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## (54) System and method for capping containers

(57) Machine and method for mounting screw-type caps (10) on containers (51), by making use of a cap carrier which comprises a puck (1) having a recess (3) formed in a top surface (32), and an o-ring (6) placed in the recess for gripping an inserted cap. The machine comprises a cap feeding device (41) operative to feed caps forward side by side, a cap applicator device (49) operative to apply caps onto container necks (52), and a tightening device (56) operative to fasten applied caps to the container necks by screwing. A cap loading device (43,45) is operative to place each cap in gripping fit with the cap carrier (1), wherein the tightening device is operative to engage a surface (2) of the cap carrier for fastening the carrier-fitted caps.

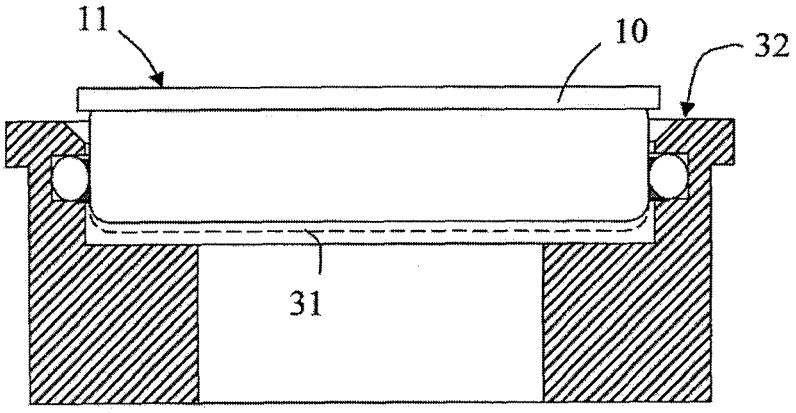


Fig. 3

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## Description

### Field of the invention

**[0001]** The present invention relates to a machine and a method for placing screw-type caps on container openings, and to fasten the caps by screwing. More specifically, the invention provides a cap carrier to be used for mounting of the caps, which makes a capping machine less sensitive to dimensional variations in caps.

### Background

**[0002]** Commercial distribution and sale of viscous substances are as a rule performed with the substance in question contained in consumer-adapted containers in the shape of cans, jars, boxes, or bottles of different types. Most types of such containers are often in some way recloseable, e.g. by being provided with a lid for closing an opening in the container, or with a cap which can be tightly screwed to a threaded opening of the container and thereby sealing it. Different types of pourable substances that are packed in this way comprise beverages, oils, body and hair products, solvents, toners, corn flakes etc, but also solid products such as vegetables and pharmaceutical pills. Consequently, capping is a frequently occurring procedure within the packaging industry, involving a cap being mounted to an opening in a container. This procedure is performed just after the moment when the containers are filled with their content, or at an earlier stage when the containers themselves are produced.

**[0003]** A typical prior art solution for mounting screw-type caps onto container openings is disclosed in US 3,112,591 to Stover. This document shows how a series of caps are provided in a chute, in which they slide downwards side by side with their bottom facing the slide surface of the chute. The caps are stopped at a gate function at the lower end of the chute, in which position at least a portion of the bottom side of the lowermost cap is exposed. A series of containers are passed forward horizontally such that the container neck closest to the stopped cap will engage with the leading edge rim of that cap. The cap is thereby brought along and released by the container neck, and correctly placed thereon by means of an applicator shoe. In the subsequent step the caps are tightened by screwing by means of overhead rollers.

### Object of the invention

**[0004]** When mounting caps of different dimensions to container openings, which also may vary in size and shape, the capping machine needs to be adjusted at every change of cap type. Otherwise the mounting and screwing functions may not work properly. Furthermore, caps are typically cheap and often disposable items, which are manufactured with less than perfect tolerance with regard to dimension. However, it is not feasible to re-adjust the capping machine only because the caps tend to differ in size by tenths of a millimetre, or even up to a couple of millimetres, so the machine simply has to cope with this tolerance range. Typically, this means that if the machine is set to mount caps at the smaller end of the dimension tolerance range, the larger caps will put extra pressure and wear on the capping equipment. If instead the equipment is set adjusted to the larger end of the dimension tolerance range, the risk you face is that the smaller caps will not be engaged and screwed on properly. Some form of intermediate setting is the typical choice, but it is still a problem with equipment wear and temporary halts in the process due to dimensional deviations in the caps.

