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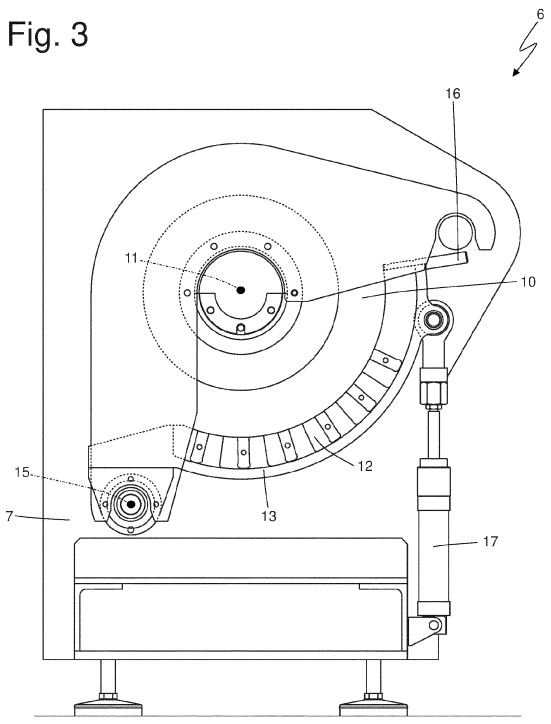
(54) STRAW CORRUGATING UNIT AND METHOD

(57) A corrugating unit (6) and method for a straw (1). The following are provided: at least one seat (9), which is designed to house the straw (1); a conveyor (8), which is configured to move the seat (9) carrying the straw (1) along a processing path (P); a corrugating station (S3), which is arranged along the processing path (P) and has a plurality of blades (12), which are all arranged parallel to the processing path (P), and are mounted so as to remain, in use, still relative to the conveyor (8) so that the seat (9), while moving along the processing path (P), causes the straw (1) to come into contact with the blades (12), thus determining a deformation of the straw (1) in the area of each blade (12); and a support arm (13), which supports all the blades (12) and is mounted in a movable manner on the frame (7), so as to move between a work position, in which the blades (12) are in the area of the processing path (P), and a rest position, in which the blades (12) are far from the processing path (P).

Fig. 3



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Description

Technical Field of the Invention

[0001] The present invention relates to a corrugating unit and method for a straw.

[0002] The present invention finds advantageous application to the packing of straws, to which the following disclosure will explicitly refer without thereby losing generality.

State of the Art

[0003] Straws are known which provide an intermediate corrugated portion aimed to allow the bending of the straw in order to assume, in use, the most suitable shape to satisfy the user.

[0004] A known packing machine for straws comprises a corrugating unit provided with a conveyor which moves a series of gripping heads (each suitable to engage and hold a corresponding straw) along a processing path and between an input station in which each gripping head receives a smooth straw and an output station in which each gripping head releases a corrugated straw. Each gripping head comprises a support needle which is axially and perpendicularly oriented relative to the processing path and is movable between an exchange position in which the support needle is arranged on the outside of a straw and a holding position in which the support needle is at least partially arranged inside the straw. Each support needle has an intermediate corrugated portion which reproduces the corrugated shape that must be impressed on the straws. Furthermore, each support needle, in addition to being mounted axially movable, is also mounted so as to rotate on itself around a central symmetry axis.

[0005] The corrugating unit comprises a plurality of corrugating blades which are arranged parallel to one another and spaced apart in a fixed position along the working path so that each straw moving along the working path is held by a corresponding support needle (which in the meantime is made to rotate on itself to set the straw in rotation as well) comes into contact with the corrugating blades which, by cooperating on the opposite side of the straw with the intermediate corrugated portion of the needle, permanently deform the straw thus forming in the straw the desired intermediate corrugated portion.

[0006] It has been observed that by using a known corrugating unit of the type described above, the intermediate corrugated portion of each straw has an irregular (non-uniform) shape, namely, the rings of the corrugation have different depths; this defect, although not so evident to the naked eye, is particularly negative since, when the straw is bent or compressed at the intermediate corrugated portion, the straw loses its initial circular cross section to assume a cross section markedly (and completely unwanted) elliptical-shaped.

[0007] US10524599B1 describes a corrugating machine for imparting a series of annular corrugations to a paper straw.

Subject and Summary of the Invention

[0008] The object of the present invention is to provide a corrugating unit and method for a straw which allow to obtain an intermediate corrugated portion of a perfectly regular (uniform) shape, namely, in which all the rings of the corrugation have exactly the same depth.

[0009] According to the present invention, a corrugating unit and method for a straw are provided, according to what is established in the attached claims.

[0010] The claims describe preferred embodiments of the present invention forming an integral part of the present description.

Brief Description of the Drawings

[0011] The present invention will now be described with reference to the attached drawings, which illustrate a non-limiting embodiment thereof, wherein:

- Figure 1 is a perspective view of a straw applied to a beverage package;
- Figure 2 is an enlarged scale view of the straw of Figure 1;
- Figure 3 is a front view of a corrugating unit which forms an intermediate corrugated portion in the straw of Figure 1;
- Figure 4 is a schematic view of part of the corrugating unit of Figure 3;
- Figure 5 is an enlarged scale view of a series of blades of the corrugating unit of Figure 3;
- Figures 6 and 7 are two different views of a device for adjusting the blades of Figure 5; and
- Figures 8 and 9 are two views of a part of the corrugating unit of Figure 3 in two different instants of operation.

Detailed Description of Preferred Embodiments of the Invention

[0012] In Figure 1, the reference number 1 indicates as a whole a straw (made of paper or plastic material) which is applied to a beverage package. The straw 1 has a flat end 2 (which is held by the lips of the user) and a pointed end 3 (to more effectively break through the cap that seals a dispensing opening of the package).

[0013] In addition, the straw 1 has an intermediate corrugated portion 4 in the area of which the straw 1 can be easily bent/compressed/expanded and without breaking (namely, in an elastic manner) so as to assume, in use, the most suitable shape in order to satisfy the user.

[0014] The straw 1 is individually packaged (namely, it has been inserted singularly in its own wrap 5 not illustrated in Figure 1 and illustrated in Figure 2) after being bent in a "U" shape (i.e., by 180°) in the area of the intermediate corrugated portion 4 (the purpose of the "U"

bending is to reduce the overall dimensions of the straw 1 to remain within the dimensions of the rear or front wall of the package to which the straw 1 is applied).

[0015] In Figure 3, number 6 denotes as a whole a corrugating unit which forms the corresponding intermediate corrugated portion 4 in each straw 1 and is part of a packing machine that receives the straws 1 from a processing machine, performs the corrugation of the straws 1, if necessary, folds the straws 1 into a "U" shape, and inserts the straws 1 into corresponding wraps 5.

