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(54) **METHOD FOR PLACING A PALLETLESS GOODS PACKAGE IN A STOCK SHELF AND DELIVERING THEREFROM AND FOR CONTROLLING LOGISTICS OF PACKAGES**

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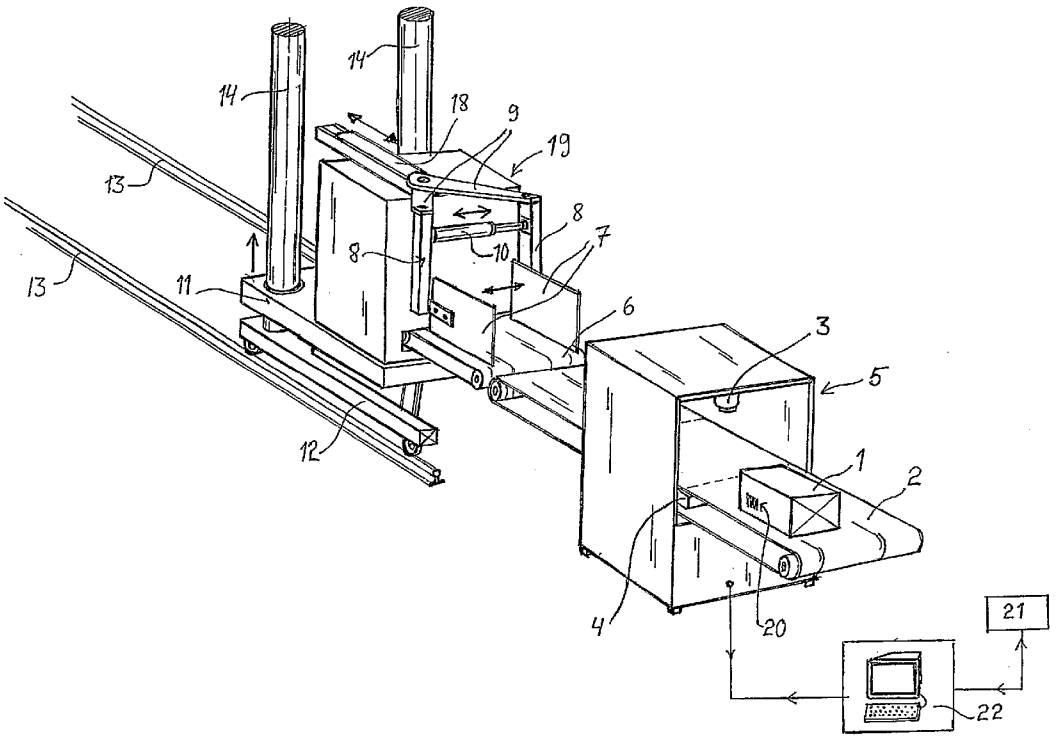
(57) **ABSTRACT**

A method to stack palletless and as to their size variable packages (**1**) on warehouse rack (**15**) and to retrieve them from said rack and to control the logistics of packages, in which method the said warehouse rack is furnished with an automatic packages stacking and retrieving robot, and in the method the control of warehouse data and logistics takes place by means of a data system. Equipment (**5**) included in the method receives package (**1**), for instance, onto conveyor belt (**2**), equipment (**5**) carries out weighing of package (**1**), determination for it necessary space requirement, reading of remote code connected to package (**1**), as RFID code (**20**) in order to choose the rack space determined for it on basis of previous functions, and package (**1**) is retrieved from the rack steered either by the order of the user or of the data system, and the data from above mentioned stacking and retrieving functions are transmitted to the data system.



