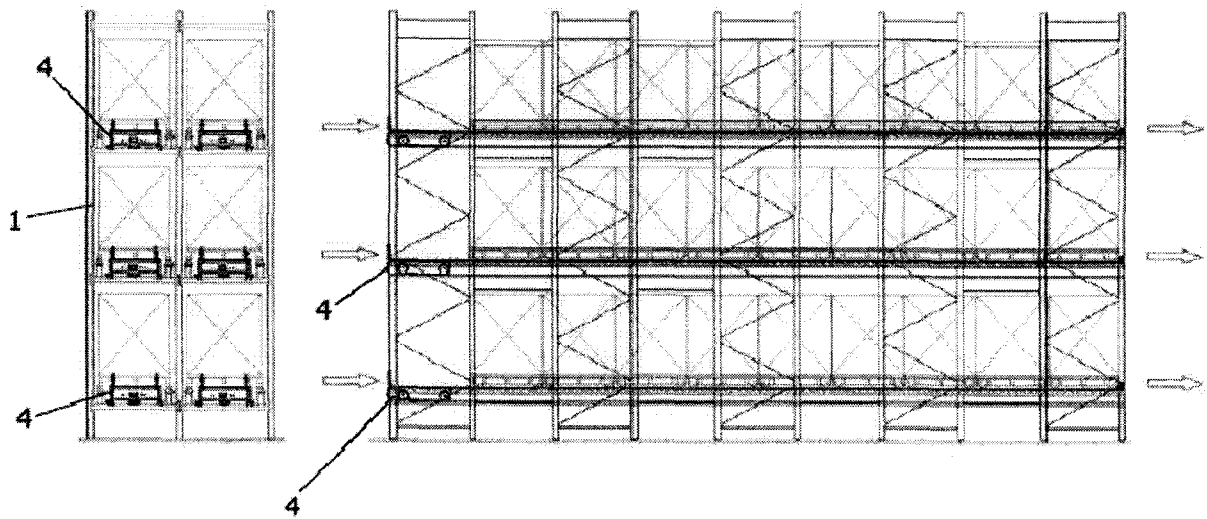


FIG 1b

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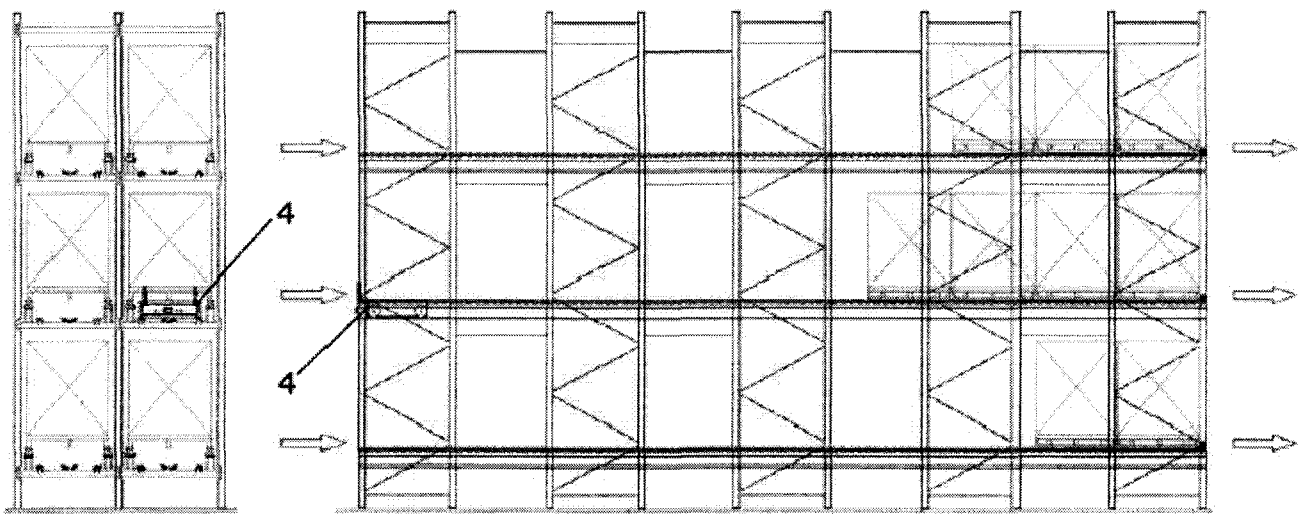


FIG 2

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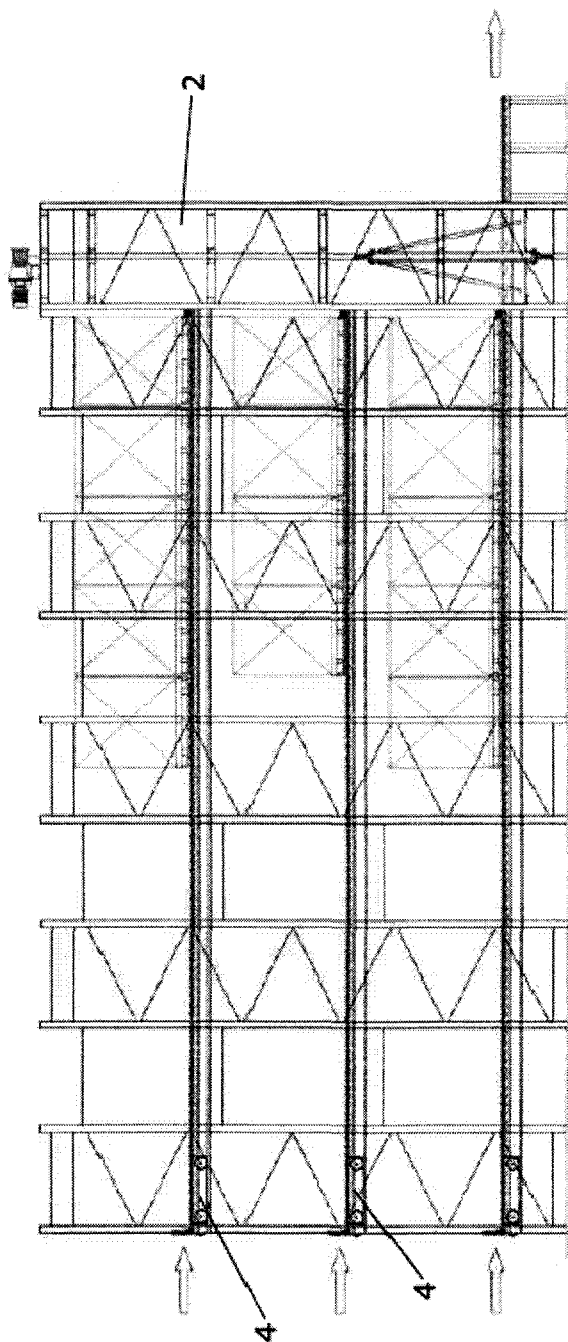


