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Method for providing transport units from a warehouse

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(56) Related Art
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Abstract

Method for providing transport units (T) from a storage facility (1) on at least one removal-from-storage feeding line (6), wherein the transport units (T) are stored in a plurality of storage racks (R) and storage rack levels (3), wherein the storage racks not arranged on the outside are each arranged in pairs adjoining one another and have a racking storage aisle (2) on one side; at least one storage-entry feeding line (4) is provided; the transport units (T) are placed into storage in, and removed from storage from, the storage rack via a storage-entry and removal-from-storage apparatus (5) for each storage racking aisle (2); at least one removal-from storage feeding line (6) is provided; for each storage racking aisle (2) a storage-entry and removal-from-storage apparatus (5) is provided, at least one removal-from-storage lift (8) is used to transfer the transport units (T) to the removal-from-storage feeding line (6) connected downstream in each case; wherein between two adjoining storage racks (R), a direct exchange of transport units (T) takes place from one storage racking aisle (2) to an adjacent storage racking aisle (2') via transverse conveyance locations (Q) in the storage racks, wherein the storage-entry and removal-from-storage apparatus (5) moves the transport units (T) in the transverse conveyance locations (Q).

(cf. figure 1)

Method for providing transport units from a storage facility

Technical Field

The present invention relates to a method for providing transport units from a storage facility on at least one removal-from-storage feeding.

Background

When picking or compiling orders from ready-picked transport units, such as e.g. articles or containers, it is necessary to provide the transport units, which are associated with a common order, in a targeted or sorted manner. For this purpose, it is typical to temporarily store (buffer) the transport units of one order until all of the transport units required for the order are present. They are then passed collectively onto a collecting line which guides them e.g. to the palletisation area, picking station, goods issuing department, dispatch etc.

A (high) rack storage facility includes a feeding or storage-entry area, via which the goods are delivered and from which the racking serving units collect the goods for entry into storage, the so-called pre-zone. Similarly, a removal-from-storage area is required, at which after removal from storage the racking serving units place down the goods also assigned to the pre-zone. In the case of automatic picking warehouses, picking points are typically arranged in the pre-zone. The pre-zone is also where the goods are identified for the inventory management system or the material flow computer.

The applicant's EP 1 964 792 B1 discloses a method for providing transport units from a storage facility in a desired sequence on at least one collecting line. Racking serving units in each storage racking aisle, removal-from-storage lifts and removal-from-storage feeding lines are controlled so as to be coordinated with one another and are loaded with goods such that they ultimately end up sorted on the collecting line or are delivered thereby.

The control and coordination is therefore relatively complex and requires obvious technical outlay in the so-called pre-zone, i.e. the area outside the actual racking.

The above references to the background art do not constitute an admission that the

art forms a part of the common general knowledge of a person of ordinary skill in the art. The above references are also not intended to limit the application of the method and system as disclosed herein.

Summary

The present invention is directed to providing a method and a storage system which permits sorted removal-from-storage in a convenient manner and with reduced technical outlay whilst at the same time dispensing with sorting outside of the aisles.

In accordance with a first aspect, a method for providing transport units from a storage facility is disclosed wherein the storage facilitate includes a plurality of storage racks each having multiple storage rack levels, wherein interior storage racks are arranged in pairs adjoining one another and have an access aisle on at least one side of each pair, said storage facility further including at least one storage line and at least one removal line, a storage and removal vehicle for each access aisle and at least one lift that is adjoined by the at least one storage line and the at least one removal line; said method comprising: directly exchanging transport units between two adjoining racks from one access aisle to an adjacent access aisle via transverse conveyance locations in the storage racks, wherein the storage and removal vehicle comprises a shuttle at each level of the storage racks, wherein the directly exchanging comprises the shuttle acting on the transport units to displace the transport units by contact with the shuttle in the transverse conveyance locations from one of the adjoining racks to the other of the adjoining racks including transferring product transport units to a specific aisle using the transverse conveyance locations, wherein the specific aisle is selected based upon minimization of the movement in the transverse conveyance locations between aisles, the product transport units having articles to make up a particular order.

In accordance with a second aspect, a method for providing transport units from a storage facility wherein the storage facility includes a plurality of storage racks each having multiple storage rack levels, wherein interior storage racks are arranged in pairs adjoining one another and have an access aisle on at least one side of each pair, said storage facility further including at least one storage line and at least one removal line, a storage and removal vehicle for each access aisle and at least one lift that is adjoined by the at least one storage line and the at least one removal line, said

method comprising: directly exchanging transport units between two adjoining storage racks from one access aisle to an adjacent storage access aisle via transverse conveyance locations in the storage racks, wherein the storage and removal vehicle comprises a shuttle at each level of the storage racks each shuttle having a platform for supporting transport units and telescopic arms which extend into the storage racks to push transport units off the platform and pull transport units onto the platform and wherein said directly exchanging transport units comprises pushing the transport units with the telescopic arms in the transverse conveyance locations from one of the adjoining storage racks to the other of the adjoining storage racks including transferring product transport units to a specific aisle using the transverse conveyance locations, wherein the specific aisle is selected based upon minimization of the movement in the transverse conveyance locations between aisles, the product transport units having articles to make up a particular order.

It has been recognised that if, between two adjoining storage racks, a direct exchange of transport units takes place from one storage racking aisle to an adjacent storage racking aisle via transverse conveyance locations in the storage racks, it is possible to dispense with the distribution and/or complex sorting in the pre-zone, since the transport units are already sorted when removed from storage, even if initially they were not arranged in a common racking aisle, as they are stored in the meantime in the removal-from-storage aisle, even if initially they were stored somewhere else. Therefore, by dispensing with the distribution and sorting outside of the aisles it is possible to achieve a direct transfer of the transport units without conveyors crossing one another, and this can be achieved with reduced and simplified technical outlay as well as with a smaller space requirement and a high level of reliability. The transport units can thus be simply removed from storage from the respective aisle in the required sequence. In accordance with the invention, the storage-entry and removal-from-storage apparatus serves to move the transport units in the transverse conveyance locations (Q), i.e., there is no further drive technology in the rack, but the storage-entry and removal-from-storage apparatus itself is the only active mechanism involved in the transverse displacement. In particular, the storage-entry and removal-from-storage apparatus places the transport units from the source aisle directly into the transverse conveyance locations of the target aisle (by means of multiple-depth storage entry), which means that the storage-entry and removal-from-storage apparatus of the adjacent target aisle simply has access thereto. In particular, this

relates to a fully automated storage facility.

In other words, racking storage locations of abutting racks are used for passing transport units from one side of the rack to the next, so that the transport units can be transferred from one rack to the next as in the case of a hatch.

Therefore, transverse conveyance or sorting are possible within the racks themselves and "transverse conveyance" in the pre-zone can be dispensed with accordingly.

