

PATENT SPECIFICATION

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(54) HANDLING FREIGHT USING GRID-LIKE PALLETS

(71) We, MITSUBISHI JUKOGYO KABUSHIKI KAISHA, a Japanese Company, of 5-1 Marunouchi 2-chome, Chiyoda-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to a method of and apparatus for handling articles of freight, especially palletized air-freight containers.

15 Palletized containers for air cargoes are made lightweight with a sacrifice of strength, and they cannot keep their shapes when being handled unless their entire bottom surface is supported. This has made it impossible for such pallet loads to be handled by fork lifts as in ordinary automated warehouses.

20 In an attempt to solve the problem, arrangements have been adopted in some automated warehouses storing palletized containers for air transportation, wherein the inside of the storage racks and the lifting carriage of a stacker crane are provided with rows of rollers which, when driven, convey the containers into and out of the racks. The method has the following advantages:—

- (1) Supported on the entire bottom surface, the pallets and containers are protected against damage.
 35 (2) Transfer of loads between the stacker crane and racks is accomplished more rapidly than when the loads are handled by a fork lift.

40 On the other hand, the method has drawbacks. That is:—

- (1) A large number of rollers that have to be mounted over the entire width of each rack add much to the initial investment in equipment.

- 45 (2) The stacker crane must be stopped at

any level with extreme accuracy. Otherwise, smooth conveyance on the rollers will not be ensured.

- (3) The rollers in the rack are driven either by motors and reduction gears installed in the individual racks or by power transmitted from the lifting carriage of stacker crane via a friction wheel. The former involves high construction cost, and the latter complicated structure.
 55 (4) Because a number of rollers must be installed in elevated racks with good accuracy, the equipment cost is increased and maintenance is made difficult.

It is, therefore, an object of the present invention to provide a method for handling palletized containers without any of the foregoing drawbacks, and an apparatus therefor.

In one aspect of the present invention resides in a method of handling articles of freight, comprising providing horizontal grid-shaped support pallets and in which an article is loaded on a said pallet by causing an assembly of support rollers to project upwards through open spaces of the pallet and conveying the article onto the pallet, the support rollers supporting the article during movement thereof onto the pallet and then lowering the rollers thereby allowing the article to rest on the pallet, and in which an article is unloaded from a said pallet by raising an assembly of support rollers through open spaces of the pallet to lift the article from the pallet, and then conveying the article from the pallet.

In another aspect the invention resides in apparatus for handling articles of freight, including a plurality of grid-shaped support pallets, at least one horizontal assembly of support rollers which rollers are disposed in an arrangement corresponding to the arrangement of open spaces in the pallets, means for raising and lowering the support roller assembly, means for supporting a said

pallet above the support roller assembly whereby the rollers can be raised to project above the pallet or lowered below the level of the top of the pallet, and means
5 for conveying an article onto or off the support rollers in the raised position of the latter, whereby articles can be loaded onto and unloaded from the pallets.

Thus when a container with a pallet is
10 to be accommodated in a rack, a support pallet is placed under the palletized container which is then lowered onto the support pallet and, when the container is to be delivered out of the rack, the support
15 pallet can be easily removed from under the container after the latter is lifted and conveyed away.

Preferably, feeding and conveyance of the support pallet is accomplished by carrying
20 the support pallet with a conveying roller assembly for supporting the support pallet frame.

The present method and apparatus make it possible to store palletized air cargo
25 containers in racks by means of conventional stacker crane of fork type. This permits the use of a stacker crane with a simplified lift structure and with low accuracy of lift position.

Preferably there are as many support
30 pallets as storage rack compartments for the articles, to enable every article being received to be placed on a support pallet and every article being shipped out to be
35 deprived of its support pallet. This eliminates the possibility of any support pallet being conveyed out of the rack, and greatly simplifies the disposal of empty support pallets and hence the system itself.

Further, because there is no need for
40 complicated and expensive roller arrangements in the racks, a material saving in cost is realized. The maintenance of equipment is simplified and, without the need
45 of erection work at elevated levels, the construction cost is remarkably low.

