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(54) A device and a method for applying a cap to a package

(57) A device (10) for applying a threaded cap (11) to a threaded neck (12) of a package (13), comprising a container conveyor (22) for conveying the package (13) in a travel direction (A), a package handling system (14) for supporting the package on the conveyor (22), a cap dispenser (15) for supplying a cap (11) to the neck (12) of a package (13) conveyed by the package handling system (14), and a cap tightening device (16) having a rotating first cap tightening belt (26) and a rotating second cap tightening belt (27) arranged opposite to the first cap tightening belt (26) for tightening the cap (11) on the package neck (13) by rotation. The device (10) comprises a neck position sensor (32) for detecting a position of the neck (12) in a lateral direction perpendicular to the travel direction (A) of the package (13). At least one motor (25, 28, 30, 38) is connected to the cap position sensor (32), and the cap dispenser (15) and the cap tightening device (16) and/or the package handling system (14) is laterally adjustable and connected to said motor (25, 28, 30, 38) for adjusting the relative position between the package handling system (14) and the cap dispenser (15) and the cap tightening device (16) according to the detected position of the neck (12). Disclosed is also a method for applying the cap (11) to the neck (12).

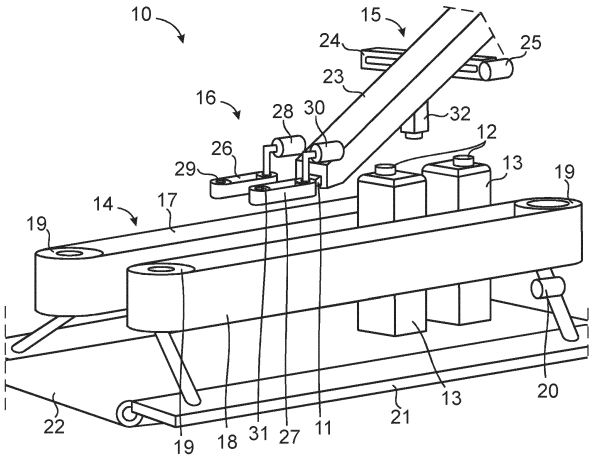

Fig. 1

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Description

FIELD OF THE INVENTION

[0001] The invention relates to a device and a method for applying a cap to a package. More specifically the invention relates to a device and a method for applying a threaded cap to a threaded neck of a package. This type of devices comprises a conveyor, a package handling system, a cap dispenser and a cap tightening device having oppositely arranged and rotating cap tightening belts for tightening the cap on the package neck by rotation, so that the threads of the cap engages the threads of the neck.

[0002] Packages of this type are generally used in connection with packages for liquid foodstuff, such as milk, juice, water, yoghurt and similar, but can be used for other types of packages having a threaded neck. One common type of packages of this type is carton packages having a neck and a cap of plastic materials.

PRIOR ART

[0003] There is a plurality of different types of devices for applying a threaded cap to a package in the prior art. One such type of device comprises a conveyor for transporting packages in a travel direction, wherein a cap is supplied to the top of the neck when the package passes a cap dispenser. Then, the cap is tightened by means of a cap tightening device having oppositely arranged cap tightening belts for engaging and rotating the cap onto the neck. For example, a line of packages are transported on a continuously operating conveyor, wherein the continuously conveyed packages at short intervals pass the cap dispenser and wherein caps at short intervals are tightened by means of the cap tightening belts.

SUMMARY OF THE INVENTION

[0004] An object of the invention is to provide a device and a method which result in a reduced number of caps not being applied properly, wherein the number of discarded packages and the amount of discarded content can be reduced. Hence, a more cost efficient device and method is achieved.

[0005] It has surprisingly been found that caps not being applied properly many times are due to small variations in the position of the neck. Hence, a number of packages having tilted caps or caps not tightened correctly are obtained with prior art capping devices. Due to manufacturing tolerances the neck is not positioned exactly at the same position for every single package. Variations in neck position in production can be from less than 2 mm to several millimetres. There can be other variations for other types of packages. Moreover, a change from one package type to another can change the range of neck position variations. When a line of packages is conveyed to a cap dispenser and a cap tightening device, many times at high speed, such variations can result in deficient engagement between the neck and the cap and also deficient tightening of the cap onto the neck, leading to tilted caps or caps not being tightened properly.

[0006] The present invention relates to a device for applying a threaded cap to a threaded neck of a package, comprising a container conveyor for conveying the package in a travel direction, a package handling system for supporting the packages, a cap dispenser for supplying a cap to the neck of the package conveyed by the conveyor, and a cap tightening device having a rotating first cap tightening belt and a rotating second cap tightening belt arranged opposite to the first cap tightening belt for tightening the cap on the package neck by rotation, characterised in that the device comprises a neck position sensor for detecting a position of the neck in a lateral direction perpendicular to the travel direction of the package, that at least one motor is connected to the cap position sensor, and that the cap dispenser and the cap tightening device and/or the package handling system is laterally adjustable and connected to said motor for adjusting the relative position between the package handling system and the cap dispenser and the cap tightening device according to the detected position of the neck. Hence, the device according to the invention compensate automatically for any neck position variations between individual packages in a line of packages conveyed through the device, which results in a substantially reduced number of deficiently mounted caps.

[0007] The neck position sensor can be arranged for detecting the position of the neck in relation to a predetermined edge or side wall of the package in the lateral direction perpendicular to the travel direction of the package on the conveyor. For example, the neck position sensor is arranged for detecting a distance between the neck and the predetermined side wall of the package. Hence, an easy and reliable way of obtaining the lateral position of the neck is provided, wherein the cap dispenser, cap tightening device and/or package handling system efficiently can be adjusted in a corresponding way.

[0008] The first cap tightening belt can be connected to a first motor for alter-natingly operating the first cap tightening belt in a non-tightening first mode and in a cap tightening second mode. In the first mode the first cap tightening belt can be rotated in a direction and at a speed corresponding to the package handling system, and in the second mode the first cap tightening belt can be rotated in a reversed direction for tightening the cap. The second cap tightening belt can be connected to a second motor for alternatingly operating the second cap tightening belt in a non-tightening first mode and in a cap tightening second mode. In the first mode the second cap tightening belt can be rotated in a direction and at a speed corresponding to the package handling system, and in the second mode the second cap tightening belt can be rotated at a higher speed and in the same direction as in the first mode for tightening the cap. Hence, an efficient and precise tightening of the cap is achieved while re-

ducing any wear on the cap tightening belts.

[0009] The invention also relates to a method for applying a threaded cap to a threaded neck of a package, comprising the steps of

a) conveying a package in a travel direction by a conveyor, said package having a threaded neck,
b) detecting a position of said neck in a lateral direction perpendicular to the travel direction of the package on the conveyor,
c) by means of at least one motor adjusting a position of the package handling system and/or a cap dispenser and a cap tightening device in the lateral direction and thereby aligning the position of the neck and the position of the cap dispenser according to the detected position of the neck,
d) by means of the conveyor bringing the neck to engage the threaded cap in the cap dispenser and supplying the cap to the neck,
e) by means of the conveyor conveying the package carrying the cap into engagement with a rotating first cap tightening belt and a rotating second cap tightening belt arranged opposite to the first cap tightening belt, and
f) tightening the cap on the neck by rotating the first and second cap tightening belts.

[0010] Further characteristics and advantages of the present invention will become apparent from the description of the embodiments below, the appended drawings and the dependent claims.

SHORT DESCRIPTION OF THE DRAWINGS

[0011] The invention will now be described more in detail with the aid of embodiment examples and with reference to the appended drawings, in which

Fig. 1 is a schematic perspective view illustrating a part of a device for applying a cap to a package according to one embodiment of the present invention, in which a container conveyor, a package handling system, a part of a cap dispenser and a cap tightening device is illustrated schematically, and wherein two packages are illustrated in the device,

Fig. 2 is a schematic side view of a part of the device as illustrated in Fig. 1, partly in section and in which a part of the device has been removed, wherein packages are transported by means of the conveyor,

Fig. 3 is a schematic side view according to Fig. 2, illustrating a package passing the cap dispenser for supplying a cap onto the top of the package neck before tightening thereof in the cap tightening device,

Figs. 4 and 5 are schematic front views of a part of the device according to one embodiment, schematically illustrating packages having necks at different positions and lateral adjustment of the cap dispenser and cap tightening device in accordance with a detected neck position,

Figs. 6 and 7 are schematic front views of a part of the device according to an alternative embodiment, schematically illustrating packages having necks at different positions and lateral adjustment of the package handling system in accordance with the detected neck position,

Figs. 8 and 9 are schematic front views of a part of the device according to another alternative embodiment, schematically illustrating packages having necks at different positions and lateral adjustment of the cap dispenser, cap tightening device and the package handling system in accordance with the detected neck position,

Figs. 10-12 are schematic top views of the package handling system and the cap tightening device, illustrating the operation thereof according to one embodiment of the invention,

Figs. 13-15 are schematic top views of the cap tightening device and a package, illustrating the operation of the cap tightening device according to Figs. 10-12 more in detail,

Fig 16 is a schematic perspective view a part of the device for applying a cap to a package according to one embodiment, and

Fig. 17 is a schematic top view of a part of the device of Fig. 16.