**[0005]** The object of the invention is therefore to provide a machine and a method for mounting screw-type caps on containers, which is more reliable than prior art solutions.

### Summary of the invention

**[0006]** According to a first aspect of the invention, this object is fulfilled by a machine for mounting screw-type caps on containers, comprising a cap feeding device operative to feed caps forward side by side, a cap applicator device operative to apply caps onto container necks, and a tightening device operative to fasten applied caps to the container necks by screwing, wherein a cap loading device is operative to place each cap in gripping fit with a cap carrier, wherein the tightening device is operative to engage a surface of the cap carrier for fastening the carrier-fitted caps.

**[0007]** According to a second aspect of the invention, the stated object is fulfilled by a cap carrier for use in a capping machine, comprising a puck-shaped body having a circular cylindrical outer wall, a recess formed in a top surface of the body, which recess has an inner wall which is concentric with the circular cylindrical outer wall, a circumferential notch formed in the inner wall, and a resilient o-ring positioned in the notch, wherein the inner diameter of the o- ring is smaller than the inner diameter of the inner wall.

**[0008]** According to a third aspect of the invention, the stated object is fulfilled by a method for mounting screw-type caps on containers, comprising the steps of:

- feeding caps forward side by side;
- placing each cap in gripping fit with a cap carrier;
- applying the carrier-fitted caps onto container necks; and
- fastening the applied caps to the container necks by engaging a surface of the cap carrier and screwing the carrier-fitted cap onto the container neck.

**[0009]** The invention is defined by the appended claims.

Brief description of the drawings

**[0010]** Preferred embodiments will be described below with reference to the accompanying drawings, on which:

Fig. 1 shows a cross-sectional drawing of an embodiment of a cap carrier for use in a machine and method according to an embodiment of the invention;
Figs 2-3 illustrate placing and fitting of a cap into the cap carrier of Fig. 1; and
Fig. 4 illustrates schematically an embodiment of a capping machine

Detailed description of preferred embodiments

**[0011]** Fig. 1 shows a cross-sectional drawing of an embodiment of a cap carrier 1 according to an embodiment of the invention. Cap carrier 1 is a puck with a outer circular cylindrical wall 2, and a recess 3 formed in the top surface of the cap carrier. The cap carrier may be formed in metal, but is preferably made in a suitable plastic material. Recess 3 has an inner circular cylindrical wall 4, which is concentric with outer wall 2. Recess 3 may be a blind bore, or go through the cap carrier as shown in the drawing. The edge 5 of the opening to recess 3 is preferably slightly inclined, to guide caps into recess 3. In order to grip a cap placed and pressed into cap carrier 1, cap gripping means are included. The cap gripping means may be in the form of one or more spring blades protruding inwards from inner wall 4, devised to engage at one or more positions of a periphery portion of the introduced cap. However, the preferred embodiment shown in the drawings includes cap gripping means in the form of an o-ring 6, marked grey, disposed in a notch 7 in inner wall 4. Notch 7 and o-ring 6 are devised such that notch 7 preferably is deeper than half the diameter of the o-ring cross-section, but not as deep as the full cross-section diameter. This way, the inner diameter of o-ring 6 is smaller than the inner diameter of recess 3, as defined by inner wall 4. In a preferred embodiment, as shown, cap carrier 1 is further devised with a flange 8, projecting from the side envelope wall 2 at the top surface by 2-5 millimetres. This flange is used for guiding the cap carrier in the capping machine, as will be explained.

**[0012]** Figs 2 and 3 illustrate schematically how a cap 10 is fitted to cap carrier 1. In a first step, shown in Fig. 2, cap 10 is placed in the opening of recess 3, guided by inclined edge 5 to rest on o-ring 6. In the subsequent step the cap 10 is pressed down into recess 3, such that o-ring 6 yields an slightly deforms, and thereby firmly grips the cap 10 by circumferential engagement. As will be explained, cap 10 is pressed down under control, such that a lower rim 11 of the cap is positioned at a predetermined distance relative to the cap carrier 1, typically to project a predetermined distance over the top surface 32.