These and other features and advantages of this invention will become more apparent
50 in the detailed description, taken in connection with the accompanying drawings, in which:—

FIG. 1 is a diagrammatic perspective view of an embodiment of the invention in
55 which support pallets are placed under, and removed from, the bottoms of unit loads;

FIG. 2 is a front view of the embodiment;

FIG. 3 is a plan view of the embodiment;

FIG. 4 is a plan view of a support pallet;

60 FIG. 5 is a plan view of a palletiser used in the above embodiment;

FIG. 6 is a plan view of a support pallet and the rollers of the palletiser in their relative positions.

65 FIG. 7 is a front view of the palletiser

and a support pallet feeder;

FIG. 8 is a detailed front view of the support pallet feeder;

FIG. 9 is a detail as viewed in the direction of arrows in FIG. 8; and

70 FIGS. 10 and 11 are views similar to FIG. 7 but showing the palletiser and support pallet feeder in their different operating conditions.

Referring to FIGS. 1 to 3, there is shown
75 an ordinary fork-type stacker crane 1 equipped with a fork 2, which travels along overhead and floor rails 3, 4.

On both sides of the aisle where the rails run are arranged racks 10 in parallel rows.
80 The racks consist of corner posts 11 standing upright at given intervals and beams 12 horizontally connecting the posts in depth at given vertical intervals to form tiers. In the upper and lower parts at one
85 end of each rack 10 are located an issuing station 13 and a receiving station 14, respectively. These stations are connected to an issuing conveyor 15 and a receiving conveyor 16 which are driven by conventional
90 drives not shown. Containers 5 for transportation by air, as placed on grid-like support pallets 20, are carried by the stacker crane 1 and stored in each rack 10 via the receiving station 14 or are delivered out of
95 the rack 10 through the issuing station 13.

As FIG. 4 shows, each of the pallets 20 consists of a grid or grating of latticed bars 22, 23 so crossed as to form rectangular open spaces 21 in a rectangular pattern. The
100 outermost bars 23 are formed with grooves 24 adapted to engage flippers 69 shown in FIG. 8.

The receiving station 13 and issuing station 14 are equipped with palletisers 30,
105 one for each, for applying support pallets 20 to incoming pallet loads and removing them from outgoing loads.

The palletisers 30 are similarly constructed as shown in FIGS. 7, 10 and 11. Each
110 comprises a conveying-roller frame 31 and a plurality of support pallet-conveying rollers 32 which are rotatably supported by the frame and driven by a conventional drive (not shown). The rollers 32 are
115 arranged in rows corresponding to the bars 22 of the pallet 20, as will be clear from FIG. 6. Hoisting chains 34 are connected at one end each to the ends of the conveying-roller frame 31 with hoisting joints 33
120 and are wound at their other ends on a common hoisting drum 36 via sprocket wheels 35 mounted on the rack posts 11. The drum 36 is mounted on a rack post 11 and is driven by an ordinary drive 125 equipped with a brake which drive is not shown.

A support roller frame 37 (FIGS. 5, 10), which is accommodated in the conveying-roller frame 31, has such a configuration
130

that it can ascend and descend through the open spaces 21 of each pallet 20. A plurality of support rollers 38 are rotatably supported by the frame 37 and are driven by a conventional drive here omitted. Hoisting chains 40 each have one end secured to a respective end of the support roller frame 37 with hoisting joints 39.

Sprockets 41 are revolvably supported by the conveying-roller frame 31, and a chain-hoisting drum 42 is also mounted on the underside of the same frame, so that the hoisting chains 40 can be coiled on the drum 42 or uncoiled therefrom via the sprockets 41. By the coiling and uncoiling motions of the drum 42 the support roller frame 37 is raised and lowered.

Adjacent the receiving and issuing stations 13, 14, there is located a support pallet feeder 50 for storing and supplying pallets 20 when required, having the following construction. As illustrated in FIGS. 8 and 9, support pallet-receiving frames 51 are held on the same level as the palletiser 30 in the issuing station 13. The frames 51 are integrally secured to brackets 53 which in turn are tiltably pivoted by pins 52. Pallet receiving rollers 54 driven by a drive not shown are rotatably supported by the frames 51, and the brackets 53 can be tilted downward or held horizontally by means of air cylinders 55.

Above the pallet feeder 50 is mounted a hoisting drum 56, which suspends a frame 59 with a sling chain 58 via a suspending rope 57. To this suspended frame 59 are connected lifting magnets 61 with lift links 60, in such a manner that the lifting magnets 61 upon excitation attract the pallet 20.

