

KNIFE FOR A FILLING MACHINE, CUTTING DEVICE COMPRISING SAID KNIFE AND KIT OF PARTS COMPRISING SAID KNIFE

5 **Field of the invention**

The invention relates to a knife in a filling machine for food packages. The invention also relates to a cutting device comprising said knife, a kit of parts comprising said knife, and a method of operating a filling machine using said knife.

10 **Background of the invention**

In the production of liquid food packages, one commonly employed method utilises a vertical longitudinally sealed tube of laminated carton-based packaging material. This tube is filled with liquid beverage or food, and a jaw system seals the tube transversally to form pillow packages. These packages are subsequently separated from the tube of packaging
15 material using a knife that cuts in the transversal seal of the packages. Sometimes it is also wanted to provide the transversal seal with a perforation, and to sell a chain of packages being interconnected by such perforations. However, current methods are not optimal from a quality and flexibility point of view.

In CN101108542A, a perforation knife is shown which is adapted for providing
20 perforations with varying length, by controlling the depth of the perforation stroke. This knife is also modified in a central area, for creating more perforation in the area of a longitudinal seal of a package, see Fig. 12. In Fig. 10, a cutting edge of a typical perforation knife is shown that is used for making perforations. This knife has a continuous sharp edge which has gaps therein, which are typically created by grinding away portions at
25 regular intervals. In Fig. 11, a cutting edge of another known perforation knife is shown, having sharpened tips which are pushed to a predetermined depth into the material to be perforated.

Summary of the invention

30 The present invention provides a solution for providing liquid food packages, manufactured in a tube, with a perforation in a flexible and controllable way according to claim 1.

According to a first aspect of the invention, a knife is provided for a filling machine for manufacturing packages from a continuous tube, said knife comprising a serrated edge
35 having a portion with teeth of a first profile being configured to either perforate or completely sever the transversal seal of said tube, depending on the maximum stroke of the

knife during cutting. In this way, it is possible to use one knife for either cutting or perforating the packaging material in a suitable way.

According to another aspect of the invention, a portion of the serrated edge cutting a longitudinal seal of the tube is provided with teeth of a second profile, for completely
5 severing the longitudinal seal during a perforation stroke.

According to another aspect of the invention, a cutting device is provided comprising a knife according to one or several aspects of the invention.

According to yet another aspect of the invention, a kit of parts is provided comprising a knife according to at least one aspect of the invention, and a control device
10 comprising a cam with a contact surface, and an actuator, said actuator being operable for moving the position of the contact surface of the cam for changing the maximum stroke of a cutting device of a filling machine.

Further aspects of the invention are given by the dependent claims.

All features described in connection with any aspect of the invention can be used
15 with any other aspect of the invention.

Brief description of the drawings

The invention will be further described with reference to a specific embodiment, as shown in the drawings in which:

20 Figs. 1 and 2 show a top view of a knife according to one aspect of the invention,

Fig. 3 shows an enlarged view of a portion of the knife according to one aspect of the invention,

Fig. 4 shows an enlarged view of another portion of the knife according to one aspect of the invention,

25 Fig. 5 shows a cross-sectional view of a serrated edge according to one aspect of the invention,

Fig. 6 shows a knife and a tube of packaging material in their relative position prior to cutting, according to one aspect of the invention,

30 Figs. 7a and 7b show plan views of a control device for the knife according to one aspect of the invention,

Figs. 8 and 9 show sectional views of a cutting device, according to one aspect of the invention, and

Figs. 10 to 12 show prior art perforation knives.

Detailed description of the invention

35 Figs. 1 and 2 show a knife 10 for a sealing jaw in a filling machine, such as Tetra Pak® A1, for producing liquid food packages, wherein the knife 10 is utilized to separate a

continuous tube of packaging material and product into individual packages, in connection with the sealing of said tube, such as transversal sealing. The knife 10 is typically made from a stainless steel plate 11, indicated in Fig. 1, having a thickness t of about 0.75 mm. The plate 11 has an oblong rectangular shape, having a front long side 12, a back long side 13, and left 14 and right 15 short sides, as viewed from above. Machining of the plate 11 will form a knife body 21 with different features of the knife.