In an expedient manner the transverse conveyance locations are provided on each level of the storage racks or on selected levels.

Particularly effective displacement-time optimisation is achieved if the transverse conveyance locations are arranged centrally or more closely to the removal-from-storage lift or the storage-entry lift in the longitudinal direction of the rack. It is likewise possible to provide a plurality of transverse conveyance locations on the respective level and optionally at different positions.

The transverse conveyance locations can also be used as temporary storage areas, i.e. the transport units remain therein until they are actually required or removed from storage. This is particularly expedient if the transverse conveyance locations are associated with the final target aisle of the transport unit.

The exchange can be effected actively or passively with regard to the storage-entry or removal-from-storage apparatus, i.e. on the one hand, the transverse conveyance location can simply be a passive storing location, in which the storage-entry and removal-from-storage apparatus of one aisle stores transport units (quasi places them into storage) and from which the racking serving unit of the adjacent aisle receives transport units (quasi removes them from storage). This procedure can be performed for each racking storage location or transverse conveyance location always only in one direction or in both directions.

On the other hand, it is likewise possible to equip the transverse conveyance location with corresponding materials handling technology, such as driven rollers, loose roller conveyor optionally inclined, conveyor belts with or without a drive etc. Then, the

storage-entry and removal-from-storage apparatus can store the transport units and the materials handling technology of the transverse conveyance location performs the transportation. Accordingly, the transverse conveyance locations can be configured as conventional storage locations, live storage racks inclined or not inclined, with or without an active or passive drive, as roller conveyors, belt conveyors etc. The transverse conveyance locations can also comprise a pushing mechanism for the transport units.

The simplicity of the transverse conveyance locations also permits subsequent retrofitting and conversion of transverse conveyance locations and flexible adaptation to the required capacity of the storage system.

The transverse conveyance locations can thus optionally be configured for bidirectional or unidirectional exchange and/or for active or passive exchange.

The storage-entry and removal-from-storage apparatuses can likewise place the transport units into storage at double depth or multiple depths in the transverse conveyance locations for exchange purposes. The storage-entry and removal-from-storage apparatuses of one aisle can thus place into storage the transport units in the transverse conveyance locations at such a depth that they are already to be assigned to the adjacent rack and can be reached "normally" by the corresponding storage-entry and removal-from-storage apparatus.

For this purpose, the load picking-up means of the storage-entry and removal-from-storage apparatuses, e.g. telescopic rail arms, can have an extended reach.

It is likewise feasible for the transport units to be stored in a stacked manner.

Since the transverse conveyance locations are subject to very considerable loads, it is expedient if the transverse conveyance locations have a friction-reducing surface and/or structural reinforcement is undertaken. Therefore, damage to the transport units is also reduced or even completely prevented.

It is particularly preferred if the storage-entry and removal-from-storage apparatuses are racking serving units or single-level racking serving units. Shuttles or satellite

vehicles are particularly suitable. It is also possible to use those shuttles which have a lifting platform or a plurality of load picking-up means platforms, which are arranged one above the other, for serving a plurality of levels from one travel rail.

Therefore, in accordance with the invention it is possible to achieve a particularly high level of removal-from-storage efficiency whilst completely maintaining the desired sequence of the transport units in each aisle. This is also achieved with considerably less technical outlay compared with the prior art.

It is understood that where the term "transport units" is used, this is not to be interpreted as limiting, but other types of transport (e.g. trays, pallets etc.) can also be used to like effect within the scope of the invention. The term "transport units" also includes in particular trays, containers, cartons, packing units – i.e. combined individual articles etc. and individual articles.

These transport units can be either source units, from which a picker takes articles of an order so that they function as source or donor (frequently also called product units), or these units can be order units for collecting/compiling articles of an order. For ease of understanding, only the term "transport units" will be used where possible hereinafter.

The transport units can be placed into storage randomly ("chaotically") so as to be distributed over the entire system without knowledge of the subsequent sequence. In contrast to DE 299 12 230 U1, there is no requirement for a limitation to possible modules or storage areas.

So-called MultiShuttle® devices are used in particular as the single level racking serving unit or shuttle. They are described inter alia in EP 1 254 852 A1. The MultiShuttle® is a system which can be used universally, is constructed in modular fashion and combines storage and transport in one integrated concept. The MultiShuttle® complements the domain of the automatic small-parts warehouse as a highly efficient, cost-effective and innovative solution. It is a rail-bound vehicle which operates in the rack and serves the entire storage facility system. The system concept is based upon autonomous, rail-guided vehicles for container transport which operate inside and outside the storage facility system. A specific load picking-up means

permits short load cycle times as well as simultaneous loading and unloading. The system has travel rails which are installed on each level of the storage facility or are installed so as to be elevated or suspended in the pre-zone. They not only guide the vehicles but also supply voltage thereto.

The shuttles can be used in two variants, a so-called "captive" or "roaming" arrangement. In the captive arrangement, the shuttles remain on their respective level. In the roaming arrangement, they change levels according to requirement.

Vertical conveyors can be used in particular as the removal-from-storage lift. It is favourable if each removal-from-storage lift has one or a plurality of, in particular two, locations.

It is also expedient if each storage racking level has at least one buffer location for decoupling the single level racking serving unit and the removal-from-storage lift. This renders it possible to fully utilise the faster single level racking serving units and to prevent the lift from running empty.

In a preferred manner, each removal-from-storage lift is connected to a plurality of removal-from-storage feeding lines. This improves sorting options and increases the number of orders which can be processed in parallel or increases the number of stations which can be supplied.

In the simplest case, the removal-from-storage feeding lines are designed as store delay feeding lines or conveyors. They can be provided e.g. with delay mechanisms, in particular a displaceable stop element.

It is also advantageous if each removal-from-storage lift has, for each location, a separately driven conveyor. In particular, it is then meaningful if each removal-from-storage lift has two locations which are each provided with a separately driven conveyor, which conveyors are displaceable in different directions. Therefore, the transfer of two transport units for each level (e.g. in the case of the above-referenced arrangement) can always be effected simultaneously in different directions or onto different removal-from-storage buffers, e.g. to the left and right. To this end, the reception of the transport units onto the lift is preferably controlled in such a manner

that the two transport units are to be delivered to one level. This is possible on account of the high level of efficiency of the MultiShuttles which are used, as the transfer locations (buffer location) with respect to the removal-from-storage lift are practically always occupied, which means that for the purpose of controlling the removal-from-storage lift a selection option is provided which allows the lift to be occupied accordingly by transport units for different removal-from-storage buffers of one level.

The system is also characterised by a high level of flexibility, since the storage-entry and removal-from-storage feeding lines can be connected at random points to the corresponding lifts.

