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DESCRIPTION

[0001] The invention relates to a device for unloading stacked objects, like boxes. In particular, the invention relates to a device, which is suitable to unload cardboard boxes from shipping containers. To efficiently utilize the space within a shipping container, cardboard boxes are stacked directly on the floor, without using pallets. When such a shipping container needs to be unloaded, one cannot use a forklift and has to handle each box by hand. This is very labor intensive and could cause, for example, back injuries to the people unloading the boxes.

[0002] DE19719748 discloses a device and a method for unloading stacked boxes within a container. This device comprises a support surface having two adjacent surface zones, wherein a first surface zone has rollers to move a box on it and wherein a second surface zone has rollers to move a box on it in a perpendicular direction. DE19719748 further discloses a gripper based on suction that is moveable over and parallel to the first surface zone to grip and move boxes one by one. DE19719748 further discloses an optical sensor for recognizing rows in a stack of boxes and for determining the contours of a box. Based on the contours of a box determined using the sensor, the gripper is aligned for gripping the box.

[0003] EP1885636 discloses a device for unloading stacked boxes from a shipping container. This device has the features of the preamble of claim 1 and comprises a movable arm, which is manually operable. A gripper is arranged at the free end of the arm and is used to grip cardboard boxes from the top side. With this device a few adjacent boxes are picked up together, are rotated and are then moved onto a conveyor belt, which transports the boxes away from the device. The boxes are still abutting each other, like they were in the stack of boxes inside the shipping container. The close distance of the boxes will lead to problems in the further chain of transport, for example at a palletizing machine.

[0004] The arm used in this device requires a lot of space to be able to pick up the boxes, to rotate the row of boxes and to place the boxes onto a conveyor. Furthermore, it takes time to perform all the movements with the arm, which reduces the unloading speed of the shipping container.

[0005] It is an object of the invention to reduce at least partially the above mentioned disadvantages and to provide an efficient device for unloading stacked objects.

[0006] This object is achieved with a device according to claim 1.

[0007] With the device according to the invention, the objects, like cardboard boxes, are pulled by the gripper means onto the support surface. Then the surface zones will move the objects over the support surface, while the position of the objects is monitored by the position detection means.

[0008] Because the second surface zone moves perpendicular to the first surface zone, the objects are pulled out of their row one by one. As a result the objects are spaced apart and transported away over the second surface zone.

[0009] As it is not necessary to rotate the row of boxes, like with the device according to the prior art, the device according to the invention could be designed more compact. For example, the width of the support surface could almost be the same as the inner width of a shipping container.

[0010] Preferably, the first and second surface zones are formed by a first and second conveyor. Such a conveyor could, for example, be a conveyor belt or a roller conveyor.

[0011] In a preferred embodiment of the device according to the invention the first conveyor is a roller conveyor and the gripper means comprise a first guide track arranged parallel and between the rollers for moving the gripper means in the axial direction of the rollers of the first conveyor.

[0012] By using a roller conveyor, it is possible to provide a guide track in between the rollers, wherein the guide track is somewhat lowered relative to the rollers. With this guide track it is possible to move the gripper means over the support surface to pick the objects from a stack and pull the gripped objects onto the support surface.

[0013] In a further preferred embodiment the gripper means further comprise a second guide track arranged on and perpendicular to the first guide track, for moving the gripper means in the transport direction of the first conveyor.

[0014] The second guide track ensures that the gripper can also be moved sideways, which is particularly relevant, when the

support surface is almost the same width as the inner width of a shipping container. The support surface is then kept stationary, while the gripper will move sideways to pick all the objects from a layer of the stack.

[0015] Preferably, the gripper means could also be lifted over a short vertical distance relative to the support surface, such that gripped objects are easily pulled onto the support surface.

[0016] Furthermore, the gripper means could comprise an array of suction cups for suction to an object. The size of the objects can vary per shipping container and even within one single container. By using an array of suction cups, one can move the array towards the stack of objects. At least some of the cups will get a hold on the objects, which enable the gripping means to pull the objects onto the support surface.

[0017] It is preferred if the suction cups are each independently telescopic movable, such that the suction cups can adjust easily to an uneven surface of the objects.

[0018] The suction cups are preferably provided with low pressure. Each could be provided with a restriction to reduce the volume of air, when a cup is not pressed against an object and to ensure that sufficient low pressure is available for the cups which are in contact with an object.

[0019] The suction cups could also each be provided with a venturi, which provides for each and every cup a separate low pressure source.

