

Warehouse loading machine

The subject of the patent is a warehouse loading machine for the handling of goods stored in a suspended manner in warehouses with automated merchandise handling systems, which includes a motor-powered rolling frame with wheels.

The known and generally used automated warehouse goods handling systems have been predominantly designed for the transfer of merchandises stored on shelves in warehouses, moving storage units such as pallets, crates, etc. containing multiple types of merchandises between reception/dispatch stations and the storage shelves. The self-propelled transport and loading element of these systems is able to find the appropriate storage unit, to load or unload the goods there, and to transport them between the shelf and the reception/dispatch station.

The known solutions generally appertain to the warehousing system itself, in which the goods are transported between the reception/dispatch point and the racking system by the same equipment that performs loading on and unloading from the shelves. These robots are too complicated in comparison to the loading machine being the subject of the present invention, and perform loading and unloading operations in a completely different way, mostly using loading machines connected to the rack system mechanically as well, such as elevators, winches and the like. The loading machines are usually only described in broad terms, as these solutions apply to the entire warehouse system, therefore the operations of placing onto and removal from the shelves are only discussed in connection with the shelves. A further important difference is that the known warehousing solutions generally serve to load and unload bulk goods, when the goods are placed into some kind of unit packaging, such as crates or pallets, so the equipment does not actually perform individual handling of the products themselves. Even fewer are solutions that concern the warehouse handling of goods stored in a suspended way, especially if these goods are suspended individually, and their loading and offloading also take place individually. In the known systems, the loading machines usually employ elevators, i.e. equipment capable of moving up and down at a certain point of the racking system, and the goods are placed onto and are removed from these by using special machine units installed on the shelf in question. It follows from the above that they are not suitable for the individual handling of goods that are stored in a suspended way. Such warehouse systems, generally used for the loading and unloading of goods, and loading solutions are described in the following documents: EP0615946A1, US2052690A, US6929440B1, US7101139B1, US7381022B1, US2011142581A1, EP1086910A1, EP1348646A2, WO2010100513A2, CN103359441A, EP2025625A1, US5147176A, US2004197171A1 and US2006239801A1.

The large number of known automated goods handling systems have generally been designed for the manipulation of product storing containers or unit packages, and not for the storage of individually suspended products. Solutions are also known where carriages (shuttles) commute between the shelves and the reception/dispatch station, carrying goods, and a lifting module operates between the shuttle and the shelf. These, in view of their purposes, are solutions similar to our invention, but are generally unsuitable for storing suspended goods. Solutions for handling suspended goods are described in documents CN217375879U, EP3050828A1, US2001051085A1, US10370179B2, US10710802B2, US11124365B2, US11370611B2 and WO2014029202A1, but these solutions transport and load the goods onto and offload them from the shelves conventionally, i.e. by means of a device, and the goods are not stored individually, but either in bulk or in containers.

The solutions closest to the invention are described in announcement documents No. P0900218 and P1400194.

Announcement document No. P0900128 (whose licensed version is patent specification No. HU229022B1, containing a far less informative description) describes a loading machine operating in a warehouse arrangement, which carries a goods storing container, and lifts that container by means of lifting equipment to the height of the shelf, where a device providing lateral movement places the container on a rack system. The loading machine is a carriage on wheels, but the document does not detail its movement. The lifting of the containers is effected by means of a winch, where the elements of the winch can be e.g. a cable and a cable drum, chain and sprocket, or a rack and pinion drive. The lateral movement of the lifted container is effected by means of a pusher and drawer unit, where the container lifted to the same elevation as the shelf is pushed onto the shelf or retracted from it by, for example, a magnetic device.

The loading machine according to the document has been developed for the handling of bulk goods, and is suitable neither for the individual hanging on and off of goods stored in a suspended manner, nor for drawing out the hanger beams to the aisle way of the racking system and pushing them back into the racking system.