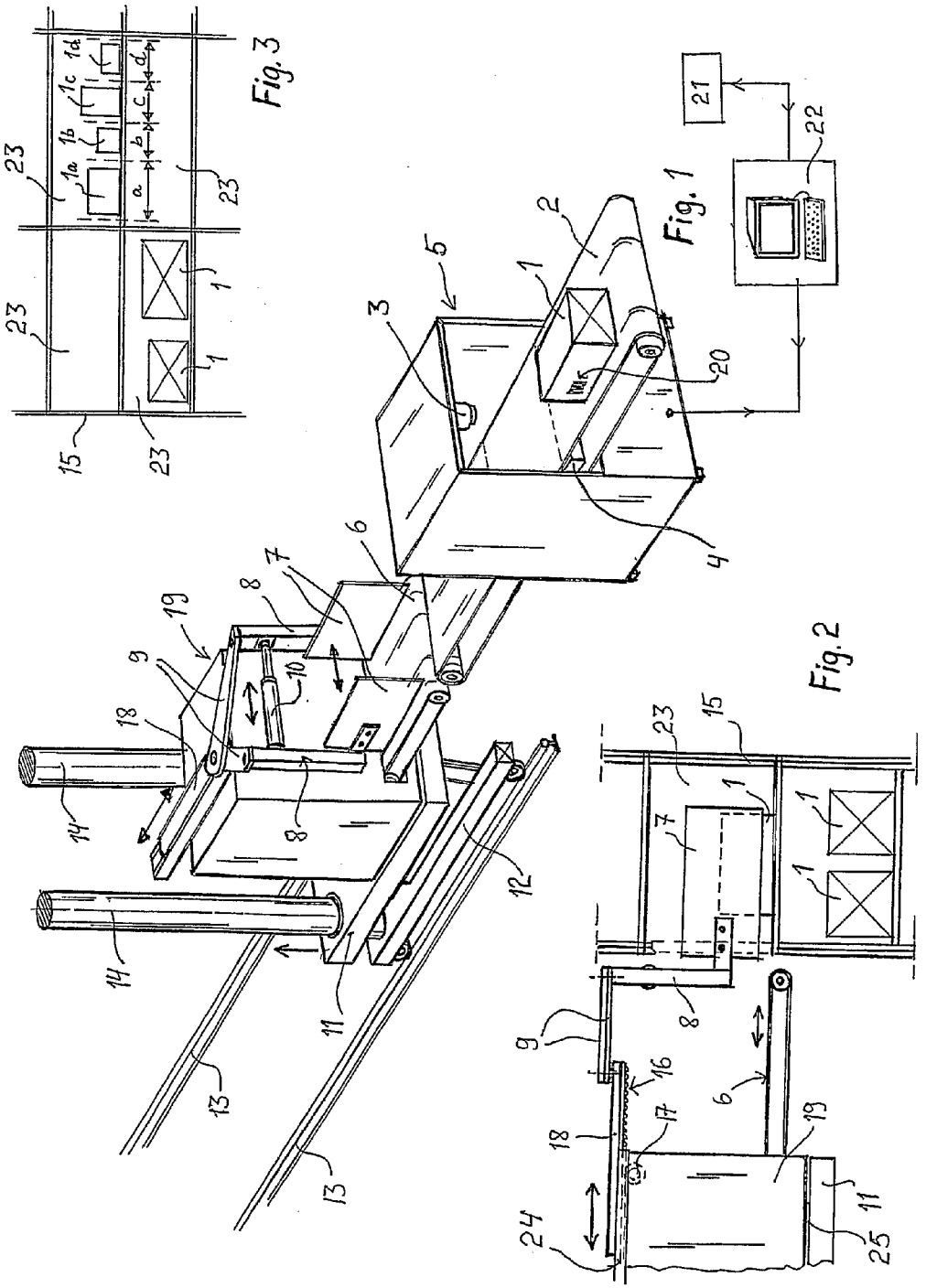


Fig. 3
Fig. 1
Fig. 2
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