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(54) A KNIFE, A FILLING MACHINE AND A METHOD FOR FILLING AND SEALING A PACKAGE

(57) A knife (100) for cutting through a tube-shaped body of packaging material such that individual packages are formed. The knife (100) comprises an attachment portion (111, 112) for connecting the knife (100) to a cutting unit, such that the knife (100) is movable in a cutting direction (C), from a retracted position, to a cutting position and back to the retracted position. The knife (100) has a cutting edge (102) that extends in a direction (T) transverse to the cutting direction (C), and has a protrusion (131) which extends, as seen in the cutting direction (C), beyond the cutting edge (102) and includes an interaction surface (133) configured to interact with a sensor unit if the knife (100) is not moved to the retraced position (P1) after cutting through the tube-shaped body.

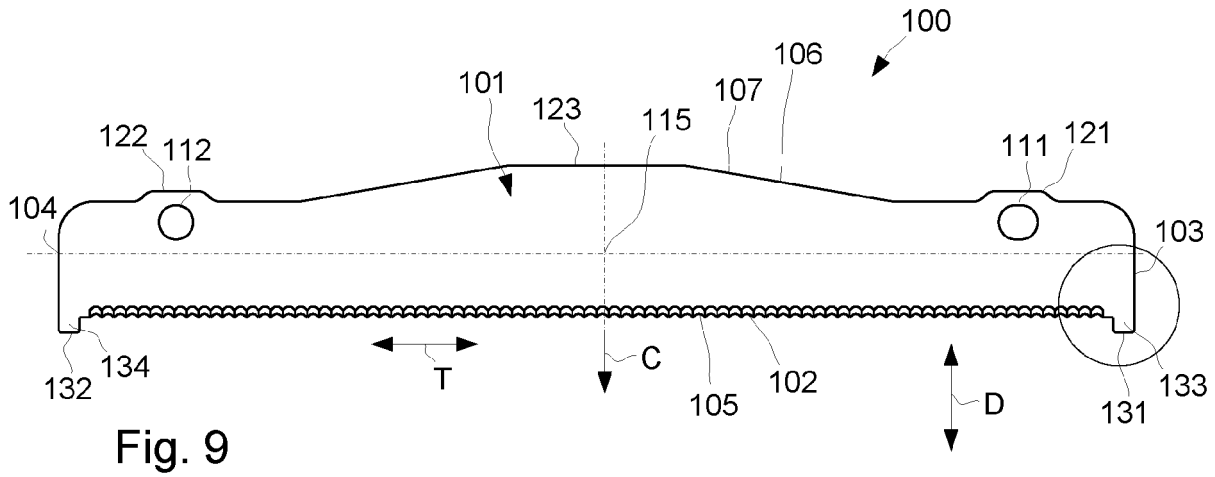

Fig. 9

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Description

Technical Field

[0001] The invention relates to packaging technology. More particularly, it is related to a knife for cutting through packaging material, a filling machine comprising such knife and a method for filling and sealing a package.

Background Art

[0002] Roll-fed filling machines, also referred to as packaging machines, are well known within the field of liquid food packaging. One example of such machines is the Tetra Pak® A3 machine, which receives a reel of carton-based packaging material and, via a pipe, a liquid food product. The machine operates to create individual packages that are made from the packaging material and filled with the liquid food product.

[0003] In brief, machines like this unwind the packaging material from the reel. After being sterilized, e.g., by using hydrogen peroxide, the packaging material is continuously formed into a tube. While feeding the tube in a vertical position, an upper end of the tube is filled with food product, e.g., milk, via a product filling pipe that extends into an interior of the tube from above. By continuously and transversally sealing and cutting the tube at its lower end, packages filled with food product are formed at impressive speeds.

[0004] Over the years the roll-fed filling machines have used various knives for cutting the tube to form individual packages. The knives are typically mounted to a cutting unit that moves the knives towards and through the tube to thereby cut off its lower end. To accomplish this the cutting unit has a sealing jaw and a pressure jaw that are mounted on a respective side of the tube. In some configurations the jaws may be referred to as a cutting jaw and an opposite jaw. Either the cutting jaw and/or the opposite jaw can then perform the sealing, i.e. act as a sealing jaw. The jaws move along the tube at the same speed of the tube. The jaws are movable towards each other to "pinch" the tube by pressing inner surfaces of the tube towards each other, thereby sealing off the lowermost portion of the tube. The sealing jaw has two heating elements which are used to create two seals in the tube, by partially melting the "pinched" surfaces of the packaging material such that the material is joined at the seals. The knife is moved out from a position between the heating elements and pushed through the tube in between the two seals, thereby separating an individual package from the lowermost part of the tube. The knife is thereafter retracted into the sealing jaw and the two jaws are moved away from the tube.

[0005] The jaws move along tracks that are parallel to the tube and eventually perform the same operation again to create another package from the tube. Multiple pairs of sealing jaws and pressure jaws move along the tracks to perform this operation, thereby continuously creating individual, product-filled packages from the tube.

[0006] To create reliable seals it is important that the heating elements properly heats the packaging material as intended. It is also important that each knife cuts through all packaging material between the seals, at the exact position only, and that the knife is moved back to its retracted position once the cut is complete.

[0007] Even though knives used today successfully cut through tubes of packaging material to create individual packages, there is still room for improvement, in particular when it comes to reliably ensuring that the knives cut the tube only at the intended location.

[0008] Further prior art is described in patent document WO2015/028198A1.

Summary

[0009] It is an object of the invention to at least partly overcome one or more of the above-identified limitations of the prior art. In particular, it is an object to provide a knife that facilitates ensuring that a tube-shaped body of packaging material is cut only at the desired places.

[0010] To solve these objects, according to a first aspect a knife is provided for cutting through a tube-shaped body of packaging material such that individual packages are formed from the packaging material. The knife comprises an attachment portion for connecting the knife to a cutting unit, such that the knife may be moved in a direction parallel to a cutting direction of the knife, from a retracted position, to a cutting position and back to the retracted position. A cutting edge of the knife extends in a direction transverse to the cutting direction and is configured to cut through the tube-shaped body when the knife is moved towards the tube-shaped body, from the retracted position to the cutting position. The knife has also a protrusion that extends, as seen in the cutting direction, beyond the cutting edge. The protrusion comprises an interaction surface configured to interact with a sensor unit if the knife is not moved to the retraced position after cutting through the tube-shaped body.