Announcement description No. P1400194 (HU230618B1) describes a warehouse loading machine that can move in mutually perpendicular directions along the aisle ways of the rack system such that it has wheels rolling along rails mounted at multiple levels of the rack system. The loading machine is moved vertically by a winch assembly between the levels. The loading machine carries goods storage containers, from which the goods are placed by a manipulator onto the shelves such that the loading machine has a drawing element that pulls the shelf panels out of the racking system. Then the manipulator lifts the goods out of the container and places

them onto the shelf, and the drawing element pushes the shelf back into the racking system. The loading machine according to the document has been developed for the handling of bulk or palletised goods, and is suitable neither for the individual hanging on and off of goods stored in a suspended manner, nor for drawing out the hanger holder to the aisle way of the racking system and pushing it back into the racking system.

Thus, the known systems storing suspended goods follow the construction of conventional automated warehousing systems. In most cases, the goods are not transported by shuttle carriages to the loading robots, but the transport and loading operations are performed by the same unit, rolling on rails. This deteriorates availability, and, in the case of malfunctions, the storage spaces that become inaccessible and inoperative are too large. Therefore, there is a need for a system that stores goods in a suspended way and fundamentally follows the usual warehouse arrangement, but the loading and unloading operations are performed by equipment independent of the transport of the products. Such equipment is the loading machine forming the subject of the present invention.

Our objective was to design a loading machine that can be used in automated merchandise handling warehouses and is capable of loading and offloading individually suspended goods to and from a warehouse racking system, where the goods are individually suspended on hangers fastened to the racking system, with the loading machine being capable of drawing out and pushing back the hanger holders from and to the said racking system, and to hang the goods onto (storage) and off from (removal) the hanger holders.

A further objective of ours was that the loading machine be capable of automatically positioning itself according to the positions of the individually stored goods with impeccable precision, lifting the goods in and out, while all this must be implemented by a structurally straightforward, easy-to-manage construction.

The development of the invention was aided by the recognition that if the loading machine is fitted with a drawing unit positionable in every direction, and a tiltable lifting fork unit, likewise positionable and movable in every direction, we have effectively achieved our objective.

The solution of the target task is presented by the loading machine specified in claim 1. The advantageous solutions of the invention are represented by the variants specified by claims 2 – 10.

Hereinafter, the invention is introduced by means of detailed figures, wherein

Figure 1 is the schematic perspective view of the loading machine,
Figure 2 is the schematic perspective top view of the lifting frame,
Figure 3 is the schematic perspective side view of the lifting frame,
Figure 4 is the schematic perspective top view of the lifting fork unit,
Figure 5 is the schematic perspective bottom view of the lifting fork unit.

The loading machine shown in Figure 1 therefore includes a motor-powered rolling frame 2, which has driven wheels 3 and idle wheels 4. Wheels 3 and 4 run in the rails installed in the aiseways of the racking system (not shown). The wheels 3 arranged on a common axle are driven by the drive motor 10 according to the forward or backward movement of the loading machine 1. On the longitudinal supports of the rolling frame 2 parallel to the direction of travel, two vertical lifting posts 5 are mounted, and they have circular cross-section in the presently implemented variant, with a lifting block 6 installed on each of them, and these lifting blocks together carry a lifting frame 7. The lifting blocks 6 are fitted to toothed belts 12, which run parallel to the lifting posts 5 and are driven over toothed pulleys 13 equipped with bearings at the top and bottom ends of the lifting posts 5. The lower toothed pulleys 13 are mounted on a common axle 14, rotated by a lifting motor 11 via a gearbox 40. Thanks to the toothed belt 12, the lifting frame 7 can be lifted and lowered vertically.

The vertical movement of the lifting frame could naturally be solved by using, for example, ball screws or a rack and pinion system instead of the lifting blocks 6 sliding on the lifting posts 5, which would likewise be operated by the lifting motor 11.