**[0013]** For any series of caps to be mounted to container necks, a certain puck, or cap carrier 1, needs to be used. Typically, the diameter and depth of recess 3 must be wide enough to cope with foreseeable dimensional variations in cap size, whereas the inner diameter of o-ring 6 must be small enough to securely grip the smallest possible caps within a given range of tolerance. The diameter of outer wall 2, however, is preferably held constant. Even if pucks produced for different series of caps may have different outer diameter, the capping machine needs only be calibrated once, since every cap carrier used for one series will be virtually identical in terms of outer diameter, at least in comparison with the caps as such. Typically, the tolerance of the outer diameter of cap carrier 1 should not be more than a tenth of a millimetre.

**[0014]** Fig. 4 schematically illustrates a system for capping containers in accordance with the invention, comprising a capping machine making use of cap carriers 1 as illustrated in Figs 1-3. Screw-type caps are provided side by side in a chute 41, in which the caps are arranged upside down. Chute 41 ends with an open end at a cap dispenser 42, where the caps are dispensed one by one at an angle to the horizontal plane. A series of cap carrier pucks 1 are queued and push forward from behind, in a manner which will be explained, towards cap dispenser 42, wherein the cap carriers 1 are arranged with recess 3 opening upwards. A cap loading device comprises a passive wheel 43 rotating about a horizontal axis in a plane parallel to the feeding direction of the cap carriers. A cog 44 of wheel 43 engages the interior of the cap present in the cap dispenser 42, and as the cap and cap carrier present under wheel 43, in engagement with the preceding cog, is pushed forward wheel 43 will be forced to rotate and thereby place the cap present in cap dispenser 42 into recess 3 of the next cap carrier. At this point, the cap is typically placed in the cap carrier as shown in Fig. 2, or optionally slightly pressed down into engagement with the o-ring. However, as the cap-fitted carrier is pushed onwards, it will be forced under a wedge-shaped element 45, having an inclination directed downwards in the feeding direction. The wedge-shaped element 45 thereby engages the cap present in the cap carrier and presses the cap down into the fitting grip with o-ring 6. Furthermore, the height of the lowermost point of the wedge-shaped element 45 defines how deep into recess the cap is inserted. More correctly, even if the actual height of the caps vary, the lower rim of the cap will be placed at the same position with reference to the cap carrier bottom surface. Since the height of the cap carrier is the same for all pucks 1, preferably also within a tolerance of a tenth of a millimetre, the projection of the lower rim of the caps will also be substantially constant. The engaged cap and cap carrier will now be a in Fig. 3. As is also shown in Fig. 3 by means of a broken line, a slightly higher cap 31 will have the same projection as cap 10, from top surface 32 of cap carrier 1. In a preferred embodiment, the loading device comprises a tunnel 45, through which the cap-fitted carriers are forced, wherein the ceiling of the tunnel is inclined to form the wedge-

shaped element.

**[0015]** The cap-fitted carriers are subsequently pushed to a position 46, from which they fall by the force of gravity along an arched guiding rail 47, along which the cap carriers turn such that the gripped cap faces downwards at an angle to the horizontal plane, at which they are again queued in a chute 48. At the end of chute 48, an applicator device 49 provides a spring-loaded gate function, which stops the foremost cap of the queue in chute 48 in a position at which the cap, or at least the leading edge of the lower rim of the cap, is exposed.

**[0016]** A conveyor 50 carries and fees containers 51 forward side by side, arranged with their necks 52 directed upwards. A pair of rotating belts 53 arranged at opposite sides of the container track, or as in the shown embodiment two pairs of rotating belts 53,54, drive the containers forward in a controlled speed by means of a motor 55. As a container is forced forward under cap applicator device 49, the leading edge of the container neck will grab onto the lower rim of the cap present in the applicator device. As the container is forced forward, the spring-loaded gate function will release the carrier-fitted cap, which is thereby placed on neck. Subsequent to the gate function a tightening device is arranged, devised to grab hold of the cap carrier engaged with the cap placed on the container neck, and screw the cap onto the neck by a preset moment. In the illustrated embodiment, the tightening device comprises a pair of rotating belts 56 located at opposite sides of the cap carrier as the container passes, and rotating with relatively different speeds along the feeding direction of the containers, such that a resulting rotation of the cap carrier and cap is achieved to screw the cap into place on the neck. Belts 53, 54 ensure that the container is not rotated when the tightening device acts to screw the cap into place. The tightening device may also include a spring-loaded pressing element 57, providing a downwards directed force on the cap carrier before or upon engaging the cap carrier with belts 56, in order to accommodate for variations in the height of the containers. Belts 56 typically have a high friction surface of rubber or silicone, devised to provide suitable grip of the smooth outer wall 2 of the cap carrier. An alternative embodiment makes use of tightening means devised to engage with the bottom surface of the cap carrier, similar to the solution of the mentioned US patent to Stover.