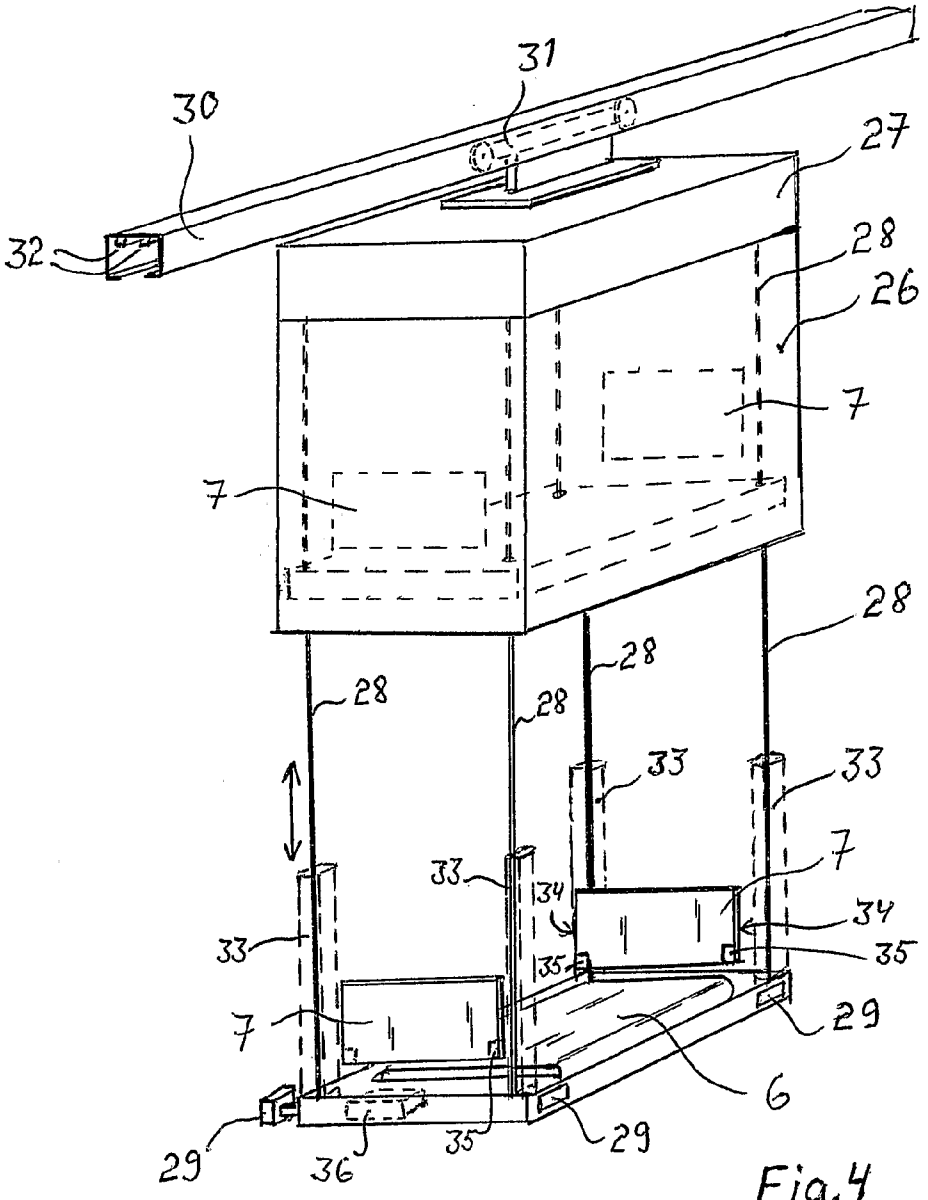
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Fig.4