THE INVENTION

[0012] Referring to Fig. 1 a device 10 for applying a threaded cap 11 to a threaded neck 12 of a package 13 is illustrated schematically. For example, the device 10 is arranged for applying caps 11 to packages 13, such as carton packages, plastic packages or packages of a combination of carton and plastic materials. For example, the packages 13 are packages for liquid foodstuff. According to one embodiment, the package 13 is formed with a flat top. Alternatively, the package 13 is formed with an inclined top or is a gable top package. For example, the cap 11 and neck 12 are of plastic materials. According to one embodiment the neck 12 is provided in the top of the package 13 and extends at least partially vertically. The neck 12 is, for example, formed as a closure spout.

[0013] The device 10 comprises a package handling system 14, a cap dispenser 15 and a cap tightening device 16. The package handling system 14 is arranged for supporting and transporting packages 13 in a travel di-

rection, such as a horizontal or substantially horizontal travel direction. The package handling system 14 is arranged for continuously supporting packages 13 along the package handling system 14, wherein the packages 13, e.g., are arranged with a gap between them and form a line of packages 13. In the illustrated embodiment the package handling system 14 comprises a rotating first belt 17 and an opposite rotating second belt 18 for engaging and supporting the packages 13. The first and second belts 17, 18 of the package handling system 14 are arranged for engaging opposite sides, such as opposite vertical sides, of the package 13. The first and second belts 17, 18 are mounted to pulleys 19 and are operated by one or more motors 20. For example, the pulleys 19 are rotated around vertical axes for transporting the packages 13 in a horizontal direction. The pulleys 19 are supported by a supporting structure 21, which is illustrated schematically in the drawings and which can be of various designs. In the illustrated embodiment the package bottoms are supported by a conveyor 22, such as a conventional conveyor for conveying the packages 13. The conveyor 22 is arranged as a rotating belt or similar moving the packages 13 in the travel direction. For example, the conveyor 22 rotates in the same speed as the first and second belts 17, 18 of the package handling system 14.

[0014] The cap dispenser 15 is arranged for supplying caps 11 to the necks 12 of the packages 13. In the illustrated embodiment the cap dispenser 15 comprises a chute 23 for feeding caps 11 to a cap supplying position, in which position packages 13 moving on the conveyor 22 and in the package handling system 14 engages the caps 11. The chute 23 is, for example, connected to conventional cap storage and cap aligning means, which are not illustrated in the drawings. The cap dispenser 15 of Fig. 1 is supported by a structure 24, which is illustrated schematically. In the embodiment of Fig. 1 the cap dispenser 15 is displaceable in relation to said structure 24, wherein a position of the cap dispenser 15 is adjustable by means of a motor 25.

[0015] The cap tightening device 16 is arranged for tightening caps 11 on the necks 12 of the packages 13 by rotating the caps 11. The cap tightening device 16 comprises a rotating first cap tightening belt 26 and a rotating second cap tightening belt 27 arranged opposite to the first cap tightening belt 26 for tightening the cap 11 on the package neck 12 by rotation. The first and second cap tightening belts 26, 27 are arranged for engaging the cap 11 and rotating the cap 11 of a package 13 being conveyed by the conveyor 22 and the package handling system 14. The first cap tightening belt 26 is driven by a first motor 28, such as a servomotor, and is, for example, mounted to a first set of pulleys 29. The second cap tightening belt 27 is driven by a second motor 30, such as a servomotor, and is, for example, mounted to a second set of pulleys 31. The first and second cap tightening belts 26, 27 are arranged in parallel to the first and second belts 17, 18 of the package handling system 14. For example, the first and second cap tightening belts 26, 27 are rotated around vertical axes. In the illustrated embodiment, the cap tightening device 16 is connected to the cap dispenser 15, wherein the cap tightening device 16 is adjustable in the lateral direction perpendicular to the travel direction of the packages 13 together with the cap dispenser 15. Alternatively, the cap tightening device 16 is supported by a separate structure and is, for example, adjustable in the lateral direction separate from the cap dispenser 15.

[0016] The device 10 comprises a neck position sensor 32 for detecting a position of the neck 12. The sensor 32 is, for example, a camera, a photocell or any other suitable type of device for detecting the position of the neck 12. The sensor 32 is arranged for detecting a position of the neck 12 in a lateral direction perpendicular to a travel direction of the package 13 on the conveyor 22 and in the package handling system 14. In the embodiment of Fig. 1 the sensor 32 is connected to the motor 25 of the cap dispenser 15, wherein the position of the cap dispenser 15 is adjusted by means of the motor 25 according to the detected position of the neck 12, which is described in more detail below. Also the position of the cap tightening device 16 is adjusted according to the detected position of the neck 12, wherein the cap tightening device 16 is aligned with the cap dispenser 15. For example, the position of the cap tightening device 16 is always adjusted according to the position of the cap dispenser 15.

[0017] With reference to Figs. 2 and 3 packages 13 are conveyed in the travel direction by means of the conveyor 22 and the package handling system 14, which travel direction is illustrated by means of the arrow A in Figs. 2 and 3. The conveyor 22 and the package handling system 14 is arranged for conveying the packages 13 continuously in the travel direction A, e.g. at a constant speed. The conveyor 22 and the package handling system 14 is arranged for conveying a single line of packages 13, so that one single package 13 at a time passes the sensor 32 and so that one single package 13 at a time passes the cap dispenser 15 and the cap tightening device 16. For example, packages 13 are conveyed continuously and pass the cap dispenser 15 at short intervals and are tightened at short intervals by means of the cap tightening device 16.

[0018] During transport along the conveyor 22 and the package handling system 14 a first package 13a passes the sensor 32, wherein the position of the neck 12 of the first package 13a passing the sensor 32 is detected. Then, the relative position between the first package 13a and the cap dispenser 15 and the cap tightening device 16 is adjusted if required. Hence, the sensor 32 is arranged for detecting the position of the neck 12 before the first package 13a reaches the cap supplying position of the cap dispenser 15. After detecting the position of the neck 12 and after adjusting the relative position between the first package 13a and the cap dispenser 15 and the cap tightening device 16, the neck 12 engages

a cap 11 and, by further movement of the first package 13a in the travel direction A, pulls a cap 11 from the cap dispenser 15, wherein a cap 11 is applied on the top of the neck 12 without being tightened onto the neck 12, which is illustrated in Fig. 3. For example, the cap 11 is tilted or inclined in relation to the neck 12, wherein a front edge of the neck 12 of the first package 13a travelling in the travel direction A is brought into contact with an inner surface of the cap 11, wherein the cap 11 is removed from the cap dispenser 15 and falls down on the neck 12, so that the cap 11 is carried by the neck 12. Then, the package 13 with the cap 11 being carried on the top of the neck 12 is conveyed to the cap tightening device 16, wherein the cap 11 is tightened by rotation by means of the first and second belts 26, 27. Then, the first package 13a is finished and exits the cap tightening device 16 for further handling. After the first package 13a exits the cap tightening device 16, the relative position between a second package 13b, the second package 13b being conveyed consecutively after the first package 13a, and the cap dispenser 15 and the cap tightening device 16 is adjusted according to the detected position of the neck 12 of the second package 13b by means of the sensor 32. Hence, the first package 13a is provided with a cap 11, which cap 11 is also tightened in the cap tightening device 16 before the second package 13b is provided with a cap 11. Alternatively, the cap tightening device 16 is arranged adjustable separate from the cap dispenser 15, wherein the second package 13b can be provided with a cap 11 prior to the first package 13a exiting the cap tightening device 16. Hence, one single package 13 at a time is conveyed through the cap tightening device 16, after which the relative position between the next package 13 and the cap dispenser 15 and/or cap tightening device 16 is adjusted according to the detected position of the neck 12 of the package to be provided with a cap 11.

[0019] According to one embodiment the relative position between the package 13 to be provided with a cap 11 and the cap dispenser 15 and the relative position between said package 13 and the cap tightening device 16 is adjusted a predetermined period of time after detecting the position of the neck 12 by means of the sensor 32. Hence, the position of the next package 13b can be detected while the first package 13a is provided with a cap 11 or while the cap 11 is tightened on the neck 12 of the first package 13a. Any offset between the position of the neck 12 of the first package 13a and the position of the neck 12 of the second package 13b is accounted for by lateral displacement of the second package 13b in relation to the cap dispenser 15 and the cap tightening device 16, such as by lateral displacement of the package handling system 14, or by lateral displacement of the cap dispenser 15 and the cap tightening device 16 in relation to the second package 13b, such as in relation to the package handling system 14. Hence, the neck 12 of the second package 13b is aligned with the cap dispenser 15 and the cap tightening device 16, even though the position of the neck 12 of the second package 13b may vary from the neck position of the first package 13a.