[0016] The corrugating unit 6 comprises a frame 7 which rests on the ground by means of a series of feet and supports all the various components of the corrugating unit 6. According to what is better illustrated in Figure 4, the corrugating unit 6 comprises a conveyor 8 which is mounted on the frame 7 and has a plurality of seats 9, each adapted to house a corresponding straw 1; the conveyor 8 moves each seat 9 along a processing path P which extends between an input station S1 in which the seat 9 receives a smooth straw 1 and an output station S2 in which the seat 9 releases a corrugated straw 2. Between the input station S1 and the output station S2 a corrugating station S3 is provided, along which the intermediate corrugated portion 4 on each straw 1 carried by a seat 9 is formed.

[0017] In the preferred embodiment illustrated in the attached figures, the conveyor 8 comprises a drum 10 which supports the seats 9 and is mounted on the frame 7 so as to rotate around a central rotation axis 11; consequently, in this embodiment the processing path P is circular. According to a different and not illustrated embodiment, the conveyor 8 comprises a conveyor belt which supports the seats 9 and is wound in a ring-like manner around two end pulleys; consequently, in this embodiment the processing path P is straight.

[0018] The corrugating station S3 extends over a relatively extended section of the processing path P (namely, for more than 90° of angular extension of the processing path P which corresponds to more than half of the entire extension of the processing path P) and comprises a plurality of blades 12 (better illustrated in Figure 5), each having the shape of an arc of a circle. As illustrated in Figure 5, all the blades 12 are arranged along the processing path P, they are all oriented parallel to the processing path P (therefore they are all parallel to one another), and are mounted (indirectly) on the frame 7 so as to remain, in use, still relative to the conveyor 8 so that each seat 9 moving along the processing path P causes the corresponding straw 1 to come into contact with the blades 12, thus determining a deformation of the straw 1 in the area of each blade 12 (namely, determining the formation of the intermediate corrugated portion 4).

[0019] According to a preferred embodiment, the blades 12 are at least partially staggered along the processing path P so that not all the blades 12 can simultaneously come into contact with the straw 1 carried by each seat 9 moving along the processing path P. In particular, all the blades 12 are arranged staggered along the processing path P so that each seat 9, while moving along the processing path P, causes the straw 1 to come into contact with no more than two blades 12 at a time and, preferably, with one single blade 12 at a time. In this way, the intermediate corrugated portion 4 of each straw 1 is not formed all together, but a small piece (one ring) at a time.

[0020] According to what is illustrated in Figures 3 and 5, the corrugating unit 6 comprises a support arm 13 which is mounted on the frame 7, is shaped like an arc of a circle in order to have the same conformation as the processing path P, and supports all the blades 12 by interposing corresponding adjustment devices 14 (better illustrated in Figures 6 and 7). In particular, for each blade 12 a corresponding adjustment device 14 is provided which is separate and independent of the other adjustment devices 14 and is configured to keep, in use, (namely, when the corrugating unit 6 is in operation for normal production) its blade 12 in a fixed work position relative to the frame 7 (therefore relative to the conveyor 8), and is configured to change, during an adjustment step with the conveyor 8 still (namely, when the corrugating unit 6 is still for maintenance/adjustment), the work position of the blade 12 in order to move the blade 12 close to/away from the processing path P in a separate manner and independently of the work position of the other blades 12. Obviously, given the circular shape of the processing path P, each adjustment device 14 is configured to change radially (namely, perpendicularly to the rotation axis 11 of the drum 10) the work position of the corresponding blade 12 in order to move the blade 12 close to/away from the rotation axis 11 of the drum 10.

[0021] In other words, each adjustment device 14 is interposed between the frame 7 (namely, the arm 14 mounted on the frame 7) and a corresponding blade 12 and is configured to change the work position of the corresponding blade 12 in order to move the blade 12 close to/away from the processing path P (namely, to the conveyor 8 which moves the seats 9 along the processing path P) in a separate manner and independently of the work position of the other blades 12. Furthermore, each adjustment device 14 is configured to maintain, in use, the corresponding blade 12 in a fixed work position relative to the frame 7 (namely, the conveyor 8 that moves the seats 9 along the processing path P).

[0022] Obviously, by moving the blade 12 close to/away from the processing path P (namely, by moving the blade 12 close to/away from the rotation axis 11 of the drum 10) a depth of a corrugation made by the blade 12 on the straw 1 is increased or decreased; therefore the purpose of moving each blade 12 close to/away from the processing path P (namely, to move a blade 12 close to/away from the rotation axis 11 of the drum 10) is to change (adjust) the depth of the corrugation made by blade 12 on the straw 1. According to what is illustrated in Figure 3, the support arm 13 which supports all the adjustment devices 14 carrying the blades 12 is mounted in a movable manner on the frame 7 to move between a

work position (illustrated in the attached figures) in which the blades 12 are in the area of the processing path P in order to be able to interact with the straws 1 which move along the processing path P and therefore carry out the corrugation of the straws 1, and a rest position, (not illustrated) in which the blades 12 are (relatively) away (actually a few centimetres) from the processing path P so as not to interact with the straws 1 which move along or the processing path P. The rest position of the support arm 13 is used above all when it is necessary to test the corrugating unit 6 *"on empty"*, that is, when it is necessary to operate the corrugating unit 6 without straws 1 (a rather frequent operating mode during assembly, maintenance and adjustment steps of the corrugating unit 6) to ensure that the blades 12 do not accidentally come into contact with the metal parts of the seats 9 without the interposition of the straws 1 (which are not present when the corrugating unit 6 works *"on empty"*).

[0023] Preferably, the support arm 13 is hinged so as to rotate around a rotation axis 15 parallel to the rotation axis 11 of the drum 10 between the work position and the rest position. Preferably, an abutment body 16 is provided which is fixed directly on the frame 7 and forms an end stop for the support arm 13 to establish the work position so that, in the work position, the support arm 13 abuts against the abutment body 16; namely, the abutment body 16 allows to establish in a given and repeatable way the exact location of the work position of the support arm 13 so that the work position is certain (namely, always the same) and therefore repeatable (namely, obtainable again each time the support arm 13 is moved). An actuator device 17 is preferably provided, which moves the support arm 13 between the work position and the rest position. In the embodiment illustrated in the attached figures, the actuator device 17 is linear (namely, it produces a linear movement) and has one end fixed (hinged) to the frame 7 and an opposite end fixed (hinged) to the support arm 13 at a given distance from the rotation axis 15 of the support arm 13 (actually on the opposite side relative to the rotation axis 15). By way of example, the actuator device 17 has a single-acting pneumatic actuation and can assume only two positions; preferably, an elastic element of the actuator device 17 pushes the support arm 13 against the abutment body 16 and therefore into the work position.