[0020] In another preferred embodiment of the device according to the invention the position detection means comprise a scanning laser rangefinder. A scanning laser rangefinder is a device, which uses a laser beam and a sensor to measure the distance between the device and an object, which reflects the laser beam. The laser beam is scanned over a surface, for example by rotating the laser beam, which results in a number of distance measurements in relation to the rotation angle of the device. This provides a digital image of the surface in front of the scanning laser rangefinder. With this digital image it is thus possible to distinguish the objects and to determine the position of the objects on the supporting surface.

[0021] Preferably the scanning laser rangefinder is arranged adjacent the interface between the first and second surface zones. This will enable the device to track the objects, which are moved over the first surface zone and in perpendicular direction over the second surface zone.

[0022] It will even be possible to detect any objects in front of the support surface, which would even enable fully automated unloading of a shipping container.

[0023] A further preferred embodiment of the device according to the invention further comprises:

- a movable frame to which the support surface is height adjustable arranged;
- a third conveyor arranged between the movable frame and the second surface zone of the support surface for transporting away the unloaded objects.

[0024] With the movable frame it is possible to advance the support surface into a shipping container as it is getting emptier by the unloading of the objects. With the height adjustment it is possible to level the support surface with a top layer of objects at the stack. In this way the gripper means will take rows of objects of a single object height one at a time toward the support surface.

[0025] The third conveyor is used to further transport away the spaced apart objects, which are transported over the second surface zone.

[0026] The invention also relates to a method for unloading objects with a device according to the invention, which method comprises the steps of claim 9.

[0027] These and other features of the invention will be elucidated in conjunction with the accompanying drawings.

Figure 1 shows a perspective view of an embodiment of the device according to the invention.

Figure 2 shows a different perspective view of the device according to figure 1.

Figure 3 shows a perspective of the support surface of the device according to figure 1.

Figures 4A - 4C shows a top view of the support surface in different stages.

Figure 1 shows an embodiment of the device 1 according to the invention placed in front of a stack 2 of boxes 3.

[0028] The device 1 has a movable frame 4 having wheels 5. An arm 6 is arranged on the movable frame 4 and tiltable by hydraulic cylinders 7. A support surface 8 with a gripper 9 is arranged at the free end of the arm 6. A conveyor belt 10 is provided next to the arm 6 for transporting away unloaded boxes 3.

[0029] Figure 2 shows the device of figure 1 from behind. On the side of the arm 6 opposite of the conveyor belt 10, a seat 11 is provided for an operator. The seat 11 is provided with controls 12 for manually controlling the device 1. Furthermore, a gangway 13 is provided behind the seat 11 for easy access of the operator.

[0030] Figure 3 shows the support surface 8 in more detail. The support surface 8 has two roller conveyors, first roller conveyor 14 in width direction of the support surface 8 and a second roller conveyor 15 extending in depth direction of the support surface 8. The first roller conveyor 14 defines the first surface zone of the support surface 8, while the second surface zone is defined by the second roller conveyor 15.

[0031] The gripper 9 has a plurality of suction cups 16 arranged in a matrix on a frame part 17. This frame part 17 is guided over guide rails 18, such that the gripper 9 can move over the support surface 8.

[0032] A scanning laser rangefinder 19 is arranged adjacent the interface between the first and second surface zones 14, 15.

[0033] Figures 4A - 4C shows a top view of the support surface 8 in three different states.

[0034] In figure 4A the gripper 9 is moved over the support surface 8 via the guide rails 18. The frame part 17 is slidable arranged on a frame base 20, such that the gripper with suction cups 16 is movable both in depth direction as in width direction of the support surface 8.

[0035] In figure 4A the gripper 9 has gripped three boxes 3 from a layer and pulls these boxes 3 onto the support surface.

[0036] The scanning laser rangefinder 19 constantly measures in several direction the distance between the rangefinder 19 and the surrounding objects, such as the boxes 3 in order to determine the position of these boxes 3.

[0037] As shown in figure 4B, the gripper 9 has positioned the three boxes 3 mainly in the first surface zone 14 and has returned to the home position in the left bottom corner of the support surface 8.

[0038] With the measurements of the rangefinder 19, the controller (not shown) knows the position of the boxes 3 and controls the movement of the roller conveyor 14 such that the most right box 3 is moved into the second surface zone 15/

[0039] As soon as the right box 8 is within the second surface zone, the movement of the roller conveyor 14 is stopped and the movement of the roller conveyor 15 is started, such that the first box 3 is transported away (see figure 4C) toward the conveyor belt 10.

[0040] When the controller detects based on the measurements of the rangefinder 19, that the first box 3 has moved sufficiently far, the movement of the first roller conveyor 14 can be started again to bring the second box 3 within the second surface zone 15.

[0041] In this way, the boxes 3 are unloaded from a stack of boxes and moved with a certain spacing onto the conveyor belt 10 for further processing.