FIG 3

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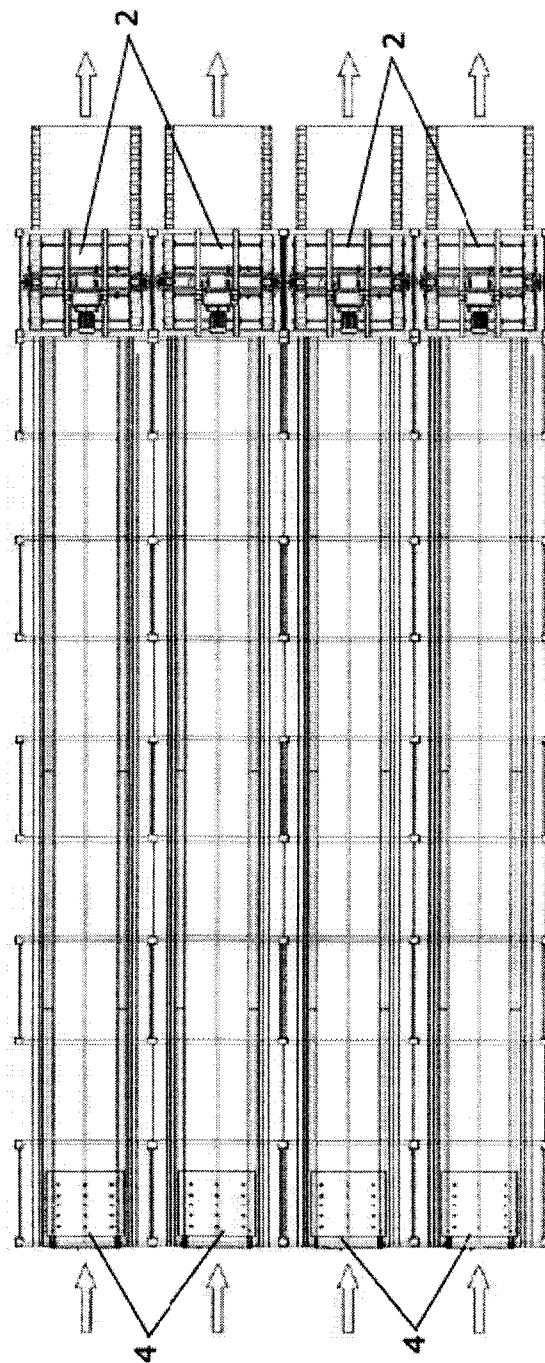


FIG 4

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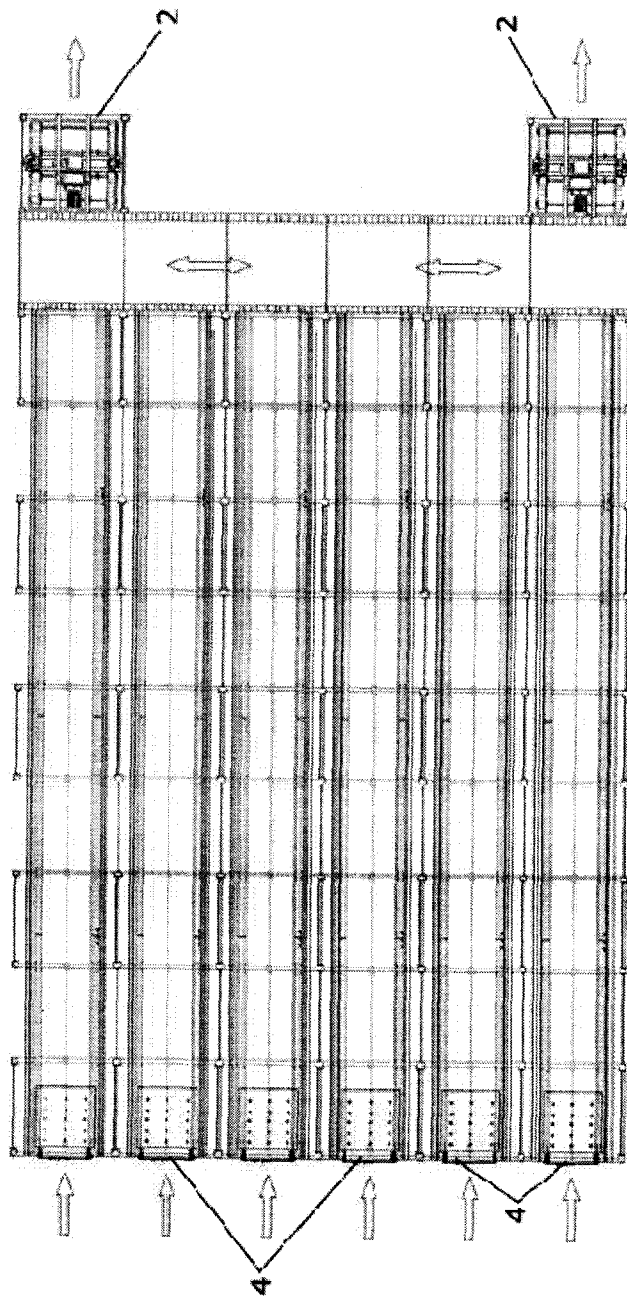


FIG 5

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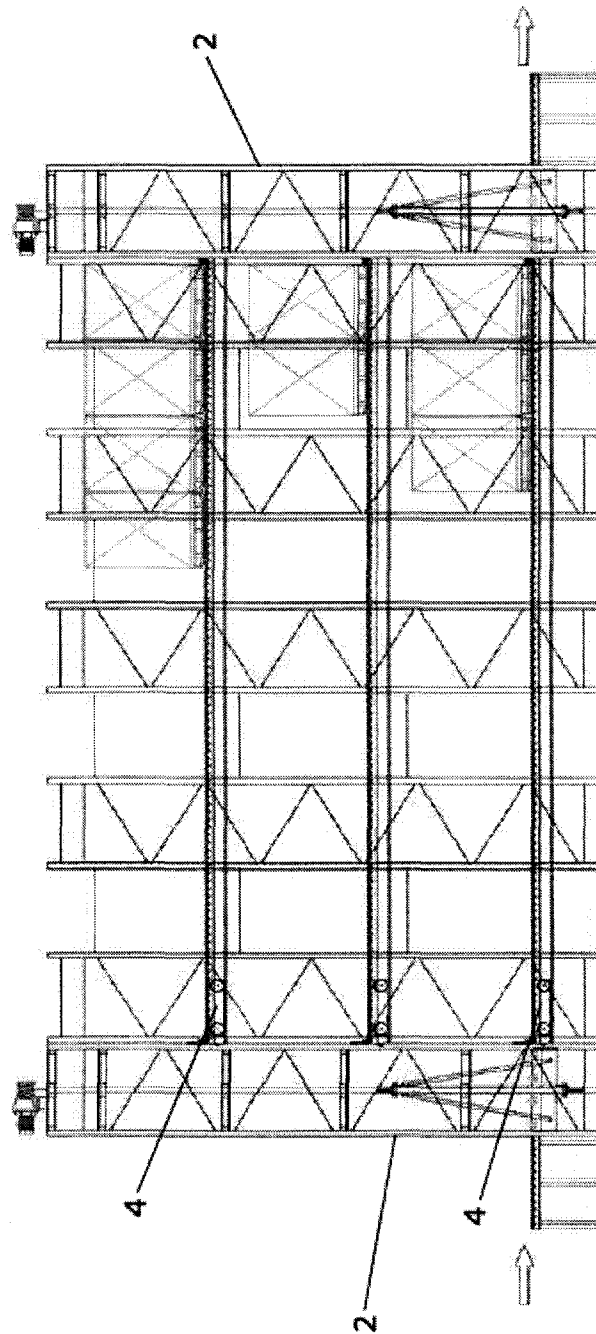