[0024] As illustrated in Figures 8 and 9, each seat 9 comprises a support needle 18 which is arranged parallel to the rotation axis 11 of the drum 10 and is mounted in an axially movable manner on the conveyor 8 (namely, on the drum 10) to move perpendicular to the processing path P (i.e. parallel to the rotation axis 11) between an exchange position (illustrated in Figure 8) in which the support needle 18 is arranged outside a corresponding straw 1 (and therefore leaves the straw 1 free) and a holding position (illustrated in Figure 9) in which the support needle 18 is at least partially arranged inside the straw 1 (and therefore engages the straw while holding the straw 1) .

[0025] The conveyor 8 comprises an actuator device 19 which axially moves each support needle 18, places the support needle 18 in the exchange position when the seat 9 is in the input station S1 or in the output station S2 at the two ends of the processing path P, and places the support needle 18 in the holding position when the seat 9 is between the input station S1 and the output station S2. In other words, when a straw 1 has to be gripped by the corresponding seat 9 (namely, in the input station S1), the actuator device 19 axially moves the support needle from the exchange position to the holding position to internally engage the straw 1 which is arranged in the input station S1; on the other hand, when a straw 1 has to be released from the corresponding seat 9 (namely, in the output station S2), the actuator device 19 axially moves the support needle from the holding position to the exchange position to disengage the straw 1 which is in the output station S2. Obviously, between the input station S1 and the output station S2, the actuator device 19 keeps each support needle 18 in the holding position to engage the corresponding straw 1.

[0026] It is important to note that between the input station S1 and the output station S2 (and in particular downstream of the corrugating station S3), the actuator device 19 can modify the holding position by axially sliding the support needle 18 while keeping, in any case, the support needle 18 inside the straw 1 to keep the straw 1 internally engaged by the support needle 18; this movement of each support needle 18 is meant to allow axial compression of the straw 1 downstream of the corrugating station S3 and in the area of the intermediate portion 4.

[0027] Each support needle 18 is mounted on the conveyor 8 in a rotary manner so as to rotate on itself around a central rotation axis 20 (parallel to the rotation axis 11 of the drum 10). The conveyor 8 comprises an actuator device 21 which rotates each support needle 18 on itself and around the rotation axis 20 when the seat 9 is in the corrugating station S3 (namely, when the seat 9 passes through the corrugating station S3). The rotation of each support needle 18 in the area of the corrugating station S3 causes a corresponding rotation of the straw 1 internally engaged by the support needle 18 and therefore allows the blades 12 to deform the straw 1 by 360°, namely, along the entire circumferential extension of the straw 1 (hence the corrugation of the straw 1 has a series of adjacent circular deformations).

[0028] The actuator devices 19 and 21 which impart an axial translation movement and a rotational movement, respectively, to the support needles 18 are preferably provided by means of cams; that is, fixed cams are provided which are arranged around the rotation axis 11 of the drum 10 and which generate the motion necessary for the actuator devices 19 and 21 by exploiting the rotation of the drum 10 around the rotation axis 11.

[0029] Each support needle 18 has an intermediate indented portion 22 (namely, presenting an alternation of valleys and peaks) which is arranged in the area of

the intermediate corrugated portion 4 of a straw carried by the support needle 18 and is configured to cooperate with the blades 12 to form the intermediate corrugated portion 4. In other words, the intermediate indented portion 22 of each support needle 18 forms a matrix (mould) which reproduces in negative the shape of the intermediate corrugated portion 4 of the straw 1 whereas the blades 12 form the punches which deform the straw 1 against the matrix (the intermediate indented portion 22).

[0030] Once the intermediate corrugated portion 4 has been made along the corrugating station S3, each straw 1 could be subjected to an axial compression of the intermediate corrugated portion 4 between the corrugating station S3 and the output station S2; for this purpose, immediately downstream of the corrugating station S3, the actuator device 19 modifies the holding position by axially sliding the support needle 18 so as to withdraw the intermediate indented portion 22 of the support needle 18 from the intermediate corrugated portion 4 of the straw 1 and thus allowing the intermediate corrugated portion 4 to be compressed without hindrance.

[0031] According to a preferred embodiment illustrated in Figures 6 and 7, each adjustment device 14 comprises a screw 23 which can be rotated in both directions, and a mechanical transmission 24 which transforms the rotation movement of the screw 23 into a radial translation movement of the corresponding blade 12 in both directions.

[0032] According to a preferred embodiment, the corrugating unit 6 operates on a double line, namely, treats two straws 1 fed head on, arranged side by side (that is, axially aligned to one another) at a time. In other words, the conveyor 8 has a series of pairs of seats 9 (axially aligned to one another) to pick up two smooth straws 1 at a time in the input station S1 and then release two corrugated straws 1 at a time in the output station S2. According to a different embodiment, the corrugating unit 6 operates on a single line, namely treats only one straw 1 at a time.

[0033] Each support needle 18 being mounted on one side only (namely, being mounted in a cantilevered manner) inevitably tends to flex when loaded and shows a bending that increases progressively while moving away from the fixing point of the support needle 18 to the conveyor 8 (namely, to the drum 10); consequently, as moving away from the fixing point of each support needle 18 to the conveyor 8 (namely, to the drum 10), the blades 12 must be progressively closer to the processing path P (namely, to the rotation axis 11 of the drum 10) to compensate for the increasingly greater bending of the support needle 18 and therefore create corrugations of constant depth (if instead the blades 12 were all arranged at the same distance from the processing path P then they would produce, in a completely desired way, corrugations of progressively decreasing depth due to the bending of each support needle 18).

[0034] It is important to note that the support needles 18 must have a reduced diameter in order to slip inside the corresponding straws 1 and therefore it is impossible to make the support needles 18 rigid enough to avoid, in use, a significant bending of the same.

[0035] In other words, the blades 12 are arranged at different distances from the processing path P (namely, from the rotation axis 11 of the drum 10) and in particular the blades 12 are arranged at progressively decreasing distances from the processing path P (namely, from the rotation axis 11 of the drum 10). Therefore, the blades 12 are arranged at progressively decreasing distances from the processing path P (namely, from the rotation axis 11 of the drum 10) as the distance of the blades 12 increases from a cantilever mounting point of each seat 9 (namely, of the corresponding support needle 18) on the conveyor 8. The embodiments described here can be combined with one another without departing from the scope of the present invention.