The lifting frame 7 includes a drawing unit 8 and a lifting fork unit 9. The drawing unit 8 performs the pulling out and pushing back of the hanger holders mentioned above from and to the rack system, and the suspended goods are stored on these holders. The lifting fork unit 9 performs the lifting of the suspended goods off the hanger holder and hanging them back onto it. The drawing unit 8 includes hanger holder catcher hooks 20, arranged perpendicularly to the direction of travel of the rolling frame 2. The lifting fork unit 9 includes lifting forks 24 that point in the direction of travel of the rolling carriage 2.

To stabilise the lifting posts 5, the top of the lifting posts 5 are fastened to a further point of the rolling frame 2 by bracing rods 32. Guide bars 37 are fitted to the top of the lifting posts 5, and they run along the warehouse aisle ways in rails placed above the loading machine 1 (not shown), stabilising the movement of the loading machine 1.

Hereinafter, the components of the lifting frame 7 are described primarily with reference to Figures 2 and 3. The lifting frame 7 is assembled from two longitudinal supports 17 parallel to the direction of travel of the rolling frame 2, and the front transverse support 15 and rear

transverse support 26 perpendicular to them. Rails 16 are mounted on the front transverse support 15, onto which the drawing unit 8 is seated such that it can be moved perpendicularly to the direction of travel along the rails 16. The movement of the drawing unit 8 is carried out by a drive motor 19 that is installed in the unit's cantilever and runs a toothed pulley 41. The toothed pulley 41 is connected to a toothed belt 18, with the toothed belt 18 connected to the longitudinal supports 17, properly tensioned between them. The toothed pulley 41, running on the toothed belt 18, is able to move the drawing unit 8 in transverse direction. The front end of the unit carries a holder block 42 that is positioned perpendicularly to the direction of travel and contains at each end a schematically illustrated hanger holder catcher hook 20, by means of which the loading machine 1 pulls out the hanger holders storing the suspended goods from the rack system, and pushes them back into it.

The lifting frame 7 carries also a lifting fork unit 9, which includes a slide support 30. The slide support 30 is seated on the rails 43 mounted on the front transverse support 17 and the rear transverse support 26, and can slide on them in transverse direction.

The cantilever 29 of the lifting fork unit 9 is suspended on the slide support 30 (See Figures 4 and 5), which contains a lifting fork 24 extending forward in the rolling direction of the rolling frame 2, and the slide support 30 carries a lifting motor 21 and a transverse drive motor 22. The transverse drive motor 22 drives a toothed pulley 31, which is connected to a toothed belt 25. The toothed belt 25 is connected to and tensioned between the longitudinal supports 17. The toothed pulley 31, running with the toothed belt 25, can move the slide support 30 and thereby the lifting fork unit 9 in transverse direction.

The detailed structure of the lifting fork unit 9 is shown in Figures 4 and 5. Cantilever 29 of the lifting fork unit 9 is suspended on the slide support 30 via a joint 27 and an eccentric cam 28. The eccentric cam 28 is connected through a gearbox 40 to the lifting motor 21. The lifting motor 21 causes the eccentric cam 38 to turn and to vertically lift or lower the cantilever 29, i.e. to tilt it in the vertical direction and to rotate it about the joint 27.

The slide support 30 is connected to the front transverse support 15 and rear transverse support 26 of the lifting frame 7 through the slides 36 (Figure 4) connected on the rails 43, allowing it to slide.

A feeding motor 23 is mounted on the rear end of the cantilever 29, to which a toothed pulley 34 is connected through a gearbox 40. A toothed belt 33 is driven over the toothed pulley 34, driven by the rollers 35 shown from above in Figure 4 and from below in Figure 5, and is then driven over a further toothed pulley 44, embedded in the sliding block 39 mounted on the bottom of the cantilever 29. The lifting fork 24 is mounted on the front of the sliding block 39.

The sliding block 39 is placed on the rail 45 on the bottom of the cantilever 29, and is able to move on it by means of a wheel not shown here. The toothed belt 33 moved by the feeding motor 23 therefore rotates the toothed pulley 44, and it is thereby able to move the sliding block 39 and the lifting fork 24 mounted on it back and forth.