FIG 6

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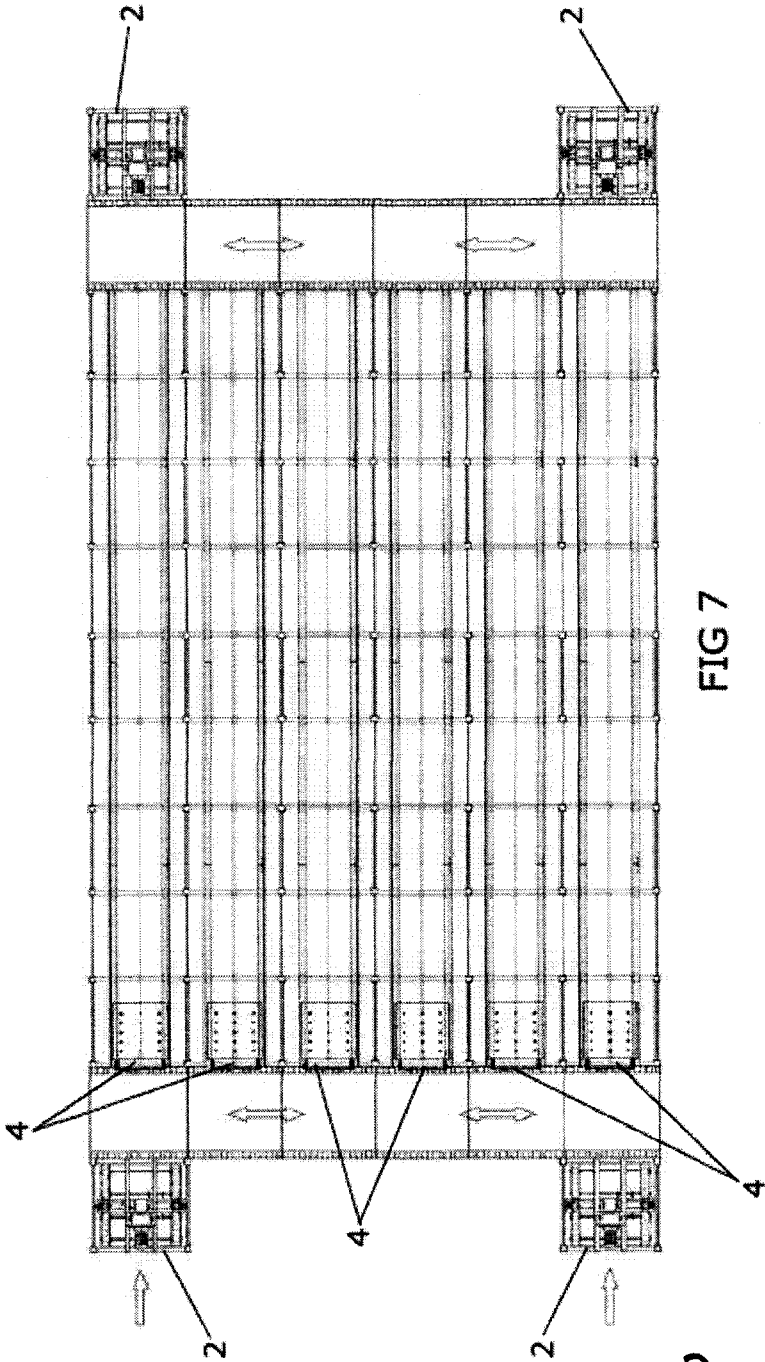


FIG 7

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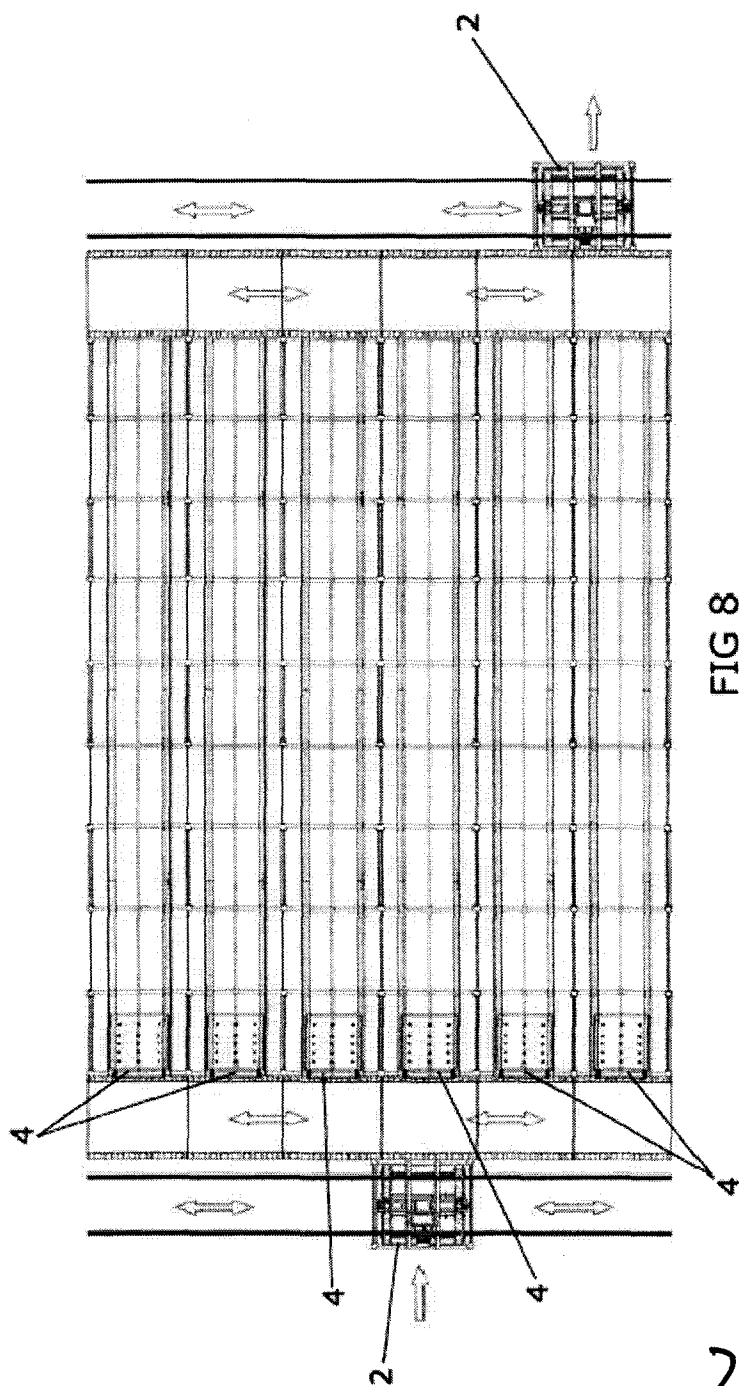
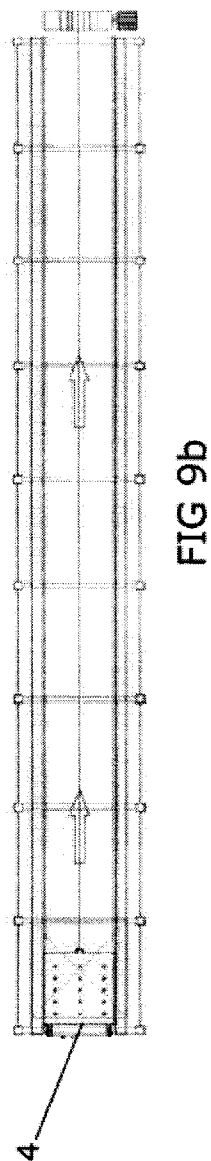
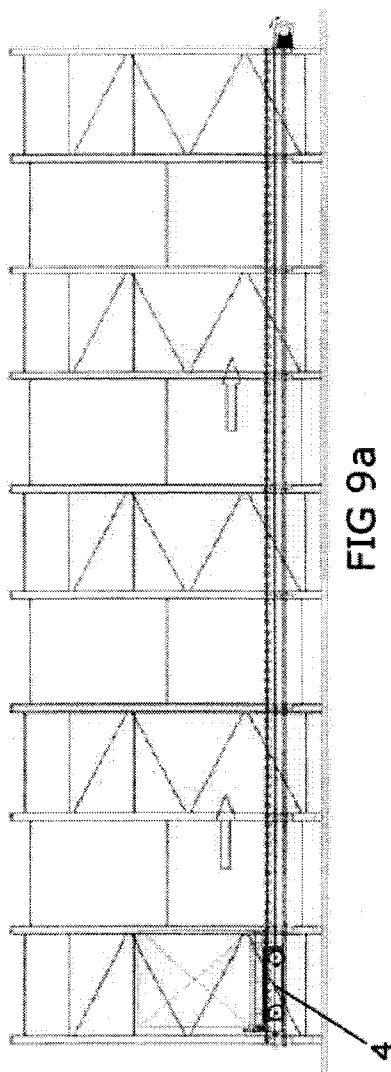


