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(54) Chamfering equipment for cylindrical stoppers

(57) The present invention relates to equipment for chamfering the ends of cylindrical closures or stoppers for containers containing liquids, low viscosity substrates, and small solids.

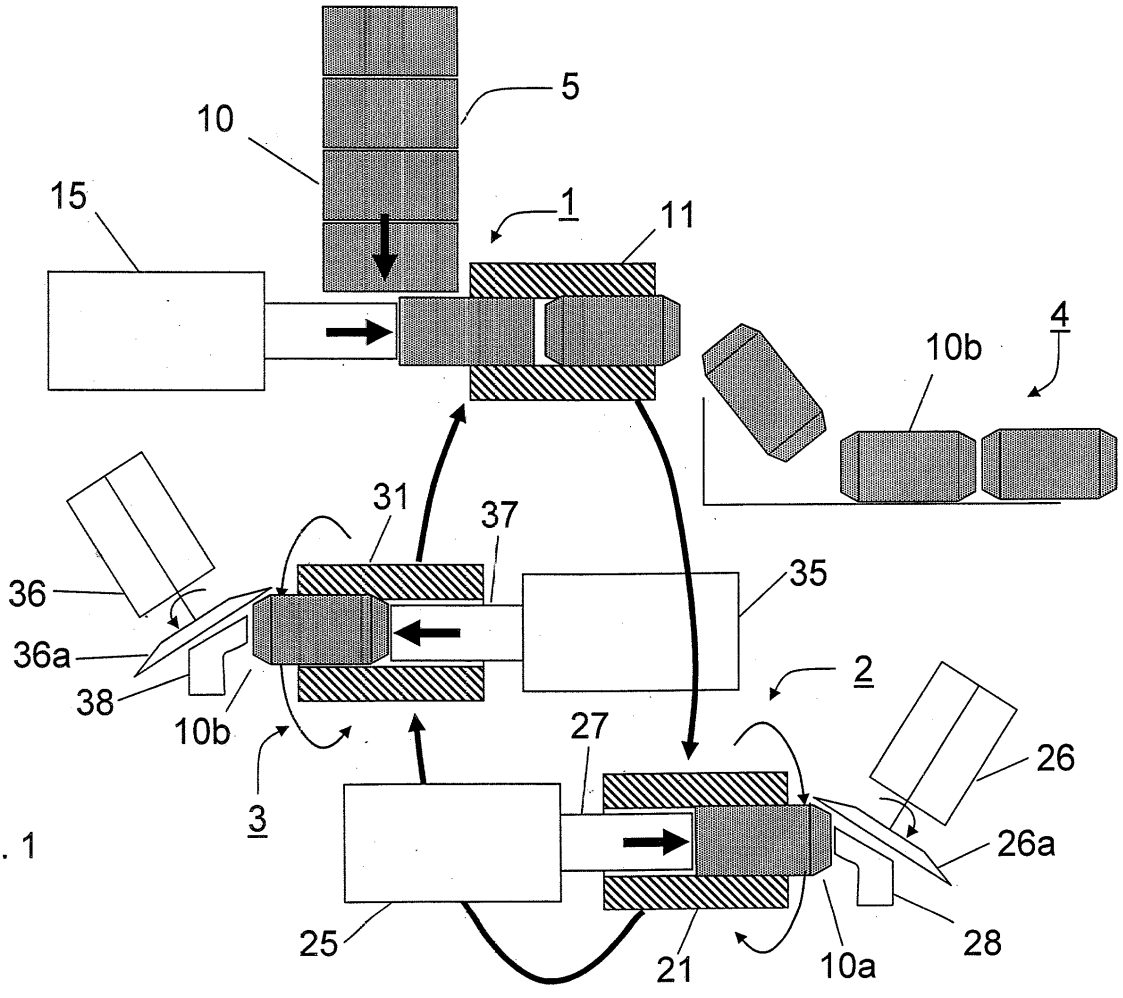

FIG. 1

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Description

Technical field

[0001] The present invention relates to the machining of closures or stoppers for containers containing fluids, such as low viscosity liquids, pastes, or low pressure gases, and particulate solids. More specifically, the present invention is directed to apparatuses for chamfering the ends of cylindrical stoppers, particularly synthetic ones.

Background of the invention

[0002] Stoppers made from cork obtained from the cork oak have traditionally been used to close bottles such as wine bottles. In use, the cork is inserted into the neck of the bottle where its inherent elasticity enables it to expand to seal the neck such that the ingress of air is reduced and the contents of the bottle are prevented from escaping from the bottle. However, numerous disadvantages associated with the use of natural corks have been identified, such as their cost, scarcity, and unequal quality. Accordingly, alternatives to natural cork have been sought. One alternative solution is to produce a stopper wholly from synthetic materials. In general such stoppers are produced to resemble the natural corks in color to yield a higher acceptability from the consumer. Again, mono-component synthetic stoppers made e.g. of a polymer or a foamed resin have been unable to satisfy all of the stringent requirements associated therewith. More recently, multi-component/multi-layer synthetic closures have been shown to provide numerous advantages over the synthetic, mono-component stoppers known in the art. Such closures are typically of the core-sheath (or core-skin) type comprising a foamed core and an outer layer peripherally surrounding the core member.

[0003] In parallel, it has been well known in the art of bottle stoppers that by incorporating a beveled edge or a chamfer to the ends of the closures, correct entry and acceptable insertion into the neck of a bottle is greatly facilitated. Chamfered edges are particularly advantageous for core-skin stoppers as they greatly reduce the risk of delamination caused by the sheath being turned inside out upon incorporation of the stopper into the bottle neck. In case stoppers are produced by injection molding, the chamfered edges can be formed in-mold by providing the corresponding mold geometry to form a product with the final shape desired as described in US2003/0161985. Injection molding, however, is most suitable for the production of stoppers having a single component. Although core-skin stoppers could theoretically be produced by injection molding, the production costs would be too high. It is generally preferred to produce core-skin stoppers by co-extrusion thus forming a continuous elongated member which is thereafter cut at the desired length to form the individual stoppers as also explained in US2003/0161985. In this case, the chamfers at the edges of the stoppers must be formed after -or upon- cutting the elongated member into individual stoppers.

[0004] Examples of extruded multi-layered synthetic stoppers provided with chamfers are described e.g. in US2003/0161985, US-B1-6,221,450 and in US-A1-2006/0035074. No details as to how the chamfer is obtained are, however, provided therein. US2006/0222800 discloses a method of treating a stopper made of expanded plastic material including heat shrinking the ends of the stopper to effect a beveled edge. However, the heat shrinking treatment is not without affecting the structure and properties of the resulting stopper and the production rate is limited. An alternative solution is described in EP-A1-1493681 which discloses a process for producing synthetic bi-layered bottle closures provided with chamfered edges wherein the beveled ends are obtained by a grinding process. A problem with the grinding process, however, is that as material is ground away from the edges, shavings and dust may electrostatically adhere to the surfaces of the stopper and thus contaminate the liquid contained in the container the stopper is inserted into.

[0005] It appears from the technical solutions described in the literature, that there still remains a need for reliably, hygienically, economically, and rapidly providing a chamfer at the edges of cylindrical stoppers. It is therefore an objective of the present invention to provide an apparatus for chamfering the ends of cylindrical stoppers capable of fulfilling such requirements. It has now been found that the above objective can be met by providing an apparatus according to the present invention.

Summary of the invention

[0006] The present invention is defined in the appended independent claims. Preferred embodiments are defined in the dependent claims.