[0020] With reference to Figs. 4 and 5 tightening of the cap 11 of the first and second packages 13a, 13b is illustrated, wherein tightening of the cap 11 of the first package 13a is illustrated in in Fig. 4 and tightening of the cap 11 of the second package 13b is illustrated in Fig. 5. After detecting the position of the neck 12 of the first package 13a by means of the sensor 32, the position of the cap dispenser 15 and the cap tightening device 16 are, if required, adjusted in the lateral direction according to the detected position of the neck 12, which is illustrated by means of the arrow B in Fig. 4. Hence, the cap dispenser 15 and the cap tightening device 16 are displaceable in a direction perpendicular to the travel direction A of the packages 13 conveyed by the conveyor 22 and the package handling system 14. In the illustrated embodiment the cap tightening device 16 is supported by the cap dispenser 15 and is adjustable along therewith. As illustrated schematically in Figs. 4 and 5 the cap dispenser 15 supporting the cap tightening device 16 is movably connected to the structure 34 through an elongated slot 33 extending perpendicular to the travel direction A and the package handling system 14, wherein the cap dispenser 15 is movable in the slot 33 by means of the motor 25. Of course, in view of the teachings of this disclosure a skilled person would be able to design a structure 24 supporting the cap dispenser 15 in a plurality of different ways.

[0021] According to one embodiment the sensor 32 is arranged for detecting the position of the neck 12 in relation to a predetermined side wall 34 of the package 13, wherein a distance between the neck 12 and the side wall 34 is obtained. For example, a distance between the centre of the neck 12 or the edge of the neck 12 and the side wall 34 is obtained by measurement and/or calculation of data obtained from the sensor 32. For example, the device 10 comprises control means 35 for handling data from the sensor 32 and, if required, adjusting the position of the cap dispenser 15 by means of the motor 25. For example, the position of the package side wall 34 is fixed and determined by the package handling system 14, such as the position of one of the package handling system belts 17, 18. For example, the relative lateral adjustment between the package 13 and the cap dispenser 15 is less than 3 mm, such as 0.1-3 mm, 0.5-3 mm, 0.5-2 mm, 1-3 mm or 1-2 mm to compensate for manufacturing tolerances related to the neck position of the packages 13. Alternatively, the relative lateral adjustment between the package 13 and the cap dispenser 15 is up to 50 mm, such as 1-50 mm or 1-30 mm to adjust the lateral relative positions of the package 13 and the cap dispenser 15, e.g., for packages 13 having an off-centre neck 12 and being fed in random positions on the conveyor 22 to the cap dispenser 15.

[0022] With reference to Fig. 5 the second package 13b is conveyed through the cap tightening device 16 consecutively after the first package 13a, so that the sec-

ond package 13b is next to the first package 13a on the conveyor 22 and in package handling system 14. Hence, the second package 13b is the next package after the first package 13a in a line of packages conveyed on the conveyor 22 and in package handling system 14. After or during tightening of the first package 13a in the cap tightening device 16 the position of the neck 12 of the second package 13b is detected by the sensor 32. After the first package 13a exits the cap tightening device 16 the position of the cap dispenser 15 is adjusted laterally according to the detected position of the neck 12 of the second package 13b, which is illustrated by means of the arrow C in Fig. 5. The lateral adjustment of the cap dispenser 15 takes place automatically and is effected by means of the sensor 32, the control means 35 and the motor 25. Hence, the position of the neck 12 is detected for each individual package 13 in consecutive order when a line of packages 13 continuously conveyed by the conveyor 22 and the package handling system 14 in the travel direction A pass the sensor 32. Then, the position of the cap dispenser 15 and the cap tightening device 16 is adjusted, if required, for each individual package 13 in the lateral direction perpendicular to the travel direction in accordance with the detected position of the neck 12 of the package 13 to be provided with a cap 11.

[0023] With reference to Figs. 6 and 7 an alternative embodiment is disclosed, in which the package handling system 14 is adjustable in the lateral direction according to the detected position of the neck 12 of the package 13 to be provided with a cap 11, so that the package 13 is aligned with the cap dispenser 15 and the cap tightening device 16. In Fig. 6 the first package 13a is illustrated in the cap tightening device 16. The package handling system 14 is movably guided in tracks 36 or similar, which is illustrated schematically in the drawings, wherein the package handling system 14 is displaceable along the tracks 36 in a direction perpendicular to the travel direction A of the packages 13, which is illustrated by means of the arrows D in Fig. 6. For example, each of the package handling system belts 17, 18 are movably supported by a supporting structure 37 through the tracks 36, so that the position of the package handling system 14 can be adapted to the position of the neck 12 of the package 13 to be provided with a cap. Then, subsequent to tightening of the cap 11 of the first package 13a, the package handling system 14 is adjusted laterally by means of motors 38 and according to the detected position of the neck 12 of the second package 13b, which is illustrated by means of the arrows E in Fig. 7 to align the package 13 with the cap dispenser 15 and the cap tightening device 16. Of course, in view of this disclosure a skilled person is able to design a suitable supporting structure and drive for lateral adjustment of the package handling system 14. For example, the first and second belts 17, 18 could be supported by a single structure and adjustable by a single motor.

[0024] With reference to Figs. 8 and 9 another alternative embodiment is disclosed, wherein the package handling system 14 and the cap dispenser 15 and the cap tightening device 16 are laterally adjustable, which is illustrated in Fig. 8 by means of the arrows B and D. In Fig. 8 a first package 13a is illustrated passing through the cap tightening device 16. When the cap 11 of the first package 13a has been tightened and has left the cap tightening device 16 by means of the conveyor 22 and the package handling system 14, the package handling system 14 and the cap dispenser 15 are adjusted according to the detected position of the neck 12 of the second package 13b. The cap tightening device 16 is adjustable together with the cap dispenser 15 or separately. Hence, the package handling system 14 and the cap dispenser 15 are adjusted according to the position of the neck 12 detected by the sensor 32. The cap dispenser 15 and the cap tightening device 16 are adjusted in a first direction, wherein the package handling system 14 is adjusted in an opposite second direction perpendicular to the travel direction A of the packages 13. A part of any lateral offset between the neck position of the first package 13a and the neck position of the second package 13b is adjusted for by the cap dispenser 15, which is illustrated by means of the arrow F, and the remaining part of said offset is adjusted for by the package handling system 14, which is illustrated by means of the arrows G, to align the neck 12 of the second package 13b with the cap dispenser 15 and the cap tightening device 16.

[0025] With reference to Figs. 10-12 the operation of the package handling system 14 and the cap tightening device 16 is illustrated schematically. With reference to Figs. 13-15 the operation of the cap tightening device 16 is illustrated more in detail. In the illustrated embodiment, the first and second belts 17, 18 of the package handling system 14 are continuously operated at the same speed and in opposite directions, which is illustrated by means of the arrows H and I, for conveying the packages 13 arranged between the first and second belts 17, 18 in the travel direction A at a constant speed. Alternatively, the package handling system 14 is operated intermittently and/or at a varying speed. For example, the conveyor 22 is operated at the same speed as the package handling system 14.

[0026] The cap tightening device 16 is operable in a first mode as illustrated in Figs. 10, 12, 13 and 15, and a second mode as illustrated in Figs. 11 and 14. Hence, the mode of operation of the cap tightening device 16 is variable, so that the mode of operation can be changed by means of the first and second motors 28, 30, respectively, between the first and second modes. In the first mode the first and second cap tightening belts 26, 27 are operated at the same speed and in opposite directions, which is illustrated by means of the arrows J and K, for conveying the caps 11 arranged between the first and second cap tightening belts 26, 27 in the travel direction A at the same speed as the package handling system 14, so that the cap 11 is transported in the travel direction A without being tightened. Hence, in the first mode the first cap tightening belt 26 is rotated at the same speed

and in the same direction as the first belt 17 of the package handling system 14, wherein the second cap tightening belt 27 is rotated at the same speed and in the same direction as the second belt 18 of the package handling system 14.

[0027] For tightening the cap 11 on the neck 12 of a package 13 the first and second cap tightening belts 26, 27 are operated by means of the first and second motors 28, 30, respectively, in the second mode. Hence, for tightening the cap 11 the mode of operation is switched from being operated by the first and second motors 28, 30 in the first mode to being operated by the first and second motors 28, 30 in the second mode. For example, when a package 13 has entered the cap tightening device 16 and is engaged by the first and second cap tightening belts 26, 27 the first and second motors 28, 30 are changed from first mode operation to second mode operation. For example, the mode of operation is switched from the first mode to the second mode a predetermined time after detecting the neck position by the sensor 32 or by means of a separate detector, which is not illustrated in the drawings.

[0028] In the second mode the first cap tightening belt 26 is operated in the opposite direction as in the first mode, which is illustrated by the arrow L in Figs. 11 and 14. Hence, in the second mode the first cap tightening belt 26 is rotated in the opposite direction as in the first mode by means of the first motor 28. Simultaneously, in the second mode the second cap tightening belt 27 is operated in the same direction as in the first mode but at higher speed, which is illustrated by the arrow M in Figs. 11 and 14. Hence, in the second mode the second cap tightening belt 27 is rotated in the same direction and at a higher speed as in the first mode by means of the second motor 30.

[0029] In the second mode the speeds of the first and second cap tightening belts 26, 27 are adapted to each other so as to tighten the cap 11 without any of the cap tightening belts 26, 27 sliding on the cap 11. According to the illustrated embodiment, in the second mode the first cap tightening belt 26 is rotated at a speed which is slower than the speed in the first mode. Hence, according to the illustrated embodiment, the speed and direction of rotation of the first cap tightening belt 26 is changed when the mode of operation is changed between the first and second modes of operation, wherein only the speed of the second cap tightening belt 27 is changed when the mode of operation is changed between the first and second modes of operation. In the tightening second mode the speed of the second cap tightening belt 27 is higher than the speed of the conveyor 22. In the tightening second mode the speed of the first cap tightening belt 26 is, for example, lower than or similar to the speed of the conveyor 22.