FIG 8

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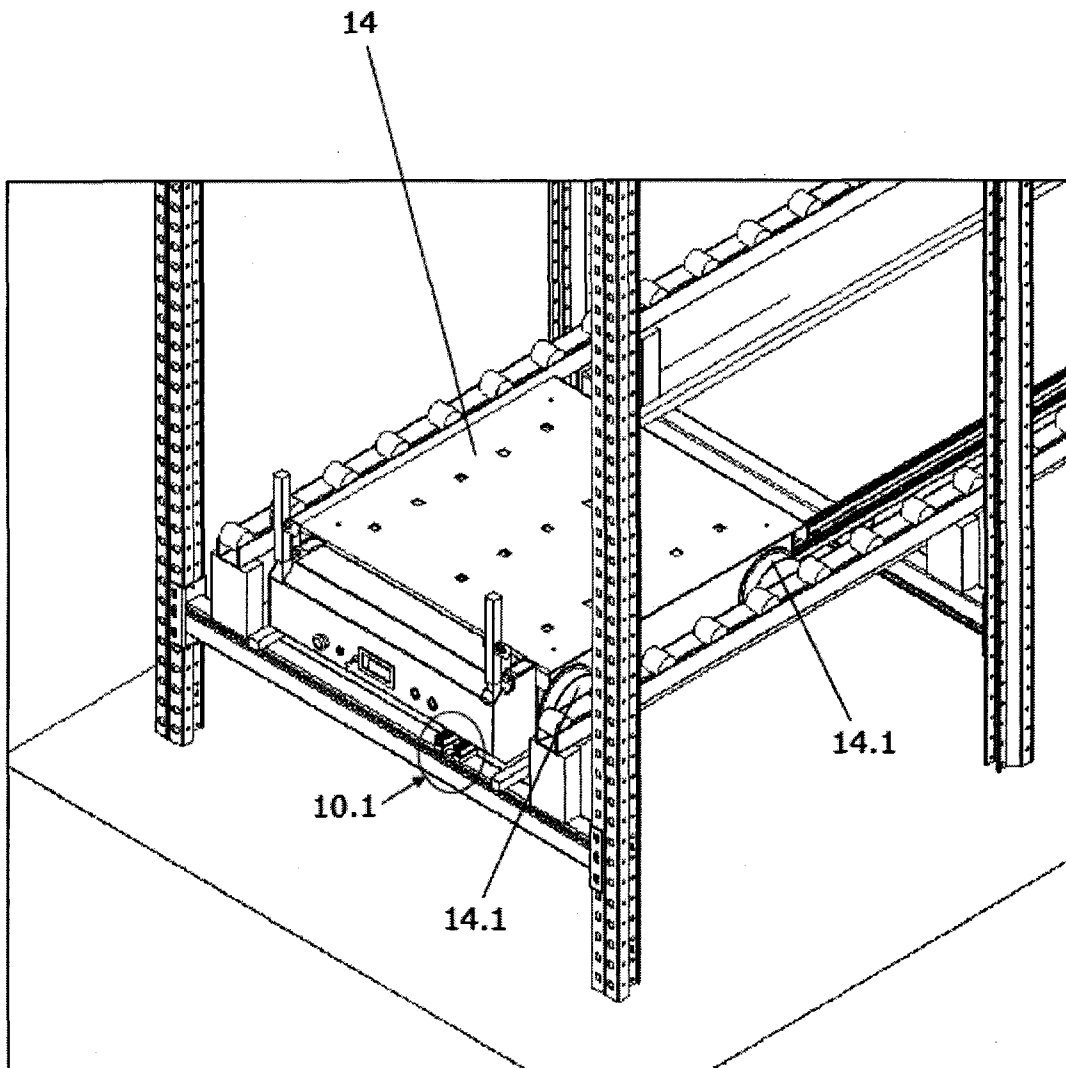


FIG 10

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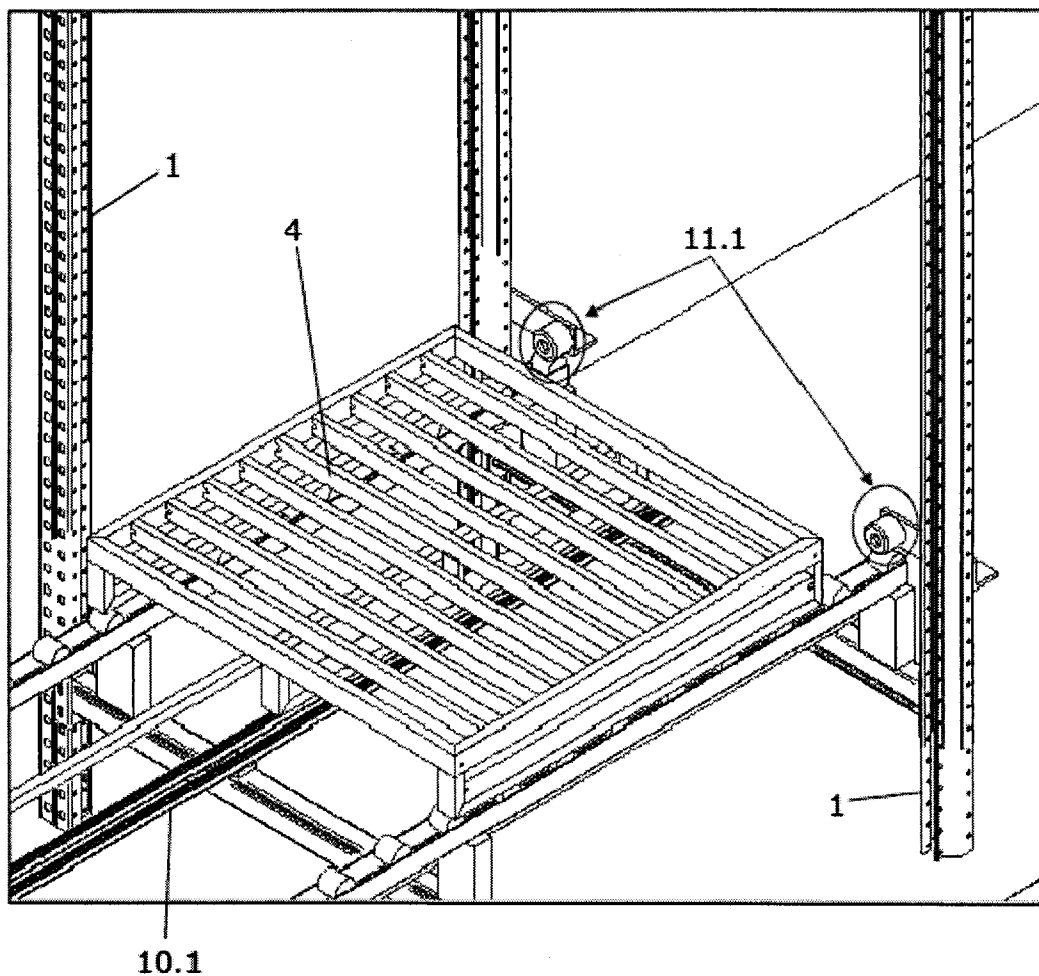