Therefore, thanks to the structural arrangement described above, the lifting motor 21 moves the cantilever 29 and thereby the lifting fork 24 in the vertical direction, the feeding motor 23 moves the sliding block 39 and thereby the lifting fork 24 back and forth, this dual motion enabling the lifting fork 24 to lift suspended goods off the aforementioned hanger beam, and to hang them back onto it.

The operation of the transverse drive motor 22 causes the lifting fork unit 9 to move transversally, allowing the lifting fork 24 to be moved horizontally into the a position appropriate for the suspended goods.

The implemented variant of the loading machine 1 illustrated herein furthermore contains control electronics 51, a battery 50, for example placed on the rolling frame 2, as well as a current collector (not shown), placed, for example, between the guide bars 37, which may be connected, for example, to an electric power supply line running above the loading machine 1. As the loading machine 1 operates in a fully automated warehouse, we mention here for the sake of completeness that the guide rails are equipped with limit switches, and the elements participating in the handling of goods may be fitted with cameras and distance measuring sensors; the motors are fitted with encoders for positioning, and certain elements of the warehousing system that includes the loading machine 1 of are equipped with weighing scales to check and record the weight of the goods.

The loading machine 1 according to the invention is used in automated merchandise handling warehouses where goods are stored suspended in the warehouse racking system. The goods are suspended on the hanger holders fixed in the racking system; the hanger holders can be pulled out of the racking system to the aisle way between the racks, and can be pushed back into the racking system. The loading machine 1 subject to intellectual property protection moves along the aisleway , pulls the hanger holder out of the racking system and hangs the goods on the hanger holder (storage), or removes them from it (removal), and pushes the hanger holder back into the racking system.

The arrival of the goods at the warehouse and their dispatch from it take place through a reception/dispatch point. The goods are transported between the loading machine 1, forming the subject of the invention and the reception and dispatch point by a shuttle carriage, moving on a suspended overhead conveyor track. Upon storage of the goods, the goods brought by the

suspended transport carriage are lifted off the carriage by the loading machine 1, the hanger holder is pulled out, the goods are hung on the hanger holder, which is then pushed back into the racking system, where the goods are stored in suspended manner.

When the goods are removed, the loading machine 1 pulls out the hanger beam from the racking system, unhooks the goods from the beam and hangs them onto the transport carriage, which then will carry it to the reception/dispatch point.

Advantages of the loading machine being the subject matter of the invention:

- it is suitable for lifting goods stored in warehouses with automated goods handling systems, where the goods are suspended on racking systems, in and out from shelves, where the goods are hung individually on the hanger holders fitted into the racking system,
- it is suitable for drawing out and pushing back the hanger holders from and to the racking system, and to hang the goods onto (storage) and off from (removal) the hanger holders,
- it is capable of automatically positioning itself according to the positions of the individually stored goods with precision, lifting the goods in and out, while all this is implemented by a structurally straightforward, easy-to-manage arrangement,
- it is capable of operating in an automated warehousing system, while the delivery and loading and unloading of the goods are performed with independent devices,
- the availability is improved, and the storage space lost due to inaccessibility during the malfunction of components is greatly reduced.

List of reference codes

- 1 loading machine
- 2 rolling frame
- 3 wheel
- 4 wheel
- 5 lifting post
- 6 lifting block
- 7 lifting frame
- 8 beam drawing unit
- 9 lifting fork unit
- 10 drive motor
- 11 lifting motor
- 12 toothed belt
- 13 gear
- 14 axle
- 15 front transverse support
- 16 rail
- 17 longitudinal support
- 18 toothed belt
- 19 drive motor
- 20 beam catcher hook
- 21 lifting motor
- 22 transverse drive motor
- 23 feeding motor
- 24 lifting fork
- 25 toothed belt
- 26 rear transverse support
- 27 joint
- 28 excentric cam unit
- 29 cantilever
- 30 slide support
- 31 gear
- 32 bracing bar
- 33 toothed belt