[0036] The corrugating unit 6 described above has numerous advantages.

[0037] Firstly, the corrugating unit 6 described above allows to obtain an intermediate corrugated portion 4 having a perfectly regular (uniform) shape, namely, in which all the rings of the corrugation have exactly the same depth. This result is essentially obtained due to the fact that the position of each blade 12 is adjustable in a completely independent way of the position of the other blades 12 and consequently it is possible to give each blade 12 the optimal position to obtain the optimal deformation (that is, having the desired depth) of the straw 1 which impacts against the blade 12, compensating for all the negative effects that would determine a non-optimal deformation (that is, not having the desired depth); in particular, the adjustment of the position of each blade 12 allows to compensate for the flexions of each support needle 18 which increase as moving away from the end where the support needle 18 is mounted in cantilevered manner. This result is also obtained due to the fact that the blades 12 are arranged staggered along the processing path P, since only one blade 12 at a time deforms the straw 1 and therefore its action (not being influenced by the action of the other blades 12) is very well controllable only and solely by suitably adjusting the position of the blade 12.

[0038] Furthermore, the corrugating unit 6 described above is simple, inexpensive and compact to manufacture.

Claims

1. A corrugating unit (6) for a straw (1) comprising:

   a frame (7);
   at least one seat (9) which is designed to house the straw (1); a conveyor (8), which is configured to move the seat (9) carrying the straw (1) along a processing path (P); and
   a corrugating station (S3), which is arranged

along the processing path (P) and comprises a plurality of blades (12), which are all arranged parallel to the processing path (P) and are mounted on a frame (7) so as to remain, in use, still relative to the conveyor (8) so that the seat (9), while moving along the processing path (P), causes the straw (1) to come into contact with the blades (12), thus determining a deformation of the straw (1) in the area of each blade (12); the corrugating unit (6) is **characterized in that** it comprises a support arm (13), which supports all the blades (12) and is mounted in a movable manner on the frame (7), so as to move between a work position, in which the blades (12) are in the area of the processing path (P), and a rest position, in which the blades (12) are far from the processing path (P).

2. The corrugating unit (6) according to claim 1, wherein the support arm (13) is hinged so as to rotate around a first rotation axis (15) between the work position and the rest position.

3. The corrugating unit (6) according to claim 1 or 2 and comprising an abutment body (16) which forms an end stop for the support arm (13) in order to establish the work position so that, in the work position, the support arm (13) is in abutment against the abutment body (16).

4. The corrugating unit (6) according to claim 1, 2 or 3 and comprising an actuator device (17), which moves the support arm (13) between the work position and the rest position.

5. The corrugating unit (6) according to one of the claims from 1 to 4, wherein:

the conveyor (8) comprises a drum (10), which supports the seat (9) and is mounted to rotate around a first central rotation axis (11);
the processing path (P) is circular; and
each blade (12) has the shape of an arc of a circle.

6. The corrugating unit (6) according to one of the claims from 1 to 5, wherein:

the seat (9) comprises a support needle (18), which is mounted on the conveyor (8) in an axially movable manner so as to move perpendicularly to the processing path (P) between an exchange position, in which the support needle (18) is arranged on the outside of the straw (1), and a holding position, in which the support needle (18) is at least partially arranged inside the straw (1); and
an actuator device (19) is provided, which axially moves the support needle (18), places the support needle (18) in the exchange position when the seat (9) is in an input station (S1) or in an output station (S2) at the two ends of the processing path (P), and places the support needle (18) in the holding position when the seat (9) is between the input station (S1) and the output station (S2).

7. The corrugating unit (6) according to claim 6, wherein:

the support needle (18) is mounted on the conveyor (8) in a rotary manner to rotate on itself around a second central rotation axis (20); and
a third actuator device (21) is provided, which rotates the support needle (18) on itself and around the second rotation axis (20) when the seat (9) is in the corrugating station (S3).

8. The corrugating unit (6) according to claim 7, wherein each adjustment device (14) is configured to radically change the work position of the corresponding blade (12) in order to move the blade (12) close to/away from the third rotation axis (11).

9. The corrugating unit (6) according to one of the claims from 1 to 8, wherein the blades (12) are arranged at different distances from the processing path (P).

10. The corrugating unit (6) according to claim 9, wherein the blades (12) are arranged at progressively decreasing distances from the processing path (P).

11. The corrugating unit (6) according to claim 10, wherein:

the seat (9) is mounted in a cantilevered manner on the conveyor (8); and
the blades (12) are arranged at progressively decreasing distances from the processing path (P) as the distance of the blades (12) increases from a cantilevered mounting point of the seat (9) on the conveyor (8).

12. The corrugating unit (6) according to one of the claims from 1 to 11 and comprising a plurality of adjustment devices (14), each configured to change the work position of the blade (12) in order to move the blade (12) close to/away from the processing path (P) in a separate manner and independently of the work position of the other blades (12).

13. The corrugating unit (6) according to claim 12, wherein each adjustment device (14) is configured to change the work position of the corresponding blade (12) in order to move the blade (12) close

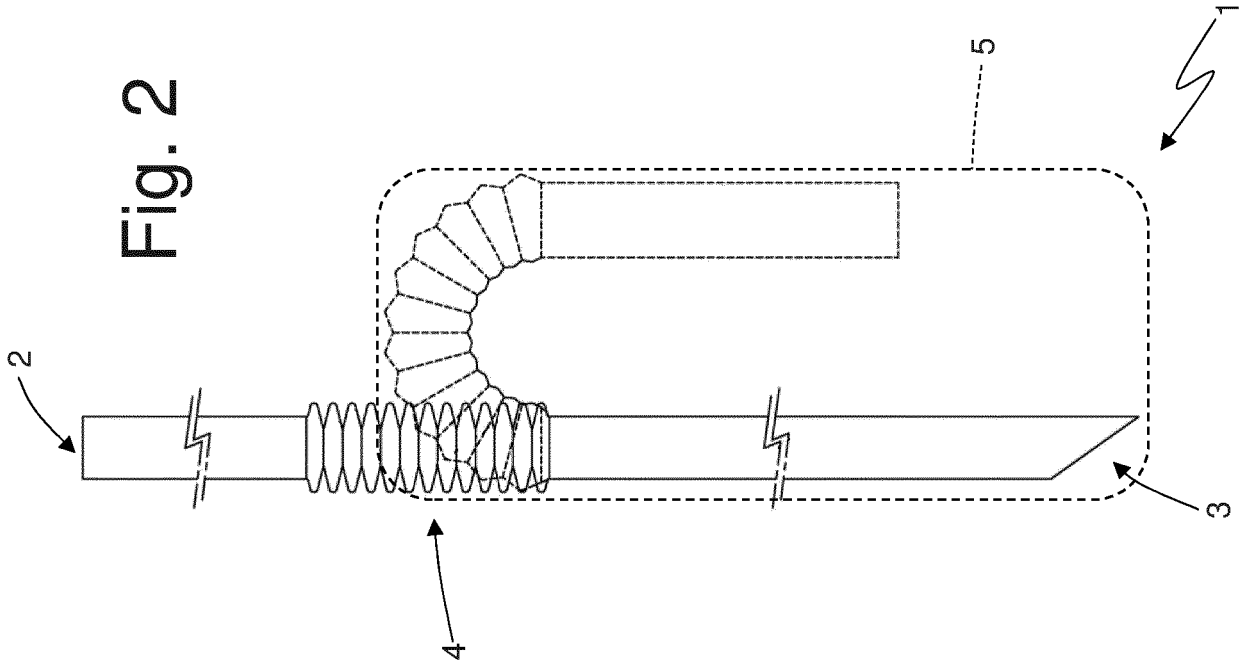
to/away from the processing path (P) in a separate manner and independently of the work position of the other blades (12) so as to increase or decrease a depth of a corrugation made by the blade (12) on the straw (1).