[0042] It would be possible with the device according to the invention to unload boxes from a stack, wherein other boxes are stacked on top of the unloaded boxes. This will speed up the unloading process.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- DE19719748 [0002] [0002] [0002]
- EP1885636A [0003]

Patentkrav

1. Indretning (1) til aflæsning af stablede genstande (3), såsom kasser, hvilken indretning omfatter:

- 5 - en støtteflade (8) med mindst to tilstødende overfladezoner, hvor en første overfladezone er bevægelig i en første retning og en anden overfladezone er bevægelig i en anden retning i alt væsentligt vinkelret på den første retning;
- 10 - gribeorgan (9) bevægeligt over og parallelt med støttefladen (8) til at gribe og bevæge genstande på støttefladen;

kendetegnet ved

- positionsdetekteringsorgan (19) til at detektere positionen af genstande i de mindst to tilstødende overfladezoner; og
- 15 - en controller til at styre mindst bevægelsen af den første overfladezone og den anden overfladezone afhængigt af positionen af genstandene detekteret i de mindst to overfladezoner.

2. Indretning (1) ifølge krav 1, hvor den første og anden overfladezone er dannet af en første og anden fremføringsindretning (14,15).

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3. Indretning (1) ifølge krav 2, hvor den første fremføringsindretning (14) er en rullefremføringsindretning og hvor gribeorganet (9) omfatter en første føringsskinne anbragt parallelt og mellem rullerne for at bevæge gribeorganet i den aksiale retning af rullerne af den første fremføringsindretning.

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4. Indretning (1) ifølge krav 3, hvor gribeorganet endvidere omfatter en anden føringsskinne anbragt på og vinkelret på den første føringsskinne, til at bevæge gribeorganet (9) i transportretningen af den første fremføringsindretning.

30 **5.** Indretning (1) ifølge et hvilket som helst af de foregående krav, hvor gribeorganet omfatter et array af sugekopper (16) til sugning til en genstand.

6. Indretning (1) ifølge et hvilket som helst af de foregående krav, hvor positionsdetekteringsorganet omfatter en scanningslaser-afstandsmåler (19).

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7. Indretning (1) ifølge krav 6, hvor scanningslaser-afstandsmåleren (19) er anbragt tilstødende grænsefladen mellem den første og anden overfladezone.

8. Indretning (1) ifølge et hvilket som helst af de foregående krav, endvidere
5 omfattende:

- en bevægelig ramme (4) til hvilken støttefladen (8) er højdejusterbart anbragt;
- en tredje fremføringsindretning anbragt mellem den bevægelige ramme (4) og den anden overfladezone af støttefladen (8) for at transportere de
10 uafløstede genstande (3) væk.

9. Fremgangsmåde til aflæsning af genstande (3) med en indretning (1) ifølge et hvilket som helst af de foregående krav, hvilken fremgangsmåden omfatter trinnene:

- 15 - at bevæge støttefladen (8) tilstødende en række af genstande;

kendetegnet ved

- at bevæge gribeorganet (9) over og parallelt med støttefladen (8) til at gribe rækken af genstande og bevæge genstandene over på den første overfladezone af støttefladen;
- 20 - at bevæge den første overfladezone, således at rækken af genstande bevæges mod den anden overfladezone,
samtidig med detektering af positionen af genstandene; og
- at styre bevægelsen af den første og anden overfladezone baseret på de detekterede positioner, således at genstandene bevæges fra den første
25 overfladezone over på den anden overfladezone og genstandene derefter bevæges over den anden overfladezone, samtidig med at tilvejebringe en afstand mellem genstandene.