- 34 gear
- 35 roller
- 36 slide
- 37 guiding bar
- 38 eccentric cam
- 39 sliding block
- 40 gearbox
- 41 gear
- 42 holder block
- 43 rail
- 44 gear
- 45 rail
- 50 battery
- 51 control box

Claims:

1. A warehouse loading machine (1) for the handling of suspended goods in warehouses with automated merchandise handling systems, which includes a motor-powered rolling frame (2) equipped with wheels (3, 4), characterised in that the rolling frame (2) is equipped with lifting posts (5), the said lifting posts (5) are equipped with motor-powered lifting and lowering blocks (6) that can be moved along the posts and hold a lifting frame (7), and the said lifting frame (7) includes a motor-powered drawing unit (8) and a motor-powered lifting fork unit (9).
2. A loading machine (1) according to claim 1, characterised in that the wheels of the rolling frame (2) consist of a pair of idle wheels (4) mounted on a common axle and a pair of driven wheels (3) mounted on a common axle; with a drive motor (10) connected to the driven wheels (3).
3. A loading machine (1) according to claim 1 or 2, characterised in that toothed belts (12) are fastened to the lifting blocks (6), driven over the toothed pulleys (13) fitted to the bottom and top of the lifting posts (5); and the lower toothed pulleys (13) are mounted on a common axle (14), which is connected to a lifting motor (11).
4. A loading machine (1) according to any of claims 1 - 3, characterised in that the drawing unit (8) is seated on the rails (16) of the front transverse support (15) of the lifting frame (7) in a manner that allows it to slide, and the drawing unit (8) is equipped with a drive motor (19), and the longitudinal supports (17) of the lifting frame (7) are equipped with a toothed belt (18) parallel to the transverse support (15), to which the toothed pulley (41) of the drive motor (19) is connected.
5. A loading machine (1) according to any of claims 1 - 4, characterised in that hanger holder catcher hooks (20) are mounted on the front end of the drawing unit (8), perpendicularly to the rolling direction of the rolling frame (2).
6. A loading machine (1) according to any of claims 1 - 5, characterised in that a lifting fork (24) protruding forward is mounted on the front end of the lifting fork unit (9), in the direction of rolling of the rolling frame (2).
7. A loading machine according to any of claims 1 - 6, characterised in that the lifting fork unit (9) includes
 - a slide support (30) which is connected, in a way that allows it to slide, through seated slides

(36) to the front transverse support (15) and the rear transverse support (26) of the lifting frame (7), and

- a cantilever (29), which is connected to the slide support (30) with a joint (27) and an eccentric cam (38), where

- a lifting motor (21) and a transverse drive motor (22) are installed on the slide support (30), and a feeding motor (23) is fitted to the rear end of the cantilever (29) such that

- the lifting motor (21) connects to the cantilever (29) through the eccentric cam unit (38).

8. A loading machine (1) according to claim 7, characterised in that

- a further toothed belt (25) is fitted to the longitudinal supports (17) of the lifting frame (7), parallel to the transverse supports (15, 26), and the toothed pulley (31) of the transverse drive motor (22) is connected to the toothed belt (25), and

- a longitudinal toothed belt (33) is placed at the bottom of the cantilever (29), and it is driven over the toothed pulley (34) of the feeding motor (23) and the toothed pulley (44) connected to the lifting fork (24) such that the toothed belt (33) is also driven over the guide rollers (35), and the lifting fork (24) is fitted to the bottom of the cantilever (29) in a manner allowing its sliding movement such that

- the lifting fork (24) is clamped in a sliding block (39), seated on the rail (45) formed at the bottom of the cantilever (29), and the toothed pulley (44) is embedded in the sliding block (39).

9. A loading machine (1) according to any of claims 1 - 8, characterised in that the upper end of the lifting post (5) and the rolling frame (2) are connected by a bracing bar (32).

10. A loading machine (1) according to any of claims 1 - 9, characterised in that horizontal guide bars (27) are mounted on top of the lifting post (5).