In a similar manner to the removal-from-storage lifts, dedicated storage-entry lifts corresponding to the removal-from-storage lifts can likewise be provided with correspondingly feeding distribution feeding lines. On the other hand, it is also possible to control the removal-from-storage lifts in such a manner that they can be used not only for the removal-from-storage work but also as storage-entry lifts. Conversely, optionally present dedicated storage-entry lifts can also be used as removal-from-storage lifts according to requirement. This also enables interruption-free operation or an increase in system performance even when individual lifts malfunction. For this purpose, the storage-entry or removal-from-storage lines between the lift and the rack must be arranged at different heights. This requires the presence of two similar combined storage-entry and removal-from-storage levels, whose collecting lines are combined after passing through the last removal-from-storage line in sequence.

The function of transverse displacement offers the advantage that in the event of a failure e.g. of a removal-from-storage/storage-entry lift or feeding lines, it is possible to maintain the function of the aisle which is affected.

The invention permits the use of four basic goods-to-person (GTP) order processing strategies and consolidation strategies of full source units in the automated storage facility based upon the number of aisles, picking stations, lifts, order utilisation and distribution and order and storage details (profiles) etc. when used in a GTP application:

- only relevant source units are transferred to a specific aisle by means of the transverse conveyance locations, wherein the aisle is selected based upon minimisation of the movement in the transverse conveyance locations between aisles and order utilisation and distribution. In other words, for picking purposes the aisle selected is the one which permits minimisation of the movement of the product units for order processing or consolidation of full source units and orders can be completed at a single picking station.
- only order units are transferred in the storage facility by means of the transverse conveyance locations. In other words, picking is performed at each relevant aisle, in which a relevant product unit is stored and the order units "travel" via a plurality of aisles to a plurality of picking stations until the order is fulfilled.
- order units as well as product units are transferred in the automated storage facility by means of the transverse conveyance locations. In other words, picking is performed at a small number of selected aisles, at which relevant product units for an order are consolidated by means of the transverse conveyance locations and the order units "travel" in the same manner via a plurality of aisles to selected picking stations until the order is fulfilled. Consolidation of the order units and product units is based upon optimisation of the order utilisation and distribution and optimum use of such mobile resources, such as e.g. racking serving units, lifts etc.
- incoming source units or full source units are placed into storage in the automated storage facility directly into the particular aisle or nearest possible aisle which will be used or most likely be used for order processing, based upon the information available at the time of storage-entry, taking into account a minimisation of the transverse displacement in the transverse conveyance locations. This information includes but is not limited to:
  - instantaneous product distribution or deviations of each product in the storage facility;
  - orders which are already associated with individual aisles;
  - orders awaiting processing;
  - summary of families or product categories

Brief Description of the Drawings

Further features and details of embodiments the invention will be apparent from the description hereinafter of the drawing, in which

Figure 1 shows a schematic view of a storage facility from above;
Figure 2 shows an enlarged section of figure 1;
Figure 3 shows a lateral view of figure 1; and
Figure 4 shows a simplified and schematic view of the inventive storage facility of figure 1 which is operated in accordance with a first principle;
Figure 5 shows a simplified and schematic view of the inventive storage facility of figure 1 which is operated in accordance with a second principle;
Figure 6 shows a simplified and schematic view of the inventive storage facility of figure 1 which is operated in accordance with a third principle; and
Figure 7 shows a simplified and schematic view of the inventive storage facility of figure 1 which is operated in accordance with a fourth principle.

Detailed Description of the Drawings

The figures illustrate a storage facility which is designated in its entirety by the reference numeral 1 and has a plurality of storage racking aisles 2 and storage racks R having a plurality of levels 3.

The storage racks R are arranged in such a manner that the storage racks R not arranged on the outside are each arranged in pairs adjoining one another and have a racking storage aisle 2 on one side. The storage racks R located on the inside in each case thus abut one another with their "backs".

On the end side, a lift 8 having two locations in each case is provided for each storage racking aisle 2. At the lowermost level, the lift 8 is adjoined in each case by a storage-entry feeding line 4 and a removal-from-storage feeding line 6. Arranged between the lift 8 and the storage rack R on each level 3 are corresponding storage-entry and removal-from-storage buffer lines 7 and 9 in order to decouple the lift 8 from the satellite vehicles 5 (also referred to as shuttles) travelling in the storage racking aisle 2.

It is understood that the storage-entry feeding lines 4 and removal-from-storage feeding lines 6 are connected to suitable conveying lines for picking locations etc.

The shuttles 5 are provided in each racking storage aisle 2 and on each level 3 at that location. This is a so-called "captive" variant, in which the shuttles 5 are fixedly

allocated to one level 3 and do not change levels or aisles which would theoretically be possible.

The shuttles 5 comprise a transport platform 10 for receiving the respective transport unit T (carton, tray, container, goods without loading aids, etc.). Arranged at the side of the transport platform 10 are in each case telescopic arms 11 which push the transport unit T off the platform 10 or pull it up onto the platform.

For this purpose, the telescopic arms 11 can be extended on both sides of the storage racking aisle 2 into the racks R and have carriers 12 which can move in a known manner.

The storage racks R are provided on each level 3 with specific exchange locations Q for transversely conveying transport units T from one rack R to the adjacent rack R, so that the transport units T are exchanged within the storage racks R themselves and corresponding outlay in the pre-zone can be avoided.

The shuttles 5 or the telescopic arms 11 thereof can therefore place transport units T in the transverse conveyance locations Q and push them into the corresponding location in the adjacent rack R.

To this end, the respective transport unit T is [lacuna] by being acted upon by means of the carriers 12 of the telescopic arms 11 beyond the rear storing location 13 of one transverse conveyance location Q of the first rack R into the respective rear storing location 13 of the adjacent transverse conveyance location Q of the adjacent rack R.

Furthermore, the storage racks R comprise a transverse conveyance location Q2. In contrast to the transverse conveyance locations Q, the transverse conveyance location Q2 is bidirectional which means that an exchange can take place from the two racks R to the respectively adjacent rack R and the direction is determined by the transport unit placed down first.

A plurality of "normal" transverse conveyance locations Q are provided in each case (in this case two for each rack R) so that they do not have to be emptied immediately but rather – depending upon the configuration of the order to be removed from

storage – can be used as a temporary storage area, from which the order is directly removed from storage. Therefore, the shuttles of adjacent racking aisles can be decoupled.

For the purposes of removal from storage, the transport units T are removed by the shuttles 5 from the storage rack R and are delivered to the removal-from-storage buffer 9 which conveys the transport units T onwards to the lift 8 and thus to the removal-from-storage feeding line 6. Conversely, storage-entry is effected via the storage-entry feeding lines 4, the lift 8 and the storage-entry buffer 7 and the shuttle 5 into the respective storage rack R.