[0007] The present invention concerns an apparatus for chamfering the first and second ends of cylindrical stoppers comprising:

(a) a feeding line, feeding the cylindrical stoppers to a loading station of a carousel,
(b) the loading station comprising means for engaging the first stopper at the end of the feeding line into a first cylindrical hollow barrel suitable for holding the stopper in position;
(c) means for rotating the carousel so as to drive the first barrel loaded with a cylindrical stopper to a first chamfering station, while a second barrel is brought to the loading station;
(d) the first chamfering station comprising:

(i) means for bringing into chamfering position a first end of the stopper engaged in the barrel located at the station;
(ii) means for rotating the barrel and the stopper engaged therein with respect to their common

axis of revolution;
(iii) a rotating blade tilted at an angle corresponding to the desired chamfering angle;

(e) means for rotating the carousel so as to drive the barrel loaded with a cylindrical stopper chamfered at one end to a second chamfering station, while the second barrel loaded with a fresh stopper is brought to the first chamfering station;
(f) the second chamfering station comprising:

(i) means for bringing into chamfering position the second, un-chamferd end of the stopper engaged in the barrel located at the station;
(ii) means for rotating the barrel and the stopper engaged therein with respect to their common axis of revolution;
(iii) a rotating blade tilted at an angle corresponding to the desired chamfering angle; and

(g) means for rotating the carousel so as to drive the barrel loaded with a cylindrical stopper chamfered at both ends to a dispensing station, while the second barrel loaded with a stopper chamfered at one end is brought to the second chamfering station.

[0008] The present invention also concerns a hollow barrel for tightly holding and centring a cylindrical stopper suitable for the apparatus as above-described, consisting of a hollow cylinder of length and diameter larger than the stopper to be engaged therein, wherein the hollow barrel comprises at least nine spherical balls mounted in, and protruding from recesses located in the inner wall of the barrel, disposed on at least three points round its circumference to define a polygonal passageway normal to the barrel's axis of revolution, and distributed on at least three rows along the length of the barrel, the balls being mounted so as to resiliently engage deeper into their corresponding recesses when pressed in, thus enlarging the passage defined thereby to accommodate the stopper.

Brief description of the drawings

[0009]

FIG.1 is a schematic representation of an apparatus according to the present invention, wherein different phases of the apparatus in operational mode are represented.
FIG.2 is a perspective view of a chamfering operation
FIG.3 represents the carousel comprising three cylindrical hollow barrels together with means for rotating the carousel and means for rotating the barrels.
FIG.4 is a view of the loading station of the carousel, wherein a fresh stopper has just been engaged in the first hollow barrel, and of the dispensing station where the stoppers with both ends chamfered are dispensed
FIG.5 is a view of the first chamfering station of the carousel, wherein the fresh stopper is being chamfered at one end by a rotating blade.
FIG.6 is a view of the second chamfering station of the carousel, wherein the stopper chamfered at one end is being chamfered at its un-chamfered end by another rotating blade.
FIG.7a represents a simplified cross-sectional side view and a simplified cross-sectional front view of a hollow barrel according to the invention, wherein the hollow barrel is free of stoppers.
FIG.7b represents the hollow barrel represented in **FIG.7a** wherein a stopper is engaged in the hollow barrel.
FIG.8 represents a carousel comprising N = 3 sequences of loading, first and second chamfering, and dispensing stations in a single carousel.
FIG.9 represents a rotating blade mounted on a guide allowing the control of the chamfering angle.

Detailed description of the invention

[0010] For the purposes of promoting and understanding the principles of the present invention, reference will be made to the embodiments illustrated in the drawings and specific language will be used to describe the same. While this invention is susceptible of embodiments in many different forms, this specification and the accompanying drawings disclose specific forms as examples of the invention. However, the invention is not intended to be limited to the embodiments so described.
[0011] In the context of the present invention, the term "stopper" encompasses any stopper which may be inserted into a receptacle to close an opening in the receptacle. Accordingly, the expression "cylindrical stopper" used hereinafter is meant to refer to any stopper which is substantially cylindrical prior to its insertion into the receptacle opening and which is made of any commonly known material such as natural cork or synthetic material, as well as multi-layer, core-skin synthetic stoppers. Suitable synthetic stoppers for use in the context of the present invention are e.g. described in US2003/0161985.
[0012] As represented in **FIG.1,** the apparatus for chamfering the ends of cylindrical stoppers according to the present invention comprises four main stations: a loading station **1,** a first chamfering station **2,** a second chamfering station **3,** and a dispensing station **4,** preferably located adjacent to the loading station. The cylindrical stoppers **10** to be chamfered are sequentially supplied to these four main stations, via suitable rotation of a carousel **6.**

CAROUSEL 6

[0013] The apparatus according to the present inven-

tion comprises a carousel **6.** Carousel **6** for use herein may have any suitable configuration, form or dimension provided that the latter is capable of bringing the cylindrical stoppers **10** sequentially from the loading station **1,** to the first chamfering station **2,** then to the second chamfering station **3,** and finally to the dispensing station **4.** Suitable form and dimensions of the carousel **6** for use in the context of the present invention may be easily identified by those skilled in the art. According to a preferred execution, the carousel **6** takes the form of a disc, as represented in **FIG.3** and **8.** Preferably, the carousel **6** for use herein is mounted on a vertical panel (not represented) having first and second opposite main surfaces.

[0014] In order for the carousel **6** to be able to bring the cylindrical stoppers **10** to the four main stations of the apparatus according to the invention, the carousel 6 shall be associated with means for rotating the carousel **6** and shall preferably comprise at least three cylindrical hollow barrels **11, 21, 31.** Indeed, as represented in **Fig. 1,** the dispensing station **4** and loading station **1** preferably correspond to a same position of the carousel **6,** and are located at opposite sides of the panel. In order to increase the output of the chamfering apparatus, it is preferred that more than a single sequence of the four main stations are distributed round the carousel. For instance, as illustrated in **Fig.8** the carousel may comprise N = 3 sequences of a loading station **1,** a first and second chamfering stations **2&3,** and a dispensing station **4.**

[0015] The rotation of the carousel **6** may be driven by a motor **20** to impart a sequential stop/go motion to the carousel, each rotation thereof bringing the stoppers from one station to the next and remaining in place for the whole duration of the treatment at each station. The time the carousel stops at each station is generally around 0.3-1.0 s, preferably around 0.5 s, which is sufficient time to load a fresh stopper at loading station **1,** to chamfer one end of the stopper at stations **2, 3,** and to dispense the chamfered stopper at station **4,** which is usually located opposite the loading station **1.** The speed of rotation of the carousel to bring each stopper from one station to the next depends on the desired output rate. It is clear that it should be as high as possible, since no chamfering may occur during rotation of the carousel. As an example, for a carousel comprising N = 3 sequences of stations **1-4,** the carousel operates 1/9 of a revolution in less than 0.5 s, typically between 0.1 and 0.3 s.

FEEDING LINE 5 AND LOADING STATION 1

[0016] The feeding line **5,** feeds fresh cylindrical stoppers **10** to a loading station **1** reachable by a barrel **11, 21, 31** mounted on a carousel **6.** When a barrel **11,** either empty or loaded with a stopper having both ends chamfered, is located at loading station **1** it is ready to receive a fresh stopper fed from feeding line **5.** The feeding line can have any geometry suitable for said purpose. As represented in **Fig.1, 3** and **4** it can be in the form of a vertical rack which bottom opens facing the loading station **1.** When a stopper is inserted by engaging means **15** into the barrel **11** located at the loading station **1** the next stopper comes into loading position in the rack by gravity. Other configurations can be considered. For instance, it is possible to feed the stoppers in a line following the cutting of the stoppers out of the extruded elongated member. Alternatively, a carousel can be used.