14. A method to corrugate a straw (1) comprising the steps of: moving, by means of a conveyor (8), a seat (9) designed to house the straw (1) along a processing path (P); and

causing, by means of the seat (9) moving along the processing path (P), the straw (1) to come into contact with a plurality of blades (12), which are all arranged, in a corrugating station (S3), parallel to the processing path (P), and are mounted so as to remain, in use, still relative to the conveyor (8) in order to determine a deformation of the straw (1) in the area of each blade (12);

the corrugating method is **characterized in that** it is provided a support arm (13), which supports all the blades (12) and is mounted in a movable manner on the frame (7), so as to move between a work position, in which the blades (12) are in the area of the processing path (P), and a rest position, in which the blades (12) are far from the processing path (P).

Fig. 2



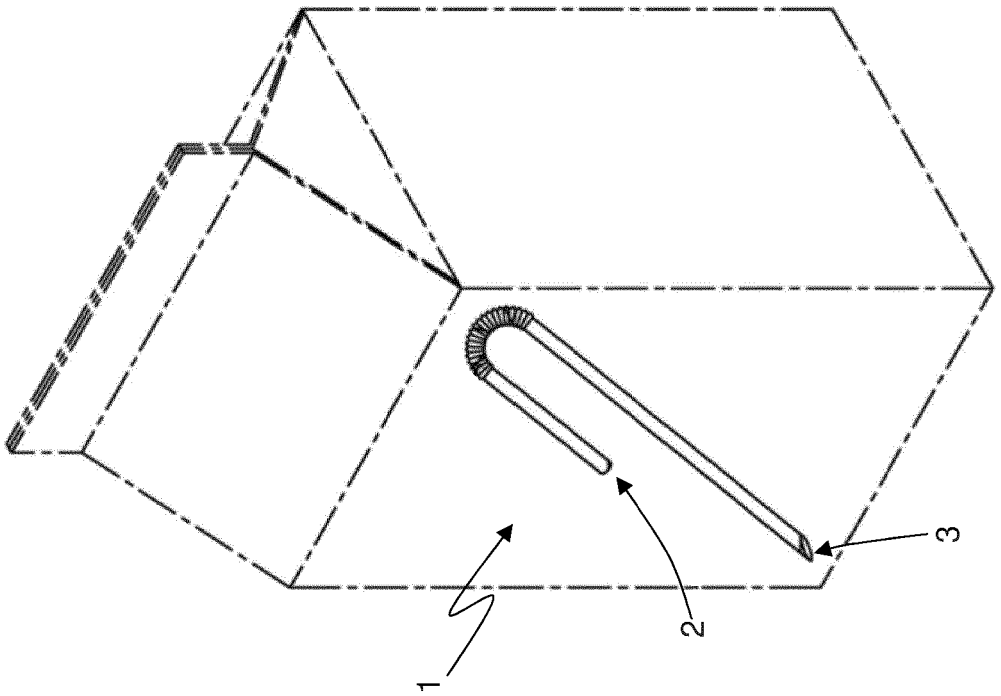
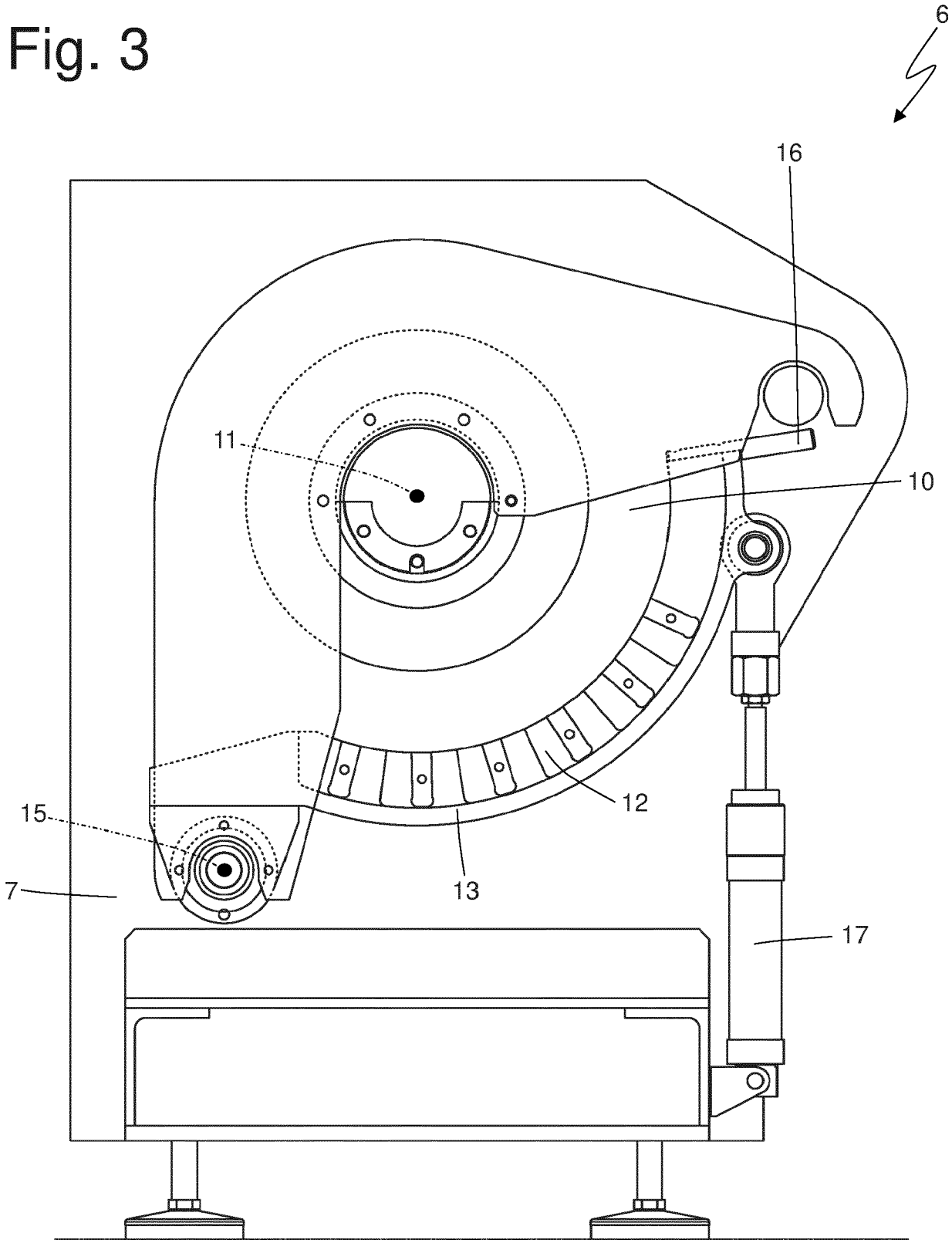