It is understood that storage entry and removal from storage can also be disentangled and can take place at different points on the storage rack R, e.g. at different end sides or even integrated laterally in the storage rack R.

In relation to figures 4-7, four principles of operation will be described hereinafter by reference to the above storage facility.

In figure 4, the so-called "airport departure" strategy is described. In accordance with this operating principle, only relevant source units D or full source units are transferred to a selected aisle by means of the transverse conveyance locations Q, wherein the aisle is selected based upon minimisation of the movement in the transverse conveyance locations Q between aisles and order utilisation and distribution. In other words, for the purpose of picking/consolidation, the aisle selected is the one which permits minimisation of the movement of the product units D for order processing and the order can be completed at one individual aisle or a single picking station P at which the order units O are filled with all of the articles of an order from the corresponding product units D. The order units O can be transferred either from the picking station P back into the storage facility for temporary storage therein and consolidation, or can be transferred to a dispatch station for completion of the order by an external conveyor E which connects the picking stations. When consolidating full source units, full source units associated with the same order are stored in an aisle until the order awaits processing. Then, the source units are removed from storage consecutively from the aisle, wherein the specified sequence can be maintained for the most part.

In figure 5, the so-called "limousines" strategy is described. In accordance with this mode of operation, only order units O are moved through the automated storage facility by means of the transverse conveyance locations Q. In other words, picking is performed at each relevant aisle, in which a relevant product unit or source unit is stored and the order units O "travel" through the aisles 2 to a plurality of picking stations P until the order is processed.

In figure 6, the so-called "bus stops" strategy is described. In accordance with this operating strategy, order units O as well as product units D are transferred in the automated storage facility by means of the transverse conveyance locations Q. In other words, picking is performed at a small number of selected aisles 2, at which relevant product units D for an order are consolidated by means of the transverse conveyance locations Q and the order units O "travel" in the same manner via a plurality of aisles 2 to selected picking stations P until the order is fulfilled. Consolidation of the order units O and product units D is based upon optimisation of the order utilisation and distribution and optimum use of such mobile resources, such as e.g. racking serving units, lifts etc.

In figure 7, the so-called "airport arrival" strategy is described. In accordance with this operating principle, source units or full source units D which are incoming (to be placed into storage) are placed into storage in the automated storage facility directly into the particular aisle 2 or nearest possible aisle 2 which will be used or most likely be used for order processing, based upon the information available at the time of storage-entry, taking into account a minimisation of the transverse displacement in the transverse conveyance locations Q. This information includes but is not limited to:

- instantaneous product distribution or deviations of each product in the storage facility;
- orders which are already associated with individual aisles;
- orders awaiting processing;
- summary of families or product categories

Source units D1 which are to be placed into storage, associated with a first order, and source units D2 which are to be placed into storage, associated with a second order, are conveyed on an input conveyor I into the storage facility or the corresponding

aisles 2, which is connected to the storage-entry feeding lines 4, based upon the above rules.

If an input conveyor I is not provided, the supply/inward transfer can also be conducted in a different way in accordance with the specification of the inventory management software, e.g. manually, by automated guided vehicles, depalletizers etc.

Within the storage facility, the source units D are transferred by means of the transverse conveyance locations Q to the actual aisle 2 where picking then actually takes place, wherein e.g. a source unit D1, after being used in one order, can subsequently become a source unit D2 to be used in a different order.

In the claims which follow and in the preceding description, except where the context requires otherwise due to express language or necessary implication, the word “comprise” or variations such as “comprises” or “comprising” is used in an inclusive sense, i.e., to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the method and apparatus.

Claims

1. Method for providing transport units from a storage facility wherein the storage facility includes a plurality of storage racks each having multiple storage rack levels, wherein interior storage racks are arranged in pairs adjoining one another and have an access aisle on at least one side of each pair, said storage facility further including at least one storage line and at least one removal line, a storage and removal vehicle for each access aisle and at least one lift that is adjoined by the at least one storage line and the at least one removal line; said method comprising:

directly exchanging transport units between two adjoining racks from one access aisle to an adjacent access aisle via transverse conveyance locations in the storage racks, wherein the storage and removal vehicle comprises a shuttle at each level of the storage racks, wherein the directly exchanging comprises the shuttle acting on the transport units to displace the transport units by contact with the shuttle in the transverse conveyance locations from one of the adjoining racks to the other of the adjoining racks including transferring product transport units to a specific aisle using the transverse conveyance locations, wherein the specific aisle is selected based upon minimization of the movement in the transverse conveyance locations between aisles, the product transport units having articles to make up a particular order.

2. Method as claimed in claim 1, wherein the transverse conveyance locations are provided on each level of the storage racks.

3. Method as claimed in claim 1 or 2, wherein the transverse conveyance locations are arranged centrally in the longitudinal direction of the rack.

4. Method as claimed in any one of the preceding claims including utilizing said transverse conveyance locations act as temporary storage locations.

5. Method as claimed in any one of the preceding claims, wherein exchanging the transverse units bi-directionally at the transverse conveyance locations.

6. Method as claimed in claim 5 including using the transverse conveyance locations as live storage rack locations for storage of transport units.

7. Method as claimed in any one of the preceding claims, wherein the transverse conveyance locations have a low friction surface.

8. Method as claimed in any one of the preceding claims, wherein the transverse conveyance locations are structurally reinforced.

9. Method as claimed in any one of the preceding claims, wherein the shuttle places the transport units into storage at at least double depth in the transverse conveyance locations for exchange purposes.

10. Method as claimed in any one of the preceding claims, wherein the shuttles are captive vehicles which are each limited to movement in a single aisle.

11. Method as claimed in any one of the preceding claims including a removal line for each storage access aisle.

12. Method as claimed in any one of the preceding claims including a storage line for each storage access aisle.

13. Method as claimed in any one of the preceding claims including a lift for each storage access aisle.

14. Method as claimed in any one of the preceding claims including a lift in selected storage access aisles.

15. Method as claimed in claim 1, wherein the transverse conveyance locations are arranged adjacent the at least one lift.

16. Method as claimed in claim 2 including utilizing said transverse conveyance locations as temporary storage locations.

17. Method as claimed in claim 3 including utilizing said transverse conveyance locations as temporary storage locations.

18. Method as claimed in claim 1 including exchanging the transport units uni-directionally at the transverse conveyance locations.

19. Method as claimed in claim 2 including exchanging the transport units bi-directionally at the transverse conveyance locations.

20. Method as claimed in claim 2 including exchanging the transport units uni-directionally at the transverse conveyance locations.