[0017] Suitable means **15** for engaging a fresh stopper **10** into the corresponding cylindrical hollow barrel **11, 21, 31** may take any form, as will be apparent to those skilled in the art. According to a preferred embodiment, said means **15** comprise a slidable piston, as represented in **FIG.1&4,** suitable for pushing a fresh stopper **10** into the corresponding cylindrical hollow barrel. Preferably, by pushing a fresh stopper **10** into barrel **11,** a stopper **10b** chamfered at both ends is pushed out off the other side of the barrel into a dispensing station **4.**

FIRST AND SECOND CHAMFERING STATIONS 2 and 3

[0018] The first and second chamfering stations **2** and **3** each comprises:

(i) means **25, 35** for bringing into chamfering position one un-chamfered end of the stopper **10, 10a** engaged in barrel **21, 31,** respectively located in said stations **2** and **3;**

(ii) means for rotating barrel **21, 31** and the stopper **10, 10a** engaged therein with respect to their axis of revolution **19;**

(iii) a rotating blade **26, 36** tilted at an angle corresponding to the desired chamfering angle.

[0019] Theoretically, chamfering one end only of the stoppers should suffice, since the chamfer serves the sole purpose to facilitate the engagement of one end of the stopper into the opening of a container. In practice, however, there is no way to control which end of the stopper is presented to the container's opening and it is essential that both ends of the stoppers be chamfered. For this reason, the apparatus of the present invention comprises a first and a second chamfering stations.

[0020] The means **25, 35** for bringing into chamfering position one end of the stopper **10, 10a** engaged in barrel **21, 31,** may be in the form of a piston facing the opening of barrel **21, 31** and suitable for pushing the stopper engaged in the corresponding barrel until it juts out thereof. Preferably, stopping means **28, 38** are provided on the opposite side of the barrel to ensure that the stopper is always accurately pushed out at its precise chamfering position, in contact with the cutting edge of the rotating blade **26a, 36a** (cf. Fig.**1, 5** and **6).**

[0021] Optimal chamfering of the stoppers is obtained according to the present invention by a combination of a rotating blade **26, 36** positioned at an angle corresponding to the desired chamfering angle, and the rotation of the stopper as illustrated in **Fig.2.** Rotation of the stopper

to be chamfered is provided by rotating the barrel in which it is engaged and firmly held in place. Rotation of the barrels may be driven by a motor connected to transmission means into which the barrels engage upon moving into the first and second chamfering stations **2, 3.** In a particularly advantageous embodiment, the transmission means may be a sling **23** running between a driving wheel connected to the motor and one or more idle wheels (two idle wheels are represented in **Fig.3),** one of the idle wheels being provided with tensioning means to ensure the sling is always under tension. As illustrated in **Fig.3** the barrels **21, 31** engage into sling **23** as they come into position at chamfering stations **2** and **3.** Other solutions can be applied. For instance, rotational motion may be transmitted from the motor to the barrels through a chain, gears or friction wheels which contact the barrels as they reach stations **2** and **3.** The rotation rate of the barrels is typically comprised between 100 and 500 rev. / min, preferably between 200 and 250 rev. / min, so that the barrels complete about three revolutions during one chamfering operation.

[0022] The rotating blade **26, 36,** comprises a circular blade **26a, 36a,** connected to a rotating motor and is set at a fixed position, tilting at an angle with respect to the stopper corresponding to the chamfering angle (cf. **Fig. 2, 5, 6,** and **9).** As illustrated in **Fig.9,** the rotating blade is preferably slidingly mounted on a guide **40,** said guide forming a circle segment centred on the point wherein the rotating blade **(26a, 36a)** intercepts the edge of the stopper **(10, 10a),** such that sliding along the guide varies the chamfering angle, but not the chamfering depth. Other types of blade positioning guides **40** may be used, such as a simple two or three degree of freedom translation means, but the sliding guide **40** represented in **Fig. 9** has the advantage of maintaining constant the relative position of the blade's cutting edge and the stopping means **28, 38.**

[0023] The chamfering angle is generally around 45 deg more or less 15 deg, i.e., it generally varies between 30 and 60 deg, although any angle could be chamfered with the present apparatus. The chamfering depth is usually comprised between 0.5 and 1.0 mm for wine bottles, but can reach up to about 3.0 mm for sweet wines, like port or brandy bottles.

[0024] Rotating blades are advantageous over static blades as the latter rapidly become too blunt to ensure clean chamfered edges. According to the apparatus of the present invention, the blade **26a, 36a,** rotates at a velocity comprised between 1000 and 12,000 rev. / min, preferably from around 5000 to 7000 rev. / min, most preferably around 6000 rev. / min. The high rotating speed of the blade ensures that its cutting edge remains sharp over long production times. The cutting edge is generally smooth and sharpened, but it may be provided with small teeth depending on the materials of the stoppers to be chamfered.

DISPENSING STATION 4

[0025] The apparatus according to the present invention further comprises a dispensing station **4,** the role of which is to extract from the barrel and dispense into a dispensing line cylindrical stoppers **10b** having both ends chamfered.

[0026] According to a preferred execution of the present invention, the dispensing station **4** is located on the opposite side of the carousel as the loading station; loading station **1** and dispensing station **4** therefore correspond to the same position of a barrel **11, 21, 31** on the carousel (cf. **Fig.1&4)** and one end of said barrel faces the loading station **1,** whilst the other end faces the dispensing station **4.** This configuration has the advantage that when a barrel loaded with a stopper **10b** having both ends chamfered reaches the dispensing station **4,** it is pushed out off one end of the barrel by the introduction into the opposite end of the barrel of a fresh stopper **10** transferred from the feeding line **5** by the actuation of engaging means **15.** Since the introduction of a fresh stopper **10** into the barrel does not necessarily suffices to push the chamfered stopper **10b** completely out of the barrel, dispensing station **4** preferably comprises means for collecting and dispensing the chamfered stopper **10b** into a dispensing line. Said means may be vacuum suction of the stopper, blowing air onto the jutting stopper **10b,** a suction cup or mechanical means. Vacuum or blowing means are preferred.

CYLINDRICAL HOLLOW BARRELS 11, 21, 31

[0027] To optimize the chamfering operations, the carousel **6** of the present invention comprises cylindrical hollow barrels **11, 21, 31** which function is to hold in place the stoppers to be chamfered and to rotate during the chamfering operations. Theoretically a single barrel hopping from one station to the next one would suffice to successfully complete the chamfering operation, but in practice this is not satisfactory for insufficient production rates. For this reason it is preferred that the carousel **6** comprises enough barrels distributed round its circumference to occupy all the stations **1-4** at each rotational increment. In case loading station **1** and dispensing station **4** correspond to a same position of the carousel, located at opposite sides thereof as illustrated in **Fig. 1&4,** then three (or any multiple, 3xN, thereof, with N = number of sequences of stations **1-4)** barrels **11, 21, 31** would allow a semi-continuous processing of the stoppers, yielding a high production rate.