The knife 10 is typically manufactured by grinding out the main profile of the knife, for forming the profile of the back long side 13, and for forming a cutting edge 22 in the front long side 12.

The back long side 13 of the knife 10 is provided with projections, which serve to provide sufficient strength around first and second mounting holes 24, 25, while other areas at the back long side 13 have been ground away to reduce weight. The first mounting hole 24 is circular, while the second mounting hole 25 is elongated, allowing for manufacturing tolerances and also allows some thermal expansion of the knife 10.

The front long side 12 is provided with a double-bevelled sharpened edge 22. Teeth of a first profile 22a of the cutting edge 22 are seen enlarged in Fig. 3. The distance between adjacent tips of the teeth, for the first profile 22a, is designated D , and the distance from a tip and an adjacent valley, measured in the travel direction of the knife, is designated H . The teeth of the first profile 22a are ground to have a distinct tip angle α when seen perpendicularly from the plane of the knife 10. Typical measurements of the first profile 22a are $D = 3.5$ mm, or 2.5 mm $< D < 4.5$ mm, $H = 2.0$ mm, or 1.5 mm $< H < 2.5$ mm, and the angle $\alpha = 75.7^\circ$, or $65^\circ < \alpha < 85^\circ$.

Teeth of a second profile 22b of the sharpened edge 22 have a typical serrated edge, with wave-shaped design and a distance d between sharp tips of the teeth, see Fig. 4. The distance between the tip of the teeth and the adjacent valley, measured in the travel direction of the knife, is designated h for the second profile 22b. When this profile 22a has entered the distance h into the packaging material, it begins to sever the packaging material completely. The second profile 22b is configured to cut the material, and not to perforate. Typical measurements of the second profile 22b are $d = 1.75$ mm, or 1.25 mm $< d < 2.25$ mm, and depth $h = 0.55$ mm, or 0.35 mm $< h < 0.75$ mm.

As can be seen in Fig. 2, the sharpened edge 22 comprises three areas having the second profile 22b, and two areas having the first profile 22a, where the second profile 22b is for cutting and the first profile 22a is for perforating. However, the first profile 22a is ground all the way into the valleys, such that they are also sharp, meaning that also the first profile 22a can be used for completely severing the packaging material, if the stroke is long enough.

In one embodiment, the distance d between the sharp tips in the second profile 22b is half of the distance D between the sharp tips of the first profile 22a. In the embodiment shown in Fig. 2, the sharp tips of both profiles 22a, 22b are all located along a common straight line, meaning that all teeth cut into the packaging material simultaneously.

5 The sharpened edge can be seen in cross-section in Fig. 5. Both profiles 22a, 22b share the same bevel geometry, where the bevel angle β is about 40 degrees, and the edge is symmetrical around a symmetry line. The bevel angle β may be $35^\circ < \beta < 45^\circ$.

The second profile 22b of the knife is configured to always cut completely through the packaging material, and the first profile 22a can either perforate or cut, depending on the stroke of the knife 10. The knife 10 is hence configured to be used in a method for
10 either making a perforated cut or a complete severing cut, depending on the stroke of the cut, and this method is used in a filling machine for making chains of packages of variable length, being interconnected by perforations.

In Fig. 6, the knife 10 can be seen as it would be mounted in the filling machine
15 (other parts of the sealing jaw being hidden for clarity reasons) in relation to a tube 40 of packaging material to be cut. The tube 40 has a transversal seal 41, being made in a previous operation by a separate sealing means, either in an upstream device or integrated with the device holding the knife 10. The tube 40 further has a longitudinal seal 42, extending along the entire tube 40 and being made continuously in an upstream device.

20 As can be seen in Fig. 6, the knife 10 is configured to have the second profile 22b of the sharpened edge 22 located at the position of the longitudinal seal 42 of the tube. This means that the area of the longitudinal seal, where the thickness is increased due to overlapping edges of packaging material, is always cut through completely, according to one aspect of the invention. In another aspect of the invention, the knife 10 is configured to
25 have the profile 22a at either lateral end of the transversal seal 41, and this may facilitate tearing and may be wanted for some packaging material specifications.

