

High-bay warehouse with storage-and-retrieval units provided therein for storing and retrieving, or transferring, articles

The invention relates to a high-bay warehouse with storage and retrieval units provided therein for storing and retrieving or repositioning storage material, wherein the storage material consists of coils of wound strips, particularly metal strips, or wire coils and the high-bay warehouse consists of a desired plurality of storage modules, which are arranged in rows in longitudinal direction and the depth direction or width direction extending transversely thereto of the high-bay warehouse and which in height comprise a plurality of rack bays disposed one above the other, the modules being separated from one another by lanes extending parallel to the storage and retrieval sides of the rack bays or storage modules, wherein at least one storage and retrieval unit movable back and forth is provided in each lane, wherein the storage and retrieval units are constructed with a frame, which consists of vertical uprights and head and foot beams connecting these together and corresponds at least with the height of the multi-floor storage modules and at the vertical uprights of which is guided a lifting bridge moved by way of drive means and constructed with at least one telescopic holder movable gradually in and out orthogonally to the lane for lefthand-side and righthand-side servicing of the rack bays of the adjacent storage modules.

Such high-bay warehouses for rolling mill products, particularly metal coils or wire coils, called metallic storage material for simplicity in the following, are known in various constructions and arrangements, for example integrated in the production sequence of a rolling train. It has become known through CH-PS 554 276 to provide a respective high-bay warehouse at each of the start and end of a rolling train or at the start and the end of a finishing shop or as an intermediate store between two elongate workshops. For the transport of wire coils produced subsequently to a rolling process or a metal coil produced by winding up a rolled metal strip, for example aluminium, and weighing, for example, 25 metric tons or more use is made of pallets utilised in, for example, a circulatory system and roller paths, coil carriages or other such transport equipment providing further conveyance thereof. The distribution of the supplied storage material in high-bay warehouses can be carried out by floor stackers movable in the lanes, optionally combined with store cranes integrated in roof structures of the high-bay warehouse and reaching over all lanes, by a portal crane moving on raised rails over the storage modules of the high-bay warehouse (cf. DE 297 04 341 U1), or the like.

An integrated fully automatic container transport system with storage and retrieval units, which are arranged in each lane and make access possible to each individual container - even with the floor stackers used - in a narrow form of construction of a high-bay warehouse, for a transshipment facility of a seaport or inland port is known from WO 2015/124342 A1.

The storage and retrieval units which are of dimensionally narrow construction and which store and retrieve the containers with the longitudinal sides thereof foremost in the rack bays are movable in floor-bound manner. The raising and lowering of the lifting bridges takes place by way of a cable traction device or a hoist, comprising a cable, cable drums, deflecting rollers, motors and transmissions. Load receiving means are provided at the lifting bridge or platform for suspended transport of the containers and are constructed in extremely space-saving manner as telescopic holders for gradual horizontal movement in and out together with a suspended container.

The telescopic holder or holders is or are composed of a base housing or upper profile member, which is attached to the lifting bridge, and two telescopic thrust members arranged therein as centre profile member and lower profile member. The centre profile member or outer telescopic thrust member runs by outer guide profile members on either side on guide rollers of the base housing or upper profile member, and the lower profile member or inner telescopic thrust member runs by guide rollers, which are arranged on either side, in inner guide profile members of the outer telescopic thrust member or centre profile member.

The invention has the object of enabling accelerated transshipment of coils and wire bundles with reduced outlay in a high-bay warehouse of the kind stated in the introduction through optimised transport and transfer means.

According to the invention this object is fulfilled in that the storage and retrieval unit is constructed at its at least one telescopic holder with a C-shaped carrier means having below the telescopic holder a horizontally extending mandrel movable into the coil eye of the storage material.

In order to take over the storage material, which is conveyed in and positioned in the

lanes, in the eye of the coil or the wire bundle the mandrel, web or the like, which extends at a sufficient spacing - depending on the largest coil diameter to be managed, for example 2,400 millimetres - below the telescopic holder, merely has to be moved into the coil eye until the bundle or the coil completely hangs on the mandrel of the storage and retrieval unit, which then takes over the storage in or with reversed movement sequences the retrieval from the rack bays without further intermediate conveying and transport means.