[0011] The knife is advantageous in that the protrusion enables a sensor unit to detect if the knife is not properly retracted after it has cut through a tube-shaped body. Faulty retraction can happen for many reasons, for example if the cutting unit malfunction. Other reasons for improper retraction could be that the attachment portion of the knife is broken, leading to misplacement of the knife relative the cutting unit, which in turn causes faulty retraction of the knife. Faulty retraction of the knife can lead to undesired holes or damages to the tube-shaped body, for example in a configuration where the cutting unit moves the knife in parallel with the tube-shaped body before the knife is moved to cut through the tube-shaped body. The knife is thereby advantageous in that it is possible to provide for that less damage happens to the tube-shaped body. This means that the numbers of individual packages which are defect is reduced.

[0012] According to a second aspect a filling machine is provided for filling and sealing packages. The filling machine comprises a longitudinal sealing unit arranged to form a tube-shaped body from a web of packaging material, a product filling pipe arranged to fill food product into the tube-shaped body, and a cutting unit to which a knife is attached, the cutting unit being arranged to transversally seal and cut the tube-shaped body for forming individual packages filled with the food product. The cutting unit is doing this by heat sealing the tube-shaped body, and moving the knife in a direction parallel to a cutting direction of the knife, from a retracted position, to a cutting position and back to the retracted position. The filling machine has a sensor unit configured to interact with a protrusion of the knife if the knife is not moved back from the cutting position to the retracted position. The knife attached to the cutting unit is a knife according to the first aspect, including any embodiments of this knife.

[0013] According to a third aspect a method is provided for filling and sealing a package. The method comprises forming a tube-shaped body from a web of packaging material, filling food product into the tube-shaped body, and transversally sealing and cutting the tube-shaped body for forming individual packages filled with the food product. The cutting comprises cutting the tube-shaped body with a knife according to the first aspect.

[0014] The filling machine and the method may use any embodiment of the knife according to the first aspect. They have the same advantages as provided by the knife.

[0015] According to a fourth aspect a knife is provided for being attached to a filling machine according the second aspect, where the attached knife is a knife according to the first aspect. According to a fifth aspect a knife is provided for being used in the method according to the third aspect, where the knife is a knife according to the first aspect.

[0016] Still other objectives, features, aspects and advantages of the invention will appear from the following detailed description as well as from the drawings.

Brief Description of the Drawings

[0017] Embodiments of the invention will now be described, by way of example, with reference to the accompanying schematic drawings, in which

Fig. 1 is a schematic view of a filling machine,
Fig. 2 is a schematic view of a cutting jaw and an opposite jaw for a cutting unit,
Fig. 3 is a side view of a cutting unit,
Fig. 4 is an enlarged section of the cutting unit in Fig. 3, showing a cutting jaw with a knife that interacts with a sensor unit,
Fig. 5 is front view of a cutting jaw and an opposite jaw used in the cutting unit in Fig. 3,
Fig. 6 is an enlarged section A of the jaws in Fig. 5, showing a protrusion of a knife that is connected to the cutting jaw,
Fig. 7 is a front view of the cutting jaw in Fig. 5, showing the knife in a retracted position,
Fig. 8 is a front view of the cutting jaw in Fig. 5, showing the knife in a cutting position,
Fig. 9 is a top view of a knife that is connectable to a cutting unit for cutting through a tube-shaped body of packaging material,
Fig. 10 is an enlarged section of the knife in Fig. 9, showing a protrusion for interacting with a sensor unit,
Fig. 11 is a perspective view of the knife in Fig. 9, and
Fig. 12 is a flow chart of a method for filling and sealing a package.

Detailed Description

[0018] With reference to Fig. 1 a filling machine 300 for filling and sealing packages 203 is illustrated. A web 201 of packaging material 200 is provided in form of a packaging material strip that is rolled of a reel of packaging material. The packaging material 200 has a carton or fiber-based support layer and, on at least one side of the support layer, a polymer layer or another layer that it suitable for heat sealing.

[0019] In a longitudinal sealing unit 302, the web 201 is formed into a tube-shaped body 202, also referred to as a tube. By directing the web 201 and also continuously providing a longitudinal sealing, i.e. attaching the two longitudinal edges of the web 201 together, a tube 202 is continuously formed. By forming the tube 202 in a vertical direction it is possible to fill it with food product 350 via a product filling pipe 301. From the longitudinal sealing unit 302, the tube 202 can be directed by a tube guiding unit 306 into a cutting unit 310.

[0020] With further reference to Fig. 2, the cutting unit 310 has a cutting jaw 311, also referred to as a heating jaw or a sealing jaw, and a pressure jaw 312 that are mounted on a respective side of vertical travelling path of the tube 202. The jaws 311, 312 are movable towards each other such that they press inner surfaces of the tube 202 towards each other, thereby sealing off the tube 202. The cutting jaw 311 has two heating elements 313, 314 which are used to create two seals 204, 205 in the tube 202. This may be done by partially melting at least one inner surface of the packaging material 200 at the location where the tube 202 it is sealed off, i.e. where it is pressed together by the jaws 311, 312. A knife 100 is moved out from a position 315, usually formed as a slot, between the heating elements 313, 314. The knife 100 is moved in a direction D parallel to a cutting direction C of the knife 100, from a retracted position to a cutting position. When the knife 100 is in the cutting position, an edge of the knife 100 is located into a groove 316 in the pressure jaw 312. The knife has then cut through the tube 202. This separates a lower part of the tube 202 from the rest of the tube 202. The separated, lower part then forms an individual package 203. After the sealing and cutting, the

knife 100 is moved back to the retracted position in between the heating elements 313, 314, such that it is again located in the slot 315. Simultaneously the jaws 311, 312 are moved away from each other.

[0021] The heating elements 313, 314 does not have to be arranged on the same jaw as the knife 100. In this case jaw that holds the heating elements 313, 314 may be referred to as a heating jaw. The groove into which the knife 100 extends when cutting through the tube 202 is then located in the heating jaw between the heating elements. The jaw that holds the knife 100 may generally be referred to as a cutting jaw. The cutting jaw may or may not have heating elements. The jaw that is opposite the cutting jaw may generally be referred to as the opposite jaw. The opposite jaw may or may not have heating elements.