Fig. 1

Fig. 3



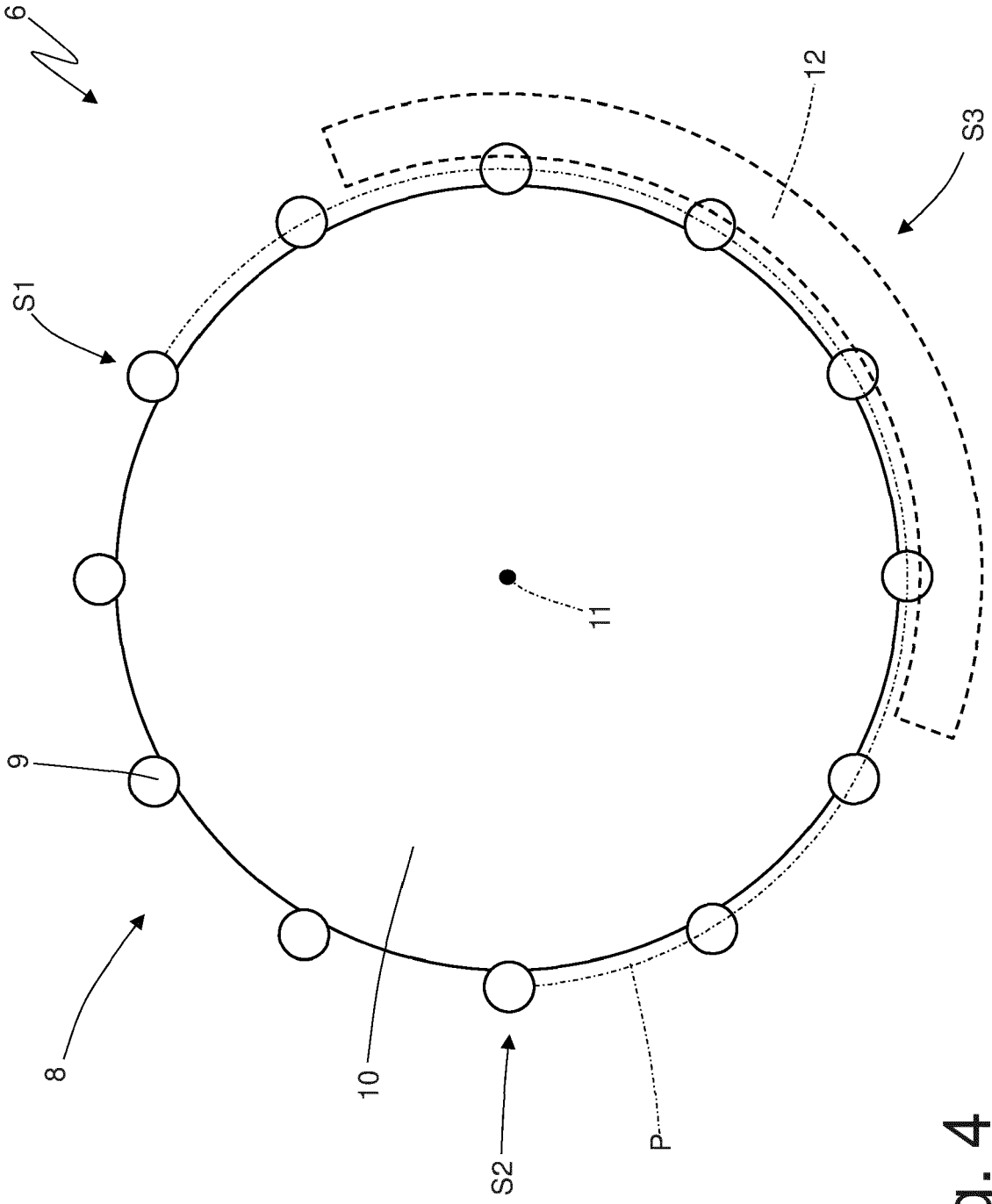


Fig. 4

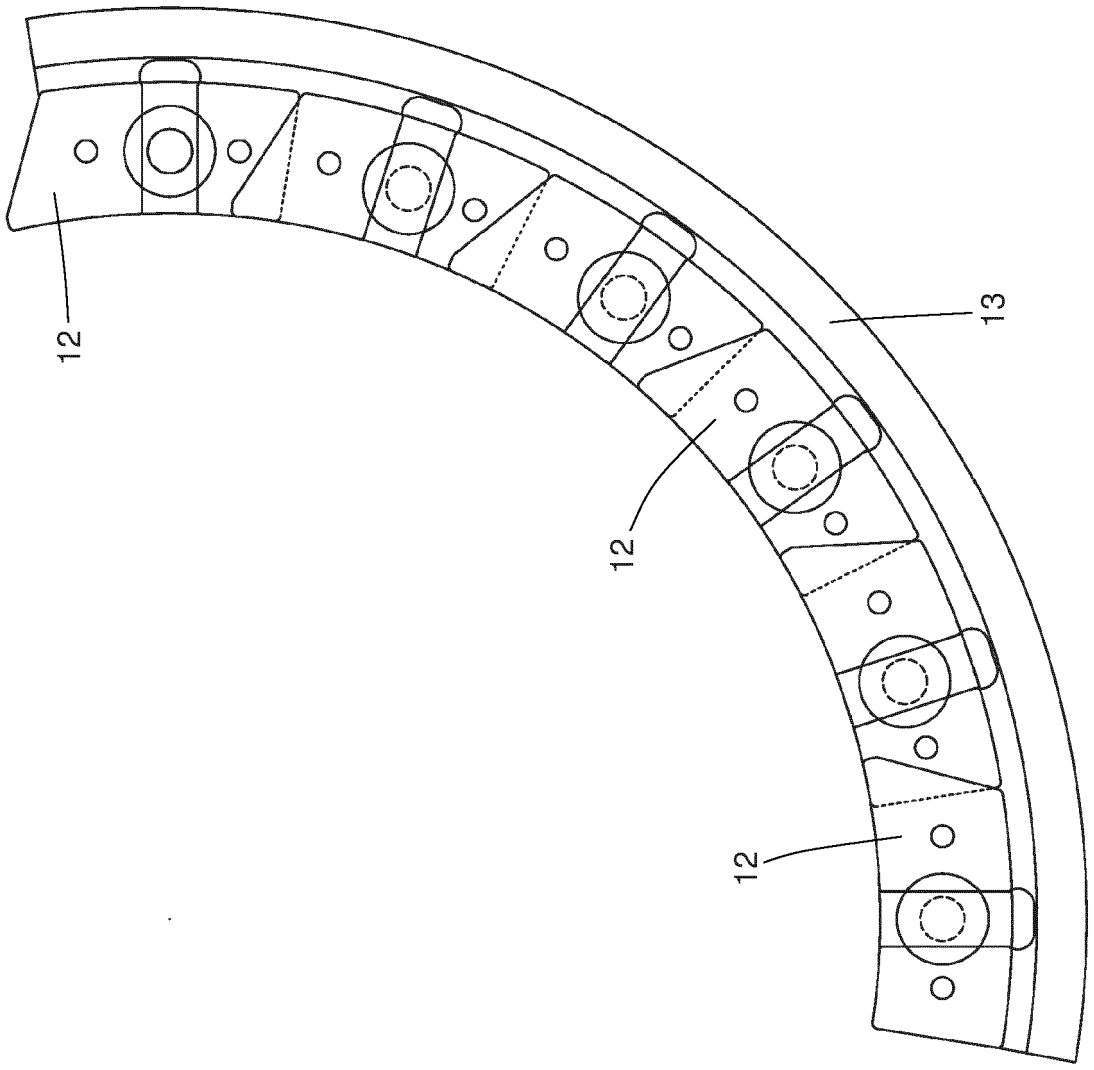


Fig. 5

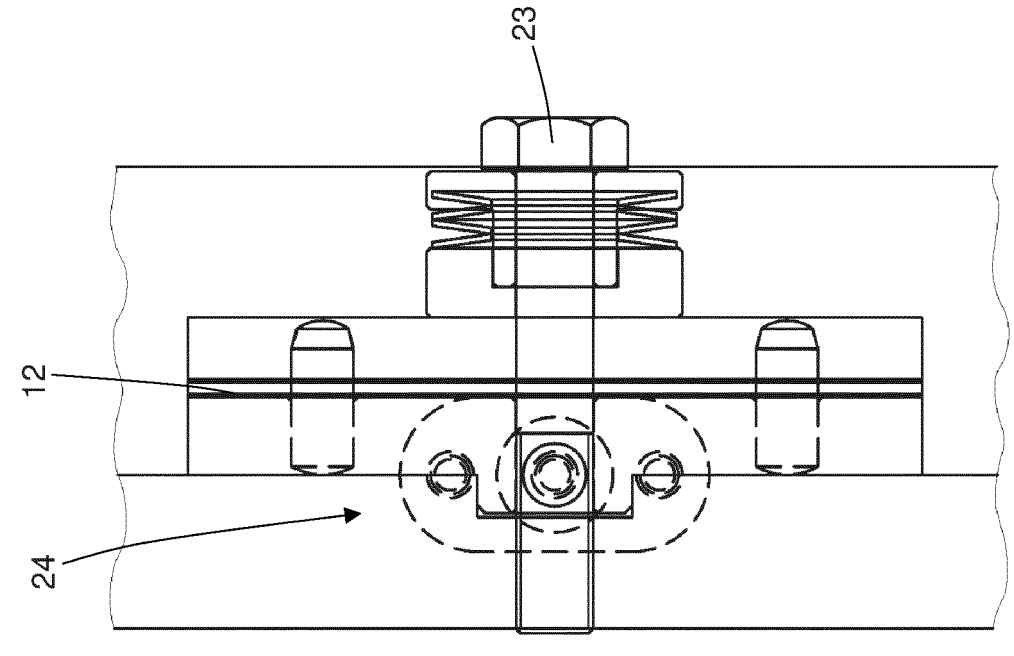