The C-shaped carrier means is secured to the lower profile member or inner telescopic thrust member of the telescopic receiver mounted on the lifting bridge and can thus be gradually moved in, from the position retracted into the storage and retrieval unit, up to the end position in a rack bay, or conversely moved out.

If the C-shaped carrier means in a preferred embodiment is connected with the lifting bridge by way of a rotary ring to which the at least one telescopic holder is secured it is possible through simple rotation of the C-shaped support means to service the rack bays of storage modules arranged to the left and right near the lane.

A further advantageous embodiment provides that a respective telescopic holder is provided on the rotary ring on the lefthand side and righthand side with respect to the vertical centre axis, which is coincident with the vertical centre axis of the storage material, of the storage and retrieval unit, wherein the C-shaped carrier means consists of an angle arm, which extends from each telescopic holder with a kink in direction towards the vertical centre axis and ends thereat, and the mandrel is arranged at the intersection of the two angle arms.

By comparison with a telescopic holder provided centrally at the lifting bridge or rotary ring the constructional height of the rack bays and, as a result, the storage modules and consequently the entire high-bay warehouse can thereby be appreciably reduced, because in the free space obtained by the two mutually spaced telescopic holders with the symmetrically spread C-shaped carrier means the rack bay receiver can be constructed with a trough-like depression adapted to the coil diameter, i.e. offering sufficient support not only to the smallest, but also largest coil diameter. The reduction in constructional height can amount to 500 millimetres and more per rack bay plane, which is accompanied by a substantial saving in steel construction.

A preferred proposal of the invention provides that the storage and retrieval unit is constructed for handling storage material below its travel plane with a frame-like passage opening in the foot beam.

This advantageously makes it possible for the storage and retrieval unit to be able to be movable above a transverse conveyor device crossing at least some lanes.

On the assumption that the lanes are arranged to extend parallel to the longitudinal sides (longitudinal sides of the high-bay warehouse) the transverse conveyor device or several transverse conveyor devices, which can be provided at a mutual spacing in distribution at the longitudinal sides, extends or extend at the floor side, i.e. at the warehouse floor or foundation, or in a pit-like depression of the foundation over the entire depth/width of the high-bay warehouse. The transverse conveyor device can consist of, for example, roller-path rollers, of which at least some are driven, on which the storage material deposited on pallets can run out directly in conveying direction and be positioned in the lanes. Optionally, use can be made of, for example, conveyor carriages or other such conveying means.

For handling of the storage material fed by way of a floor-side or recessed transverse conveyor device to the individual lanes of the high-bay warehouse the lifting bridge of the storage and retrieval unit movable directly above the lowermost rack bays or the lowermost rack bay plane is lowered until the mandrel of the telescopic holder is in alignment with the coil eye and then can be moved into the eye through gradual telescopic action. The storage material is thereafter taken over by the mandrel by raising the lifting bridge and conveyed, hanging therefrom, into the storage and retrieval unit by gradual telescoping of the telescopic holder. Subsequently, it can be brought by movement of the storage and retrieval unit in the lane to in front of a desired rack bay of the adjacent storage modules and after a 90° rotation either to the left or right stored in the desired rack bay by gradual telescopic action, whereupon the mandrel is telescoped back to its starting position so that the storage and retrieval unit is ready for a fresh storage and/or retrieval process, because the frame-like passage opening of the foot beam or travel frame also makes possible for the lifting bridge with the rotary ring and the at least one telescopic holder a free passage of the storage material, which is taken over below the travel plane, into the rack bay planes disposed thereabove. The

transverse conveyor device can be combined with a return path to form a circulatory system, so that the empty pallets or conveyor carriages can be used in a circuit.

The handling of the storage material below the travel plane of the storage and retrieval unit is assisted by the fact that the vertical uprights of the unit frame are prolonged so as to end somewhat below the travel plane, which at the same time makes possible centred guidance of the descending or ascending lifting bridge over this downwardly prolonged path, for example by means of rollers supported at the prolongations.