[0022] With further reference to Fig. 3, the jaws 311, 312, here embodied as a cutting jaw 311 that holds the knife 100 and as a heating jaw 312 that holds the heating elements 313, 314, move along a respective track 317, 318. The tracks 317, 318 have a respective portion that is parallel to the tube 202, move with the same speed as the tube 202 and returns the jaws 311, 312 to the tube 202 such that the same sealing and cutting operation can be performed again to create another package from the tube 202. Multiple pairs of sealing jaws and pressure jaws move along the tracks 317, 318 to perform this operation, thereby continuously creating individual, product-filled packages from the tube 202.

[0023] With reference to Fig. 5 and 6, where Fig. 6 shows section A of Fig. 5 in enlargement, an embodiment is illustrated where the knife 100 is located in a cutting jaw 311 and the heating elements 313, 314 are located in the opposite jaw which here forms a heating jaw 312. The major part of the knife 100 is hidden behind a cover 322. In the illustrated embodiment the cover 322 has a frontmost cover part 323 (see also Fig. 8) and a rearmost cover part 324 (see Fig. 7), which are arranged on a respective side of the knife 100. One heating element 313 of the two heating elements 313, 314 is via attachment means, here exemplified with bolts 325, connected to the heating jaw 312. The other heating element 314 is connected to the heating jaw 312 in a similar manner, in Fig. 5 and 6 located behind the illustrated heating element 313.

[0024] With further reference to Fig. 7, the cutting jaw 311 is illustrated with the knife 100 in the retracted position P1. In this case no part of a cutting edge 102 of the knife 100 extends beyond the cover 322 of the cutting jaw 311, as seen in the cutting direction C of the knife 100. In Fig. 7 the frontmost cover part 323 has been removed for illustrative purpose, such that the rearmost cover part 324 can be seen. When the knife 100 is in the retracted position P1, it may then be retracted such that no part of the cutting edge 102 extends beyond an outermost surface 320 of the cutting jaw 311, as seen in the cutting direction C of the knife 100.

[0025] With further reference to Fig. 8, the cutting jaw 311 is illustrated with the knife 100 in the cutting position P2. In this case the entire cutting edge 102 of the knife 100 extends beyond the cover 322 of the cutting jaw 311, as seen in the cutting direction C of the knife 100. When the knife 100 is in the cutting position P2 the cutting edge 102 of the knife 100 may extend beyond the outermost surface 320 of the cutting jaw 311, as seen in the cutting direction C of the knife 100.

[0026] With further reference to Fig. 9-11, the knife 100 has an attachment portion 111, 112 for connecting the knife 100 to the cutting unit 310. The cutting unit 310 has a mating attachment portion which may include pins that extend into the attachment portion 111, 112 of the knife. The cutting unit 310 can move the knife in the direction D parallel to the cutting direction C of the knife 100, from the retracted position P1, to the cutting position P2 and back to the retracted position P1. The knife 100 has a cutting edge 102 which extends in a direction T that is transverse to the cutting direction C, and allows the knife to cut through the tube 202 when the knife 100 is moved towards the tube 202, from the retracted position P1 to the cutting position P2.

[0027] The knife 100 has a protrusion 131 which extends, as seen in the cutting direction C, beyond the cutting edge 102. The protrusion 131 has an interaction surface 133 that is purposely arranged on the knife 100 for allowing the protrusion 131 to interact with a sensor unit 160 (see Fig. 3 and 4) if the knife 100 is not moved to the retraced position P1 after cutting through the tube-shaped body 202.

[0028] The protrusion 131 may, as seen in the direction T transverse to the cutting direction C, be located outside the cutting edge 102. The protrusion 131 may, as seen in the direction T transverse to the cutting direction C, be located at an end side 103 of the knife 100. The end side 103 may, as seen in the direction T transverse to the cutting direction C, be an outmost end side of the knife 100. Being the outermost end side means that the end side forms, in the direction T transverse to the cutting direction C, an end boundary pf the knife 100, i.e. no part of the knife 100 extends, as seen in the transverse direction T, beyond the outmost end side.

[0029] The protrusion 131 may form a part of the end side 103 of the knife 100. This may mean that the protrusion 131 has a surface that is integral with the end side 103 of the knife 100.

[0030] The protrusion 131 may extend, as seen in the cutting direction C, at least 1.5 mm beyond the cutting edge 102. The protrusion 131 may extend, as seen in the cutting direction C, at most 4.5 mm beyond the cutting edge 102. The protrusion 131 may have, as seen in the direction T transverse to the cutting direction C, a width of 2.7 to 3.3 mm. These numbers have, alone and in combination and even though they are surprisingly small, shown to be advantageous in that the protrusion 131 is still allowed to efficiently interact with the sensor unit 160.

[0031] The protrusion 131 may be a first protrusion 131. In this case the knife 100 may have a second pro-

trusion 132. The second protrusion 132 extends, as seen in the cutting direction C, beyond the cutting edge 102, and has an interaction surface 134 configured to interact with the sensor unit 160 if the knife 100 is not moved to the retraced position P1 after cutting through the tube-shaped body 202. The first and second protrusions 131, 132 may, as seen in the direction T transverse to the cutting direction C, be located at a respective end side 103, 104 of the knife 100.

[0032] It should be noted that each of the protrusions 131, 132 is designed with the specific purpose of being detectable by a sensor unit. In one embodiment the protrusion 131 is not designed for any other purpose than for being detectable by a sensor unit. The same may apply for the second protrusion 132.

[0033] The attachment portion 111, 112 may comprise two through holes 111, 112 that are formed in the knife 100. Each of the though holes 111, 112 may, as seen in the direction T transverse to the cutting direction C, be located entirely between the first and second protrusions 131, 132. This means that nor part of the through holes 111, 112 are located outside, as seen in the transversal direction T, the protrusions 131, 132.

[0034] In further detail, the exemplified knife 100 has a blade 101. The cutting edge 102 is formed on a first elongated end side 105 of the blade 101. The blade 101 comprises a spine 107 that is located on a second elongated end side 106 of the blade 101, opposite the first elongated end side 105 where the cutting edge 102 is formed. The attachment portion 111, 112 may comprise a first through hole 111 in the blade 101 and a second through hole 112 in the blade 101. The through holes 111, 112 may be arranged, as seen in the direction T transverse to the cutting direction C, on opposite sides of a center portion 115 of the blade 101. The spine 107 may have a first spine protrusion 121 that is, as seen in the cutting direction C, aligned with the first through hole 111. The spine may have a second spine protrusion 122 that is, as seen in the cutting direction C, aligned with the second through hole 112. The spine 107 may have a third spine protrusion 123 that is located between the first spine protrusion 121 and the second spine protrusion 122.