**[0017]** As the container with the now firmly mounted cap is passed forward, engagement with tightening belts 56 is released, after which carriers are forced off the cap. This achieved by means of a wedge member 58, engaging the top surface of the cap carrier at opposite sides of the container to pull off the cap carrier. The upward inclination of wedge member 58 places the removed cap carriers in another carrier queue 59. When pushed forward by subsequently removed cap carriers, they will be moved into engagement with a carrier driving unit 60, which grabs the carriers at queue 59 and lifts and turns them up to once again be queued towards cap dispenser 42. This way, the cap carriers have been driven and guided through a closed loop, where each cap carrier grabs and applies one cap onto a container neck at each cycle of the loop. In the shown embodiment, carrier driving unit comprises a motor-driven wheel 60, which has two parallel and spaced-apart discs 61, separated along the axis of rotation by a distance adapted to the diameter of outer wall 2 of the cap carriers. The cap carriers are fairly light, typically between 20-50 gram, and not a very strong grip is needed to engage them enough to be able to move them upwards along a guiding rail 62 to the queue before the cap dispenser 42, where the grip of the discs 61 is released by guiding the cap carriers horizontally and tangentially away from wheel 60. Preferably a pair of opposite inwards-facing guiding traces (not shown) are formed along the closed loop through which the cap carriers run, into which traces the flange 8 is devised to run. This way the risk for the cap carriers to crowd and become tilted is minimised. The guiding traces need not be provided all along the loop, but preferably at least in guiding rails 47 and 62.

**[0018]** An advantage provided by the invention is that caps with different sizes can be mounted to containers without need for special adjustments. Going from one series of caps to another differently sized series may be achieved by exchanging the cap carriers. Within some range, cap carriers with equal height and outer diameter, but with differently sized recesses and o-rings, can be used without having to make adjustments to the capping machine when changing caps and carriers. The size of the containers may of course also vary, for which some adjustment may be needed, typically the elevation of conveyor track 50 and spacing between belt pairs 53.

**[0019]** A particular advantage with the invention is that it makes the capping machine capable of performing the capping process in a secure and fail-proof manner even if caps are used for which the dimensional tolerance is low. By using the puck-shaped cap carrier, the capping machine is able to cope with variations in height and diameter of the caps to an extent of tens of millimetres, and even more than a millimetre, without causing unnecessary wear to the capping machine or process failure due to tilting of the caps. Furthermore, since a smooth engagement surface 2 is provided for interaction with belts 56 of the tightening means, wear to the capping machine is minimised even further.

**[0020]** The invention has been described by means of examples directed to mounting caps onto necks of containers. It should be noted, though, that in some cases caps are mounted to container necks before the container neck is attached to the actual container, by welding or gluing, or any other suitable method. This is beside the focus of the invention, which is equally applicable to such bare container necks. In this sense, the meaning of the term container when referring to the subject matter of mounting caps thereon, therefore also includes container necks without the actual container. The scope of the invention is defined by the appended claims.

## Claims

1. Machine for mounting screw-type caps (10) on container necks (52), comprising a cap feeding device (41) operative to feed caps forward side by side, a cap applicator device (49) operative to apply caps onto the container necks (52), and a tightening device (56) operative to fasten applied caps to the container necks by screwing, **characterised in that** a cap loading device (43,45) is operative to place each cap in gripping fit with a cap carrier (1), wherein the tightening device is operative to engage a surface (2) of the cap carrier for fastening the carrier-fitted caps.