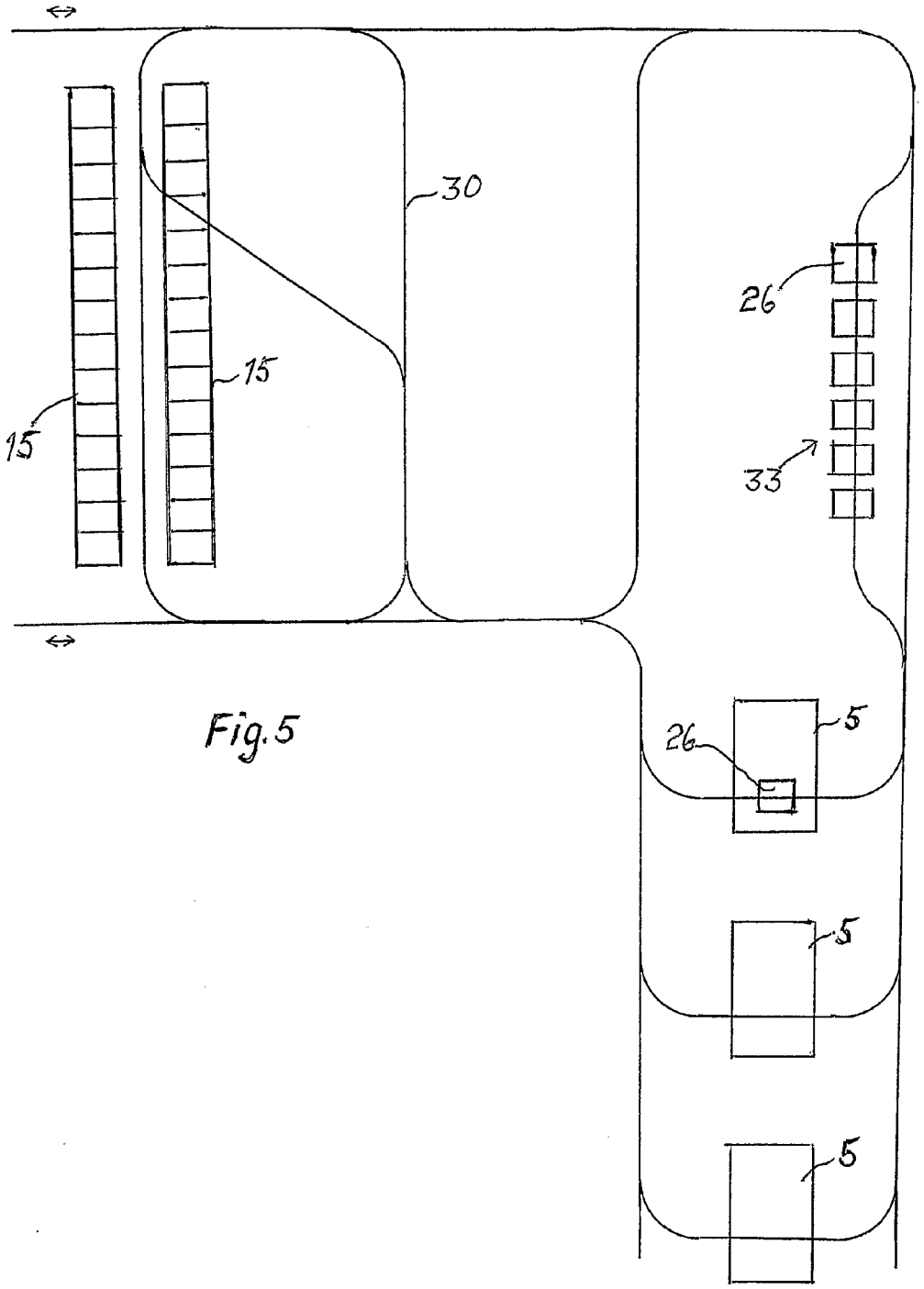

Fig. 5

METHOD FOR PLACING A PALLETLESS GOODS PACKAGE IN A STOCK SHELF AND DELIVERING THEREFROM AND FOR CONTROLLING LOGISTICS OF PACKAGES

[0001] The invention relates to a method to stack palletless and as to their size variable goods packages into the warehouse rack and to retrieve them from said rack and to control the logistics of packages, in which method the said warehouse rack is furnished with an automatic packages stacking and retrieving robot, and in the method the control of warehouse data and logistics takes place by means of a data system, and to equipment that carries out the method.