[0035] The filling machine 300 shown in Fig. 1 uses the knife 100 described above when filling and sealing individual packages 203. The filling machine 300 use the longitudinal sealing unit 302 for forming the tube-shaped body 202 from the web of packaging material 200. The filling machine 300 uses the product filling pipe 301 to fill food product 350 into the tube-shaped body 202, and uses the cutting unit 310, to which the knife 100 is attached, to transversally seal and cut the tube-shaped body 202 for forming individual packages 203 filled with the food product 350. This is done by the cutting unit 310, which heat seal the tube-shaped body 202, and move the knife 100 in the direction D parallel to a cutting direction C of the knife 100, from the retracted position P1, to the cutting position P2 and back to the retracted position P1. The filling machine 300 includes the sensor unit 160, which is arranged to interact with the protrusion 131 on the knife 100, if the knife 100 is not moved back from the cutting position P2 to the retracted position P1.

[0036] With reference to Fig. 4, the sensor unit 160 has a lever 161 that has an interaction surface 162 configured to interact with the interaction surface 133 of the protrusion 131 of the knife 100, if the knife 100 is not retracted to the retraced position P1 after cutting through the tube-shaped body 202. The lever 161 is pivotable in the direction of movement by which the knife 100 is travelling when the cutting jaw 311 moves along its track 317 (clockwise in Fig. 3 and 4). The lever 161 is positioned so that it is hit by the protrusion 131 if it extends outside the cutting jaw 311 when the cutting jaw 311 is passing by the location of the sensor unit 160. The lever 161 then rotates, or is lifted around, a pivot axis 163. When this happens the lever 161, which is made of a ferromagnetic material, loses its contact with a magnetic switch 164 in the sensor unit 160. The switch 164 is arranged to generate a signal when this happens, efficiently allowing detection if a knife is not properly retracted in its cutting jaw 311. For illustrative purpose, all knives in the cutting unit 310 in Fig. 3 are shown as not properly retracted. When the knife 100 has two protrusions the sensor unit 160 may have a second lever and second magnetic switch. Basically, the elements of the sensor unit 160 are just duplicated when it shall be able to detect two protrusions on a knife, as compared to detecting only one protrusion.

[0037] With reference to Fig. 12 a method 400 for filling and sealing a package 203 is illustrated. The method 400 includes forming 410 a tube-shaped body 202 from a web of packaging material 200. The method 400 thereafter includes filling 420 food product 350 into the tube-shaped body 202, and transversally sealing 430 and cutting 440 the tube-shaped body 202 for forming individual packages 203 filled with the food product 350. The sealing 430 and cutting 440 may be performed simultaneously. The method 400 may be performed, for example, by the filling machine 300 shown in Fig. 1. The cutting 440 may comprise cutting the tube-shaped body 202 with the knife 100 described above.

[0038] The knife 100 is preferably made of metal. The sensor unit 160 may be any sensor unit that is capable of detecting, i.e. interacting with, the protrusion 131 on the knife 100 if the knife 100 is not moved to the retraced position P1 after cutting through the tube-shaped body 202. Thus, it is possible to use a laser sensor or other optical sensor means.

[0039] The packaging material 200, the filling machine 300 including the cutting unit 310 may per se be implemented and operated according to principles that are known within the art. However, a knife and a sensor unit as described herein must be used for such machines. Also, moving a knife from the retracted position P1, to a cutting position P2 and back to the retracted position P1 may be done with techniques that are presently used within the art.

[0040] From the description above follows that, although various embodiments of the invention have been described and shown, the invention is not restricted thereto, but may also be embodied in other ways within the scope of the subject-matter defined in the following claims.

Claims

1. A knife (100) for cutting through a tube-shaped body (202) of packaging material (200) such that individual packages (203) are formed from the packaging material (200), the knife (100) comprising

an attachment portion (111, 112) for connecting the knife (100) to a cutting unit (310), such that the knife (100) may be moved in a direction (D) parallel to a cutting direction (C) of the knife (100), from a retracted position (P1), to a cutting position (P2) and back to the retracted position (P1),
a cutting edge (102) extending in a direction (T) transverse to the cutting direction (C) and configured to cut through the tube-shaped body (202) when the knife (100) is moved towards the tube-shaped body (202), from the retracted position (P1) to the cutting position (P2),
wherein the knife (100) comprises a protrusion (131) that

- extends, as seen in the cutting direction (C), beyond the cutting edge (102), and
- comprises an interaction surface (133) configured to interact with a sensor unit (160) if the knife (100) is not moved to the retraced position (P1) after cutting through the tube-shaped body (202).

2. A knife (100) according to claim 1, wherein the protrusion (131) is, as seen in the direction (T) transverse to the cutting direction (C), located outside the cutting edge (102).

3. A knife (100) according to any preceding claim, wherein the protrusion (131) is, as seen in the direction (T) transverse to the cutting direction (C), located at an end side (103) of the knife (100).

4. A knife (100) according to claim 3, wherein the end side (103) is, as seen in the direction (T) transverse to the cutting direction (C), an outmost end side of the knife (100).

5. A knife (100) according to claim 3 or 4, wherein the protrusion (131) forms a part of the end side (103) of the knife (100).

6. A knife (100) according to any preceding claim, wherein the protrusion (131) extends, as seen in the cutting direction (C), at least 1.5 mm beyond the cutting edge (102).

7. A knife (100) according to any preceding claim, wherein the protrusion (131) extends, as seen in the cutting direction (C), at most 4.5 mm beyond the cutting edge (102).

8. A knife (100) according to any preceding claim, wherein the protrusion (131) has, as seen in the direction (T) transverse to the cutting direction (C), a width of 2.7 to 3.3 mm.

9. A knife (100) according to any preceding claim, wherein the protrusion (131) is a first protrusion (131), the knife comprising a second protrusion (132) that

- extends, as seen in the cutting direction (C), beyond the cutting edge (102), and
- comprises an interaction surface (134) configured to interact with the sensor unit (160) if the knife (200) is not moved to the retraced position (P1) after cutting through the tube-shaped body (202).

10. A knife (100) according to claim 11, wherein the first and second protrusions (131, 132) are, as seen in the direction (T) transverse to the cutting direction (C), located at a respective end side (103, 104) of the knife (100).

11. A knife (100) according to claim 9 or 10, wherein

the attachment portion (111, 112) comprises two through holes (111, 112) that are formed in the knife (100), and
each one of the though holes (111, 112) is, as seen in the direction (T) transverse to the cutting direction (C), located entirely between the first and second protrusions (131, 132).