[0028] The first function of the hollow barrels **11, 21, 31** is to firmly hold the stoppers in place during the chamfering operations. This is achieved by providing each barrel with at least nine spherical balls **12** mounted in, and protruding from recesses **13** located in the inner wall of the barrel, disposed on at least three points round its circumference to define a polygonal passageway **30** normal to the barrel's axis of revolution **19,** and distributed

on at least three rows along the length of the barrel. As illustrated in **Fig.7a&7b,** the balls **12** are mounted so as to resiliently engage deeper into their corresponding recesses **13** when pressed in, thus enlarging the passage defined thereby to accommodate said stopper **10.**

[0029] The balls **12** are nested in recesses **13** such that they protrude out of the inner wall of the barrel, without falling. This is achieved by providing, on the one hand, resilient means **14** resting on the bottom of recess **13** which pushes the ball out of the recess and, on the other hand, by ensuring that recess **13** opens to the inner wall in the form of a restricted neck, of diameter smaller than the ball diameter, ensuring that the balls remain in place. The person skilled in the art knows how to process such neck. For example, a washer with opening smaller than the balls diameter may be applied to the opening of a blind recess. Alternatively, a through-hole may be drilled through an inner cylinder **11 a,** said through-hole opening to the inner wall thereof with a diameter smaller than the one of the ball. Said inner cylinder **11a** is then inserted in an outer cylinder **11 b** which constitutes the outer perimeter of the barrel thus forming the bottom of recesses **13** as illustrated in **Fig.7.**

[0030] The resilient means **14** may be a spring or an elastomeric element. Preferably, the elastomeric element has the shape of a diabolo, i.e., a prism of revolution with a restricted section in the middle. The force required to engage the ball into the recess such as to allow the passage of a stopper must be sufficiently low to permit an easy introduction of a fresh stopper **10** into, and extraction of a fully chamfered stopper **10b** out of the barrel, and sufficiently high so as to hold the stopper in place during the chamfering operations. Preferably, the balls **12** are separated from the resilient means **14** by a low friction element (e.g., in PTFE, POM, HDPE) to facilitate the translation of the stopper along the barrel by allowing a certain level of rotation of the balls. Care should be taken that the level of rotation of the balls should be sufficiently low so as to ensure that the stoppers follow the rotational movement of the barrel during a chamfering operation.

[0031] The balls are distributed along the length of the barrel over at least three rows, spread apart such that a stopper inserted in the barrel overlaps at least two rows in any position, regardless of whether or not it juts out one side of the barrel (cf. **Fig.4**, **5&7b**). In case the balls are distributed over three rows as illustrated in **Fig. 7b,** the distance, δ, between two rows is preferably characterized such that, $L/2 < \delta < L$, wherein L is the length of the stopper, so that the stopper contacts at any time and position within the barrel two rows of balls.

[0032] The second function of the hollow barrels **11, 21, 31** is to impart a rotational motion to the stoppers during a chamfering operation. For this reason, the barrels are mounted on the carousel with bearings **17.** Any bearings suitable for this purpose can be used within the scope of the present invention. The barrels are also preferably provided with means for transmitting a rotational motion thereto from a motor. Said transmitting means may be in the form of a groove **16** suitable for engaging a transmission sling **23** (cf. **Fig.7),** or a gear suitable for engaging a transmission chain or with a complementary gear connected to said motor.

APPARATUS IN OPERATION

[0033] In a preferred chamfering cycle, the apparatus according to the present invention functions as follows.

[0034] At the loading station **1,** means **15** engages a first fresh stopper **10** at the end of the feeding line **5** into a first cylindrical hollow barrel **11,** wherein it is firmly held in a position concentric to the barrel by the combined action of the balls **12** resiliently mounted in recesses distributed in the inner wall of the barrel (cf. **Fig.3&7b).** Carousel **6** is then rotated to drive the first barrel **11** loaded with a fresh stopper **10** to a first chamfering station **2** where it stops; upon reaching the first chamfering station **2,** barrel **11** engages into rotational transmission means, such as a sling, a chain or a gear, and is made to rotate round its axis of revolution (cf. **Fig.3).** Simultaneously to bringing the first barrel **11** to the first chamfering station **2,** the rotation of the carousel **6** brings a second barrel **31** to the loading station **1** where a fresh stopper is loaded into the latter as explained above (cf. **Fig.3&8).**

[0035] At the first chamfering station **2,** barrel **11** faces means **25,** preferably a piston, which pushes the fresh stopper **10** partly out of the barrel **11** until it reaches stopping means **28** to expose the edge to be chamfered to a rotating blade **26a** (cf. **Fig.1&5).** With the combined effect of the rotation of stopper **10** driven by the rotation of barrel **11** and the rotation of the blade **26a,** the exposed edge is chamfered over its whole circumference (cf. **Fig.2).** After a couple of revolutions of the barrel **11,** a stopper **10a** having one end properly chamfered at the desired angle and depth is obtained. During the time a first end of the stopper loaded in barrel **11** is being chamfered, a fresh stopper **10** is being loaded into the second barrel **31** at the loading station **1** and is ready to be transferred to the next station.

[0036] Carousel **6** is then rotated again to simultaneously drive (a) the first barrel **11,** loaded with a stopper **10a** having one end chamfered to a second chamfering station **3,** (b) the second barrel **31** loaded with a fresh stopper **10** to the first chamfering station **2,** and (c) a third barrel **21** to the loading station **1.** Once each barrel faces its corresponding station, the carousel rotation stops.

[0037] The second chamfering station **3** is a mirror reproduction of the first chamfering station **2** and comprises the same elements but disposed on opposite sides of the carousel. At the second chamfering station **3,** barrel **11** faces means **35,** preferably a piston, which pushes the stopper **10a** partly out of the barrel **11** until it reaches stopping means **38** to expose the un-chamfered edge still to be chamfered to a rotating blade **36a** (cf. **Fig.1&6).** With the combined effect of the rotation of stopper **10a** driven by the rotation of barrel **11** and the rotation of the

blade **36a,** the exposed edge is chamfered over its whole circumference (cf. **Fig.2).** After a couple of revolutions of the barrel **11,** a stopper **10b** having both ends properly chamfered at the desired angle and depth is obtained. During the time the second end of the stopper loaded in barrel **11** is being chamfered at the second chamfering station **3,** a fresh stopper **10** is being loaded into the third barrel **21** at the loading station **1** and ready to be transferred to the first chamfering station **2,** and a first end of the fresh stopper loaded in second barrel **31** positioned at the first chamfering station **2** is being chamfered to yield a stopper **10a** having one end chamfered.

[0038] Once the respective loading and chamfering operations taking place at each corresponding station are completed, carousel **6** resumes its rotation to drive simultaneously (a) the first barrel **11,** loaded with a stopper **10b** having both ends chamfered to a dispensing station **4,** (b) the second barrel **31,** loaded with a stopper **10a** having one end chamfered to the second chamfering station **3,** and (c) the third barrel **21** loaded with a fresh stopper **10** to the first chamfering station **2.** Preferably, the dispensing station **4** and the loading station **1** are located at opposite sides of a same position of the carousel. In this configuration, a fourth barrel is not necessary to complete the chamfering cycle as first barrel **11** faces on one side thereof the dispensing station **4** and on the other side the loading station **1.** It is possible, albeit less preferred, to have loading station **1** and dispensing station **4** corresponding to different positions on the carousel, but then a fourth barrel is required to ensure that each station is occupied by a barrel at each stage of the chamfering cycle.