[0030] In the illustrated embodiment, when the cap 11 of a package 13 enters between the first and second cap tightening belts 26, 27 the cap tightening device 16 is operated in the first mode, wherein the cap 11 is transported in the travel direction A at the same speed as the package 13 without any tightening of the cap 11, which is illustrated in Fig. 13. The first and second cap tightening belts 26, 27 engage the cap 11 and rotate in opposite directions and at the same speed so as to convey the cap 11 along with the package 13 conveyed by the conveyor 22 and the package handling system 14. Then, the operation of the cap tightening device 16 is switched to the second mode, which is illustrated in Fig. 14, wherein the rotation direction of the first cap tightening belt 26 is reversed and the rotation speed is lowered, and wherein the rotation speed of the second cap tightening belt 27 is increased with maintained rotation direction. In the second mode the first cap tightening belt 26 rotates in the same direction as the second cap tightening belt 27. Hence, the cap 11 is rotated as illustrated by the arrow N in Fig. 14. When a predetermined tightening torque has been reached the operation is switched to the first mode, as illustrated in Fig. 15, wherein the cap 11 again is transported along with the package 13 without any rotation of the cap 11. For example, the first and second motors 28, 30 are configured to sense a change of torque applied to the first and second cap tightening belts 26, 27, respectively, for example as a change in voltage. When the cap 11 is tightened the torque is increased and the voltage is increased correspondingly, wherein the mode of operation is changed when a predetermined voltage has been reached. When the predetermined voltage has been reached the cap tightening device is switched from the second mode to the first mode of operation, wherein the first motor 28 changes direction and speed and the second motor 30 changes speed to correspond to the package travel speed. After the cap 11 of the package 13 has left the cap tightening device 16 and no longer engages the first and second cap tightening belts 26, 27 the cap 11 of the next package 13 on the conveyor 22 enters the cap tightening device 16 for the cap 11 to be tightened.

[0031] With reference to Figs. 16 and 17 another embodiment is illustrated, wherein the cap dispenser 15 is laterally displaceable through a pivot 39 or similar, so that the cap dispenser 15, the chute 23 or at least a free end of the chute 23 is rotatable around the pivot 39 as illustrated by means of the arrow O in Fig 17 for displacement of the cap supplying position of the cap dispenser 15 in the lateral direction by means of the motor 25. The motor 25 is connected to the sensor 32, wherein the position of the cap dispenser 15 is adjustable according to the detected position of the neck 12. The cap dispenser 15 or the chute 23 is, for example, connected to conventional cap storage and cap aligning means, which are not illustrated in the drawings, through the pivot 39. For example, the pivot comprises a vertical axis of rotation. In the illustrated embodiment, the cap tightening device 16 is supported separately from the dap dispenser 15 by means of a supporting structure 40, which is illustrated in Fig. 16, wherein the cap tightening device 16 is laterally adjustable in the supporting structure 40 by means of a

motor 41. The motor 41 is, for example, connected to the sensor 32, wherein the cap tightening device 16 is displaceable perpendicular to the travel direction A, which is illustrated by means of the arrow P in Fig. 17, according to the detected position of the neck 12. Alternatively, the position of the cap tightening device 16 is adjusted according to the position of the cap dispenser 15. For example, the cap dispenser 15 and the cap tightening device 16 are arranged so that they always are aligned. The lateral adjustment of the cap dispenser 15 and the cap tightening device 16 is, for example, synchronized, so that the position of the cap tightening device 16 and the cap dispenser 15 are adjusted according to the detected position of the package neck 12. In the embodiment of Figs. 16 and 17 the conveyor 22, the package handling system 14 and the cap tightening belts 26, 27 can be arranged as described above with reference to other embodiments. Features of different embodiments can be combined as suitable.

Claims

1. A device (10) for applying a threaded cap (11) to a threaded neck (12) of a package (13), comprising a package conveyor (22) for conveying the package (13) in a travel direction (A), a package handling system (14) for supporting the package on the conveyor (22), a cap dispenser (15) for supplying a cap (11) to the neck (12) of a package (13) conveyed by the conveyor (22), and a cap tightening device (16) having a rotating first cap tightening belt (26) and a rotating second cap tightening belt (27) arranged opposite to the first cap tightening belt (26) for tightening the cap (11) on the package neck (13) by rotation, ***characterised*** **in**

   that the device (10) comprises a neck position sensor (32) for detecting a position of the neck (12) in a lateral direction perpendicular to the travel direction (A) of the package (13),
   that at least one motor (25, 38, 41) is connected to the cap position sensor (32), and
   that the cap dispenser (15) and cap tightening device (16) and/or the package handling system (14) is adjustable and connected to said motor (25, 38, 41) for adjusting the relative position between the package handling system (14) and the cap dispenser (15) and the cap tightening device (16) according to the detected position of the neck (12).

2. A device according to claim 1, wherein the cap tightening device (16) is laterally adjustable separately from the cap dispenser (15).

3. A device according to claim 1 or 2, wherein the neck position sensor (32) is arranged for detecting the position of the neck (12) in relation to a predetermined side wall (34) of the package (13) in the lateral direction perpendicular to the travel direction (A) of the package (13) on the conveyor (22), and wherein the position of the package handling system (14) in relation to the cap dispenser (15) is adjustable according to the detected position of the neck (12).

4. A device according to claim 3, wherein the neck position sensor (32) is arranged for detecting a distance between the neck (12) and the predetermined side wall (34) of the package (13).

5. A device according to any of the preceding claims, wherein the cap dispenser (15) is arranged between the neck position sensor (32) and the cap tightening device (16).

6. A device according to any of the preceding claims, wherein the first cap tightening belt (26) is connected to a first motor (28) for alternatingly operating the first cap tightening belt (26) in a first mode and in a second mode, wherein in the first mode the first cap tightening belt (26) is rotated in a direction and at a speed corresponding to the package handling system (14), and in the second mode the first cap tightening belt (26) is rotated in an opposite direction for tightening the cap (11), and wherein the second cap tightening belt (27) is connected to a second motor (30) for alternatingly operating the second cap tightening belt (27) in a first mode and in a second mode, wherein in the first mode the second cap tightening belt (27) is rotated in a direction and at a speed corresponding to the package handling system (14), and in the second mode is rotated at a higher speed in the same direction for tightening the cap (11).

7. A device according to claim 6, wherein the first and second motors (28, 30) are arranged to change from the first mode to the second mode a predetermined period of time after detecting the position of the neck (12).

8. A device according to claim 6 or 7, wherein the first and second motors (28, 30) are arranged to measure torque and to change from the second mode to the first mode when a predetermined tightening torque of the cap (11) is reached.

9. A method for applying a threaded cap (11) to a threaded neck (12) of a package (13), comprising the steps of

   a) conveying a package (13) in a travel direction (A) by a conveyor (22), said package having a threaded neck (12),
   b) detecting a position of said neck (12) in a lateral direction perpendicular to the travel direc-

tion (A),

c) by means of at least one motor (25, 38, 41) adjusting a position of a package handling system (14) and/or a cap dispenser (15) and a cap tightening device (16) and thereby aligning the position of the neck (12) and the position of the cap dispenser (15) and the cap tightening device (16) according to the detected position of the neck (12),

d) by means of the conveyor (22) bringing the neck (12) to engage the threaded cap (11) in the cap dispenser (15) and supplying a cap (11) to the neck (12),

e) by means of the conveyor (22) conveying a single package (13) carrying the cap (11) into engagement with a rotating first cap tightening belt (26) and a rotating second cap tightening belt (27) arranged opposite to the first cap tightening belt (26), and

f) tightening the cap (11) on the neck (12) by rotating the first and second cap tightening belts (26, 27).

10. A method according to claim 9, comprising the step of adjusting the cap tightening belts (26, 27) in the lateral direction corresponding to the adjustment of the cap dispenser (15).

11. A method according to claim 9 or 10, comprising the steps of detecting the position of the neck (12) in relation to a predetermined side wall (34) of the package (13), and adjusting the position of the package handling system (14) and/or cap dispenser (15) and cap tightening device (16) in relation to each other according to the detected position of the neck (12).

12. A method according to claim 11, comprising the step of detecting a distance between the neck(12) and the predetermined side wall (34) of the package (13), and adjusting the position of the package handling system (14) in relation to the cap dispenser (15) and the cap tightening device (16) according to the detected distance.

13. A method according to any of claims 9-12, comprising the steps of rotating the first and second cap tightening belts (26, 27) in a non-tightening first mode, wherein the first and second cap tightening belts (26, 27) are rotated in a direction and at a speed corresponding to the package handling system (14), and then rotating the first and second belt tightening belts (26, 27) in a cap tightening second mode, wherein the first cap tightening belt (26) is rotated in a reversed direction as in the first mode, and wherein the second cap tightening belt (27) is rotated at a higher speed but in the same direction as in the first mode.

14. A method according to claim 13, comprising the steps of changing from the first mode to the second mode a predetermined period of time after detecting the position of the neck (12) and changing from the second mode to the first mode when a predetermined tightening torque of the cap (11) is reached.