21. Method for providing transport units from a storage facility wherein the storage facility includes a plurality of storage racks each having multiple storage rack levels, wherein interior storage racks are arranged in pairs adjoining one another and have an access aisle on at least one side of each pair, said storage facility further including at least one storage line and at least one removal line, a storage and removal vehicle for each access aisle and at least one lift that is adjoined by the at least one storage line and the at least one removal line, said method comprising:

directly exchanging transport units between two adjoining storage racks from one access aisle to an adjacent storage access aisle via transverse conveyance locations in the storage racks, wherein the storage and removal vehicle comprises a shuttle at each level of the storage racks each shuttle having a platform for supporting transport units and telescopic arms which extend into the storage racks to push transport units off the platform and pull transport units onto the platform and wherein said directly exchanging transport units comprises pushing the transport units with the telescopic arms in the transverse conveyance locations from one of the adjoining storage racks to the other of the adjoining storage racks including transferring product transport units to a specific aisle using the transverse conveyance locations, wherein the specific aisle is selected based upon minimization of the movement in the transverse conveyance locations between aisles, the product transport units having articles to make up a particular order.

22. Method as claimed in claim 21 wherein said telescoping arms push transport units off the platform to at least one storage row to store the transport units and pull transport units from the at least one storage row to retrieve transport units and wherein said directly exchanging transport units comprises pushing the transport units with the telescopic arms in the transverse conveyance locations beyond the at least

one storage row to exchange the transport unit with an adjoining storage rack.

23. Method as claimed in claim 22 including fingers on the telescopic arms to pull transport units from the at least one storage row and wherein said pushing the transport units with the telescoping arms comprises pushing the transport units in the transverse conveyance locations with said fingers to exchange the transport unit with an adjoining storage rack.

24. Method as claimed in claim 21 including storing transport units to and retrieving transport units from at least two double rows of transport units on said racks.

25. Method as claimed in claim 21 wherein said pushing the transport units with the telescopic arms comprises extending said telescopic arms on both sides of the access aisle to racks on opposite sides of the access aisle.

26. Method as claimed in claim 1 wherein the specific aisle is selected based upon the order being completed at that aisle or at a particular picking station.

27. Method as claimed in claim 26 wherein order transfer units are transferred from the picking station back into the storage facility or are transferred from the picking station by an external conveyor, wherein the order transfer units contain at least one order.

28. Method as claimed in claim 21 wherein the specific aisle is selected based upon the order being completed at that aisle or at a particular picking station.

29. Method as claimed in claim 28 wherein order transfer units are transferred from the picking station back into the storage facility or are transferred from the picking station by an external conveyor, wherein the order transfer units contain at least one order.