In Figs. 7a and 7b, a control device 50 is shown which can be used for varying the stroke of the knife 10. The control device 50 comprises a holder 51, a pneumatic cylinder 52, being pivotally attached to the holder 51, and a cam 53, being eccentrically journaled
30 to a frame (not shown) of the filling machine around a pivot axis 54. The eccentric 54 is provided with a circular outer contact surface 55, intended to control the movement of the knife 10 during operation. In Fig. 7a, the pneumatic cylinder 52 is retracted, and in Fig. 7b, the pneumatic cylinder is extended. The extended cylinder rotates the cam 53 around the pivot axis 54, such that the circular contact surface 55 is moved laterally, to the right in
35 Fig. 7b, where a start position of the circular surface 55 is shown with a dashed line. An end of the pneumatic cylinder 52 is attached to the cam 53, and this end performs a circular

motion. This tilts the pneumatic cylinder slightly, which then pivots around the pivot point of the holder.

In Fig. 8, a typical cutting device 80 is shown for operating a knife 10 in a filling machine. The cutting device 80 comprises a cam follower 81, having a cam surface 82, facing away from the location of the knife. The device further comprises a pusher 83, holding the knife 10. The pusher 83 has a pusher head 84 which is spring-biased against the cam follower 81. When the cam follower 81 pushes on the pusher head 84, the pusher 83 with the knife 10 is pushed fully through cutting jaw 60 and into a slot in the sealing jaw 61, passing a centre line 62 in which the compressed packaging material tube will be located, during sealing and/or cutting.

The cam 53 can be seen schematically in Fig. 8 in a relative position in which the cam follower 81 will make contact with the contact surface 55 of the cam 53. Normally, the sealing jaw 61 and cutting jaw 60, carrying the cutting device 80, will move downwardly while making a transversal seal of the packaging material tube, and will then pass the substantially stationary cam 53. The contact surface 55 will interact with the cam surface 82 of the cam follower 81, and will start pushing the pusher 83 and the knife 10 through the packaging material and into the slot of the sealing jaw 61.

In Fig. 9, the position of the cam follower 81 and the cam surface 82 is shown in dashed lines at the position of maximum stroke of the knife. By using the control device 50, as seen in Figs. 7a and 7b, it is possible to change the position of the cam 53 and its contact surface 55, such that the maximum stroke of the knife 10 is varied. In one aspect of the invention, two distinct strokes are envisioned which correspond to a) full severing of the transversal seal (maximum stroke) and b) a perforation stroke, in which the packaging material tube is not fully cut. The depth of the perforation stroke can, in another aspect of the invention, be varied to suit different packaging material specifications, and for thus ensuring a perforation that is easy to tear. This is achieved by varying the stroke of the pneumatic cylinder.

With the new cutting device, it is now possible to operate the filling machine for producing package chains of varying length. If a chain of six packages is wanted, the control device 50 is operated to place the cam 53 at a position corresponding to a perforation cut for five consecutive packages, and the cam 53 is then moved to the second position in which the knife 10 will completely sever the transversal seal. This will result in a chain of six packages being held together by five perforations in the middle of the transversal seals. If a chain is wanted with more or less packages, this is easily changed from the operator module.

In Fig. 2, the knife 2 is shown having one central portion with teeth of the second profile 22b, a portion with teeth of the first profile 22a on either side thereof, and teeth of

the second profile 22b towards the lateral ends of the knife 10. However, it is possible that the knife 10 only has a central part with teeth of the first profile 22a, and one portion with teeth of the first profile 22a on either side thereof, i.e. not having teeth of the second profile 22b at the lateral ends of the knife 10.

5 The cam 53 having a contact surface 55 can in another aspect of the invention be replaced by another cam which position can be changed by an actuator of a similar kind to the pneumatic cylinder.

A kit of parts comprising the knife 10 and a control device 50 according to above can be fitted into existing filling machines, for introducing the technology as described above.

10 The present invention also relates to a method of operating a filling machine, comprising the steps of a) adjusting a control device 50 to a first position, corresponding to a perforation cut, b) making a pre-determined number X of perforation cuts, c) adjusting the control device (50) to a second position, corresponding to a severing cut, d) making a severing cut, in order to create a chain of packages comprising X+1 packages.

15 Whilst the invention has been described with reference to a preferred embodiment, it will be appreciated that various modifications are possible within the scope of the invention.