[0039] At the dispensing station **4** stopper **10b** having both ends chamfered is pushed out of the barrel **11.** As explained above, this operation is preferably carried out by introducing a fresh stopper **10** from the feeding line **5,** thus expulsing the chamfered stopper **10b** (cf. **Fig. 1&4).** Alternatively, a piston may be used to simply push out the chamfered stopper, but this solution is less preferred as it requires a larger number of barrels and a larger carousel to accommodate a sequence of four stops, instead of three as illustrated in **Fig.1.**

[0040] To help the extraction from a barrel of a chamfered stopper **10b,** means for collecting it may be provided adjacent to a dispensing line. The collecting means could be vacuum suction or air blowing to help dislodge the stopper from the barrel. Alternatively a suction cup or any other mechanical means such as pincers may be used instead. Air blowing is probably the easiest means to implement. By blowing air at a certain angle onto the jutting extreme of the stopper, the latter is easily dislodged from the barrel and falls into a dispensing line to be carried away for further processing,

[0041] As chamfered stopper **10b** is being dislodged from barrel **11,** a fresh stopper **10** is being inserted into the same barrel, whilst the second end of the stopper **10a** having one chamfered end and loaded in the second barrel **31** is being chamfered at the second chamfering station **3** and a first end of the fresh stopper **10** loaded in barrel **21** is being chamfered at the first chamfering stations **2** as explained supra. A chamfering cycle of a stopper loaded in a barrel **11** is thus completed and a new cycle can start with a new rotation of the carousel to bring the fresh stopper **10** loaded in barrel **11** to a first chamfering station **2.** The latter may be the same station as for the previous cycle in case the carousel **6** serves the barrels to a single sequence (N = 1) of loading **1,** first and second chamfering **2, 3,** and dispensing **4** stations. Else a carousel may serve more than one such sequence **1-4** as illustrated in **Fig.8** wherein the carousel serves three (N = 3) sequences **1-4** and comprises 3 x N (=3) = 9 barrels **11, 21, 31** distributed around its circumference. Providing a carousel with 3 x N barrels serving N station sequences **1-4** increases by a factor N the production rate or output of the apparatus. For instance, if one sequence of stations **1-4** yields the chamfering of 60 stoppers per minute (i.e., a rate of 1 stopper / s), an apparatus as illustrated in **Fig.8** with nine barrels and three sequences **1-4,** yields with the same processing parameters an output of 3 x 60 = 180 chamfered stoppers per minute.

Claims

1. Apparatus for chamfering the first and second ends of cylindrical stoppers **(10)** comprising:

(a) a feeding line **5,** feeding the cylindrical stoppers **10** to a loading station **1** of a carousel **6,**
(b) the loading station **1** comprising means **15** for engaging the first stopper **10** at the end of the feeding line **5** into a first cylindrical hollow barrel **11** suitable for holding the stopper **10** in position;
(c) means for rotating the carousel **6** so as to drive said first barrel **11** loaded with a cylindrical stopper **10** to a first chamfering station **2,** while a second barrel **31** is brought to the loading station **1;**
(d) the first chamfering station **2** comprising:

(i) means **25** for bringing into chamfering position a first end of the stopper **10** engaged in barrel **11** located in said station **2;**
(ii) means for rotating barrel **11** and the stopper **10** engaged therein with respect to their axis of revolution **19;**
(iii) a rotating blade **26** tilted at an angle corresponding to the desired chamfering angle;

(e) means for rotating the carousel **6** so as to drive said barrel **11** loaded with a cylindrical stopper **10a** chamfered at one end to a second chamfering station **3,** while said second barrel

31 loaded with a fresh stopper **10** is brought to the first chamfering station **2;**
(f) the second chamfering station **3** comprising:

(i) means **35** for bringing into chamfering position the second, un-chamfered end of the stopper **10a** engaged in barrel **11** located in said station **3;**
(ii) means for rotating barrel **11** and the stopper **10a** engaged therein with respect to their axis of revolution **19;**
(iii) a rotating blade **36** tilted at an angle corresponding to the desired chamfering angle; and

(g) means for rotating the carousel **6** so as to drive said barrel **11** loaded with a cylindrical stopper **10b** chamfered at both ends to a dispensing station **4,** while said second barrel **31** loaded with a stopper **10a** chamfered at one end is brought to the second chamfering station **3.**

2. Apparatus according to claim 1 wherein the means for rotating barrel **(11)** at the first and second chamfering stations **(2)** and **(3)** comprises a sling **(23)** connected to a driving wheel **(24)** and which the barrels **(11)** engage into via a groove **(16)** or a gear provided in their circumference, as they are brought into position at first and second chamfering stations **(2)** and **(3).**

3. Apparatus according to claim 1 wherein the means for rotating the carousel **(6)** comprise a motor **(20)** comprising a transmission wheel connected to a driving belt **(21)** which is suitable for imparting a rotating motion to said carousel **(6)** around its axis of revolution via a complementary wheel **(22)** which is preferably located in the center of said carousel **(6).**

4. Apparatus according to any of claims 1 to 3, wherein the means **(25, 35)** for bringing into chamfering position the un-chamfered end of the stoppers **(10, 10a)** comprises a piston **(27, 37)** suitable for pushing a stopper **(10, 10a)** through the barrel **(11**) in which it is engaged and a stopping means **(28, 38)** located on the opposite side of the barrel **(11)** to stop the stoppers **(10, 10a)** at their precise chamfering position.

5. Apparatus according to any of the preceding claims, wherein the rotating blade **(26, 36)** is slidingly mounted on a guide **(40),** said guide forming a circle segment centred on the point wherein the rotating blade **(26, 36)** intercepts the edge of the stopper **(10, 10a),** such that sliding along the guide changes the chamfering angle, but not the chamfering depth.

6. Apparatus according to any of the preceding claims, comprising N sequences of a loading station **(1),** a first chamfering station **(2),** and a second chamfering station **(3),** distributed round the carrousel **(6),** with corresponding number of feeding lines **(5)** associated with the loading stations **(1),** wherein N is an integer comprised between 1 and 6, preferably between 2 and 4, most preferably between 2 and 3.

7. Apparatus according to claims 4 to 6, wherein the carrousel **(6)** is mounted on a vertical panel having first and second opposite main surfaces fluidly connected by the bore of the barrels **(11),** wherein the feeding line **(5),** the piston **(27)** of the first chamfering station **(2)** and the stop **(38)** of the second chamfering station **(3)** face the first main surface of the panel, and wherein the stop **(28)** of the first chamfering station **(2)** and the piston **(37)** of the second chamfering station **(3),** face the second main surface of the panel.

8. Apparatus according to any of the preceding claims, wherein the dispensing station **(4)** comprises means **(15)** for engaging the first stopper **(10)** at the end of a feeding line **(5)** into the first cylindrical hollow barrel **(11)** containing a stopper **(10b)** chamfered at both ends, thus pushing the latter partly out of the barrel **(11),** and further comprises means for collecting and dispensing it into a dispensing line, said means being selected from vacuum suction means, air blowing means, suction cup, or mechanical means.

9. Hollow barrel **(11)** for tightly holding and centring a cylindrical stopper **(10)** suitable for the apparatus of any of claims 1 to 7 consisting of a hollow cylinder of length and diameter larger than the stopper **(10)** to be engaged therein, **characterized in that** it comprises at least nine spherical balls **(12)** mounted in, and protruding from recesses **(13)** located in the inner wall of the barrel, disposed on at least three points round its circumference to define a polygonal passageway **(30)** normal to the barrel's axis of revolution **(19),** and distributed on at least three rows along the length of the barrel, said balls **(12)** being mounted so as to resiliently engage deeper into their corresponding recesses **(13)** when pressed in, thus enlarging the passage defined thereby to accommodate said stopper **(10).**

10. Hollow barrel according to claim 9, further comprising transmission means to impart a rotating motion to the barrel around its axis of revolution **(19)** by the action of a motor, said means being a groove **(16)** or a gear running round the outer circumference at one end of the barrel.