[0002] Previously known is a palletless storing system of goods, among others from U.S. Pat. No. 6,129,497, where palletless goods crates stacked, one on top of another, are retrieved from the warehouse rack and stacked on the rack. A collecting apparatus is moving on rails in the warehouse, which apparatus is adjusted to take and stack goods crates on different rack levels. On a rack there can be many stacks of crates side by side. The stack retrieved from the rack so that the lifting means of the stacking apparatus catches the bottom-edge of he lower crate in the stack, whereby the whole stack can be lifted on and removed together with the apparatus. The crates are on the rack so that the lifting means can be placed under their edges. This has been resolved so that the crates on the rack are on a smaller base than their bottom part.

[0003] With the apparatus it is possible to handle other than crates of a certain size, which are stacked one on top of another, a certain quantity at the most. Anyway, no bearing pallets are needed. Steering of the apparatus takes place from the control centre in the lifting carrier. In the system the content of crates is not identified.

[0004] In order to eliminate the disadvantages of the above presented wagon moving and working in a high warehouse collecting and removing palletless goods packages, a new method of stacking and retrieving pallet free packages from the rack is developed and a method to control the logistics of packages, whereby the method is characterised in that the equipment of the method receives the package, for instance, onto a conveyor belt, the equipment carries out weighing of package, determination of space requirement, reading of remote code connected to the package, as reading of RFID code onto the package in order to choose the rack space determined on basis of former stages and the package is retrieved from the rack controlled either by the order of the user or the data system and that data of above mentioned stackings and retrieving are transmitted to the data system.

[0005] Characteristic for the equipment that carries out the method is that the tracking and retrieving robot has at least an encapsulated upper part so that possible encapsulations of the lower part together with the upper part encapsulation essentially close the lower part package space, at least the sides and the bottom, when the lower part is lifted into contact with the upper part, furthermore the lower part has a transport platform to facilitate moving of package, and detectors in said lower part at least for observation of package.

[0006] The advantage of the method according to the invention is that the data base of the system remains up to date in real time and to the to its contents, since the packages travel through weighing and photography into the racks. Keeping the data base updated results in plenty of other advantages, such as possibility, in connection with completion storage, of automatic delivery of orders and for instance follow-up of the age of goods. From the reception of goods a photograph and weight data arrives to the data base, which can be checked later on. The robot stacking and retrieving packages is so arranged that it can take and move packages regardless of their form and outer dimensions provided that they do not exceed the top limit.

[0007] In the following the invention is disclosed with reference to the enclosed drawing, where

[0008] FIG. **1** shows the reception and delivery station in a stacking and retrieving warehouse and the automatic stacking and retrieving robot moving in the warehouse.

[0009] FIG. **2** shows from the side a goods package getting stacked, into the rack.

[0010] FIG. **3** shows a part of the warehouse rack from the direction of goods retrieval.

[0011] FIG. **4** shows the stacking and retrieving robot travelling on overhead rails.

[0012] FIG. **5** shows schematically a rail of the warehouse rail system from above.

[0013] FIG. **1** shows the receiving and delivery station **5**, which includes a conveyor belt **2** onto which the brought goods package is placed The package is whatever article packed or unpacked, which stays put not rolling off its base. The one who brings the package or the user of the storage is identified with a code that can be fed for instance into computer **22** connected to the station. When the user is identified conveyor belt **2** gets started and moves package **1** to the tunnel in the station, which tunnel comprises the means for control of package. The bar code on package side, RFID code or any other series of characters are read, belt scale **4** weighs the package and camera takes photos of it. The data are taken to the warehouse system as data concerning the said package. If the package weight given in RFID code does not correspond to the weighing result, the reception is rejected. The pattern recognition program determines from the camera picture also the external dimensions of the package. There can also be more cameras taking pictures in different directions. Then the system seeks from the warehouse a place for package **1** and moves it by means of belt **2** to belt **6** of the package collecting robot **19**.