DRAWINGS

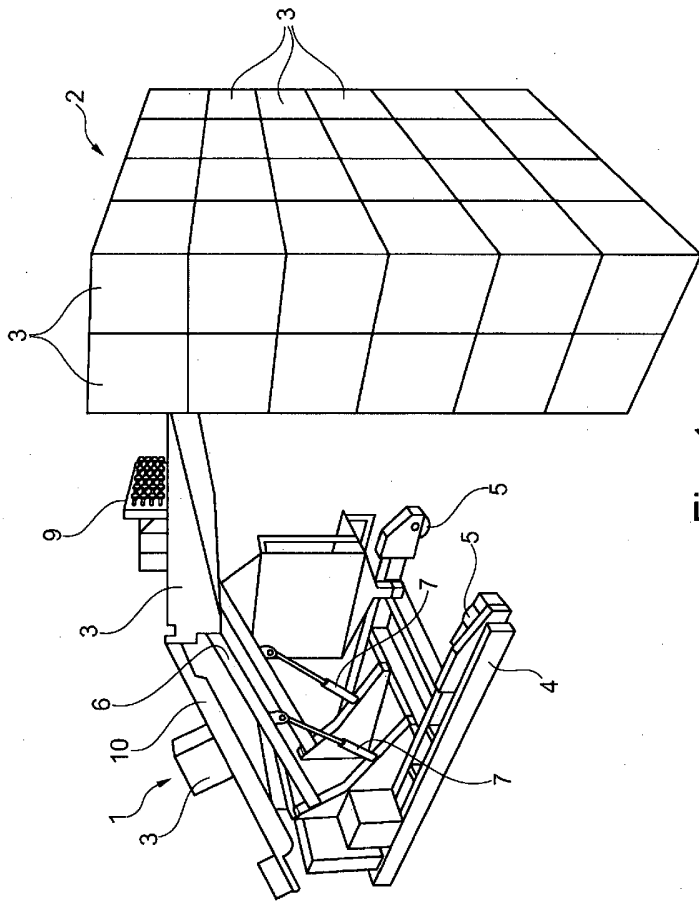


Fig. 1

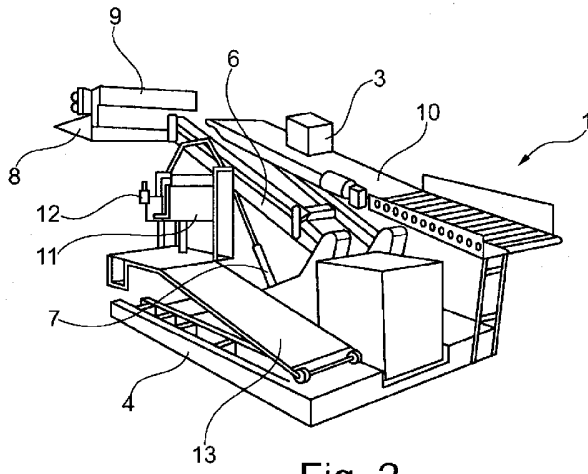


Fig. 2

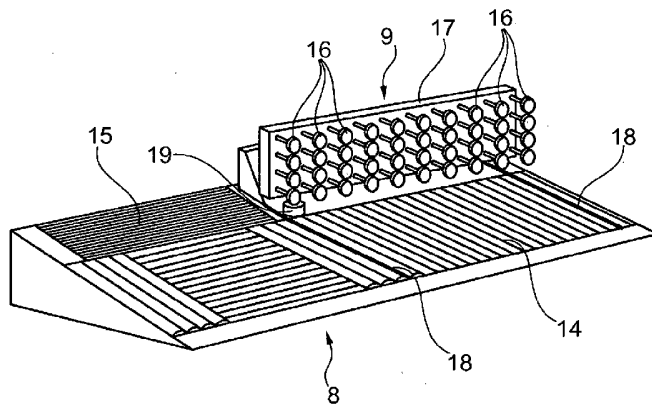


Fig. 3

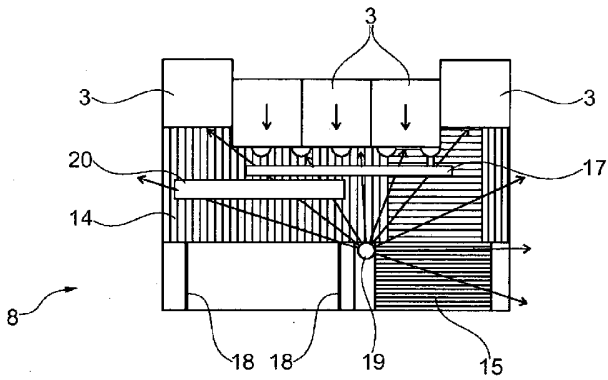


Fig. 4A

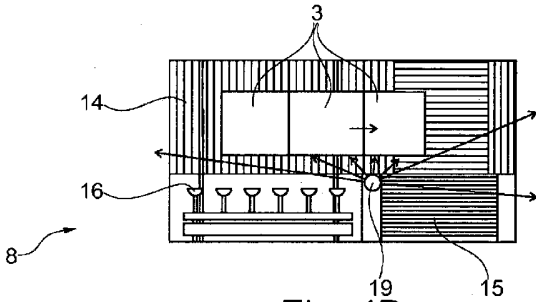


Fig. 4B

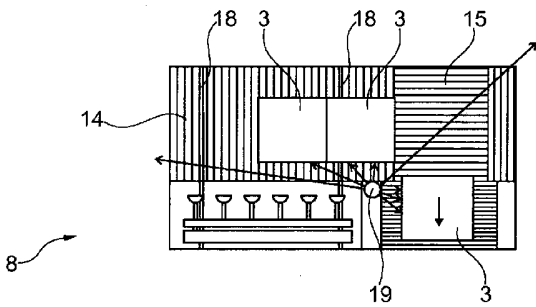


Fig. 4C