15. A method according to any of claims 9-14, comprising the steps of

conveying a line of packages (13) on the conveyor (22),

detecting the neck position of a first package (13a), if required, adjusting the relative position between the package handling system (14) and the cap dispenser (15) according to the detected position of the neck (12) of the first package (13a), and adjusting a position of the first and second cap tightening belts (26, 27) of the cap tightening device (16) according to the position of the cap dispenser (15),

providing the neck (12) of the first package (13a) with a cap (11) by conveying the first package (13a) into engagement with a cap (11) in the cap dispenser (15),

conveying the first package (13a) to the first and second cap tightening belts (26, 27), bringing the cap (11) into engagement therewith, tightening the cap (11) of the first package (13a), and disengaging the cap (11) of the first package (13a) from the first and second cap tightening belts (26, 27),

detecting the position of the neck (12) of a second package (13b) being conveyed next to the first package (13a) on the conveyor (22), and

if required, adjusting the relative position between the package handling system (14) and the cap dispenser (15) and the cap tightening device (16) according to the detected position of the neck (12) of the second package (13b) after the cap (11) of the first package (13a) has been disengaged from the first and second cap tightening belts (26, 27).

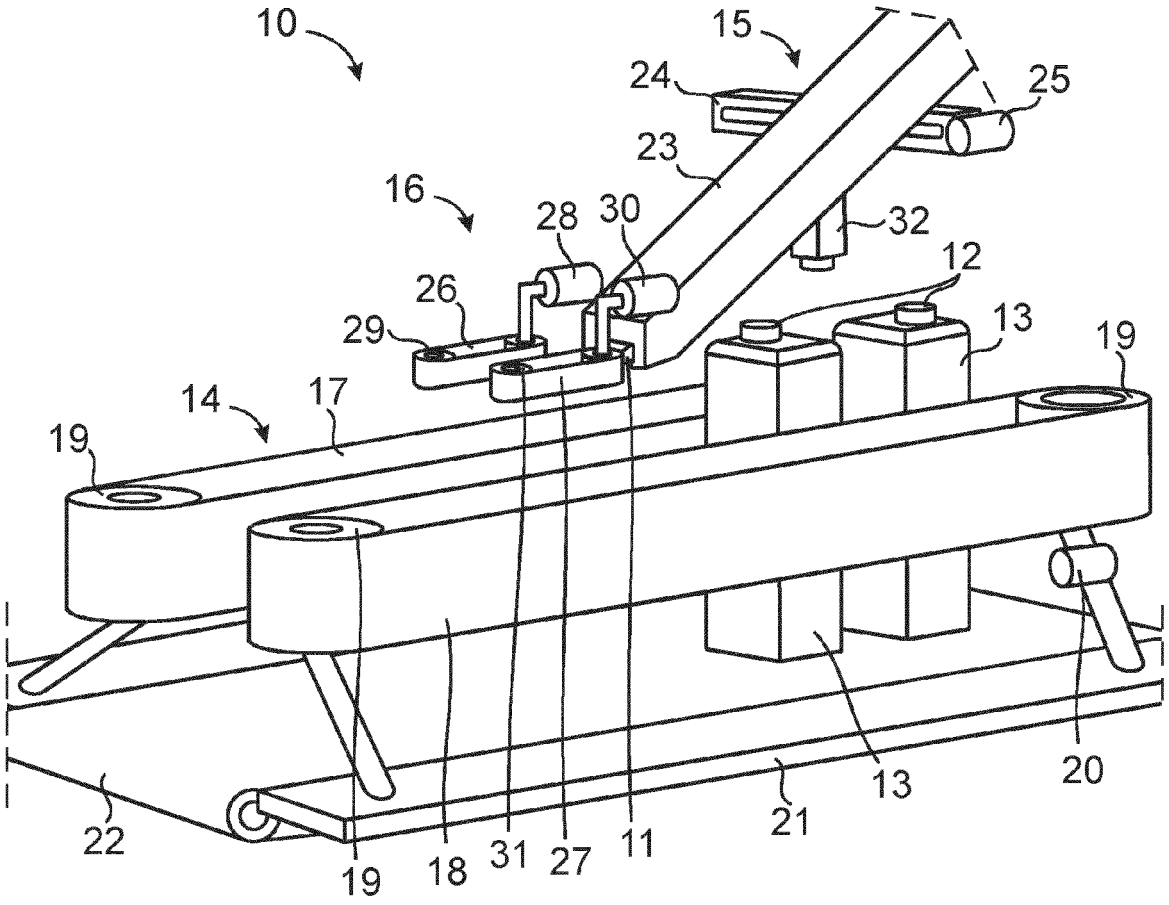
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Fig. 1

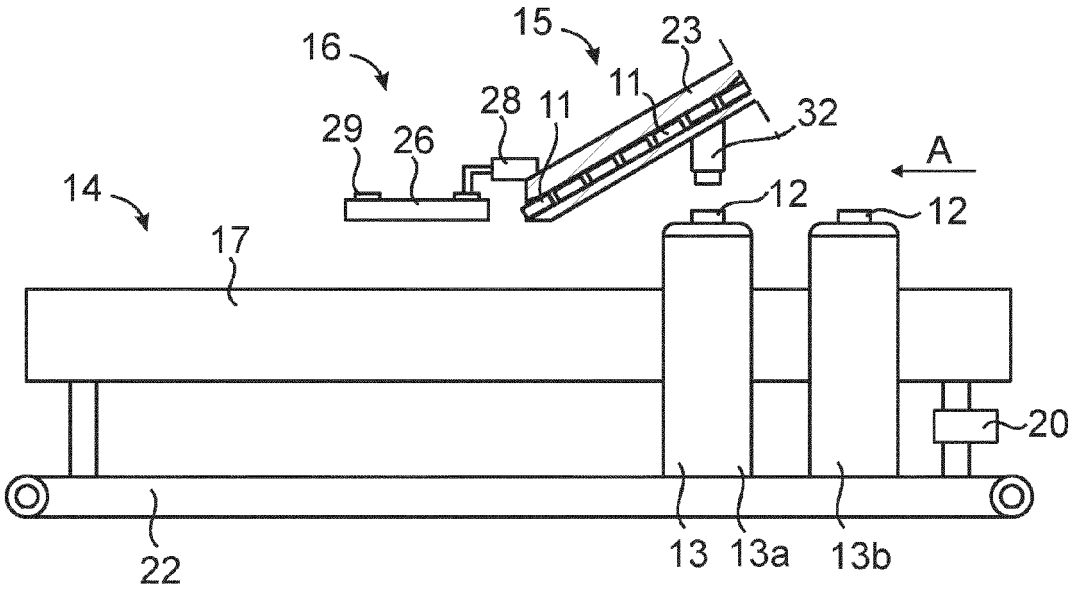
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Fig. 2

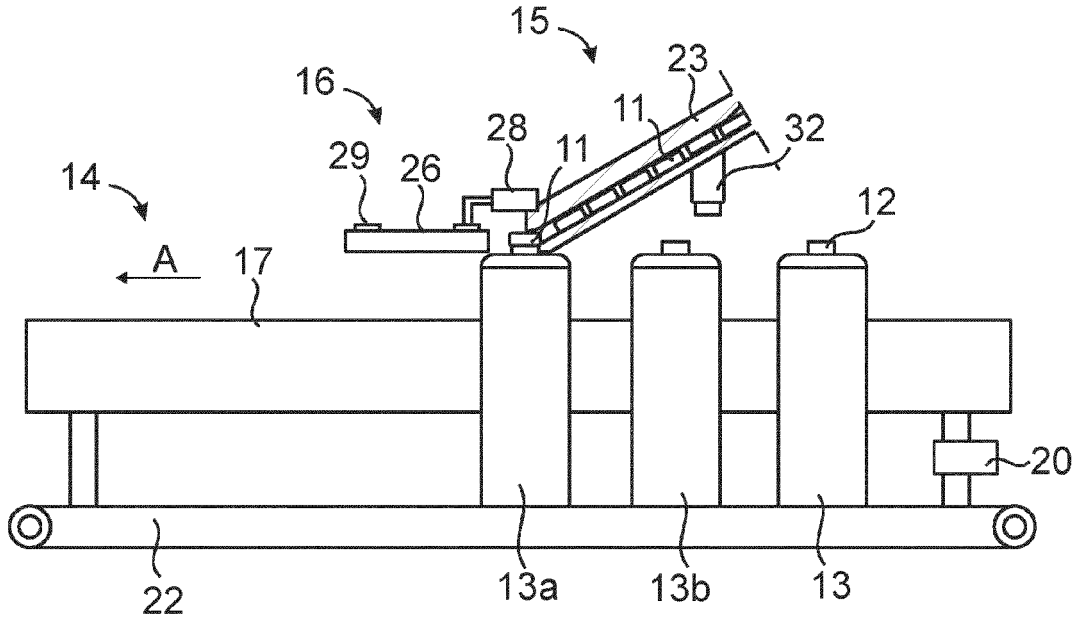
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Fig. 3