FIG 11

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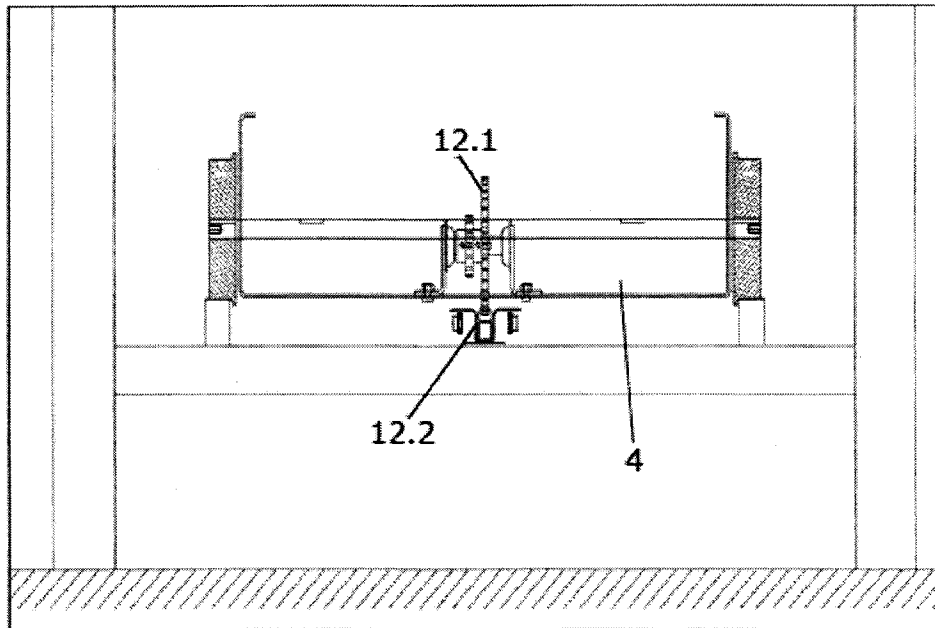


FIG 12

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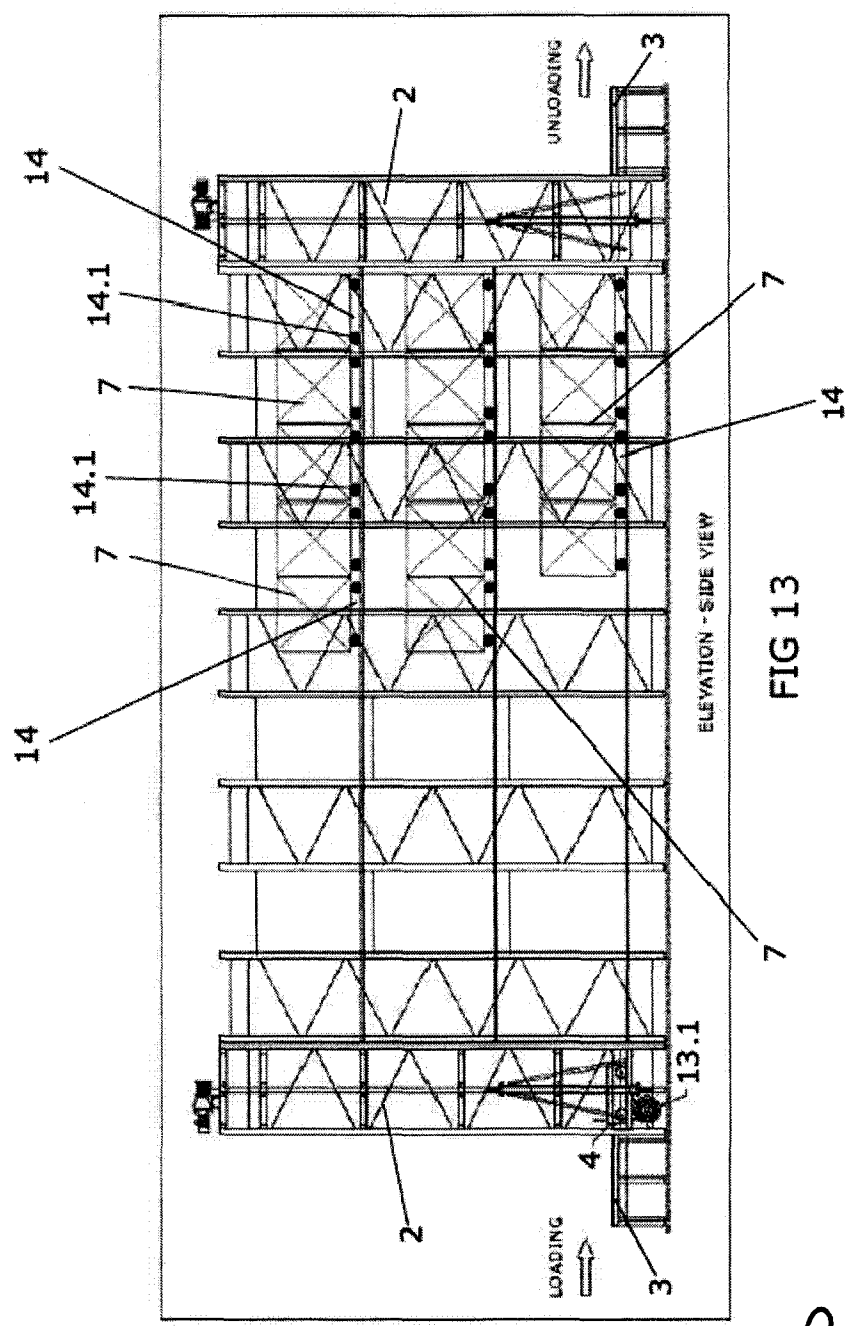


FIG 13

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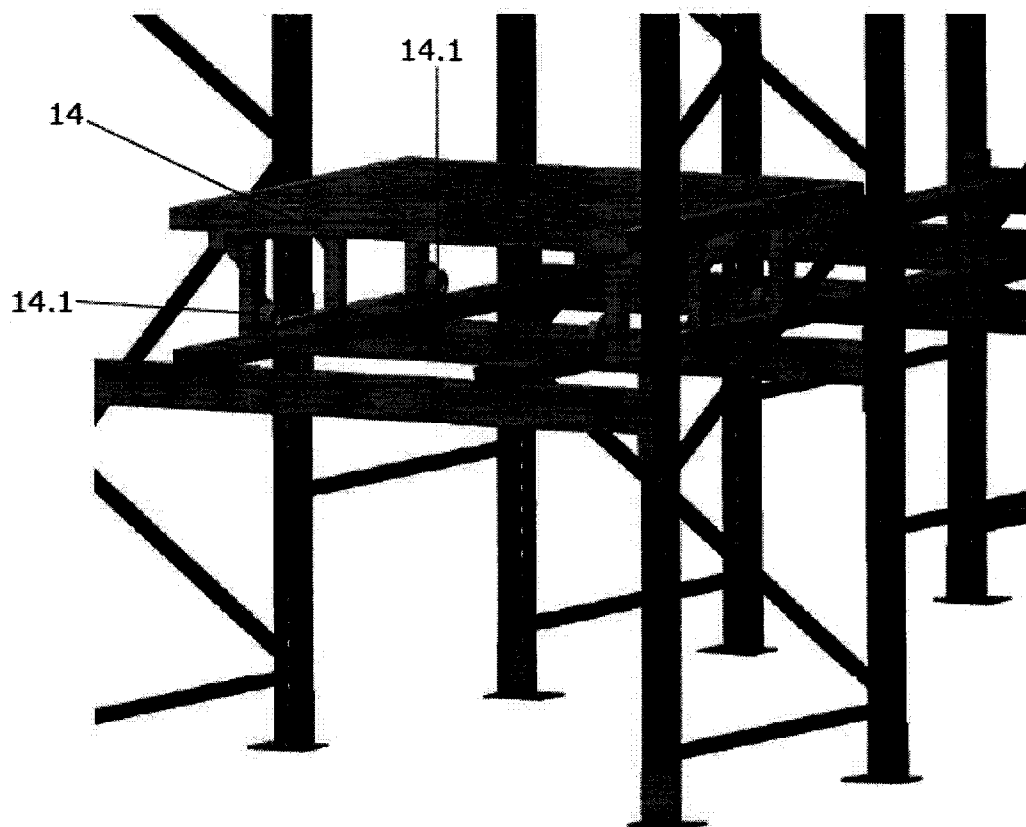