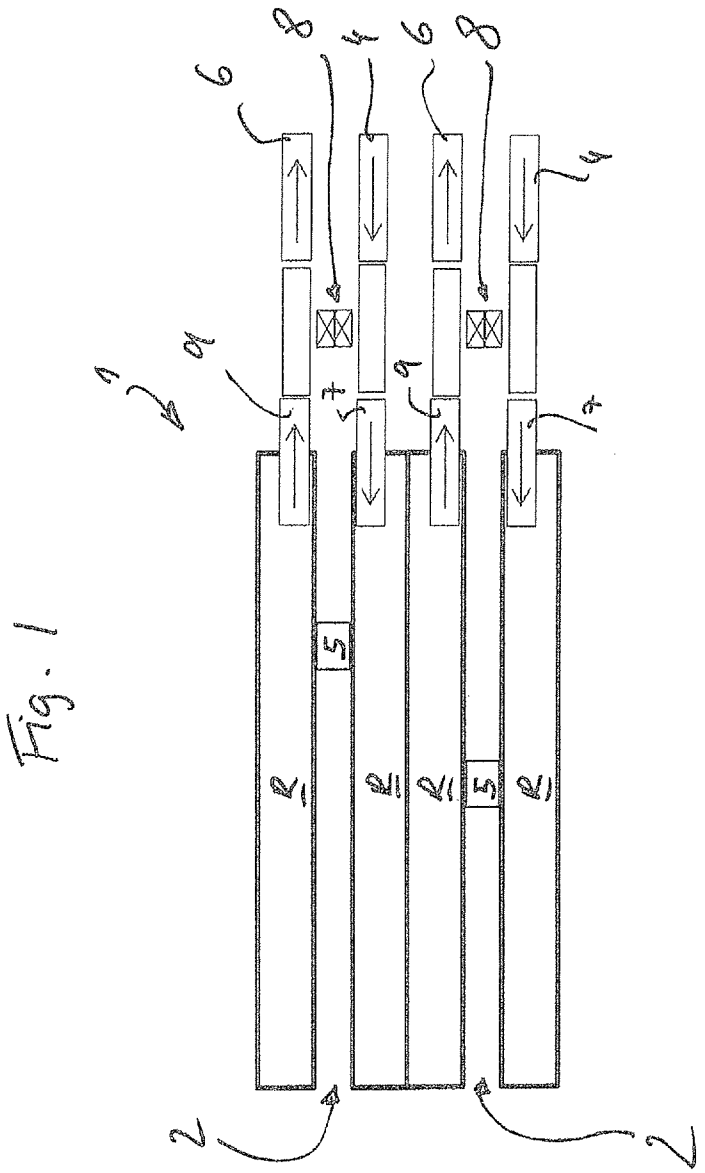

Fig. 1

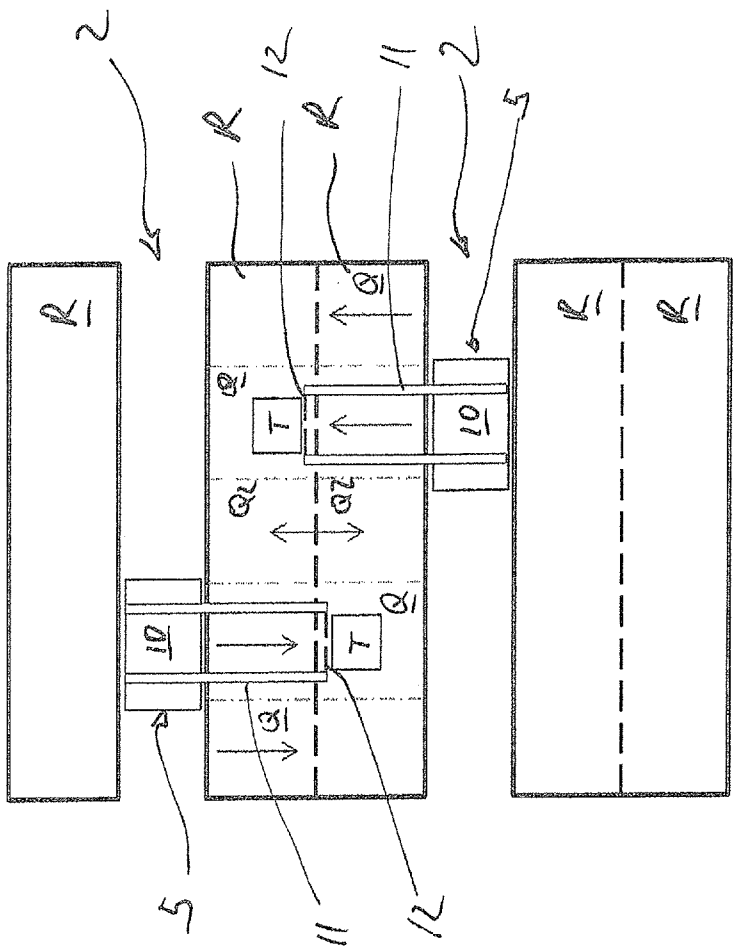

Fig. 2