12. A knife (100) according to any preceding claim, comprising a blade (101), wherein

the cutting edge (102) is formed on a first elongated end side (105) of the blade (101),
the blade (101) comprises a spine (107) that is located on a second elongated end side (106) of the blade (101), opposite the first elongated end side (105) where the cutting edge (102) is formed,
the attachment portion (111, 112) comprises a first through hole (111) in the blade (101) and a second through hole (112) in the blade (101), the through holes (111, 112) being arranged, as

seen in the direction (T) transverse to the cutting direction (C), on opposite sides of a center portion (115) of the blade (101), and
the spine (107) comprises

- a first spine protrusion (121) that is, as seen in the cutting direction (C), aligned with the first through hole (111),
- a second spine protrusion (122) that is, as seen in the cutting direction (C), aligned with the second through hole (112), and
- a third spine protrusion (123) that is located between the first spine protrusion (121) and the second spine protrusion (122).

13. A filling machine (300) for filling and sealing individual packages (203), comprising

a longitudinal sealing unit (302) arranged to form a tube-shaped body (202) from a web of packaging material (200),
a product filling pipe (301) arranged to fill food product (350) into the tube-shaped body (202), and
a cutting unit (310) to which a knife (100) is attached, the cutting unit (310) being arranged to transversally seal and cut the tube-shaped body (202) for forming individual packages (203) filled with the food product (350) by

- heat sealing the tube-shaped body (202), and
- moving the knife (100) in a direction (D) parallel to a cutting direction (C) of the knife (200), from a retracted position (P1), to a cutting position (P2) and back to the retracted position (P1), and

a sensor unit (160) configured to interact with a protrusion (131) of the knife (100) if the knife (100) is not moved back from the cutting position (P2) to the retracted position (P1), wherein
the knife (100) attached to the cutting unit (310) is a knife according to any preceding claim.

14. A filling machine according to claim 13, wherein the sensor unit (160) comprises a lever (161) that has an interaction surface (162) configured to interact with the interaction surface (133) of the protrusion (131) of the knife (100), if the knife (200) is not retracted to the retraced position (P1) after cutting through the tube-shaped body (202).

15. A method (400) for filling and sealing a package (203), said method comprising

forming (410) a tube-shaped body (202) from a web of packaging material (200),
filling (420) food product (350) into the tube-shaped body (202), and
transversally sealing (430) and cutting (440) the tube-shaped body (202) for forming individual packages (203) filled with the food product (350), wherein the cutting (440) comprises cutting the tube-shaped body (202) with
a knife (200) according to any one of claims 1 - 12.

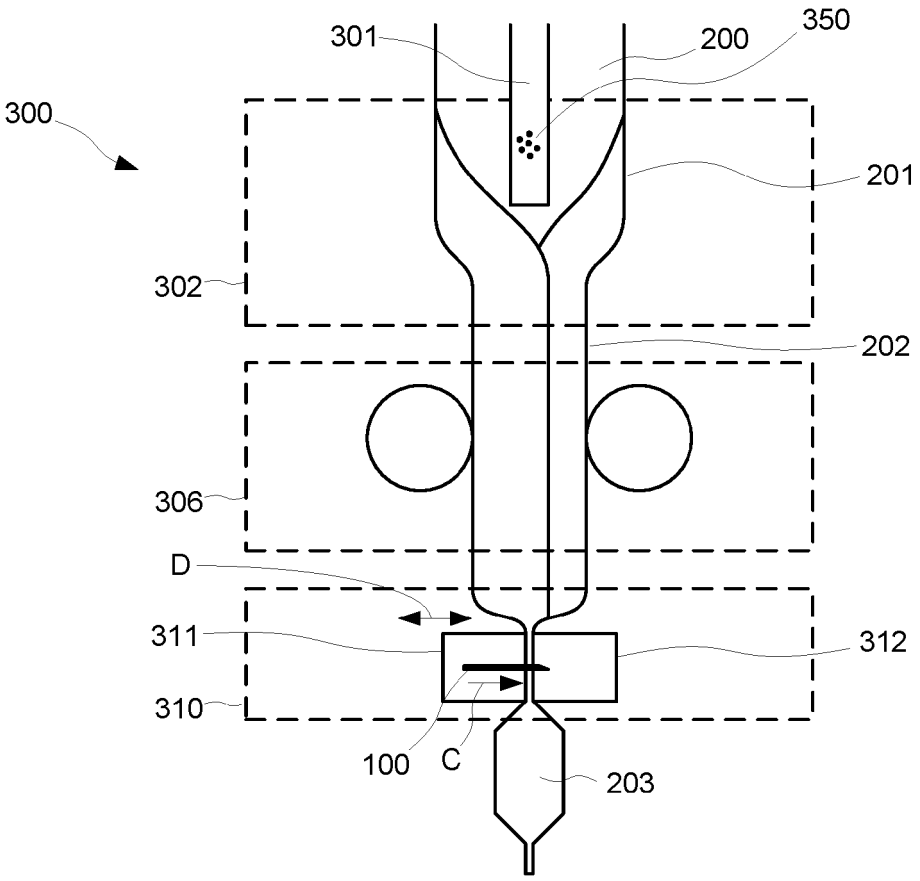
301
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Fig. 1