2. The machine as recited in claim 1, **characterised in that** the cap loading device is operative to apply carrier-fitted caps onto container necks.

3. The machine as recited in claim 1, **characterised in that** the cap carrier comprises a puck (1) having a recess (3) formed in a top surface (32), and cap gripping means (6) formed in the recess.

4. The machine as recited in claim 3, **characterised in that** the cap loading device comprises a mechanism (43,44) for placing a cap top down in the recess, and a pressing mechanism (45) for inserting the cap into the recess to a position where a lower rim (11) of the cap is positioned a preset distance from the top surface.

5. The machine as recited in claim 4, **characterised in that** the pressing mechanism comprises a wedge-shaped element (45), wherein a feeding mechanism (60) is devised to feed the cap carrier with a cap placed thereon under the wedge-shaped element such that the cap is engaged by the wedge-shaped element and pressed down into the recess to a position defined by the lowermost height of the wedge-shaped element.

6. The machine as recited in claim 5, **characterised in that** the wedge-shaped element is an inclined ceiling of a tunnel (45), through which the cap carrier with a cap placed thereon is fed.

7. The machine as recited in claim 1, **characterised in that** a carrier pulling device (58) is operative to remove the cap carrier from the fastened cap.

8. The machine as recited in claim 7, **characterised in that** a carrier pulling device comprises a wedge member (58), wherein a container feeding mechanism (53) is operative to feed capped containers by the wedge member to pull off the cap carrier.

9. The machine as recited in claim 7, **characterised in that** a closed loop cap carrier conveying mechanism (60) is operative to feed a plurality of cap carriers from the cap loading device, via the cap applicator device, the tightening device, and the carrier pulling device, and back to the cap loading device.

10. The machine as recited in claim 1, **characterised in that** the tightening device comprises a pair of moving belts (56) on opposite sides of the container, devised to engage a circular cylindrical outer surface (2) of the cap carrier.

11. The machine as recited in claim 3, **characterised in that** the cap gripping means comprises a resiliently yielding element (6) devised to engage an inserted cap at a periphery portion of the cap to provide a grip on the cap.

12. The machine as recited in claim 3, **characterised in that** the recess has a circular cylindrical inner wall (4), and the cap gripping means comprises an o-ring (6) positioned in an annular notch (7) formed in the inner wall, the o-ring having an inner diameter which is smaller than the diameter of the inner wall.

13. A cap carrier for use in a capping machine, **characterised by** a puck-shaped body (1) having a circular cylindrical outer wall (2), a recess (3) formed in a top surface (32) of the body, which recess has an inner wall (4) which is concentric with the circular cylindrical outer wall, a circumferential notch (7) formed in the inner wall, and a resilient o-ring (6) positioned in the notch, wherein the inner diameter of the o- ring is smaller than the inner diameter of the inner wall.

14. Method for mounting screw-type caps (10) on container necks (52), comprising the steps of:

    - feeding caps forward side by side (41);
    - placing each cap in gripping fit with a cap carrier (43,45);
    - applying the carrier-fitted caps onto the container necks (49); and
    - fastening the applied caps to the container necks by engaging a surface of the cap carrier and screwing the carrier-fitted cap onto the container neck (56).

15. The method as recited in claim 14, wherein the cap carrier comprises a puck (1) having a recess (3) formed in a top surface (32), and cap gripping means (6) formed in the recess, comprising the steps of:

    - placing a cap top down in the recess; and
    - inserting the cap into the recess to a position where a lower rim (11) of the cap is positioned a preset distance from the top surface.

**16.** The method as recited in claim 15, comprising the step of:

- feeding the cap carrier with a cap placed thereon under a wedge-shaped element (45) such that the cap is engaged by the wedge-shaped element and pressed down into the recess to a position defined by the lowermost height of the wedge-shaped element.

**17.** The method as recited in claim 14, comprising the step of:

- removing the cap carrier from the fastened cap (58).

**18.** The method as recited in claim 17, comprising the step of:

- feeding capped containers by a wedge member (58) to pull off the cap carrier.

**19.** The method as recited in claim 18, comprising the step of:

- feeding the removed cap carrier back in a closed loop to a position for placing a new cap therein (60).