In order that the pallet 20 suspended by the lifting magnets 61 can be raised or lowered in a stabilized way, guides 61 are fixed vertically and the suspended frame 59 is provided with guide rollers 63 to run in contact with the guides 62.

A support pallet-delivery conveyor 64 of free-roller-conveyor, dogged-transfer-chain type is installed on the same height as the palletiser 30 of the receiving station 14. This conveyor is coupled to a motor 66 via a power-transmission chain 65 and, as the motor 66 is driven, a dog 67 provided on the pallet delivery conveyor 64 engages the pallet 20 to deliver it onto the palletiser 30 of the receiving station 14.

Above the pallet-delivery conveyor 64 are provided a pair of pallet-flipper brackets 58, which carry flippers 69 adapted to be swiveled about vertical axes by actuators not shown into engagement or out of engagement with the grooves 24 of the pallet 20.

Underneath the pallet feeder 50 is installed a pallet-lifting cylinder 70, with a piston 71 that integrally carries a pallet-

lifting platform 72. Pallet-lifting stabilizers 74 are foldably interposed between the pallet-lifting platform 72 and a support beam 73, so that the platform 72 can be raised or lowered while being horizontally supported by the pallet-lifting cylinder 70.

The apparatus described above operates in the following way.

First, as shown in FIG. 7, the dog 67 of the pallet-delivery conveyor 64 feeds a pallet 20 onto the conveying-roller frame 31 of the palletiser 30 in the receiving station 14 with the aid of the pallet-conveying rollers 32, until the pallet 20 is held unmovably by the rack beams 12. When the pallet 20 has stopped in position, the support roller frame 37 (FIGS. 5, 10) is raised into the open spaces 21 of the pallet 20 by the chain-hoisting drum 42 until the support rollers 38 protrude above the upper surface of the pallet 20 as shown in FIG. 10. Next, a container 5 is carried by the receiving conveyor 16 into the receiving station 14 and is placed on the pallet 20 by means of the support rollers 38.

The chain-hoisting drums 36, 42 are driven in reverse to lower the conveying-roller frame 31 and support roller frame 37 together so that the container 5 is supported by the pallet 20 as shown in FIG. 11. Then, the pallet 20 supporting the container is lifted by the fork 2 of the stacker crane 1 and carried to and stored in a desired rack compartment 10.

When a container 5 is to be discharged from storage, the container 5 on its pallet 20 is picked up by the fork 2 of the stacker crane 1 and placed on the rack beams 12 in the issuing station 13 as shown in the upper part of FIG. 7. After the fork 2 has been withdrawn, the chain-hoisting drums 36, 42 are driven to pull the conveying-roller frame 31 upward. As a result, the support roller frame 37 is urged into the open spaces 21 of the pallet 20, until the container 5 is supported by the support rollers 38 rotatably mounted on the support roller frame 37. These support rollers 38 cooperate with the issuing conveyor 15 to deliver the container 5 out of the issuing station 13.

The container 5 having been shipped out, the support roller frame 37 is allowed to recede downward from the open spaces 21 of the pallet 20 as the chain-hoisting drum 42 is reversed.

Next, the conveying rollers 32 and pallet-receiving rollers 54 are driven and the pallet 20 is rolled out of the issuing station 15 onto the pallet feeder 50, where it is attracted by the lifting magnets 61. The air cylinders 55 cause the pallet receiving frames 51 to tilt downward, and then the hoisting drum 56 pays out the hoisting rope until the pallet 20 is placed on a pile of

pallets 20 in store.

These pallets 20 are fed, one at a time, from the pallet feeder 50 onto the palletiser 30 in the receiving station 14 by the following procedure. First, the pallet-lifting cylinder 70 is actuated to raise its piston slightly thereby to form gaps between the edge grooves 24 of a pallet 20 and the pallet flippers 69, and the flippers are turned side-wise out of engagement with the grooves. Then, the hoisting drum 56 is driven back to extend the suspending rope a distance equal to the thickness of one pallet, the flippers 69 are caused to engage the grooves 24 of the overlying pallet 20, and the pallet just released and resting on the pallet platform 72 is lowered onto the pallet-delivery conveyor 64 and conveyed out.