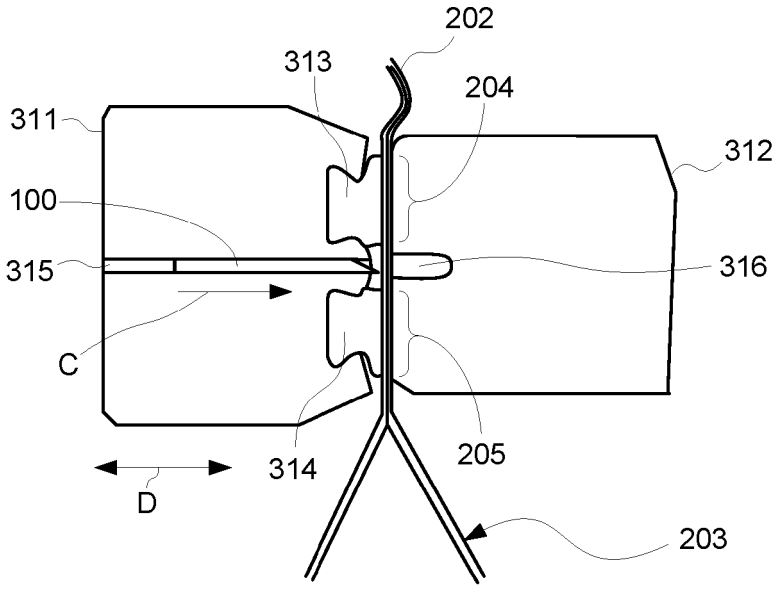
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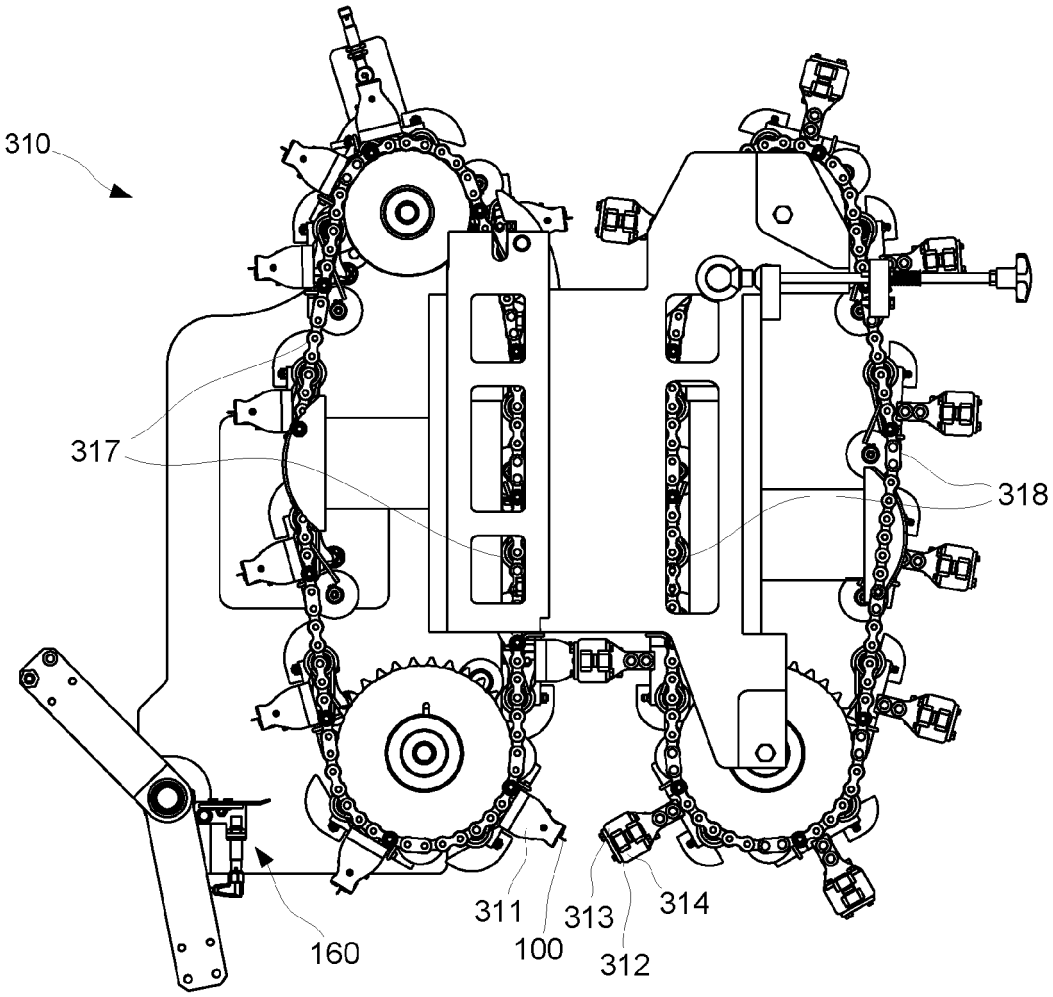
Fig. 2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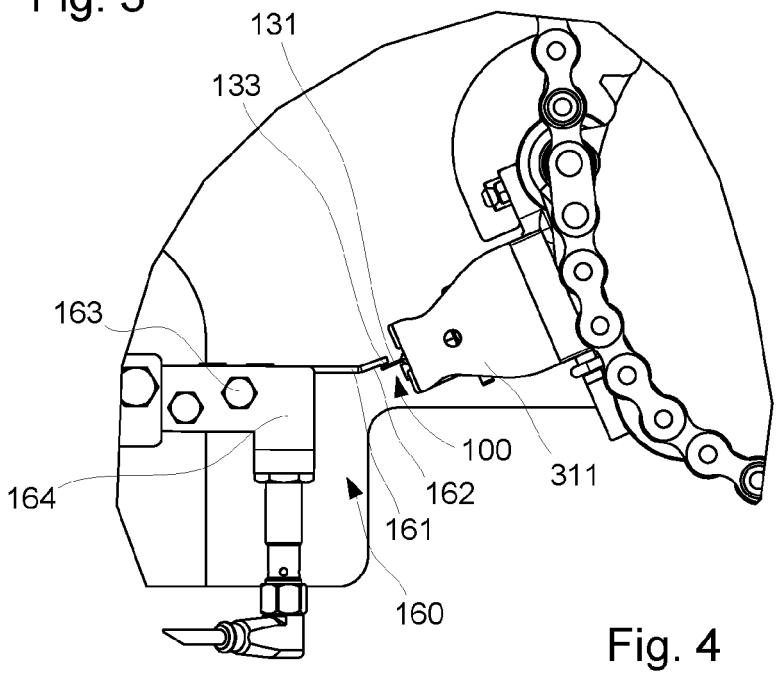
100
313
312
314

Fig. 3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163
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160
311