According to an embodiment of the invention two rails extending at a horizontal spacing from one another either on the warehouse floor or elevated at a height above the transverse conveyor device, which is constructed from a row of successive storage modules at the lowermost rack bay plane and takes over the supplied storage material in a line, are associated with the storage and retrieval unit in each lane. Through placing of rails above the lowermost rack bay plane it is possible to convert a conventional high-bay warehouse in simple manner so as to provide a transverse conveyor device for conveying in the storage material.

Further features and details of the invention are evident from the claims and the following description of embodiments of the invention illustrated in schematic drawings by way of the example of a high-bay warehouse with two-lane storage of coils, wherein:

Fig. 1 shows a two-lane high-bay warehouse in cross-section as seen from the wide or deep side;

Fig. 2 shows the high-bay warehouse in a longitudinal section with a view onto a storage and retrieval unit movable in a lane extending in warehouse longitudinal direction;

Fig. 3 shows the high-bay warehouse in a plan view as seen from above the lowermost rack bay plane or below the movable storage and retrieval unit;

Fig. 4 shows, as a detail of a storage and retrieval unit, in a perspective front view the lifting bridge or hoist platform with telescopic holder secured thereto and C-shaped carrier means arranged thereat, the horizontal web/mandrel of the

carrier means having received a coil;

Fig. 5 shows, in a side view as a detail, the lifting bridge with telescopic holder and C-shaped carrier means, illustrated in the righthand image half by dot-dashed lines in the retracted end position and in the lefthand image half with the moved-out telescopic thrust members and a coil received by the mandrel of the C-shaped carrier means; and

Fig. 6 shows, as seen from a rack bay, the C-shaped carrier means positioned for storage of a coil and constructed at two horizontally spaced-apart telescopic holders in the mode of construction according to Fig. 5, illustrated in the righthand image half with a coil or storage material hanging on the mandrel engaged into the eye and in the lefthand image half after deposit of the coil on a trough-like depression of the rack bay support.

The high-bay warehouse 1 shown in the embodiment consists of three storage modules 3, which are spaced from one another in width direction by a first lane 2a and a second lane 2b and which over the width/depth and height as well as over the length of the high-bay warehouse 1 and parallel to the lanes 2a, 2b have numerous rack bays 4 for the storage material 5, here coils (cf. Fig. 2). For storage and retrieval of the coils 5 a storage and retrieval unit 7 is movable in each lane 2a, 2b on elevated rails 6 provided above the lowermost rack bay plane, optionally on the warehouse foundation (cf. Fig. 1).

The storage and retrieval units 7 comprise a frame 8, which consists of vertical uprights 8a, 8b and head and foot beams 9 and 10, respectively, connecting these together and which extends over the height of the multi-floor storage modules 3, at the vertical uprights of which frame is guided a lifting bridge (or hoist platform) 14 moved by way of the drive means 11 (cable pulls running over rollers) and constructed with at least one telescopic holder 13 (cf. Fig. 4) or 13a, 13b (cf. Fig. 6) rotatable by way of a rotary ring 12 (as indicated in Figs. 1 and 2) and movable gradually in and out orthogonally to the lane 2a, 2b for lefthand-side and righthand-side servicing of the rack bays 4 of adjacent storage modules 3.

As can be inferred from Figs. 1 to 3, the lowermost rack bay plane I of the storage

modules 3 following one another in a row is constructed, starting from a feed 15 at a longitudinal side of the high-bay warehouse 1 (cf. Fig. 3), with a transverse conveyor device 18, which is provided on the foundation 16 and consists of conveyor rollers 17 and which crosses the lanes 2a, 2b or opens thereinto. The coils 5 taken over from a coiler position of a rolling train (not illustrated) are brought by transport means to the feed 15 at the longitudinal side of the high-bay warehouse 1 by way of, for example, pallets 19 and deposited on the transverse conveyor device 18. The laden pallets 19 run on the conveyor rollers 17 of the transverse conveyor device 18, passing the rack bays 4 of the lowermost rack bay plane I, to the first lane or to the second lane 2b, where they are taken over by the storage and retrieval unit 7 for distribution in the rack bays 4 of the storage modules 3.