Thus, in the receiving station 14, a pallet 20 is placed under a container 5 by the lower palletiser 30, while the pallet 20 under a container 5 picked out of a given rack 10 by an ordinary fork-type stacker crane into the issuing station 13 is removed by the upper palletiser 30 so that the container 5 alone can be shipped out.

The system eliminates in this way any chance of the pallets 20 being delivered out of the racks 10, and therefore it is only necessary to use as many pallets as the number of rack compartments available.

When the pallet feeder 50 has been filled up with pallets 20, excess pallets may be carried to and stored in an empty rack compartment or compartments by the stacker crane 1. Conversely when the pile of pallets in the pallet feeder 50 has been depleted by the warehousing of many articles, it may be replenished by the pallets 20 transferred back from the said rack compartment of compartments by the crane. The pallets out of use can thus be handled with utmost ease.

Since the expensive and complicated roller arrangements usually employed in such racks are not required and an ordinary stacker crane can be used, the equipment according to this invention makes a substantial reduction in cost possible.

Further, because it involves no roller installation work in the upper parts of racks, the equipment can be built at a very low cost.

The use of an ordinary stacker crane permits simplification of the structure of the lift platform and requires less exacting tolerances in stop position than heretofore.

While the present invention has so far been described as embodied in a loft automated storeroom of rack type for air cargoes that accommodates palletized containers for transportation by planes, the method and apparatus of the invention are applicable to rack-type warehouses for

general freight, automated parking buildings for automobiles, etc. as well.

WHAT WE CLAIM IS:—

1. A method of handling articles of freight, comprising providing horizontal grid-shaped support pallets and in which an article is loaded on a said pallet by causing an assembly of support rollers to project upwards through open spaces of the pallet and conveying the article onto the pallet, the support rollers supporting the article during movement thereof onto the pallet, and then lowering the rollers thereby allowing the article to rest on the pallet, and in which an article is unloaded from a pallet by raising an assembly of support rollers through open spaces of the pallet to lift the article from the pallet, and then conveying the article from the pallet.

2. A method as claimed in claim 1 in which the pallet is conveyed into place above the support roller assembly before loading, and is conveyed away from the support roller assembly after unloading by a conveying-roller assembly that supports the frame of the pallet.

3. A method as claimed in claim 1 or 2 in which the support rollers are driven to convey the articles onto and/or off the pallets.

4. A method as claimed in claim 1, 2 or 3 in which the article loaded on the pallet is inserted into a rack compartment by forked handling means for storage, and for unloading the article on the pallet is transferred from the rack compartment onto the unloading support roller assembly by forked handling means.

5. A method according to claim 4 wherein the forked handling means is a stacker crane.

6. A method according to any of claims 1 to 5 wherein the freight is air cargo.

7. A method of handling articles of freight, substantially as herein described with reference to the accompanying drawings.

8. Apparatus for handling articles of freight, including a plurality of grid-shaped support pallets, at least one horizontal assembly of support rollers which rollers are disposed in an arrangement corresponding to the arrangement of open spaces in the pallets, means for raising and lowering the support roller assembly, means for supporting a said pallet above the support roller assembly whereby the rollers can be raised to project above the pallet or lowered below the level of the top of the pallet, and means for conveying an article onto or off the support rollers in the raised position of the latter, whereby articles can be loaded onto and unloaded from the pallets.

9. Apparatus as claimed in claim 8 comprising a first said assembly, for loading

pallets 20 in store.

These pallets 20 are fed, one at a time, from the pallet feeder 50 onto the palletiser 30 in the receiving station 14 by the following procedure. First, the pallet-lifting cylinder 70 is actuated to raise its piston slightly thereby to form gaps between the edge grooves 24 of a pallet 20 and the pallet flippers 69, and the flippers are turned side-wise out of engagement with the grooves. Then, the hoisting drum 56 is driven back to extend the suspending rope a distance equal to the thickness of one pallet, the flippers 69 are caused to engage the grooves 24 of the overlying pallet 20, and the pallet just released and resting on the pallet platform 72 is lowered onto the pallet-delivery conveyor 64 and conveyed out.

Thus, in the receiving station 14, a pallet 20 is placed under a container 5 by the lower palletiser 30, while the pallet 20 under a container 5 picked out of a given rack 10 by an ordinary fork-type stacker crane into the issuing station 13 is removed by the upper palletiser 30 so that the container 5 alone can be shipped out.