Fig. 7

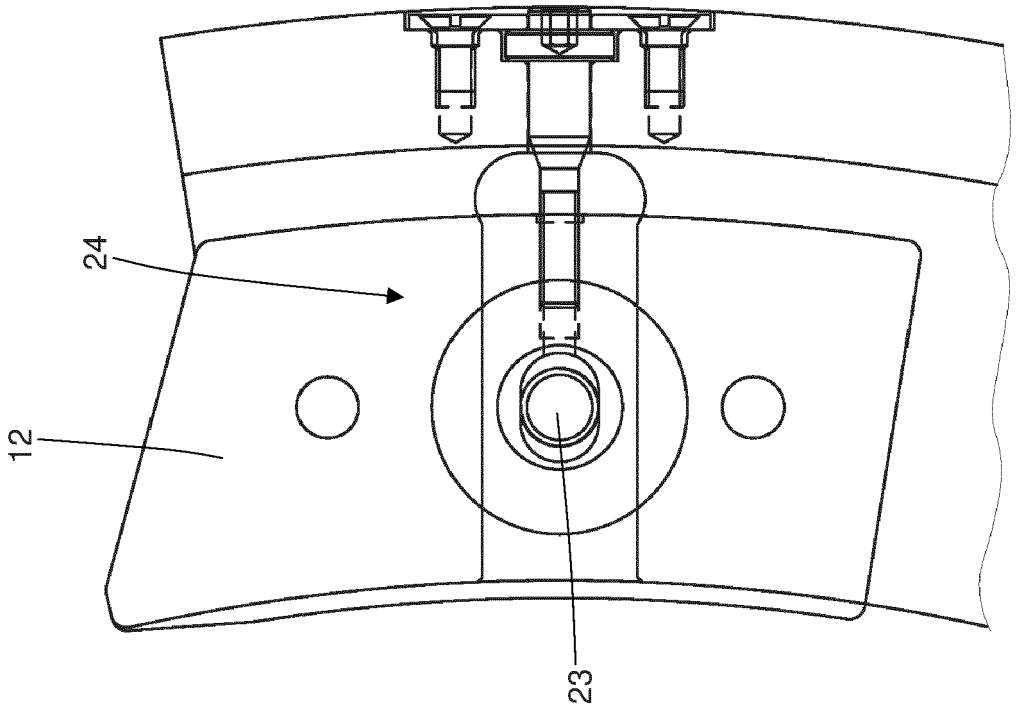
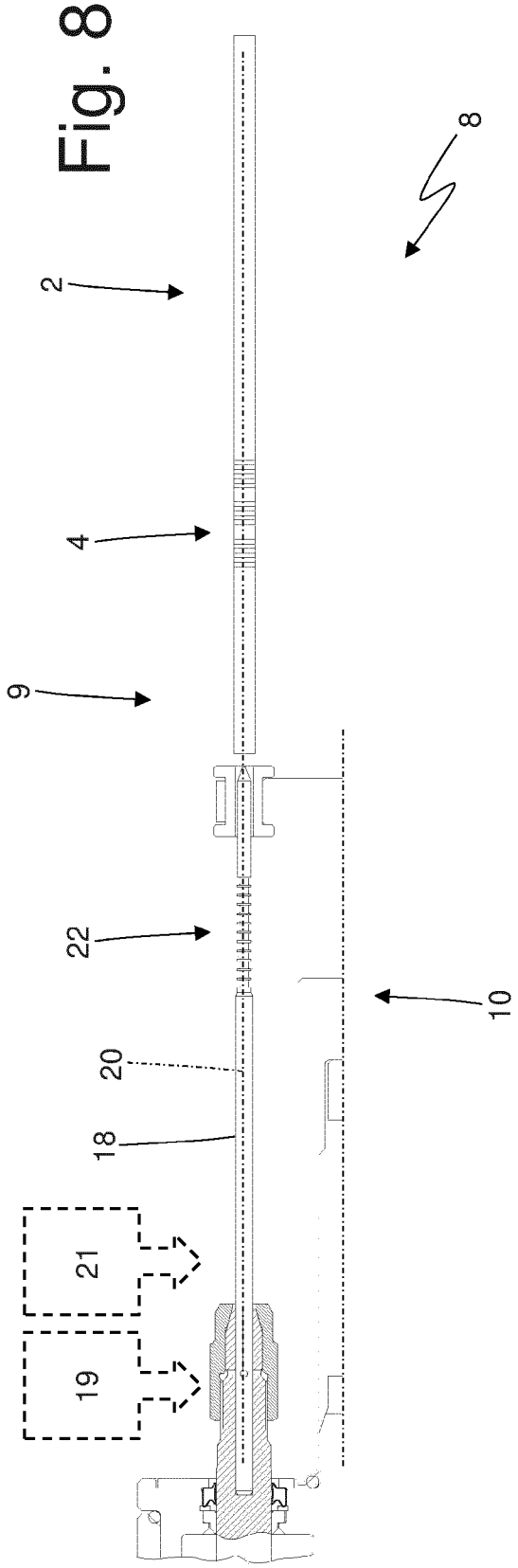


Fig. 6

Fig. 8