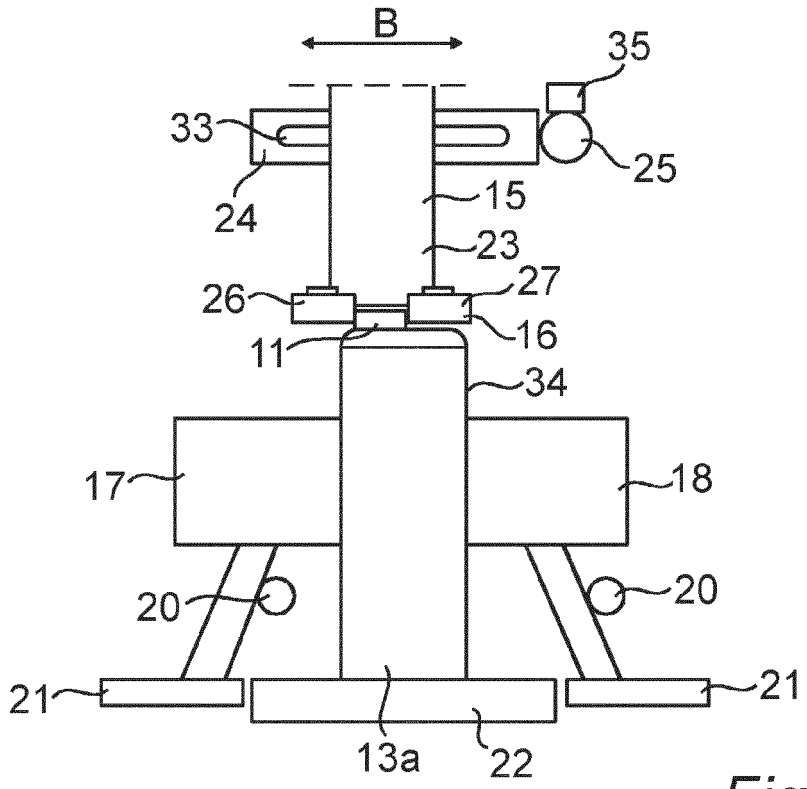
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Fig. 4

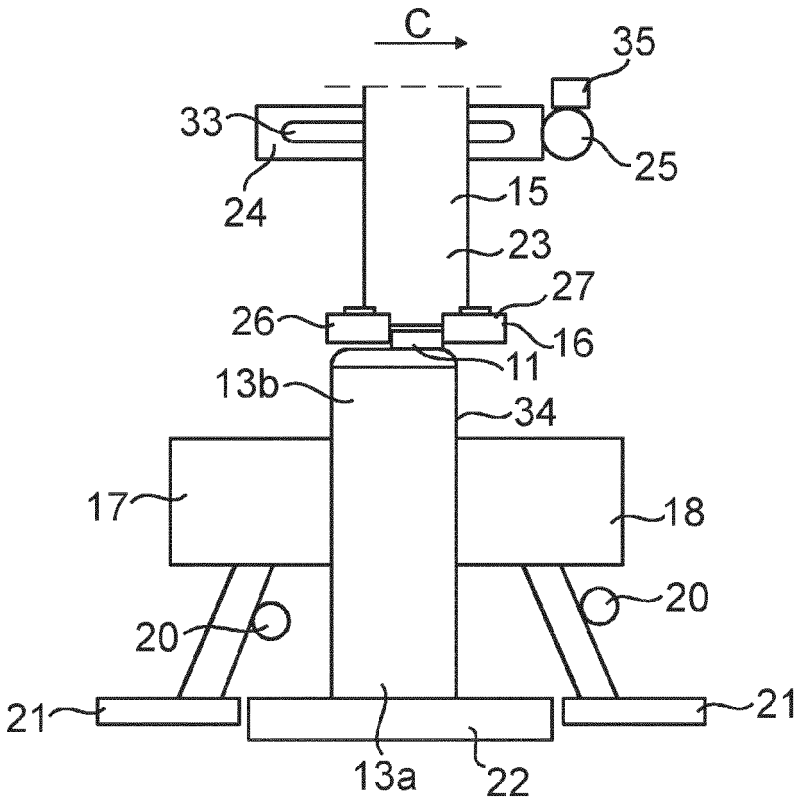
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Fig. 5

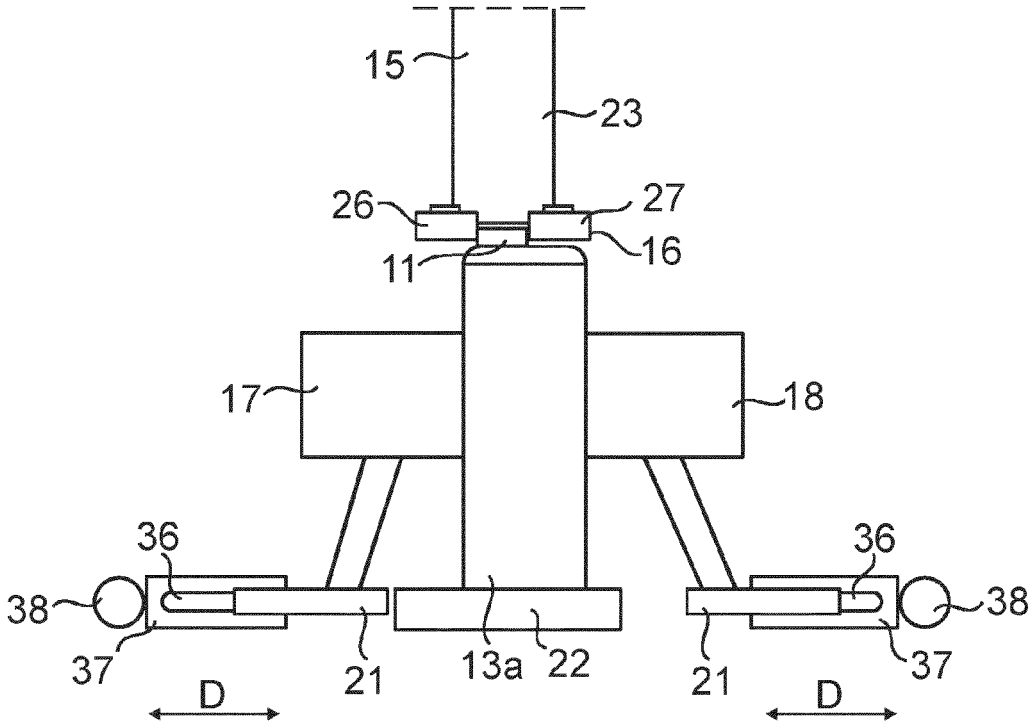
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Fig. 6

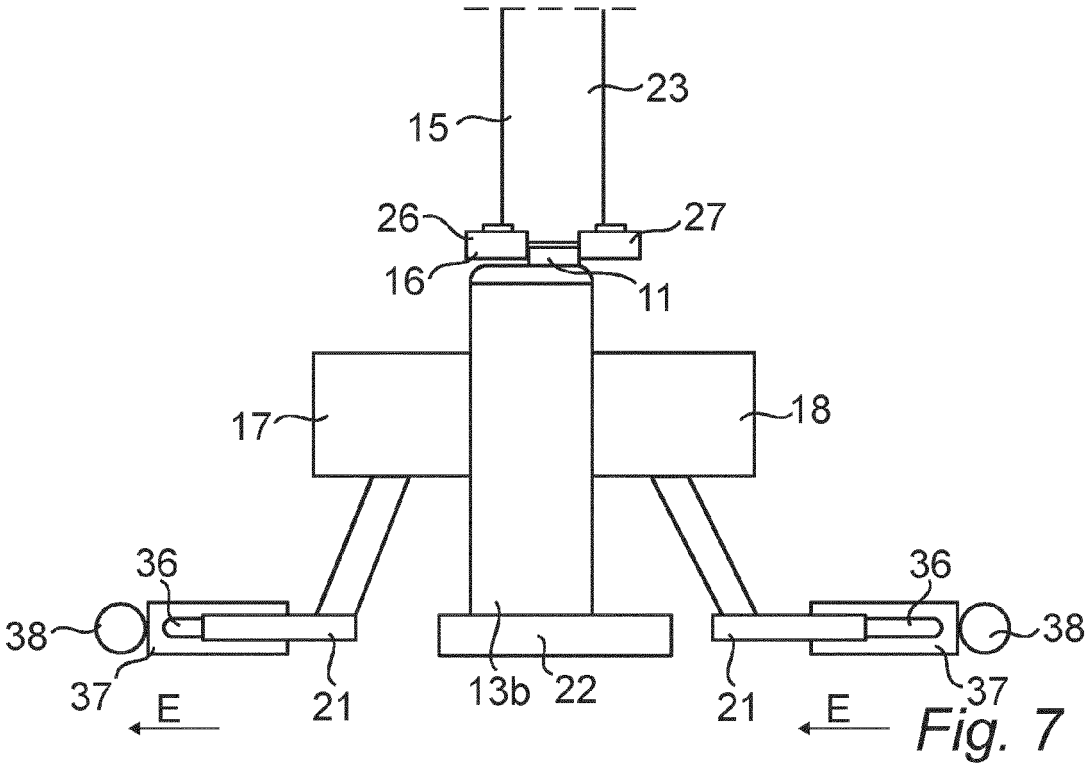
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Fig. 7