The system eliminates in this way any chance of the pallets 20 being delivered out of the racks 10, and therefore it is only necessary to use as many pallets as the number of rack compartments available.

When the pallet feeder 50 has been filled up with pallets 20, excess pallets may be carried to and stored in an empty rack compartment or compartments by the stacker crane 1. Conversely when the pile of pallets in the pallet feeder 50 has been depleted by the warehousing of many articles, it may be replenished by the pallets 20 transferred back from the said rack compartment of compartments by the crane. The pallets out of use can thus be handled with utmost ease.

Since the expensive and complicated roller arrangements usually employed in such racks are not required and an ordinary stacker crane can be used, the equipment according to this invention makes a substantial reduction in cost possible.

Further, because it involves no roller installation work in the upper parts of racks, the equipment can be built at a very low cost.

The use of an ordinary stacker crane permits simplification of the structure of the lift platform and requires less exacting tolerances in stop position than heretofore.

While the present invention has so far been described as embodied in a loft automated storeroom of rack type for air cargoes that accommodates palletized containers for transportation by planes, the method and apparatus of the invention are applicable to rack-type warehouses for

general freight, automated parking buildings for automobiles, etc. as well.

WHAT WE CLAIM IS:—

1. A method of handling articles of freight, comprising providing horizontal grid-shaped support pallets and in which an article is loaded on a said pallet by causing an assembly of support rollers to project upwards through open spaces of the pallet and conveying the article onto the pallet, the support rollers supporting the article during movement thereof onto the pallet, and then lowering the rollers thereby allowing the article to rest on the pallet, and in which an article is unloaded from a pallet by raising an assembly of support rollers through open spaces of the pallet to lift the article from the pallet, and then conveying the article from the pallet.

2. A method as claimed in claim 1 in which the pallet is conveyed into place above the support roller assembly before loading, and is conveyed away from the support roller assembly after unloading by a conveying-roller assembly that supports the frame of the pallet.

3. A method as claimed in claim 1 or 2 in which the support rollers are driven to convey the articles onto and/or off the pallets.

4. A method as claimed in claim 1, 2 or 3 in which the article loaded on the pallet is inserted into a rack compartment by forked handling means for storage, and for unloading the article on the pallet is transferred from the rack compartment onto the unloading support roller assembly by forked handling means.

5. A method according to claim 4 wherein the forked handling means is a stacker crane.

6. A method according to any of claims 1 to 5 wherein the freight is air cargo.

7. A method of handling articles of freight, substantially as herein described with reference to the accompanying drawings.

8. Apparatus for handling articles of freight, including a plurality of grid-shaped support pallets, at least one horizontal assembly of support rollers which rollers are disposed in an arrangement corresponding to the arrangement of open spaces in the pallets, means for raising and lowering the support roller assembly, means for supporting a said pallet above the support roller assembly whereby the rollers can be raised to project above the pallet or lowered below the level of the top of the pallet, and means for conveying an article onto or off the support rollers in the raised position of the latter, whereby articles can be loaded onto and unloaded from the pallets.

9. Apparatus as claimed in claim 8 comprising a first said assembly for loading



articles onto said pallets and a second said assembly for unloading articles from said pallets, each said assembly being provided with respective raising and lowering means, 5 pallet-supporting means and article-conveying means.

10 10. Apparatus as claimed in claim 8 or 9 including means for driving the support rollers to convey the articles onto or off the rollers.

15 11. Apparatus as claimed in claim 8, 9 or 10 in which the or each support roller assembly is associated with an assembly of conveying rollers arranged to convey said pallets singly into position above the support rollers for loading or away from such position after unloading of an article.

20 12. Apparatus as claimed in claim 11 in which the or each support roller assembly and its raising and lowering means is carried by a member supporting the associated conveying rollers.

13. Apparatus as claimed in claim 11 or 12 in which the or each conveying roller assembly can be raised and lowered, and 25 fixed means are provided for receiving a said pallet conveyed by the conveying rollers when raised and supporting the pallet above the conveying rollers when the latter are lowered.

30 14. Apparatus as claimed in any of claims 8 to 13 comprising storage racks, and forked handling means for transporting the articles on the pallets between the compartments of the racks and the or each 35 support roller assembly.

15. Freight-handling apparatus substantially as herein described with reference to the accompanying drawings.

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