FIG 14

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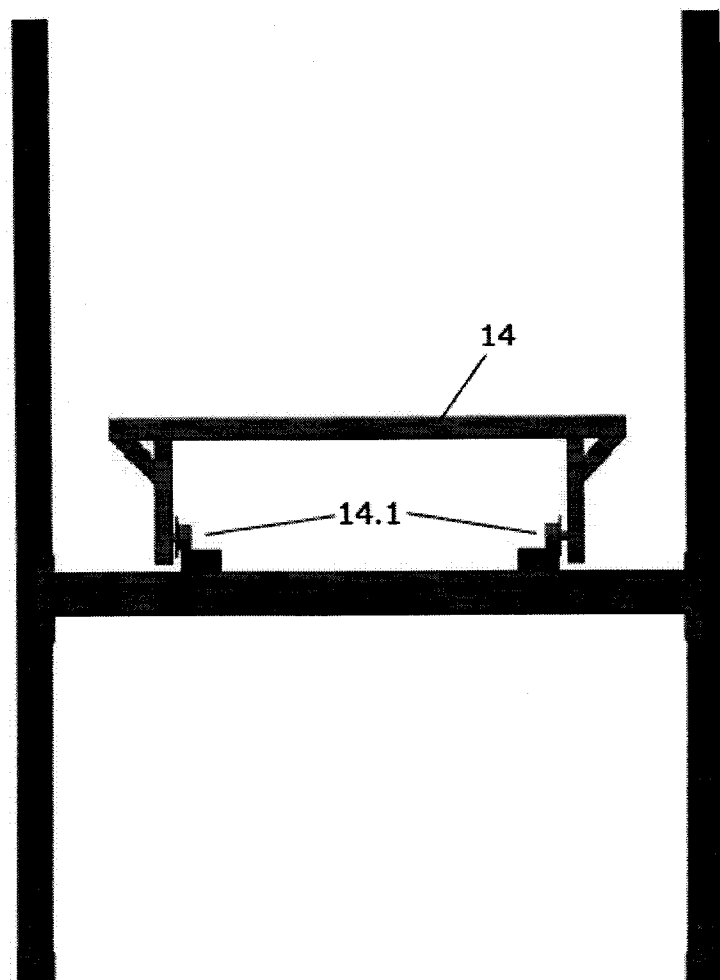


FIG 15

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HIGH DENSITY DYNAMIC STORAGE SYSTEM WITH LIFT

FIELD OF THE INVENTION

The invention relates in general to storage of material in any material handling system, and in particular to a high density dynamic storage system with lift for storing material and retrieving them. The system is adapted to easy storage and retrieval of materials stored in racks.

This invention is a further improvement over the invention covered by patent application no. 2746/CHE/2011 of 2nd August 2011, which is deemed to be incorporated in this specification in its entirety.

BACKGOURD AND PRIOR ART

In any industry, particularly in a manufacturing industry, it is very important to maintain a healthy level of inventory of all materials and components that go into the manufacturing process. Equally important are the aspects of storage and retrieval of materials so that minimum storage space is consumed and the least possible retrieval time is expended to feed the manufacturing process. These factors greatly affect the efficiency and cost-effectiveness of the manufacturing process, and thereby the cost of production of the end products.

This has resulted in continuous rethink on different ways of storing and retrieval of materials. With improvement of technology, greater strength of material for manufacturing the shelf and lesser availability of storage space, numerous designs of storage shelves and storing systems have come up.

The storage systems of the prior art suffer from several drawbacks like lack of compactness of storage, absence of lifts for both storage and retrieval, automatic and controlled movement of the transporters, centralized monitoring of all operations on-line from a remote place, enhanced safety features etc.

Therefore there is need in the industry of a high density dynamic storage (hereinafter HDDS) system provided with lifts, electronic monitoring and control of the entire operation and enhanced safety features. The present invention meets the above requirement of the industry.

OBJECTS OF THE INVENTION

The primary object of the invention is to provide an HDDS storage system which occupies minimum storage floor area and stores maximum material.

Another object of the invention is to provide a storage system which is built in the modular concept, making it highly flexible.

Yet another object of the invention is to provide a storage system which is provided with pallets that are supported on their own and integral wheels, instead of static roller track on rack, for their easy movement by the transporter.

A further object of the invention is to provide a storage system with intelligent electronic control for its storage and retrieval operations.

Another object of the invention is to provide a storage system wherein each bay is controlled independently and all bays are controlled by a master controller for synchronous loading/unloading.

Yet another object of the invention is to provide a storage system wherein the batteries of the transporters are charged whenever they are stationed in the home position.

Another object of the invention is to provide a storage system wherein when voltage level of the transporter battery drops below a certain set level, the transporter is adapted to complete the current cycle of operation and come automatically to the home position for charging purpose.

A further object of the invention is to provide a storage system which is compact and cost-effective.

How the foregoing objects are achieved will be clear from the following description. In this context it is clarified that the description provided is non-limiting and by way of explanation.

SUMMARY OF THE INVENTION

A high density dynamic storage (HDDS) system with lift is provided with complete electronic control and monitoring. It has a storage or entry side, a retrieval or delivery side and comprises of a plurality of storage bays. A plurality of metal storage racks are provided on both sides of the bays where material is stored in a plurality of uniform storage containers or bins, called SKUs

(Stock Keeping Units) in this description, which are loaded on pallets which have integral wheels, and can therefore be moved on their own wheels. The system has a plurality of transporters for moving the pallets with their own wheels for storage and retrieval and at least one lift is operatively connected to the system at the storage side and at the delivery side for storage and retrieval purposes respectively. An intermediate conveyor is located at the delivery side for coordinating with the lift to take away the pallets.

The racks have several tiers or shelves at different heights provided with rollers and the different components of the system are adapted to be configured as modular units. The system is provided with on-line intelligent electronic monitoring so that whole system monitoring can be done remotely from one place. Each bay is controlled independently and all bays are controlled by a master controller for synchronous storage/retrieval.

The transporters are provided with motorized wheels and are adapted to draw electrical power continuously from power rails provided longitudinally for moving the pallets on their own wheels by pushing them. This saves energy and renders the HDDS system more energy efficient.

The transporters are additionally provided with batteries. They are programmed to complete any particular journey cycle and return to the "home" position even in the event of the electric power supply snapping at any intermediate stage of the travel and also in the event of the voltage level of the transporter battery dropping below certain set level. The transporter is adapted to complete its current cycle of operation and come automatically to the "home" position for charging purpose.

The transporters are equipped with a sprocket assembly which engages with a guided chain assembly located underneath the transporter for ensuring the transporter's travel in a fixed longitudinal path without any slippage of the wheels.