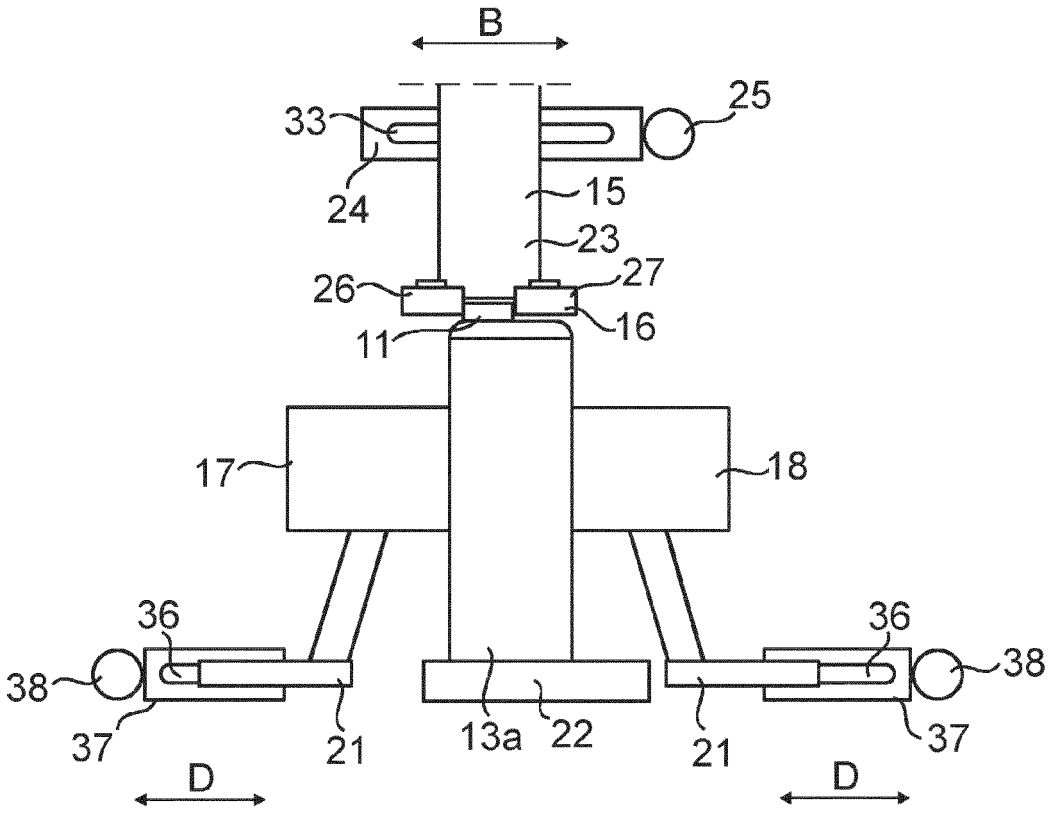
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Fig. 8

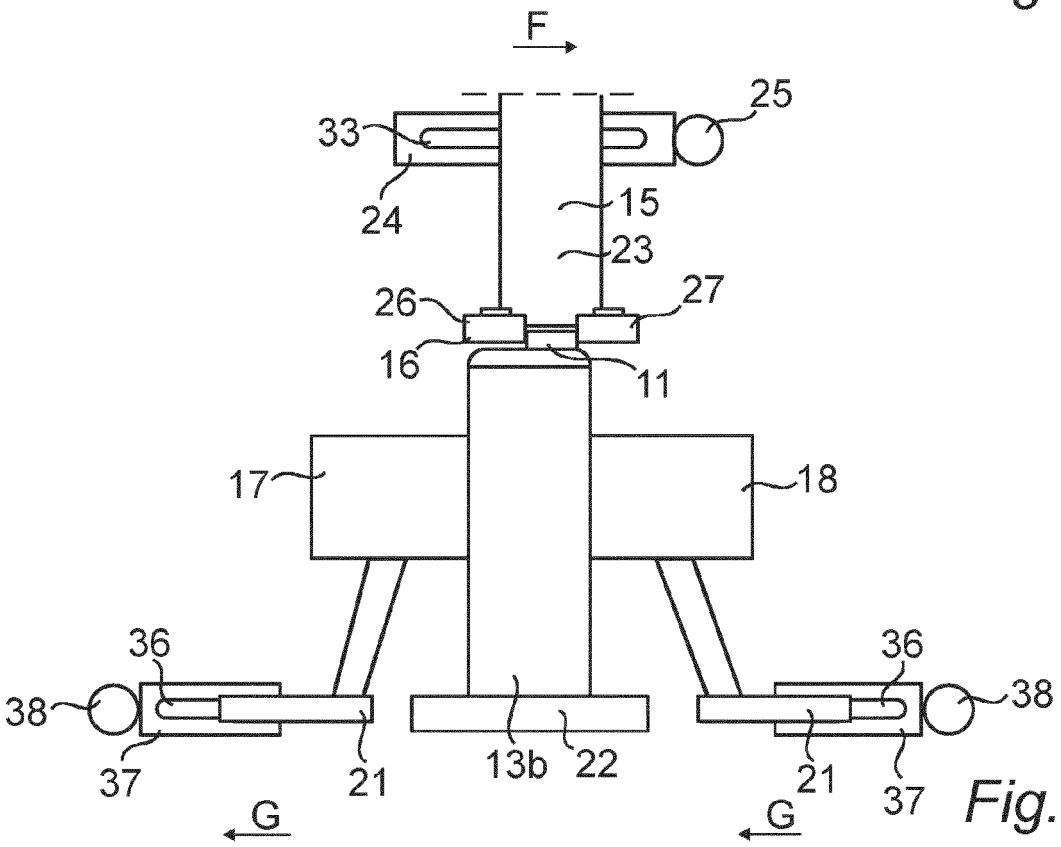
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Fig. 9