In this specification, unless expressly otherwise indicated, the word 'or' is used in the sense of an operator that returns a true value when either or both of the stated conditions is met, as opposed to the operator 'exclusive or' which requires that only one of the conditions is met. The word 'comprising' is used in the sense of 'including' rather than in to mean 'consisting of'. All prior teachings acknowledged above are hereby incorporated by reference.

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Claims

1. Knife (10) for a filling machine for manufacturing packages from a continuous tube (40) of packaging material, said knife (10) comprising a serrated edge (22) having a
5 portion with teeth of a first profile (22a) being configured to either perforate or completely sever the transversal seal (41) of said tube (40), depending on the maximum stroke of the knife (10) during cutting.
2. Knife (10) according to claim 1, wherein the serrated edge (22) further comprises a
10 portion with teeth of a second profile (22b) for completely severing an area of the transversal seal (41).
3. Knife (10) according to claim 2, wherein a portion of the serrated edge (22),
intended for cutting an area where the longitudinal seal (41) crosses the transversal seal
15 (42) of the tube (40), is provided with teeth of the second profile (22b).
4. Knife (10) according to claim 2 or 3, wherein an area of the serrated edge (22)
cutting a lateral edge of the transversal seal (41) is provided with teeth of the second
20 profile (22b).
5. Knife (10) according to any of claims 2-4, wherein a distance (D) between teeth of
the first profile (22a) is twice as large as a distance (d) between teeth of the second profile
(22b).
- 25 6. Knife (10) according to any of claims 2-5, wherein a distance (H) from the tip of
the teeth to the valleys thereof for teeth with the first profile (22a) is at least three times
larger than a corresponding distance (h) for teeth with the second profile (22b).
7. Knife (10) according to any previous claim, wherein an tip angle (α) of the tips of
30 the teeth with the first profile (22a), as seen perpendicularly from the plane of the knife
(10), is between 65° and 85°.
8. Knife (10) according to any previous claim, wherein the distance (D) between
adjacent teeth of the first profile (22a) is between 2.5 and 4.5 mm, or between 3 and 4 mm.
35
9. Knife (10) according to any claims 2-8, wherein tips of teeth of the first profile
(22a) and the second profile (22b) are located along a straight line.

10. Cutting device in a filling machine, comprising a knife (10) according to any previous claim.

11. Cutting device according to claim 10, further comprising a cam (53) with a contact surface (55), a cutting device (80) having a pusher (83) acting on the knife (10), and a control device (50) for moving the cam (53) such that the maximum stroke of the knife (10) is varied.

12. Cutting device according to claim 10, wherein the cam (53) is eccentrically journaled around an axis (54) of a frame of the filling machine, and an actuator (52) turns the cam (53) such that the contact surface (55) is moved.

13. Kit of parts comprising a knife (10) according to any of claim 1 to 9, and a control device (50) comprising a cam (53) with a contact surface (55), and an actuator (52), said actuator (51) being operable for moving the position of the contact surface (55) of the cam (53) for changing the maximum stroke of a cutting device (80) of a filling machine.

14. Method of operating a filling machine having a knife (10) according to any previous claim, comprising the steps of

- a. adjusting a control device (50) to a first position, corresponding to a perforation cut,
- b. making a pre-determined number X of perforation cuts, during production of packages,
- c. adjusting the control device (50) to a second position, corresponding to a severing cut,
- d. making a severing cut,

in order to create a chain of packages comprising X+1 packages.

15. Method according to claim 14, wherein the step of adjusting the control device (50) is carried out by a pneumatic cylinder (52) acting on an eccentrically journaled cam (53).