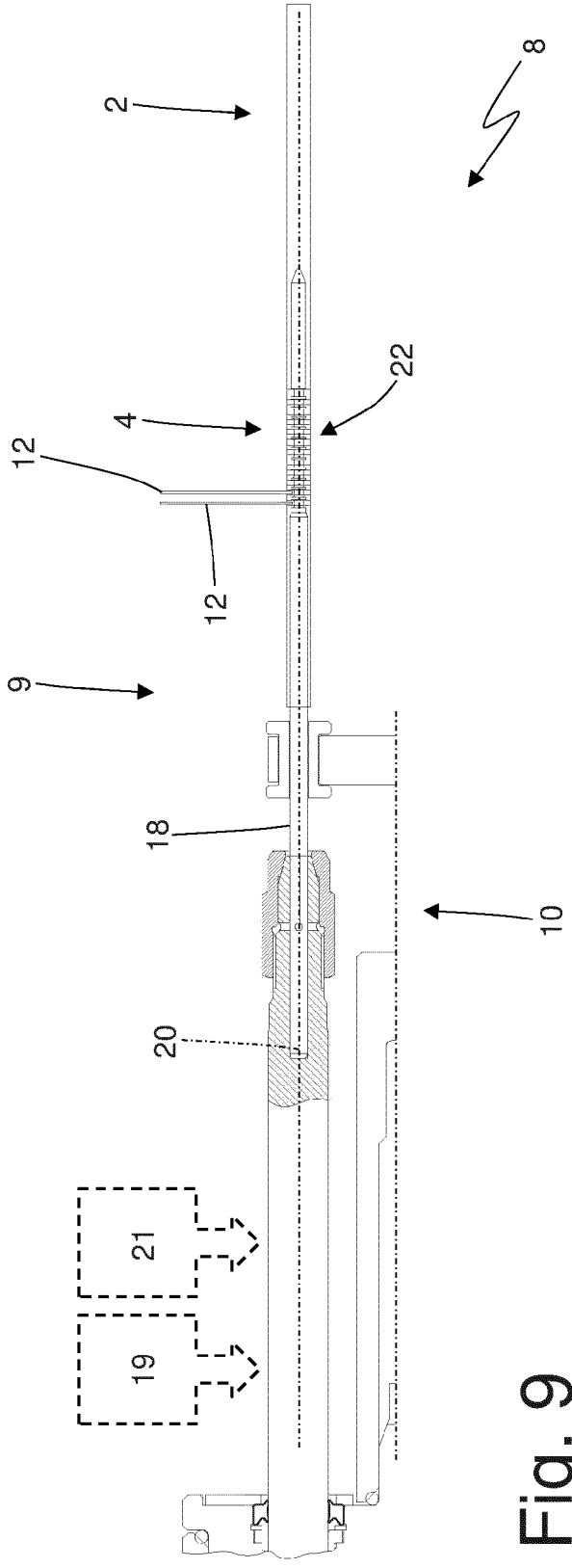


Fig. 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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