Fig. 4

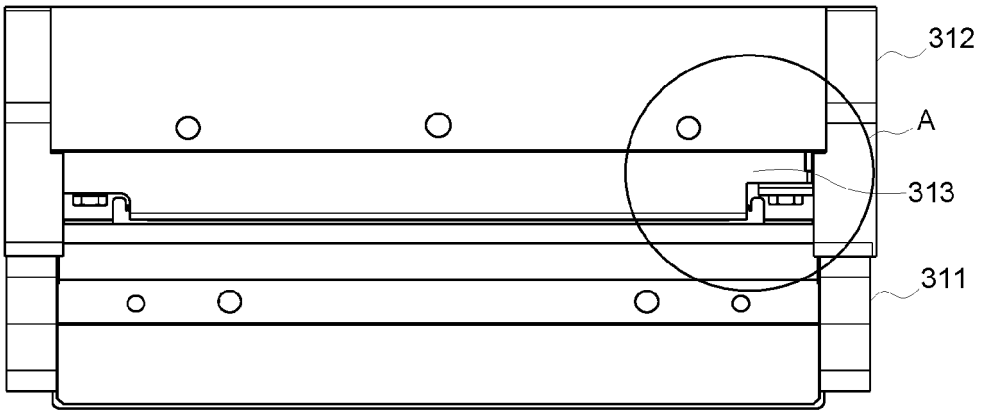

Fig. 5

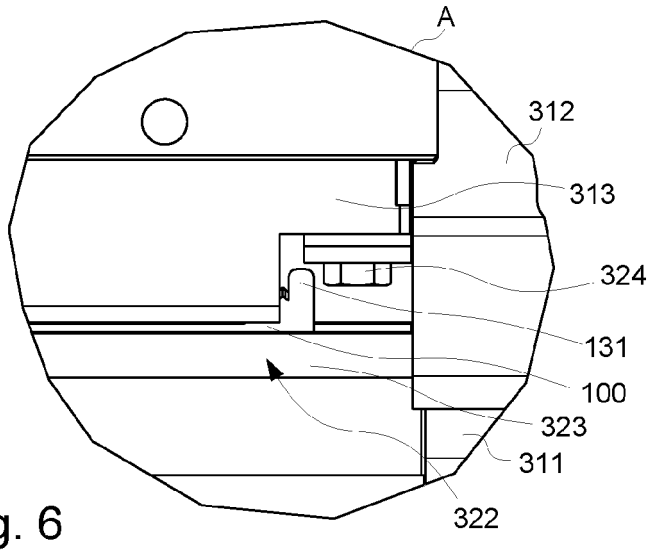

Fig. 6

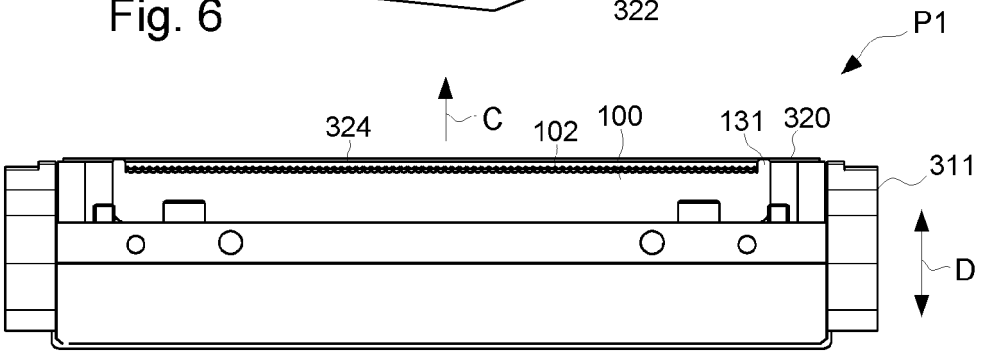

Fig. 7

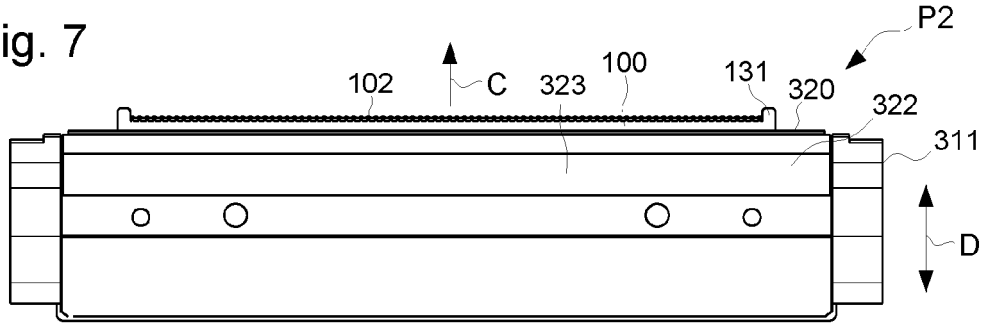

Fig. 8

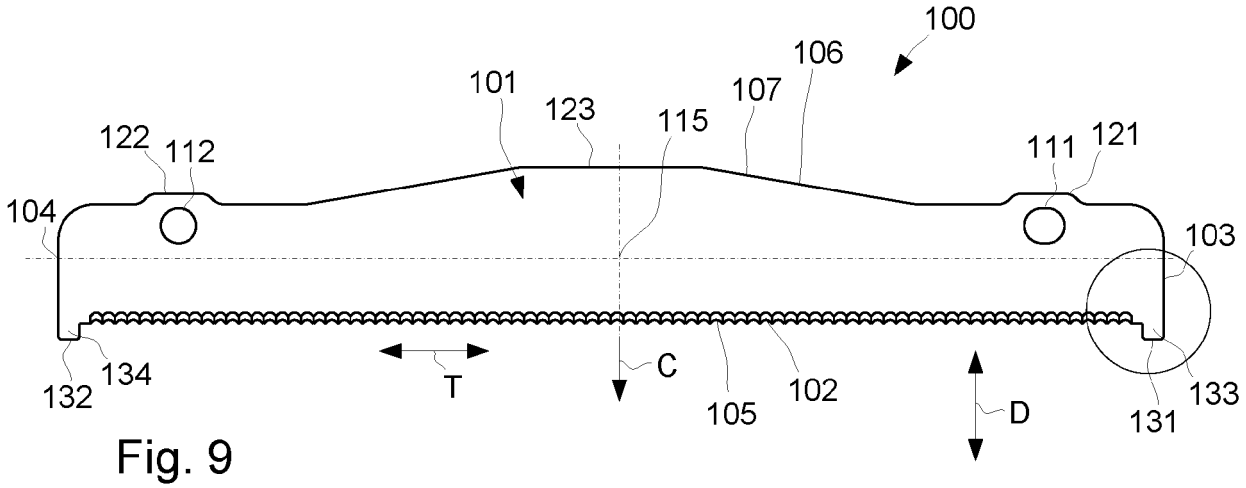

Fig. 9

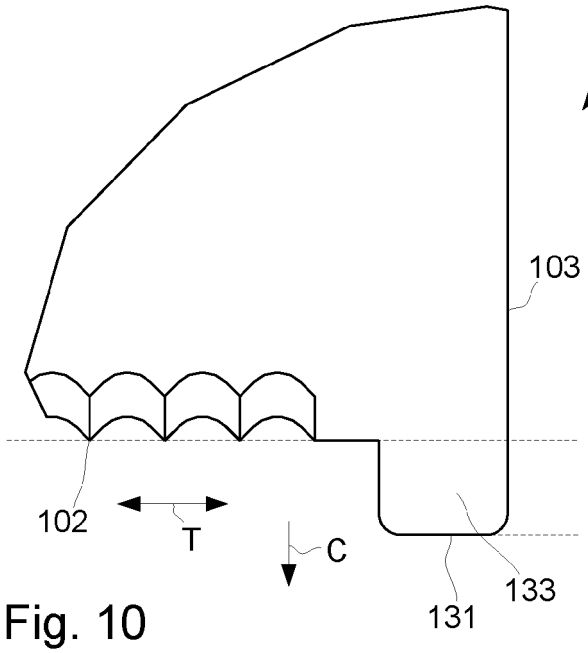

Fig. 10

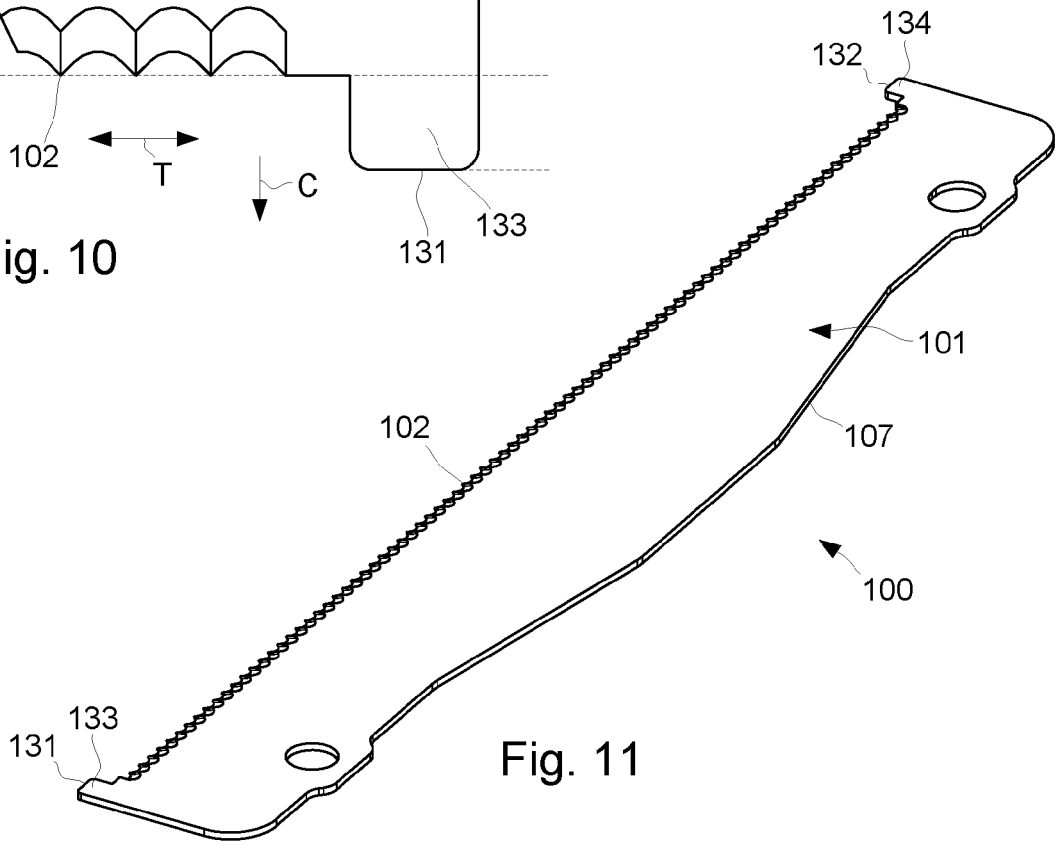

Fig. 11

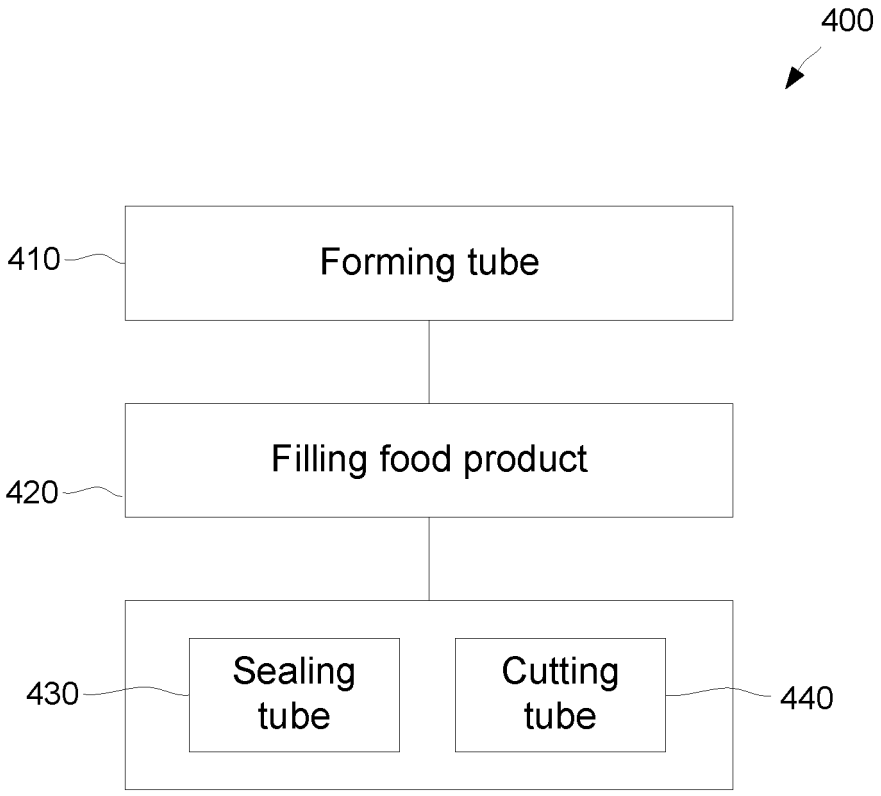
400
410
Forming tube
420
Filling food product
430
Sealing tube
Cutting tube
440

Fig. 12

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EUROPEAN SEARCH REPORT

Application Number
EP 23 17 8706

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Place of search	Date of completion of the search	Examiner
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