[0014] Belt **6** of collecting robot **11**,**12**,**19**, pulls the package between transfer plates **7** of package. In this stage it is also possible by means of transfer plates **7** to pull the package. When package **1** is on belt **6** between transfer plates **7** robot **11**,**12**,**19** starts moving along rails **13** in the warehouse. The robot comprises a rail base **12** with wheels. The robot has also high vertical guides **14**, resting on which equipment platform **11** is arranged to rise to the height needed. For instance, there are in guides **14** toothed bars, whereby equipment platform **11** comprises rotatable cogwheels, by means of which the equipment platform gets up and down in the guides.

[0015] On equipment platform **11** there is still the robot transfer gear part so fixed that it can turn on the equipment platform at least 90° sideways, most suitably to both sides. Thus the robot moving along rails between the racks collects and delivers goods to the racks on both sides of the fairway.

[0016] In transfer gear part there are driving gears of transfer plates **7**, by means of which plates **7** can be brought closer to and farther away from each other. As equipment there are arms **8** upwards from plates **7**, which by means of cylinder **10** are brought closer and farther. Vertical arms **8** are by means of articulated arm **9** fixed to horizontal beam **18**, whereby change of distance between plates is possible. Whereas hori-

zontal beam **18** is moved with regard to another fixed beam on the transfer gear part, whereby to transfer plates necessary horizontal motion is achieved. The force of cylinder **10** is so adjusted that it does not squeeze the goods too much. FIG. **1** shows a robot ravelling only on one pair of rails. When in the practise the robot has to work between many possible racks in a rack unit addressed to it, there is in connection with rails **13** a transversal transfer system in the end of the rack row, for instance so that the robot is transferred with another robot to the rails between proper racks. For instance, rails **13** are cut off immediately after the robot, whereby the track-laying under the robot is mounted on a platform movable in cross-wise direction.

[0017] However, a more recommendable embodiment is of such kind that robot **19** moves by means of its wheels on a smooth base and its control system drives the robot accurately between right racks and in there to right position and further, the unit lifts belt **6** to proper height. By means of this solution the advantage is achieved that for the robot upper part **19** no separate turning means are needed, since the whole robot turns between the racks by means of its wheels.

[0018] FIG. **2** shows from one side the bringing of package **1** to rack space **23**. With belt **6** it is not possible to accompany the package to the rack, but the final placing into rack must be carried out by means of transfer plates **7**. The horizontal motion is formed in FIG. **2** by means of beam **18** furnished with toothed bar **16**, which moves in control beam **24** rotated by toothed bar **17**. The rack units are chosen for the part of the height of the goods space according to the maximum package size. For instance, a system can be chosen, where the maximum package size is $400\times600\times600^3$ and weight 50 kg. Between the platform of equipment **11** and transfer gear part there are bearings **25** so that it is possible to go around upper part **19**, including its transfer gears, at least to both sides.

[0019] FIG. **3** shows the front of a rack, whereby rack spaces **23** are visible from their width. In the warehouse system control of band distribution is recorded, whereby rack spaces **23** comprise for different widths chosen bands a-d according to the width of packages **1***a*-**1***d*. The system is programmed to fit the packages according to the width so that package **1** can be placed in a free band corresponding well to its width.

[0020] FIG. **4** shows a stacking and retrieving robot **26** travelling along a overhead rail **30** by means of wagon **31**. The robot comprises a protective casing, into which, by means of cables **28**, the goods transporting lower part can be lifted. The lower part can be let down to different levels for stacking and retrieving packages **1**, when at first the robot in overhead rail **30** is stopped in the right point. For instance, in overhead rail **30** there is glued in the inner surface a readable location code band, whereby the control circuit of the unit receives all the time data of location on rail **30**. There area in rail **30** also power cables, from which the wagon **32** motor gets its motive force. Furthermore, rail **30** possibly comprises also an aerial band for data transmission. For moving gripping plates **7** of the lower part and conveyor belt **6** there is in the lower part a rechargeable battery and driving motors of means **7**, **6**. The battery is charged from overhead conductor rails **32**, when the lower part is lifted up into the upper part casing. Packages **1** stay in the robot ride, when the lower part is lifted up into the casing of the upper part. Encapsulation between lower part and upper part is arranged so that together their encapsulations close at least the package into a casing comprising bottom and sides. Control of wagon **30** contains blocking of movement if the lower part is not lifted up. Transportation of packages is safe, if they move on an manned area.