In one embodiment of the invention, a common transporter is provided which caters to all the shelves of the racks. In another embodiment, dedicated transporters are provided along with dedicated lifts for each bay and shelf. Each bay has a separate transporter and only two lifts on its delivery side in yet another embodiment of the invention, while in another, lifts are provided both on the entry and delivery sides of the system and dedicated transporters are provided for each shelf.

Again, lifts are provided on both entry and delivery sides of only the first and the last bay and each bay has a dedicated transporter in another embodiment.

A method of storing material implementing the HDDS system as described above comprises of :

- lifting a first loaded SKU by storage lift to the height of a roller shelf;
- placing the first loaded SKU on a designated pallet with wheels positioned on the shelf;
- moving the first loaded SKU on the pallet by a transporter towards the retrieval end till the far end of pallet touches mechanical stoppers fitted with limit switches positioned at the end of the shelf;
- stopping the transporter and then reversing it by means of limit switch provided with the stoppers; and
- repeating the above steps for storing the subsequent loaded SKUs placed on pallets.

Another method of retrieving material implementing the HDDS system as described above comprises of:

- selecting the first stored SKU on the electronic control system;
- causing delivery lift to travel up to the height of the shelf where the SKU/pallet is stored, the movement of the lift being stopped by a limit switch;
- actuating briefly the transporter drive and moving the entire row of loaded pallets stored in that particular shelf by the transporter by a suitable amount;
- activating the motor of the conveyor of the delivery lift and pulling the pallet on to the lift conveyor fully;
- lowering delivery lift along with pallet till it hits another limit switch at the lower level and stops;
- starting the lift conveyor briefly, moving the SKU on the pallet by a suitable amount on to the intermediate conveyor till the far end of the SKU hits a limit switch and stops;
- starting the drive motor of the intermediate conveyor and moving the SKU further into the intermediate conveyor till it reaches its desired position on the intermediate conveyor; and
- taking the SKU away from the intermediate conveyor by any suitable material handling means.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

The nature and scope of the present invention will be better understood from the accompanying drawings, which are by way of illustration of some preferred embodiments and not by way of any sort of limitation. In the accompanying drawings:-

Figure 1a shows the side elevation of the general arrangement of an HDDS with lift and intermediate conveyor according to the invention.

Figure 1b shows an HDDS system elevation having dedicated transporters in each storage bay where the pallet moves on Roller track.

Figure 2 shows a similar system elevation having single transporters to server any number of storage bays.

Figure 3 shows an HDDS system side view elevation having dedicated lifts at retrieval side.

Figure 4 shows the plan (top view) of the HDDS system of figure 3.

Figure 5 shows the plan (top view) of an HDDS system having lifts at retrieval side of end bays.

Figure 6 shows the elevation of an HDDS system having lifts at both storage and retrieval ends of the bays.

Figure 7 shows the plan of an HDDS system having lifts at both storage and retrieval ends of only the end bays.

Figure 8 shows the plan of an HDDS system having a single common lift for each of storage and retrieval ends of all the bays.

Figures 9a and 9b show the elevation and top view (plan) respectively of an HDDS system incorporated with winch drive.

Figure 10 shows a pallet with its own wheels according to the present invention.

Figure 11 shows details of mechanical stoppers provided for the pallet transporter.

Figure 12 shows the guided positive drive assembly of the transporter according to the invention.

Figure 13 shows the side elevation of an HDDS system with pallets with its own wheels and separate transporter in entry lift.

Figure 14 is a perspective view of the pallet with its own wheels according to the present invention.

Figure 15 is the back view of the pallet with its own wheels shown in figure 14.

DETAILED DESCRIPTION OF THE INVENTION

Having described the main features of the invention above, a more detailed and non-limiting description of some preferred embodiments will be given in the following paragraphs, with reference to the accompanying drawings. In all the figures, like reference numerals represent like features.

As stated earlier, the present need of the industry is that the material storage is most cost-effective and consumes minimum space. Additionally, the material handling within the storage system must be safe, simple and efficient. The present invention provides HDDS systems that meet all these and other needs of the industry.

Reference is made to figure 1a which shows a side elevation of the general arrangement of an HDDS with lift and intermediate conveyor according to the present invention. In this description, the storage side is also referred as the entry side and the retrieval side is also referred as delivery side.

The system comprises of a plurality of storage bays, on both sides of which are provided metal storage racks (1) where the materials are stored on roller-shelf (6). The racks have several tiers or shelves according to requirement. These shelves are provided with pallets (14) having integrated wheels on which the SKUs (7) are put and moved from the entry side to the delivery side. Materials are stored in the SKUs, which are transported up to the desired shelf of the desired rack and stored there. The storage and retrieval of the SKUs follow what is known as the FIFO (First In First Out) order, whereby the pallets that are stored first are retrieved first.

Lifts (2) are provided for lifting and/or lowering of the SKUs loaded with material, either for taking them to the height of the intended shelf for storing, or for lowering the SKUs from the shelf, or for both. Each lift has a motorized roller conveyor built within it. Whenever there is no lift, this function is carried out by other known material handling means such as the fork lift.

It would be particularly clear from figure 1a that the transporters (4) move SKUs (7) supported on pallets(14) with its own wheels(not shown in this figure but best shown in figures 13,14,15) along a particular horizontal level of the rack(1). In this connection it is clarified that the word "SKUs" as used hereinbefore and hereinafter, including the claims, refer to SKUs with material loaded thereon.

In the embodiment shown in figure 1a, the transporters(4) carry the SKUs (7) loaded on pallets(14) with wheels, which are located atop the transporters(4) and move the loaded SKUs (7) from the entry side while storing in the shelf, and again push the loaded pallets on to the lift conveyor for their retrieval. The transporters (4) are motorized. They draw their electrical power continuously from power rails or bus bars (10.1), provided longitudinally under them. They are also provided with batteries so that they can complete a journey cycle and return to the "home" position even if the electric power supply snaps at any intermediate stage of the travel. When voltage level of the transporter battery drops below certain set level, the transporter is adapted to complete the current cycle of operation and come automatically to the home position for charging purpose.

Emergency push buttons are judiciously positioned at intervals on the loading and retrieval sides and at selected points in the system are to stop the transporter from operation in case of emergencies. They are part of the safety features provided in the HDDS system. Another safety feature is that on the loading side, inclined slider type guides are provided for ease of SKU loading, particularly when the loading levels are at heights.

The system is provided with an on-line intelligent electronic monitoring so that whole system monitoring can be done from one place, like which bay is full, from which bay the loaded pallet is to be retrieved, how many pallets with SKUs are there in a bay, how many empty places are there in a bay etc. The intelligent electronic control of the storage system supervises its entire storage and retrieval operations. Each bay is controlled independently and all bays are controlled by a master controller for synchronous storage/retrieval. In case some problem arises, the online monitoring circuit is intelligent enough to identify exactly where the problem lies. These problems can then be rectified either remotely or physically. Because of this online monitoring module, operational time can be fully utilized and time required to rectify problems can be greatly reduced.

The system is built on a modular concept for maximum flexibility. Different components such as transporter, lift, intermediate conveyor, pallet with wheels, power rails (Electrified track for transporter operation) can be given as a separate modules / accessories.

Figure 1b shows the front and side elevation of one embodiment of the present invention. In this HDDS system, dedicated transporters (4) have been provided in each storage bay. This is the case when the system must meet high throughput requirements.

Figure 2 depicts another embodiment of the invention wherein a common transporter (4) is present which caters to all the shelves of the rack. When the number of shelves is large, a plurality of transporters may be provided, which is in some proportion of the shelf number. The transporter is raised or lowered to the required height by means of separate material handling equipment such as a fork lift. This is more cost-effective than the system of figure 1b, but can be used only for lower throughput requirements.