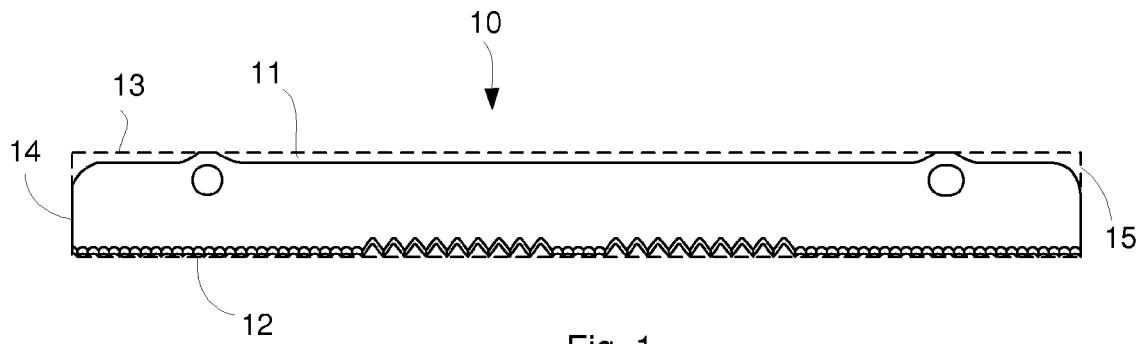


Fig. 1

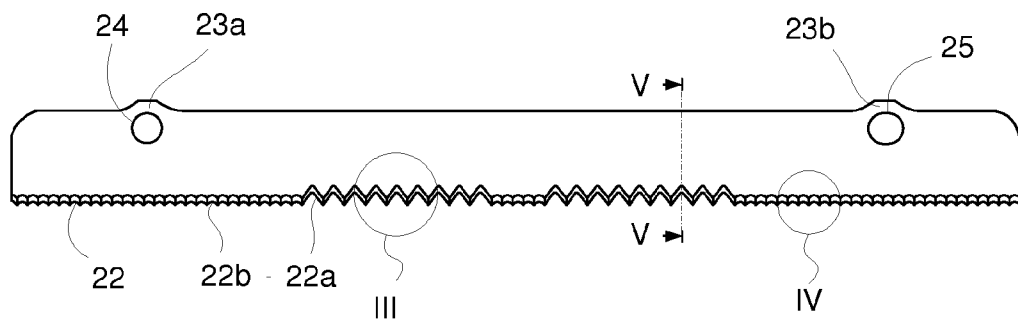


Fig. 2

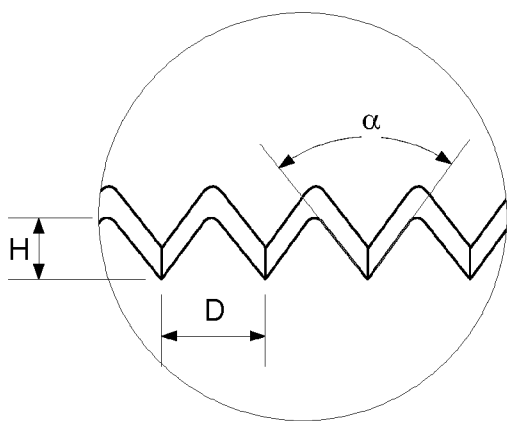


Fig. 3

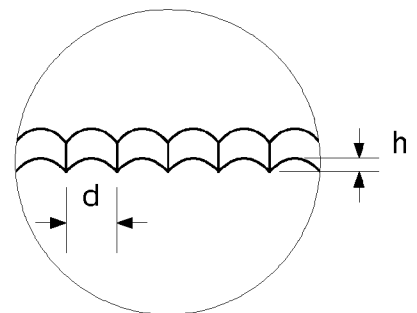


Fig. 4

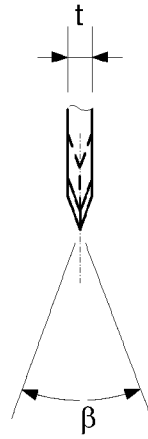


Fig. 5

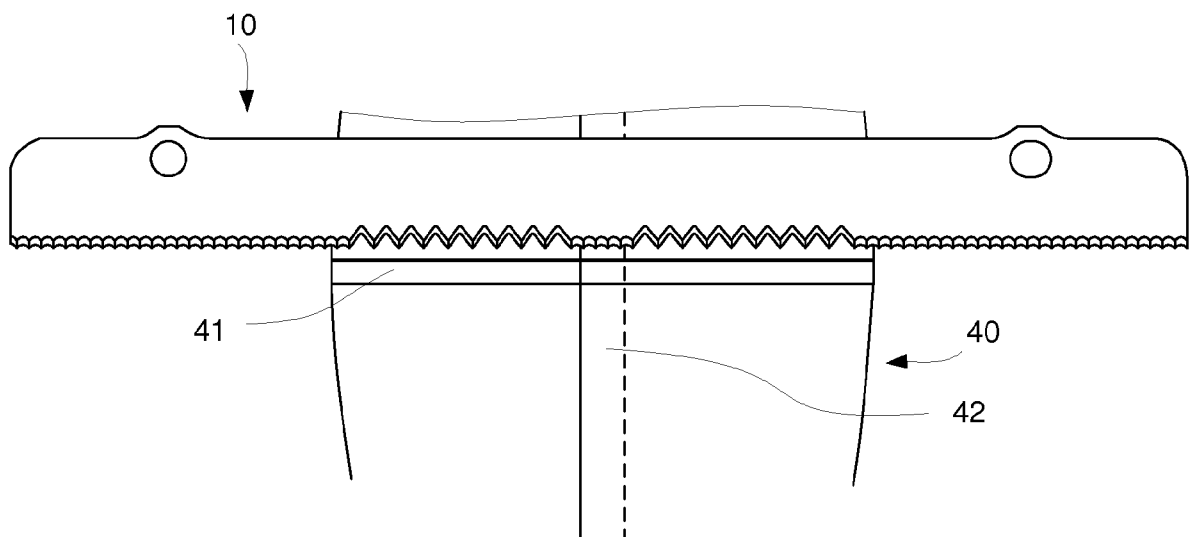


Fig. 6

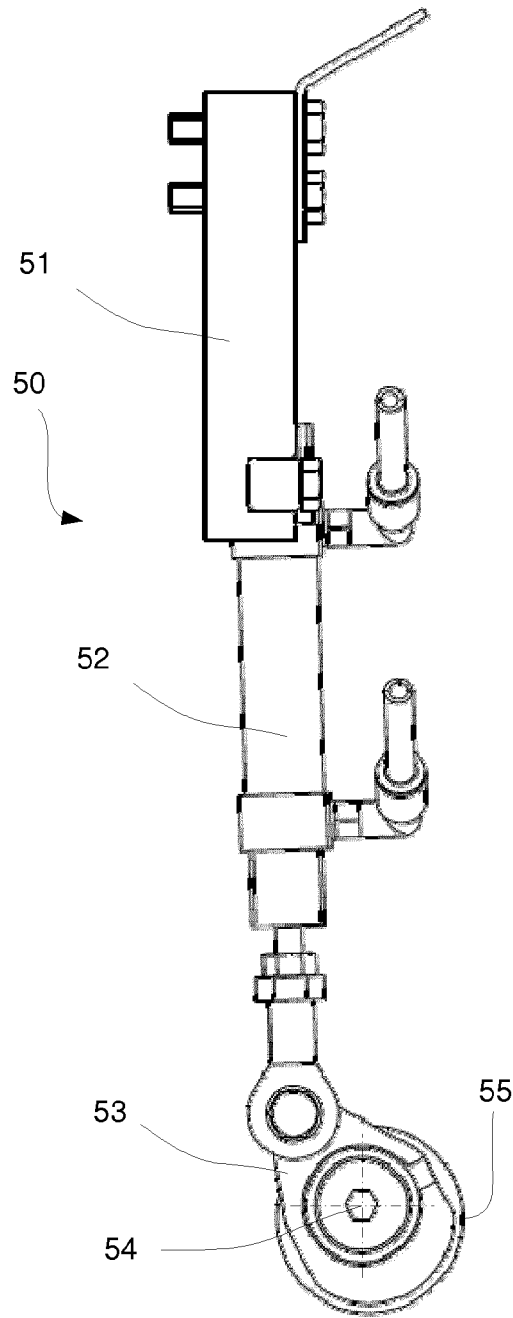


Fig. 7a

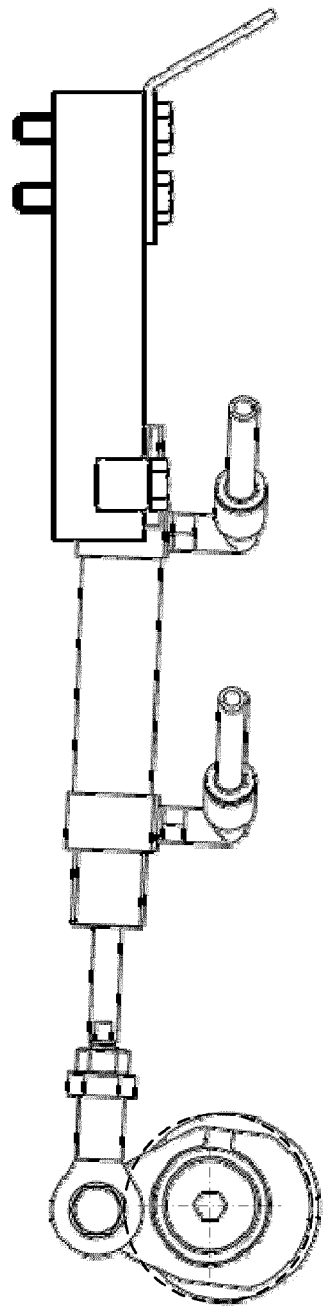


Fig. 7b

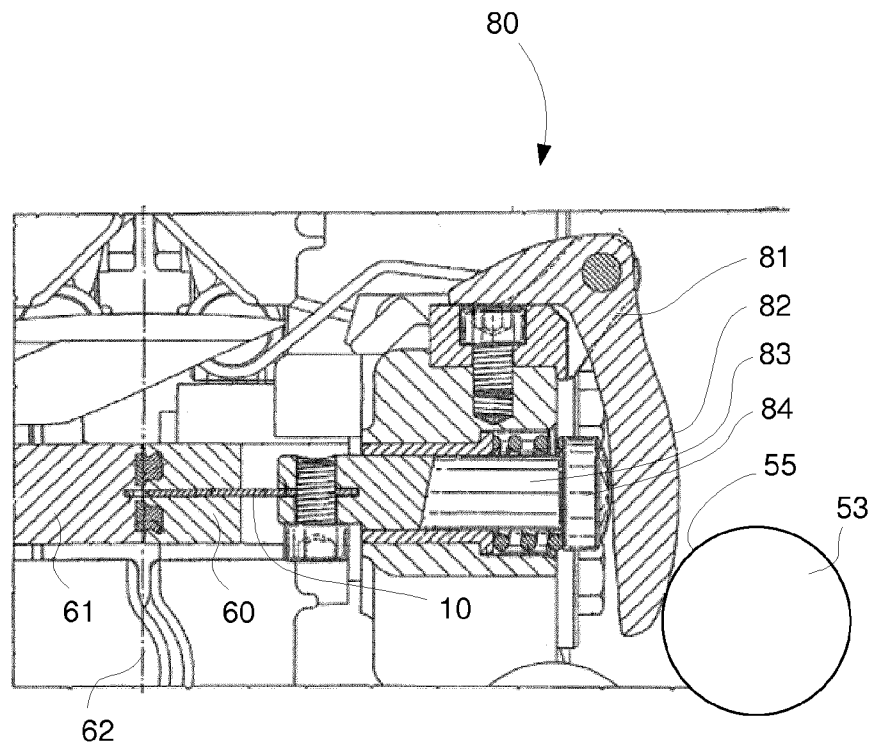


Fig. 8

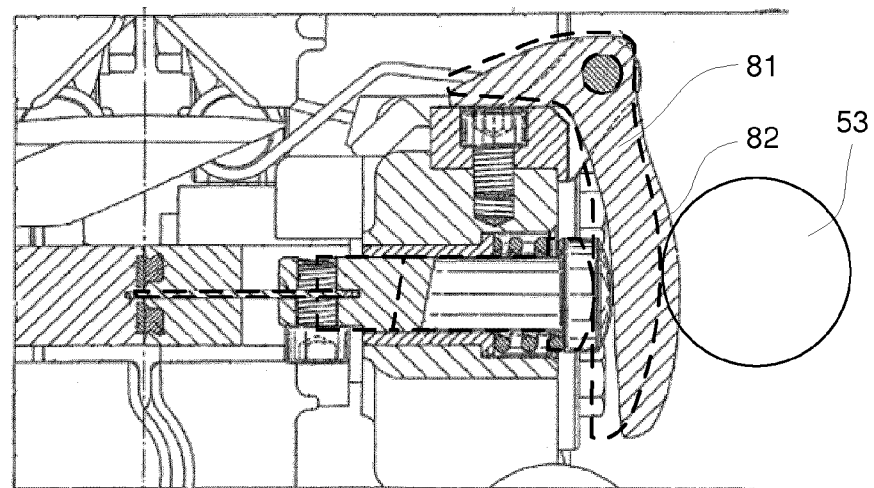