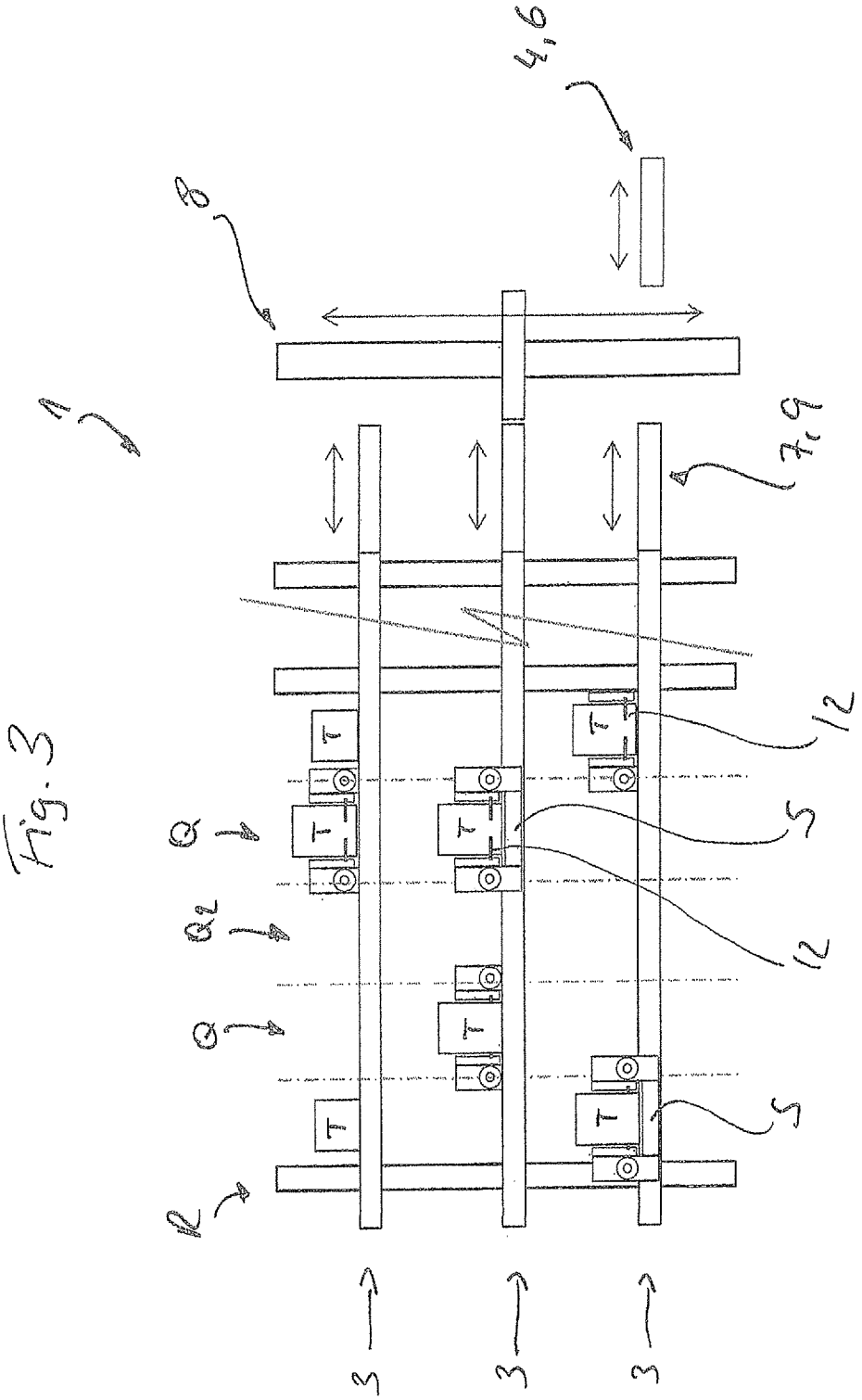

Fig. 3

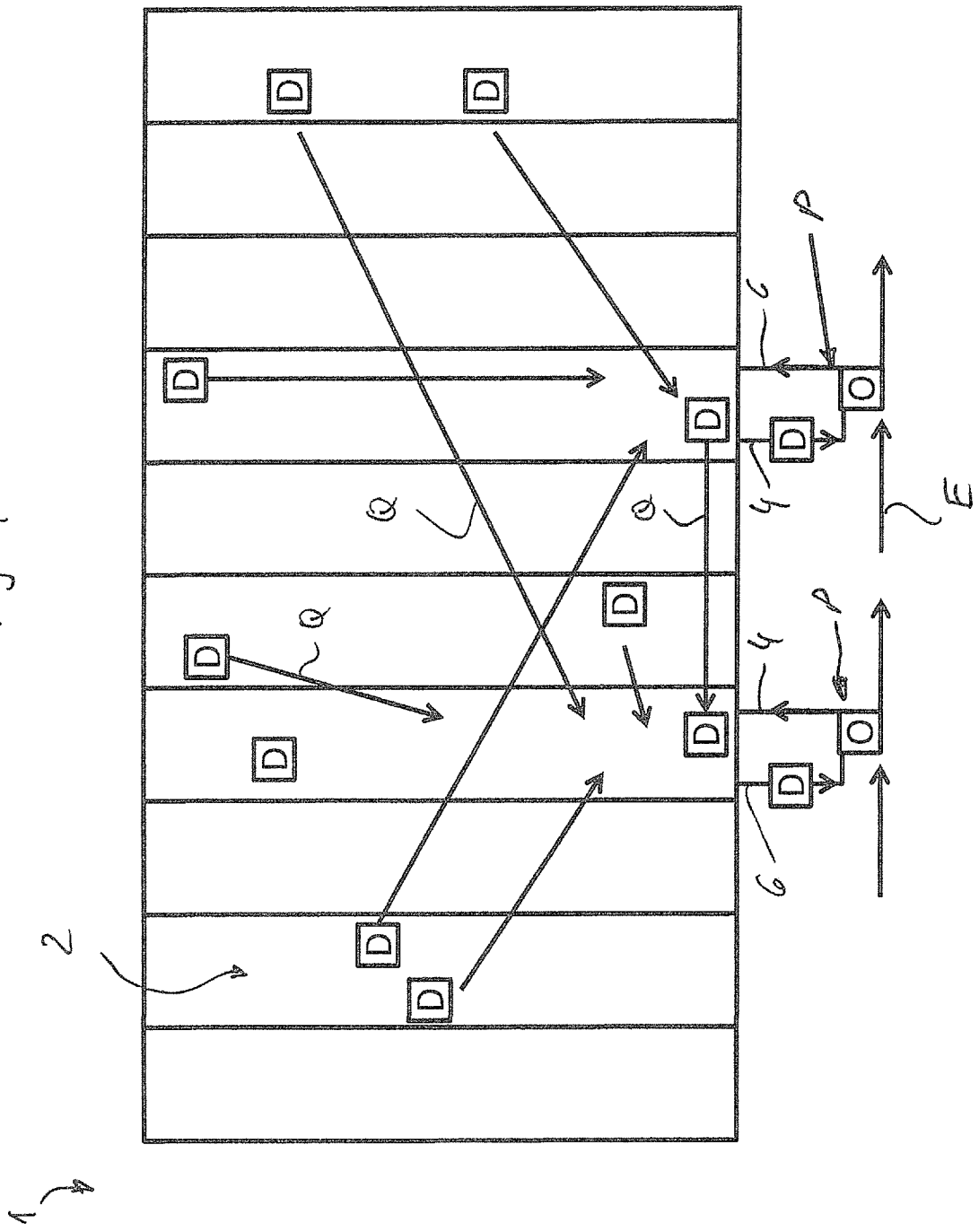

Fig. 4

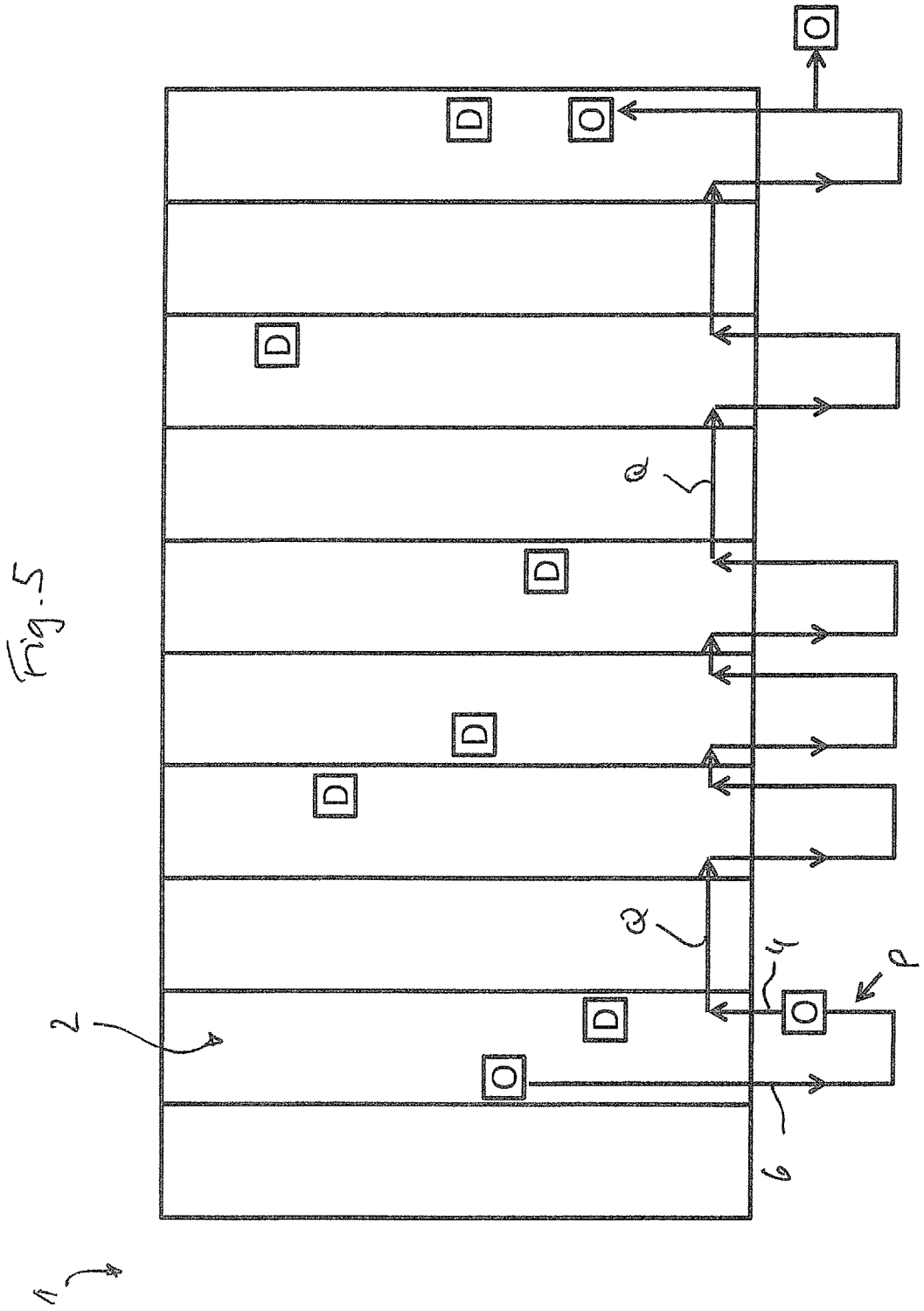