In the embodiment illustrated in figures 3 and 4, dedicated transporters (4) are provided along with dedicated lifts (2) for each bay and shelf.

Figure 5 shows another embodiment of the present invention. Here each bay has a separate transporter (4), but two lifts (2) only on its delivery side. The lifts are positioned on the first and last bay. During retrieval, loaded pallets from the other bays are required to be brought to the nearest delivery lift by means of conveyors provided for the purpose.

Figure 6 shows the side elevation of a further embodiment of the same invention. Here, lifts (2) are provided both on the entry and exit sides of the system. Dedicated transporters (4) are provided for each shelf. This arrangement results in very speedy storage and retrieval of material.

Figure 7 shows the top view of yet another embodiment, where lifts (2) have been provided on both entry and delivery sides of only the first and the last bay. Each bay however has a dedicated transporter. Loading and retrieval of pallets loaded with SKUs to or from the system is through intermediate conveyors provided for the purpose.

Figure 8 depicts another embodiment, where only one lift (2) is provided on each of entry and delivery sides. These two lifts are mobile lifts, which are adapted to move between all the bays to facilitate storage and delivery. Here again, each bay has its dedicated transporter. Since the

lift is movable, only one vertical lift is enough for one side. Hence, material handling cost and lift cost are reduced.

In the embodiment shown in figures 9a and 9b which show the elevation and top view (plan) respectively of an HDDS system, a winch drive is incorporated for the transporter movement so that the transporter can be operated with alternating current and hence, batteries and their charging is not required and load variation can be easily incorporated.

Figure 10 shows details of the transporter (14) with own wheels according to the present invention. The transporter is provided with four wheels (14.1) which move on horizontal rails provided with the power rails.

An electrical bus bar (10.1) is laid out longitudinally along the length of travel of the pallet (14) and positioned below it. This gives continuous electric power supply to the transporter (4). The motorized drive of the transporter is adapted to draw its electric power from the bus bar (10.1) uninterruptedly during its travel in either direction. In this way, the transporter is connected to its power source at any position in its travel path through the bus bar. When this aspect as shown in figure 10 is construed with reference to figure 1a and the description thereof on pages 5 and 6, the movement of the SKUs (7) loaded on the pallets(14) would be clear.

Figure 11 shows the arrangement of mechanical stoppers (11.1) with limit switch provided at the retrieval end of the longitudinal travel path. They perform the task of stopping the transporter (4) and then reversing it when it reaches the end of the roller-shelf (6) pushing a loaded pallet. These mechanical stoppers are provided at appropriate places so that fall of a loaded pallet can be avoided at all times.

Figure 12 shows the mechanical arrangement for positive locking of the transporter. The transporters (4) are ensured to travel in a fixed straight longitudinal path without slippage of wheels. For this purpose, every transporter is provided with a sprocket assembly (12.1) which engages with a guided chain assembly (12.2) which is located underneath the transporter. The chain assembly guides the pallet transporter and holds it firmly along the desired path so that the transporter with a loaded pallet is not allowed to slip or deviate from its longitudinal path. This goes a long way in avoiding malfunctioning or accidents while the transporter is moving with its heavy load.

Figure 13 shows the side elevation of yet another embodiment of the same invention. Here, separate SKUs (7) on pallets with wheels(14) are provided along the horizontal levels. The SKU

(7) on pallet (14) moves as a single unit. The pallets(14) having the load are not powered, but move on self momentum, on being pushed from behind by a transporter(4), which is on the same rail, at a particular horizontal level. A common transporter (4) is provided which is powered through power cable which is carried in a cable drum (13.1) located on the entry lift (2). The SKUs (7) and the transporter(4) move on the same rail in any particular rack as stated before.

In the embodiment shown in figure 13, no positive locking means are provided for the movement of the transporter. The pallets are thus pushed by the transporter, and thereafter they move on their own with the momentum generated by the transporter. On reaching the delivery side, the intermediate conveyor(3) comes into play in much the same way as in the embodiment in figure 1a, for retrieval of load. This is true for loading the pallets on to the system as well. Furthermore, it should be understood that once a set of loaded pallets are retrieved, the transporter(4) comes back to a favourable position, for pushing the next set of pallets, in much the same way as in the embodiment shown in figure 1a. In respect of these, the following operation of the system may be referred to.

OPERATION OF THE HDDS SYSTEM

The operation of the HDDS system is now described particularly with reference to figure 1a. The system is controlled by central electronic monitoring and its operation is made from a remote control centre on-line.

Storage:

Material is loaded in SKUs (7) and placed on pallets (14) for storage. The loaded SKU is lifted to the height of the shelf where it is desired to be stored by a storage lift (2) provided on the storage or entry side.

The loaded pallet (14) is placed on roller shelf (6). It immediately actuates a limit switch (not shown) which actuates the drive of the transporter. The transporter then pushes the loaded pallet and rolls it on its wheels (14.1) towards the retrieval end. When the far end of the pallet (14) touches the mechanical stoppers (11.1) positioned at the end of the shelf, the limit switch provided with the stoppers first stops the transporter (4) and then reverses it. The transporter then travels back to the starting position for pushing the next loaded pallet. The second pallet is then pushed by the transporter like the first pallet. The second pallet can only travel up to the

near end of the first pallet, where it touches and pushes the first pallet. This push again causes the limit switch of the stoppers (11.1) to operate, and the transporter is reversed back to the starting position. Subsequent pallets are loaded on the shelf in similar fashion till the shelf is full. This process goes on for each storage shelf of the entire HDDS system.

Retrieval:

As mentioned earlier, the retrieval follows the FIFO (first in first out) order. Hence, the pallet that was stored first is retrieved first; the second pallet next, and so on.

For retrieval, the first pallet with its SKU load is selected first on the electronic control system. The system makes lift (2) travel up to the height of the shelf where the selected pallet is stored. The movement of the lift is stopped by a limit switch provided for the purpose. The transporter (4) drive is automatically actuated briefly and the transporter pushes the entire row of pallets stored in that particular shelf only by a very small amount, such that the far end of the first SKU on its pallet is pushed only marginally, say by an amount between 100 and 300 mm, most preferably by 200 mm. Another limit switch is provided to stop the pallet at this point. This ensures that the far end of the SKU being retrieved is partially resting on the roller conveyor of the lift (2). Simultaneously the transporter (4) is commanded to travel back to its start point.

Next, the motor of the conveyor of the lift is activated and the conveyor pulls the SKU on to the conveyor fully. It travels up to a pre-determined position on the lift, when it hits yet another limit switch provided in the lift and stops.

The lift (2) along with the loaded SKU (7) then moves down till it hits another limit switch at the lower level and stops. The lift conveyor is started only briefly, when the pallet is moved partially on to the intermediate conveyor (3), till the far end of the pallet hits a limit switch and stops. In this operation, the pallet is moved by an amount between 200 mm and 500 mm, preferably by 300 mm.

Next, the drive motor of the intermediate conveyor (3) is started. The SKU moves further onwards into the intermediate conveyor till it reaches its desired position on the intermediate conveyor, when its far end hits a limit switch and the conveyor stops. The SKU is taken away from the intermediate conveyor by any suitable material handling means, which are extraneous to the HDDS system. In the same manner, all other stored SKUs of the same shelf or of other shelves of different bays are retrieved.

In the above context it should be understood that for loading of SKUs to the system, the intermediate conveyor plays a similar role in much the same way as will be understood by persons skilled in the art.

The present invention has been described with reference to some drawings and some preferred embodiments purely for the sake of understanding and not by way of any limitation and the present invention includes all legitimate developments within the scope of what has been described herein before and claimed in the appended claims.