[0021] When the lower part is let down to wanted rack, for instance determined by control codes, as a solution there are supports **29** locking the lower part and which by means power units are pushed against the frames of racks **15**, so that the lower part is locked to its place, when packages are moved from lower part to the rack and vice versa. Supports **29** work also as lower part power source, as by means of a battery placed in the rack frame For instance, in order to secure working, the lower part has a rack location detector, so that lower part can be steered just to the right height. The detector is, for instance by means of ultra sound, detecting the location of the rack frame. The front edges of gripping plates **7** are in their both directions furnished with a collision sensor **34**, which is for instance a pietzo film. The sensor informs if the front edge of plate **7** hits the package. Furthermore, the front edges of gripping plates **7** can have light cells **34** which indicate arriving of package between the gripping plates or leaving of package from between the gripping plates. Furthermore, in one embodiment the lower part can be furnished with a horizontal net curtain between vertical beams **33**. The net curtain indicates when a package or other obstacle is in immediate closeness of the lower part side, so that lifting of lower part does not necessarily work in the space between the rack. The net curtain is needed mainly on the lower part sides, via which loading of package is running. The lower part includes also a battery **36** as power source of lower part equipment. Naturally, the above mentioned equipment and properties can be adapted to gripping plates **7** of robot **19** of FIG. **1** and to the transfer opening and side parts of the package.

[0022] FIG. **5** is a schematic view of overhead track-laying **30**, along which robots **26** can be steered to move to or to get stored to depot area **33**. As example in the scheme one rack area, one depot area **33** and three reception and delivery stations **5** are presented. Rack units **15** are most suitably under overhead rail **30** so much that the track of collecting robot can cross the rack units, Several robots **26** are programmed to move at the same time on rails **30** and the program takes care every moment of the location of the robots and seeks the best routes.

[0023] The data system reception and delivery stations **5** transmits and receives over computer **22** electric data together with central server **21** physically in a different place. Whereas the central server continuously communicates electrically with suppliers and with the operation system of the customer. Naturally, computer **22** in connection with the unit, can also be communicating directly with suppliers or buyers

[0024] By supply of goods the supplier furnishes the package with RFID remote code and sends electrically the data of RFID code **20** to the warehouse data system. The RFID remote code is usually a stick-on label and contains order data, quantity data, ID number and possibly also other data, as for instance data of the cargo destination. When the package arrives at the warehouse rack station, choosing of package location in rack **15** is effected by the weight of the package and possibly also the demand of quick collection of package.

[0025] The data system included in the method controls the logistics of package **1**, by which communication electronic mail address is used and by means of which access to the web sides received, whereby by means of communication, as an electrical form, the goods (package) are ordered from the supplier, the system types the carriage note and orders freight and transport and invoices the transportation. The system

informs the supplier of arrival of the goods, transmits the chosen location of the goods (package) in the warehouse rack to the data system, updates the warehouse situation, forms invoice data and also of collection and sending of goods (package) from warehouse rack **15** to the customer according to the order received from customer in using correspondingly the above presented necessary functions.

[0026] If the goods (package) are collected from rack **15** for own use on the basis of a collection order, the control of logistics updates the content of stock, gives, if necessary, an order impulse, due to the reduction of the goods in question, and points the reduced goods to charge the work number or corresponding identified in the collection order.

1. A method to stack palletless and as to their size variable packages (**1**) on warehouse rack (**15**) and to retrieve them from said rack and to control the logistics of packages, in which method the said warehouse rack is furnished with an automatic packages stacking and retrieving robot (**19**),(**26**), and in the method the control of warehouse data and logistics takes place by means of a data system, characterized in that equipment (**5**) included in the method receives package (**1**), for instance, onto conveyor belt (**2**), the equipment (**5**) carries out weighing of package (**1**), determination for it necessary space requirement, reading of remote code connected to package (**1**), as RFID code (**20**) in order to choose the rack space determined for it on basis of previous functions, and package (**1**) is retrieved from the rack steered either by the order of the user or of the data system, and the data from above mentioned stacking and retrieving functions are transmitted to the data system.