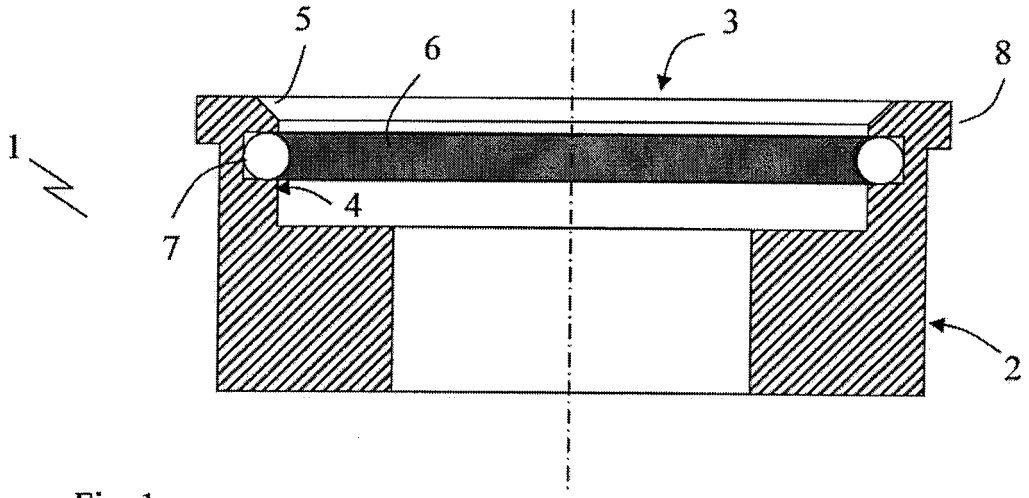


Fig. 1

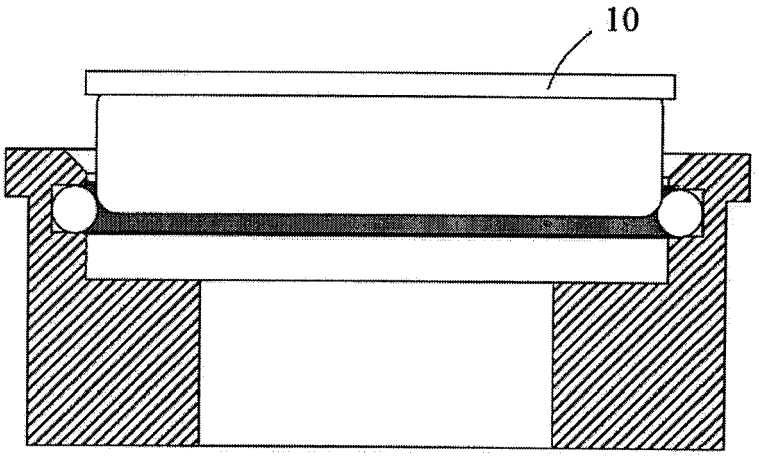


Fig. 2

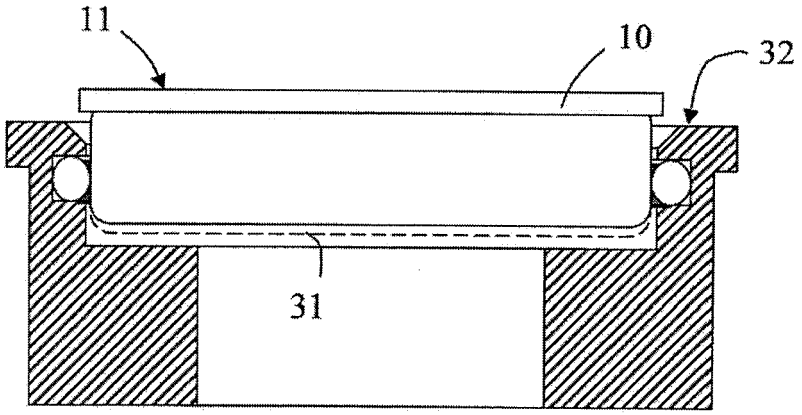


Fig. 3

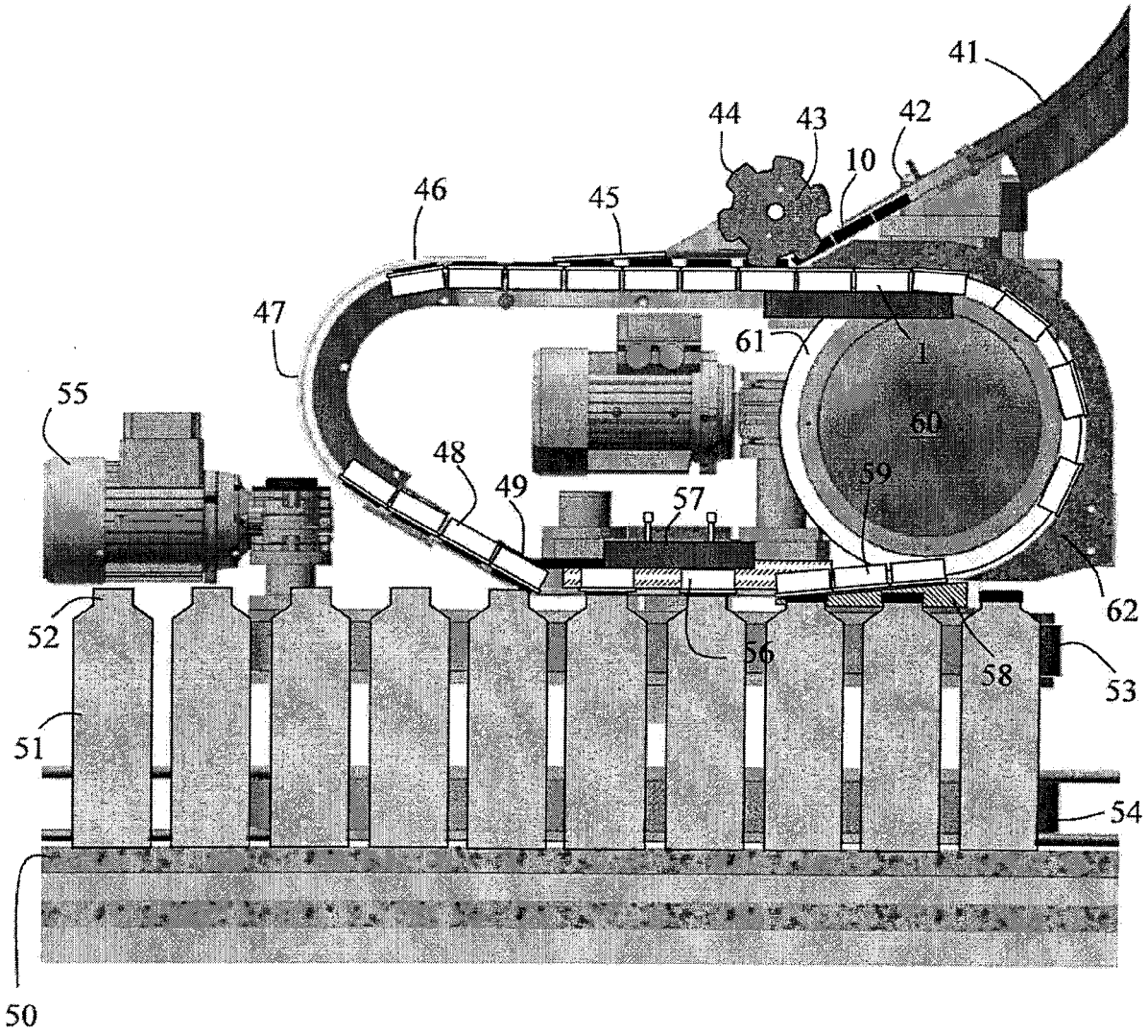


Fig. 4

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# EUROPEAN SEARCH REPORT

Application Number
EP 05 10 5446

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| X | US 5 054 260 A (HERZOG ET AL)<br>8 October 1991 (1991-10-08)<br>* column 8, line 9 - line 17 *<br>----- | 13 | B65G17/32<br>B67B3/20<br>B65G47/08<br>B65B7/28 |
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TECHNICAL FIELDS SEARCHED (IPC)

B65G
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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 22 November 2005 | Desittere, M |

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

## REFERENCES CITED IN THE DESCRIPTION

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