Fig. 5

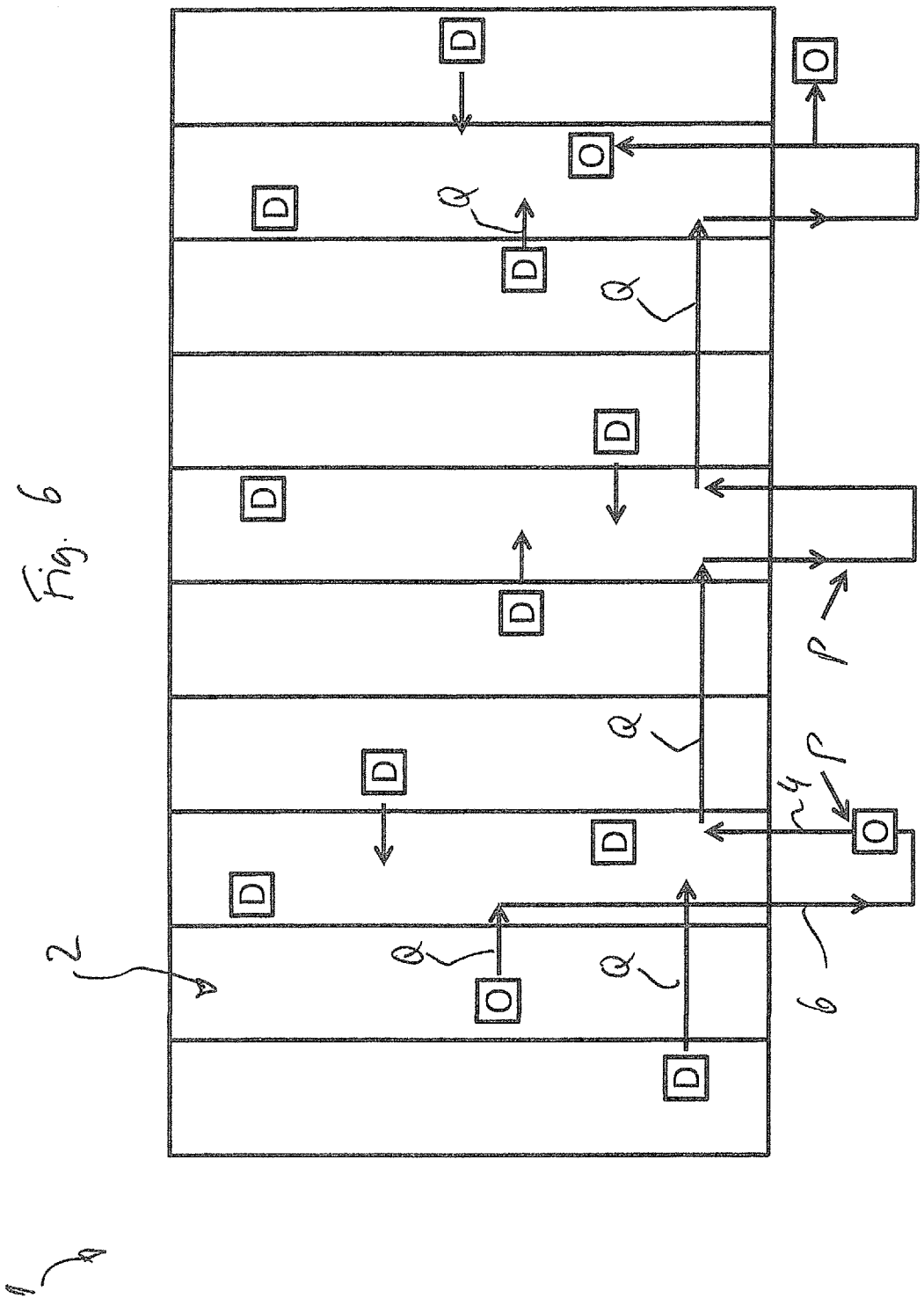

Fig. 6

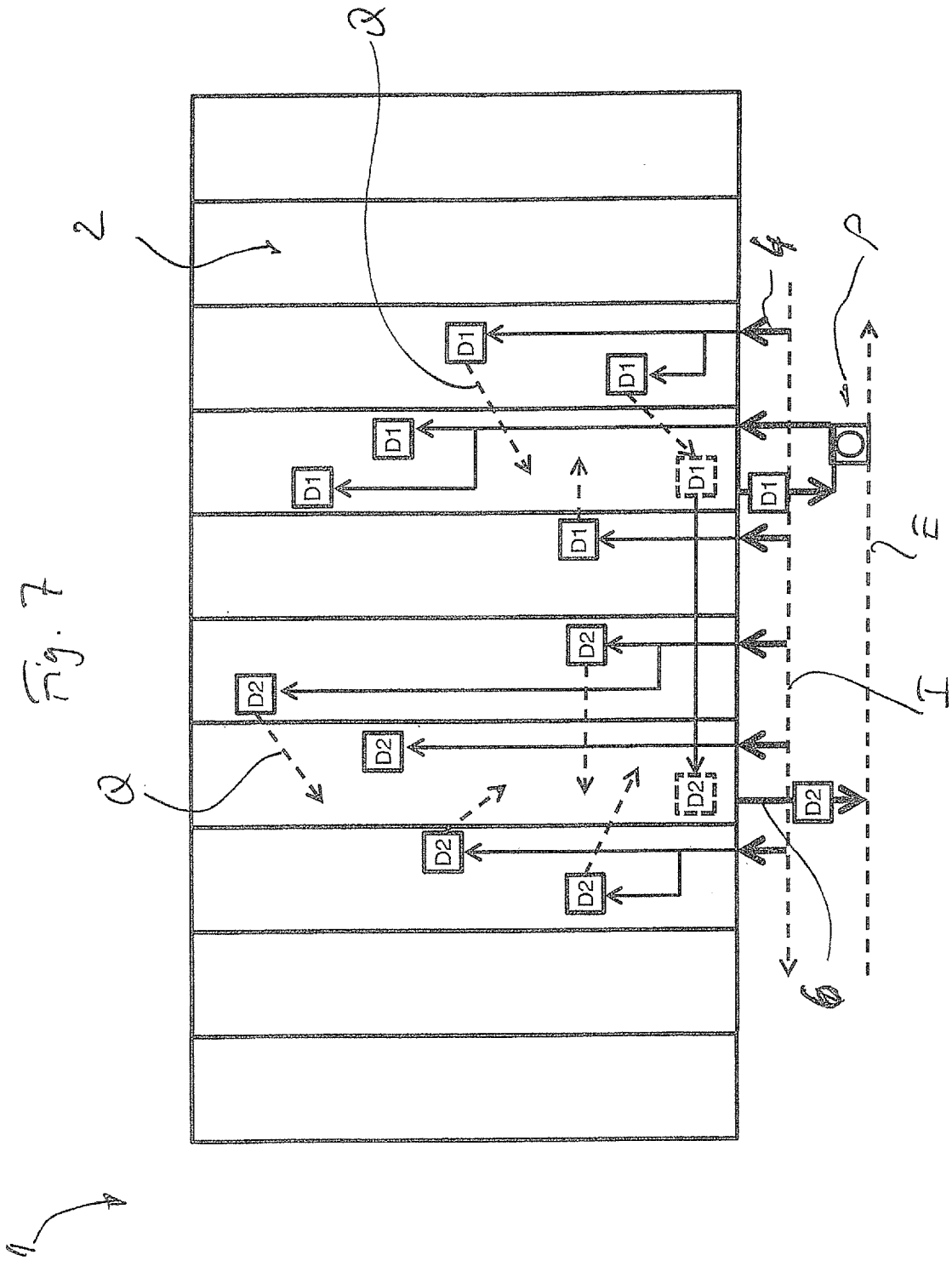

Fig. 7