2. A method according to claim **1** characterized in that the packages are stacked as to their positions in transverse direction identified as band spaces (a . . . d), of the rack, the band width of which is determined according to the external dimensions package (**1***a* . . . **1***d*).

3. A method according to claim **1** characterized in that the supplier furnishes the package with RFID remote code and electrically the sends data of package to the warehouse data system or the data follow along with the RFID remote code.

4. A method according to claim **1** characterized in that the user is identified in manners known per se, as with the RFID code, fingerprint code or PIN code.

5. A method according to claim **1** characterized in that the space requirement of package is determined by identifications of the package external dimensions.

6. A method according to claim **1** characterized in that choosing of position of package **1** in rack (**15**) is effected by the weight of package and also by the demand of quick package collection.

7. A method according to claim **1** characterized in that the data system controls the logistics of package (**1**) by means of electric communication, in which communication the e-mail address is used and by means of it access to the web sides, whereat by means of the communication the goods (package) are ordered from the supplier, the carriage note typed, freight ordered and transport carried out, the transportation invoiced, arrival of goods confirmed, chosen location of the goods (package) in the warehouse rack is transmitted to the data system, the content of stock is updated, invoice data are formed and also of collection and sending of goods (package) from warehouse rack (**15**) to the customer according to the order received from customer in using correspondingly the above presented necessary functions.

8. A method according to claim **1** characterized in that on collecting goods (package **1**) on the basis of from rack (**15**) for own use, for instance a bearing from the rack to assembly, the control of logistics updates the content of stock, gives, if needed, an order impulse, because of the reduction of the goods in question, and indicates the reduced goods to charge the work number or corresponding identified in the collection order

9. A method according to claim **1** characterized in that in the warehouse system a separate central server (**21**) is used, which receives and sends data together with the warehouse system of the supplier and customer, who has ordered the goods.

10. A method according to claim **1** characterized in that the data system compares the data of received package (**1**) with the data of the data system, as for instance the size, weight and/or the photographer makes a possible report of deviation.

11. Equipment to realise the method according to the invention and which comprises rack unit (**15**), at least one reception and delivery station (**5**), which includes detectors (**4**),(**5**) of package (**1**) and a communication arrangement to the data system (**22**), overhead rail system (**30**) of warehouse for moving robot (**26**) that stacks and retrieves packages by means of the arrangement, whereby the stacking and retrieving robot comprises equipment (**31**) for movement on rail (**31**), equipment to locate said robot on rail (**30**), equipment, as lifting cables (**28**), and the goods transporting part of said robot of the lifting motor, as for letting down the lower part on different rack levels, and transfer means (**7**) in said lower part for moving packages to the lower part and away from there, characterized in that stacking and retrieving robot (**26**) comprises at least an encapsulated upper part, that possible encapsulations of the lower part together with the encapsulation of the upper part locks at least the bottom and the sides of the lower part package space, when the lower part is lifted in connection with upper the part, furthermore, the lower part comprises a transfer platform (**6**) in order to facilitate the transfer of package and detectors in said lower part least for observation of the package.

12. A method according to claim **11**, characterized in that there is in the lower part a net curtain for detection of obstacle outside the lower part loading sides in immediate closeness of the side line and for identification of package height and assurance of lifting, collision sensors, as pietzo films in the front edge of movable plates (**7**) gripping package (**1**), sensors of rack frame, as ultrasound means and package sensors, as light cells in the front edge of said plates (**7**) for identification of the existence and transition of package.

13. A method according to claim **11** characterized in that the lower part has as power source a charged battery and a wireless data transmission arrangement in the upper part of the robot.

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