Fig. 9

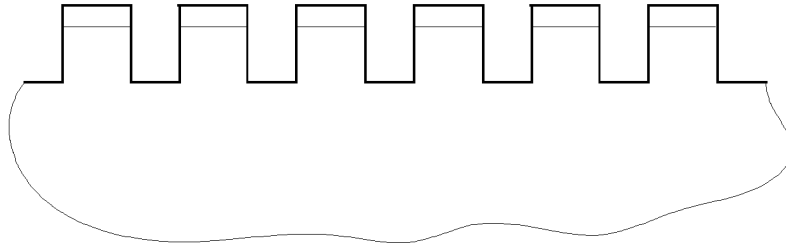


Fig. 10

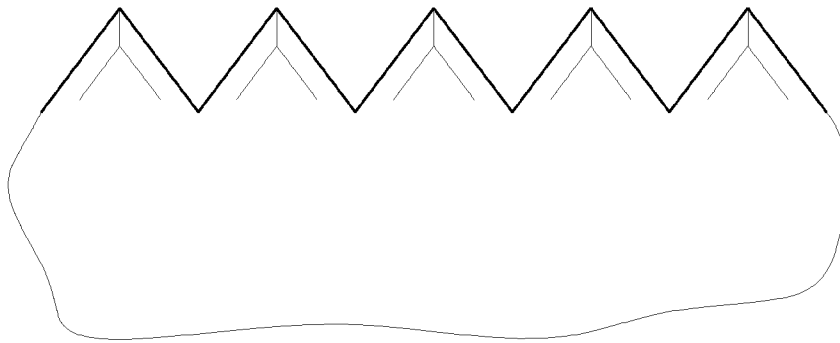


Fig. 11

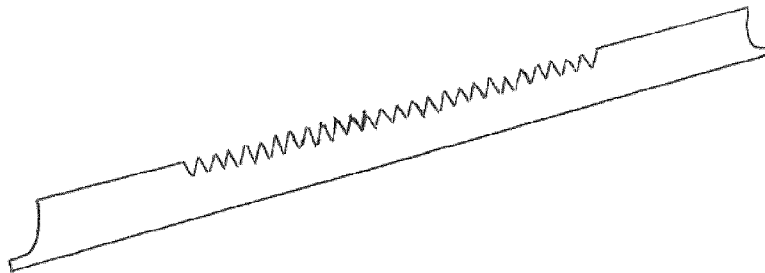


Fig. 12

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/072857

A. CLASSIFICATION OF SUBJECT MATTER INV. B26D1/00 B26D5/16 B26D9/00 B65B51/14 B65B61/00 B65B61/12 B26F1/18 ADD. According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) B26D B31B B65B B26F Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 101 108 542 A (TETRA LAVAL HOLDINGS & FINANCE [CH]) 23 January 2008 (2008-01-23)	1-10
A	page 4 - page 11; figures 1-6 -----	11-15
A	DE 103 37 864 A1 (TETRA LAVAL HOLDINGS & FINANCE [CH]) 13 May 2004 (2004-05-13) paragraph [0001] - paragraph [0036]; figures 1-10 -----	11,12
A	DE 43 15 507 C1 (SIEMENS NIXDORF INF SYST [DE]) 1 December 1994 (1994-12-01) column 1, line 3 - column 2, line 18 -----	11,12
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 19 January 2015		Date of mailing of the international search report 26/01/2015
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Maier, Michael

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2014/072857

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 101108542	A	23-01-2008	NONE
DE 10337864	A1	13-05-2004	CN 1705557 A 07-12-2005 DE 10337864 A1 13-05-2004
DE 4315507	C1	01-12-1994	DE 4315507 C1 01-12-1994 EP 0697939 A1 28-02-1996 JP H08509667 A 15-10-1996 TW 226004 B 01-07-1994 US 5613788 A 25-03-1997 WO 9426478 A1 24-11-1994