Take-over of the coils 5 is carried out by at least one - as shown in Fig. 4 - telescopic holder 13 which is secured to the lifting bridge 14 and which for that purpose is equipped with a C-shaped carrier means 20, the horizontally extending mandrel 21 of which picks up the coil 5 by entry into the eye 22 thereof. The telescopic holder 13 consists, as can be inferred in more detail from Fig. 5, of a base housing or upper profile member 23 secured to the lifting bridge 14 and two telescopic thrust members which are arranged therein as centre profile member 24 and lower profile member 25 and are movable in succession over rollers. The C-shaped carrier means 20 is secured by way of its vertical web 26 to the lower profile member or inner telescopic thrust member 25. The telescopic holder 13 in the retracted starting position (cf. Fig. 4) makes possible an extremely space-saving transport and accordingly optimally narrow lanes 2a, 2b, but at the same time also a storage and retrieval stroke of desired length, for example 3,000 millimetres, depending on the respective design of the telescopic thrust members.

Fig. 6 shows an embodiment of a storage and retrieval unit 7 with two telescopic holders 13a, 13b, which are arranged on the left and right near the vertical centre axis 27 of the storage and retrieval unit 7 or the vertical centre axis, which is coincident therewith, of the coil 5. The C-shaped carrier means 20 here consists of two angle arms 28a, 28b, each of which is secured by its respective vertical web 26 to the lower profile member 25 or inner telescopic thrust member of one or the other telescopic holder 13a or 13b. The kinked portions of the two angle arms 28a, 28b run towards one another to an intersection at the vertical centre axis 27. The horizontal mandrel 21 is

arranged at this intersection. The thus-achieved spreading of the C-shaped carrier means 20 makes it possible to utilise the free space for construction of a trough-like depression 29 of the coil support 30 in the rack bays 4 of the storage modules. As a result, for the same storage capacity the constructional height of the high-bay warehouse 1 can be appreciably reduced by comparison with rack bays with a planar coil support. Figs. 1, 2 and 5 show such C-shaped carrier means 20 coupled to two telescopic holders 13a, 13b.

The coils 5 are moved by the transverse conveyor device 28, with the eye 22 lying orthogonally to the transport direction in the embodiment, on the pallets 19 until in the lane 2a or 2b and are stored in the rack bays 4 with the eye 22 lying in transport direction, which presupposes a 90° rotation of the C-shaped carrier means 20, initiated by way of the rotary ring 12. For that purpose - in the example of the lane 2a of Fig. 1 - the lifting bridge 14 with the retracted telescopic holders 13a, 13b and the C-shaped carrier means 20 is lowered through a passage opening 13 in the foot beam 10 of the storage and retrieval unit 7 into the lowermost rack bay plane I and the mandrel 21 of the C-shaped carrier means 20 is moved into the eye 22 of the coil 5 by moving out of the telescopic thrust members 24, 25. As soon as the telescopic thrust members 24, 25 have then been moved back again to the retracted starting position thereof (cf. Fig. 5) the drive means 11 lift the lifting bridge 14 with the coil 5 hanging on the mandrel 21 through the passage opening 31 in upward direction until in front of a free rack bay 4, in a given case after prior movement of the storage and retrieval unit 7 in the lane 2a, whereupon the C-shaped carrier means 20 is rotated through 90° as indicated in Fig. 1 by solid lines. The coil 5 can then be stored in the rack bay 4 by gradual telescopic action. Retrieval is carried out in reverse sequence.

Fig. 1 shows, in the example of the rear lane 2b, the storage (or retrieval) of a coil 5 in a rack bay 4 disposed on the lowermost plane I of the high-bay warehouse 1 adjacent to the lowermost rack bay plane I by the transverse conveyor device 18 provided thereat (cf. also Fig. 2). When the lifting bridge 14 is lowered as also previously described for the lane 2a, the coil 5 is taken over by the C-shaped carrier means 20 and also immediately rotated in this lowermost plane through 90°, as indicated by solid lines of the C-shaped carrier means 20. In this rotated position of the coil 5 the storage and retrieval unit 7 moves on the elevated rails 6 until in front of a free rack bay 4 of the lowermost plane of the high-bay warehouse 1.

It can be inferred from Fig. 2 in conjunction with Fig. 3 that a circulatory system can be formed for the pallets 19, in that extending parallel to the transverse conveyor device 18 is a return path 32 on which empty pallets 19 can be transported back to the feed 15 for re-use after being moved out of the transverse conveyor device 18.