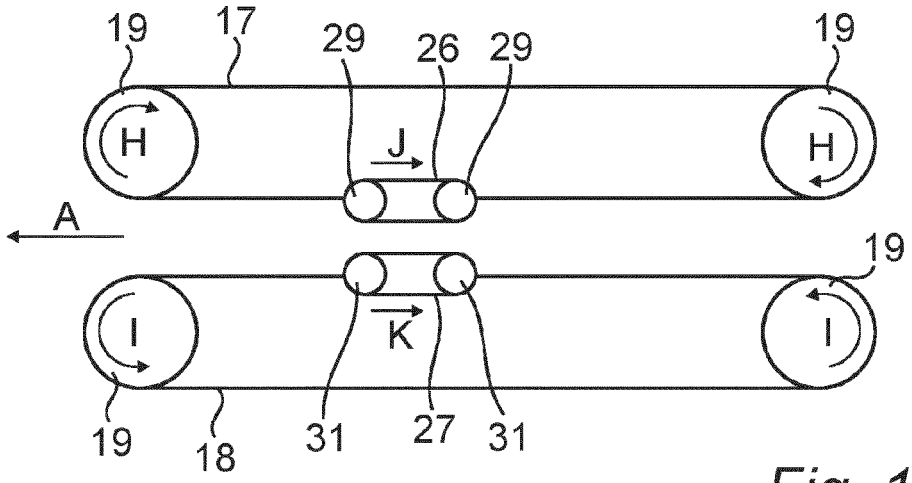

Fig. 10

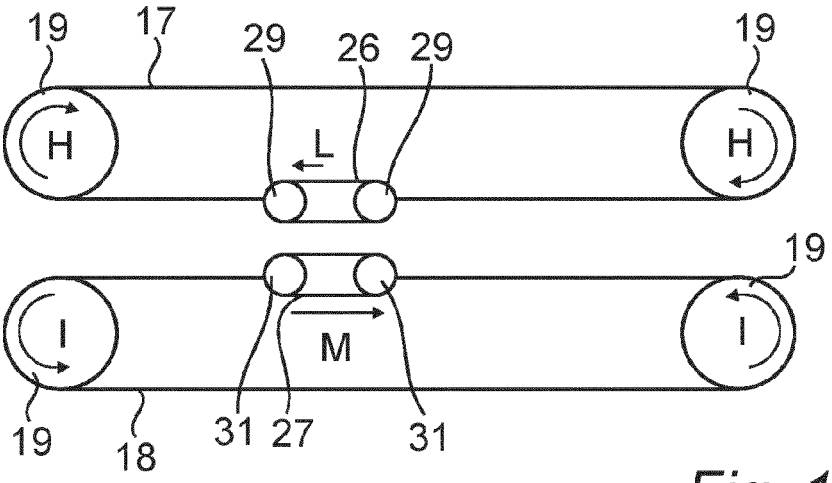

Fig. 11

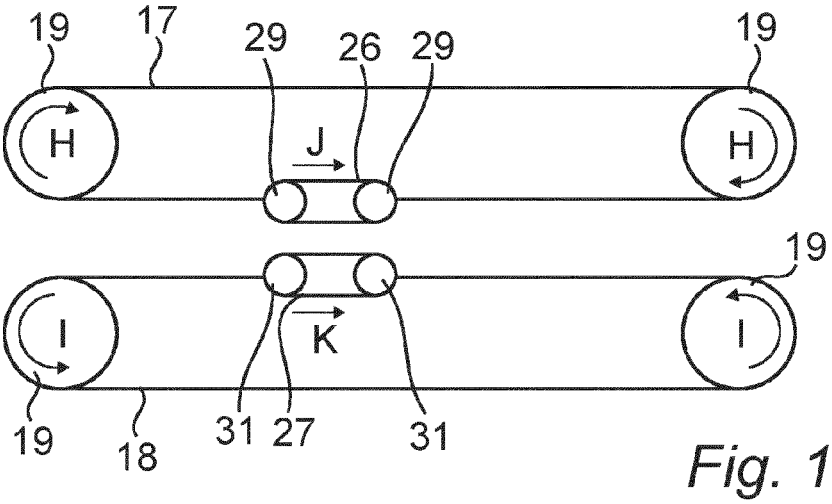

Fig. 12

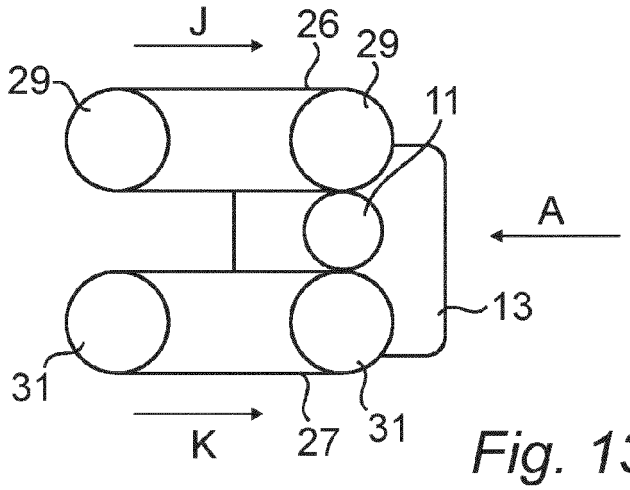

Fig. 13

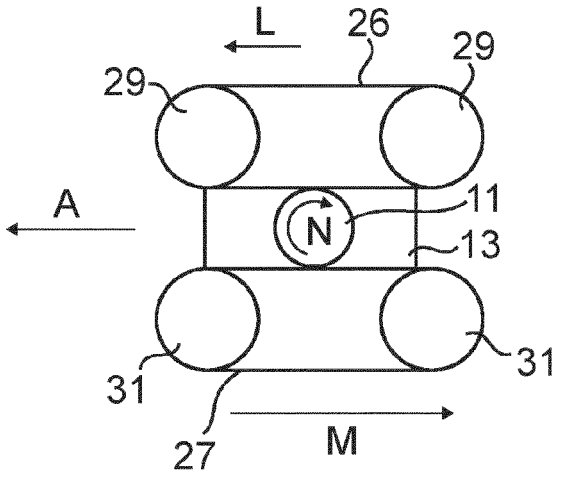

Fig. 14

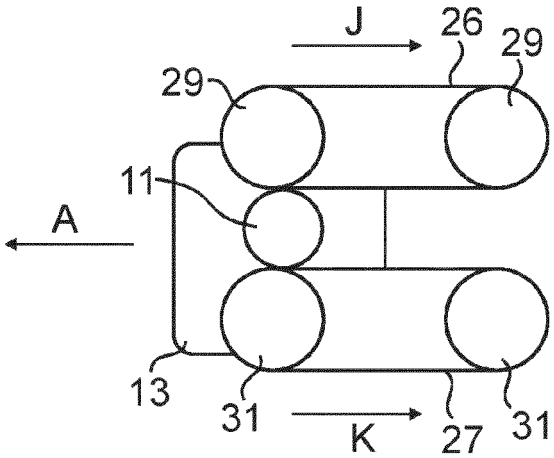

Fig. 15

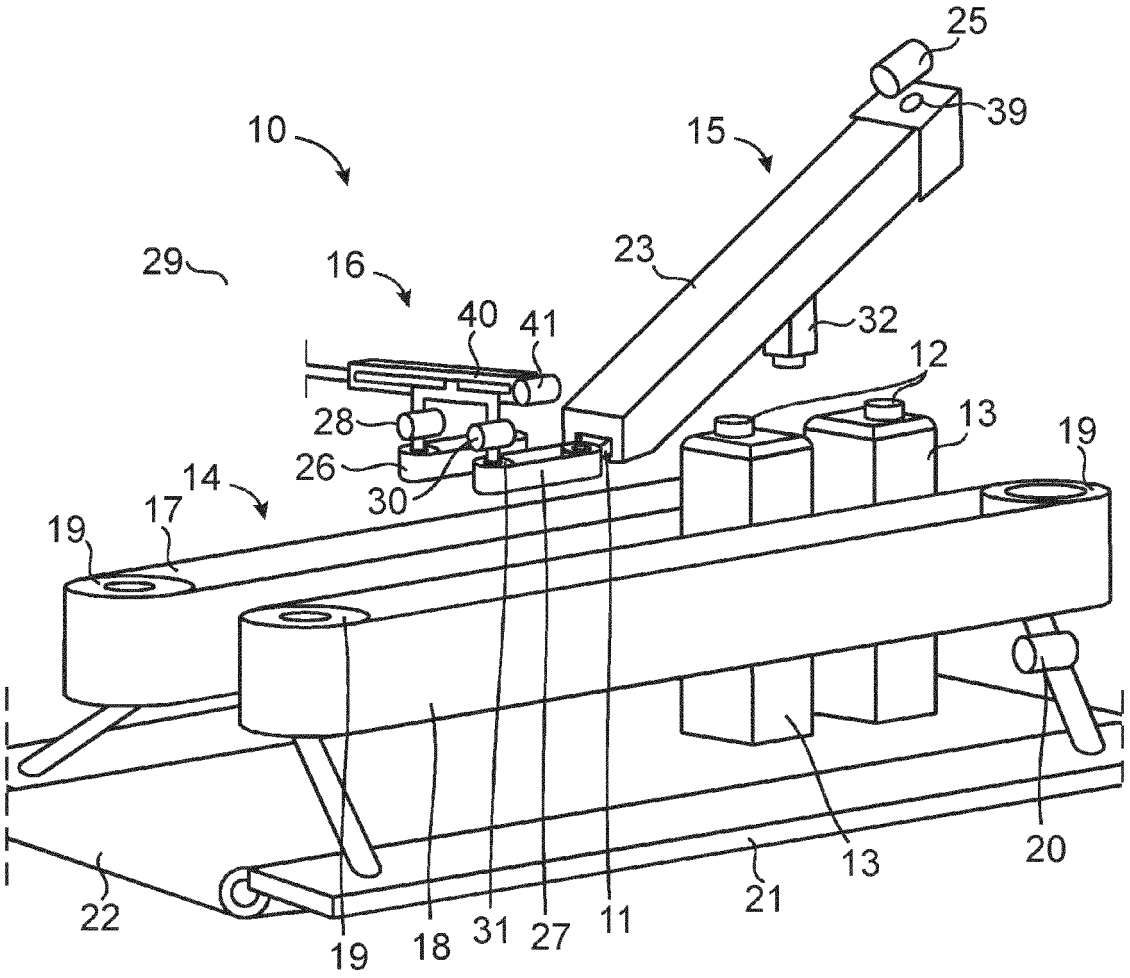
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Fig. 16

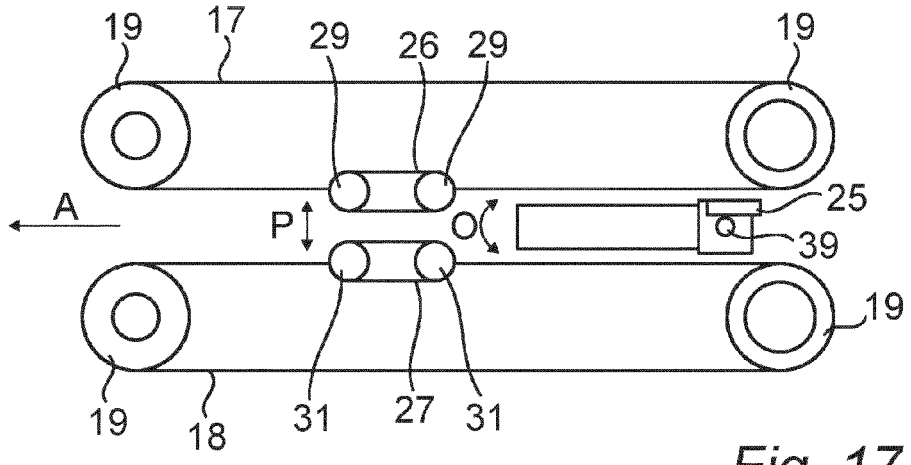
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Fig. 17

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EUROPEAN SEARCH REPORT

Application Number
EP 14 19 6690

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2007/193226 A1 (JALBERT LUC [CA]) 23 August 2007 (2007-08-23) * paragraphs [0035] - [0037], [0046], [0047], [0051]; figures 2, 5-7 *	1,2, 6-10,13, 14	INV. B67B3/20 B65B7/28 B67B3/26
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A	EP 1 215 123 A1 (TETRA LAVAL HOLDINGS & FINANCE [CH]) 19 June 2002 (2002-06-19) * paragraphs [0012] - [0014], [0031], [0032], [0035]; figures 1-5 *	1-5, 9-12,15	
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			B67B B65B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	21 May 2015	Luepke, Erik

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