The storage and retrieval unit with the lifting bridge 14 lowerable through the foot beam 10 and the rotatable C-shaped carrier means 20 allows in conjunction with the transverse conveyor device 18, which is constructed below the travel plane and here in a line of a lowermost rack bay plane I of the high-bay warehouse 1, a high throughput with reduced outlay and a compactly constructed high-bay warehouse 1.

Reference numeral list

1	high-bay warehouse
2a, 2b	lane
3	storage module
4	rack bay
5	storage material (coil, wire bundle)
6	rails
7	storage and retrieval unit
8	frame
8a, 8b	vertical upright
9	head beam
10	foot beam
11	drive means (cable pull)
12	rotary ring
13; 13a, 13b	telescopic holder
14	lifting bridge / hoist platform
15	feed
16	foundation
17	conveyor rollers
18	transverse conveyor device
19	pallet
20	C-shaped carrier means
21	mandrel
22	eye
23	base housing / upper profile member
24	centre profile member (telescopic thrust member)
25	lower profile member (telescopic thrust member)
26	vertical web
27	vertical centre axis
28a, 28b	angle arm
29	trough-like depression
30	coil support
31	passage opening
32	return path

Patent claims

1. High-bay warehouse (1) with storage and retrieval units (7) provided therein for storing and retrieving or repositioning storage material (5), wherein the storage material consists of coils of wound strips, particularly metal strips, or wire coils and the high-bay warehouse (1) consists of a desired plurality of storage modules (3), which are arranged in rows in longitudinal direction and the depth direction or width direction extending transversely thereto of the high-bay warehouse and which in height comprise a plurality of rack bays (4) disposed one above the other, the modules being separated from one another by lanes (2a, 2b) extending parallel to the storage and retrieval sides of the rack bays or storage modules (3; 4), wherein at least one storage and retrieval unit (7) movable back and forth is provided in each lane (2a, 2b), wherein the storage and retrieval units (7) are constructed with a frame (8), which consists of vertical uprights (8a, 8b) and head and foot beams (9; 10) connecting these together and corresponds at least with the height of the multi-floor storage modules (3) and at the vertical uprights of which is guided a lifting bridge (14) moved by way of drive means and constructed with at least one telescopic holder (13; 13a, 13b) movable gradually in and out orthogonally to the lane (2a, 2b) for lefthand-side and righthand-side servicing of the rack bays (4) of the adjacent storage modules (3),
characterised in that
the storage and retrieval unit (7) is constructed at its at least one telescopic holder (13; 13a, 13b) with a C-shaped carrier means having below the telescopic holder (13; 13a, 13b) a horizontally extending mandrel (21) movable into the coil eye of the storage material (5).
2. High-bay warehouse according to claim 1, characterised in that the C-shaped carrier means (20) is secured to a rotary ring (12) of the lifting bridge (14).
3. High-bay warehouse according to claim 1 or 2, characterised in that a respective telescopic holder (13a, 13b) is provided on the rotary ring (12) on the lefthand side and righthand side with respect to the vertical centre axis (27), which is coincident with the vertical centre axis of the storage material (5), of the storage and retrieval unit (7), wherein the C-shaped carrier means (20) consists of an angle arm (28a, 28b), which extends from each telescopic holder (13a, 13b) with a kink in direction towards the vertical centre axis (27) and ends thereat, and the mandrel (21) is arranged at the

intersection of the two angle arms (28a, 28b).

4. High-bay warehouse according to any one of claims 1 to 3, characterised in that the storage and retrieval unit (7) is constructed for handling storage material (5) below its travel plane with a frame-like passage opening (31) in the foot beam (10).

5. High-bay warehouse according to claim 4, characterised in that the storage and retrieval unit (7) is movable above a transverse conveyor device (18) crossing at least some lanes (2a, 2b).

6. High-bay warehouse according to claim 5, characterised in that two rails (6) extending at a horizontal spacing from one another either on the warehouse floor or elevated at a height above the transverse conveyor device (18), which is constructed from a row of successive storage modules (3) on the lowermost rack bay plane (I) and takes over the supplied storage material (5) in a line, are associated with the storage and retrieval unit (7) in each lane (2a, 2b).