11. Hollow barrel according to claim 9 or 10 comprising a first inner cylinder **(11a)** locked in a second concentric outer cylinder **(11b),**

(a) The first inner cylinder **(11a)** comprising through-holes forming the recesses **(13)** accommodating the at least nine spherical balls **(12)** and corresponding resilient means **(14);**
(b) The second outer cylinder **(11b)** is mounted on bearings **(17)** allowing the rotation of the two concentrically interlocked cylinders round their common axis of revolution **(19),** and further comprises a coaxial rim **(18)** solidly fixed at one of its ends, said rim **(18)** comprising crenulations or a groove **(16).**

12. Hollow barrel according to any of claims 9 to 11, wherein the resilient means **(14)** located in recesses **(13)** comprise a spring or a viscoelastic element, which is preferably separated from the corresponding ball **(12)** by a low friction element allowing the ball **(12)** some freedom to rotate.

13. Hollow barrel according to claim 12, wherein said viscoelastic element is an elastomeric element having the shape of a diabolo.

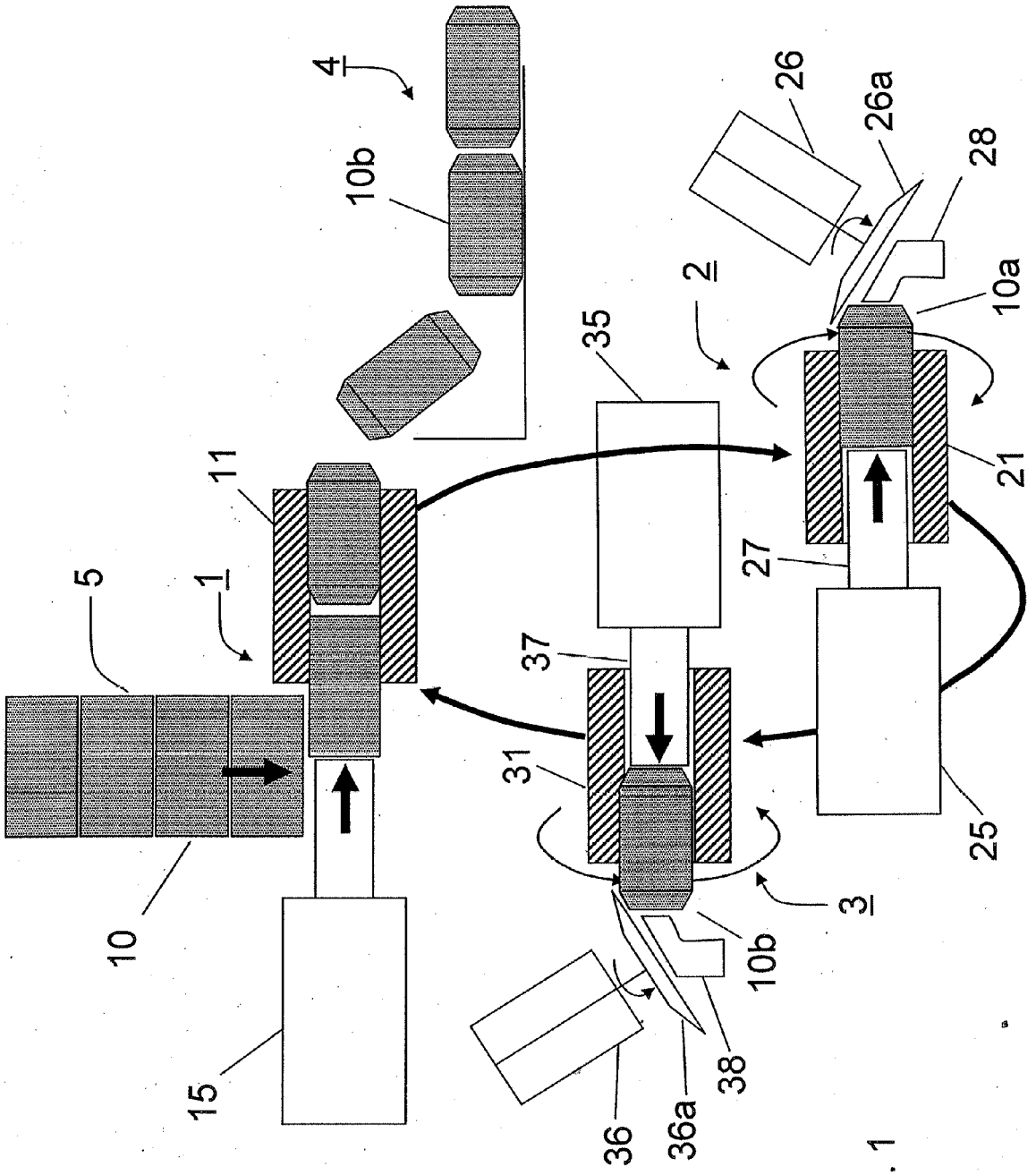

FIG. 1

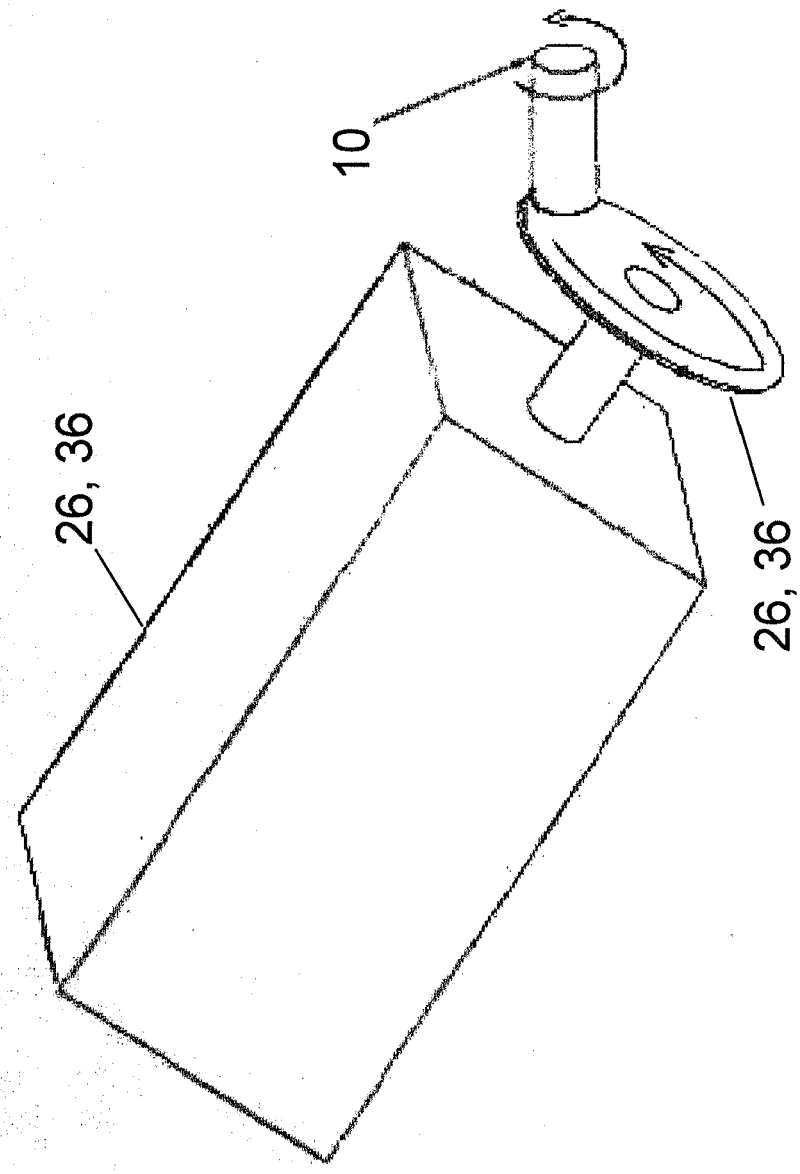

FIG. 2

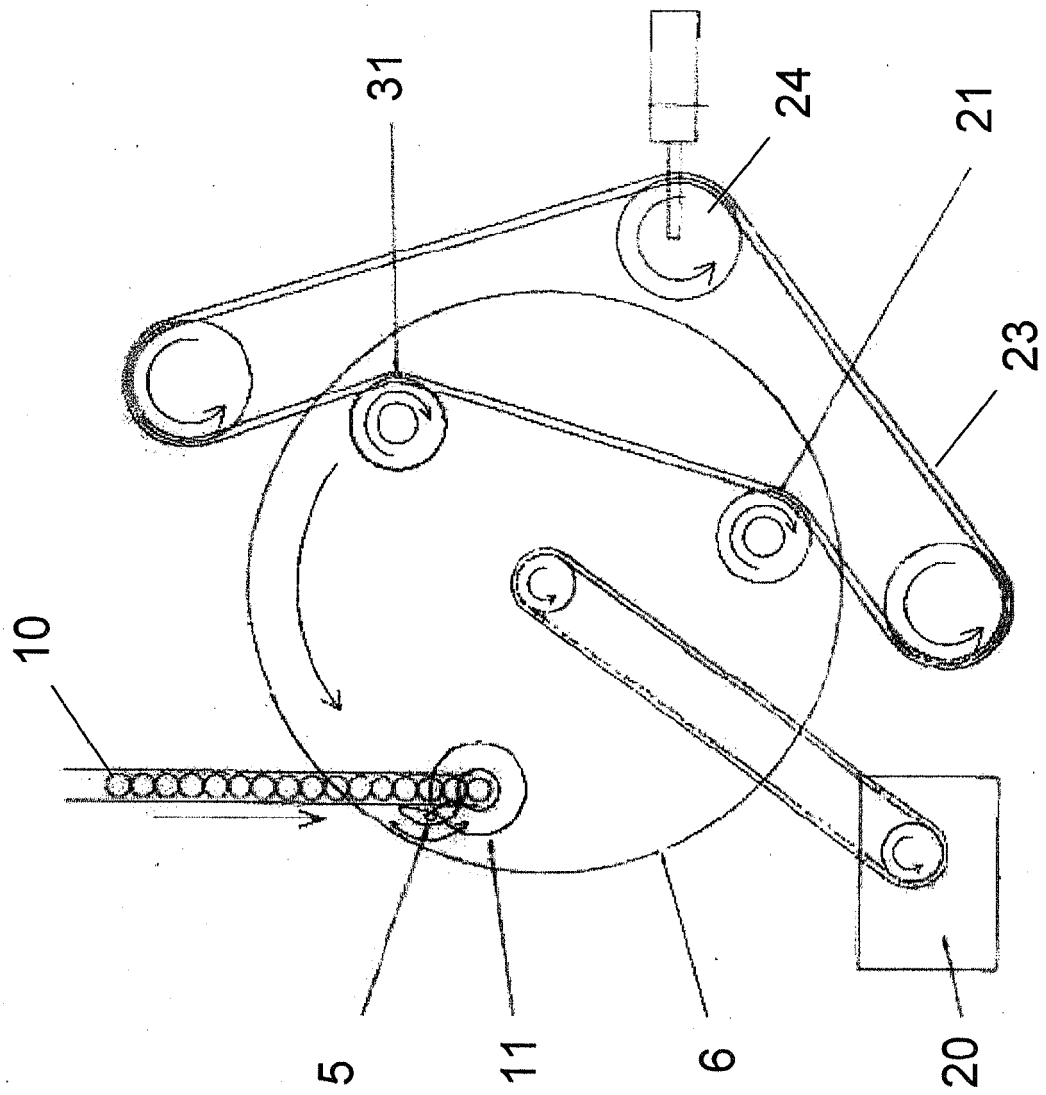

FIG. 3

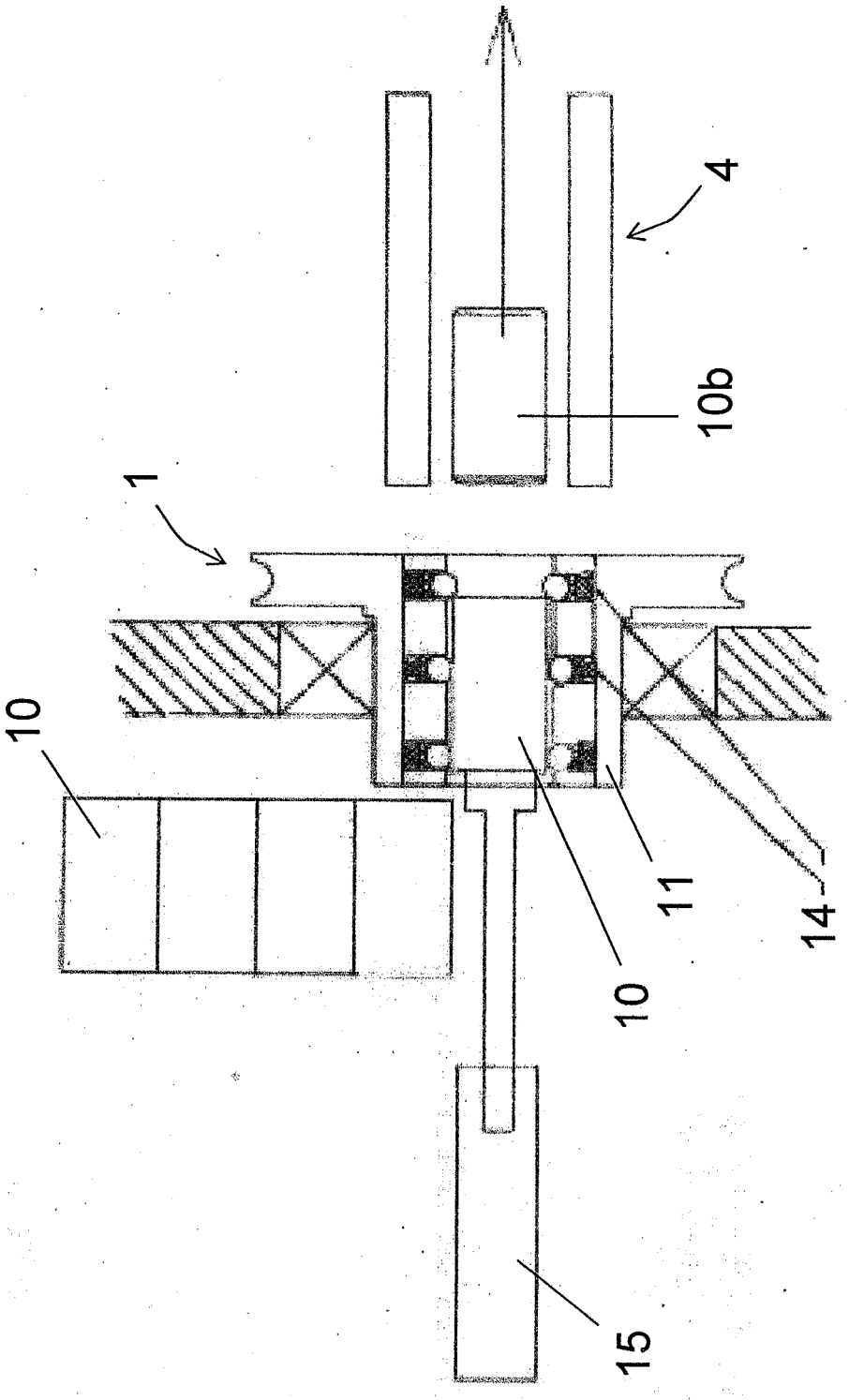

FIG. 4

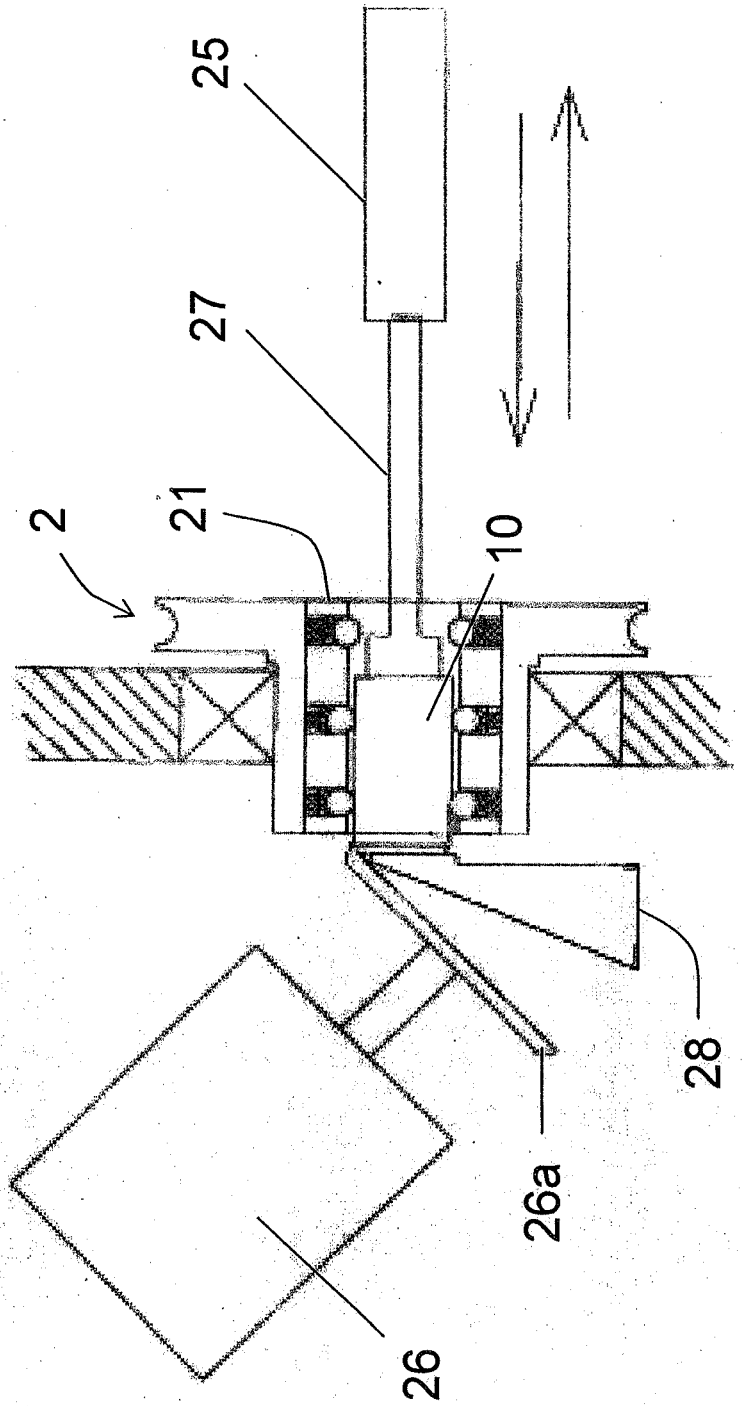

FIG. 5

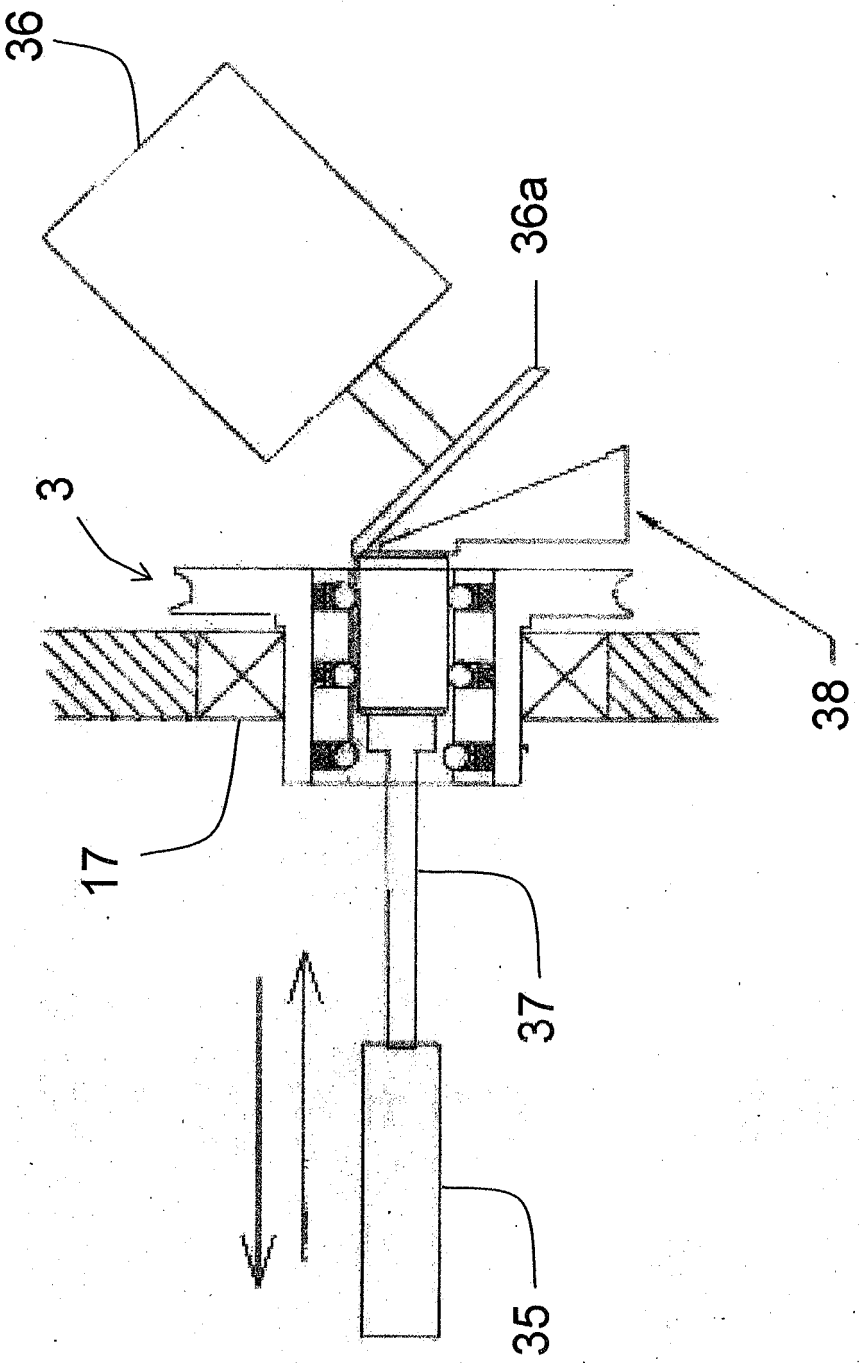

FIG. 6

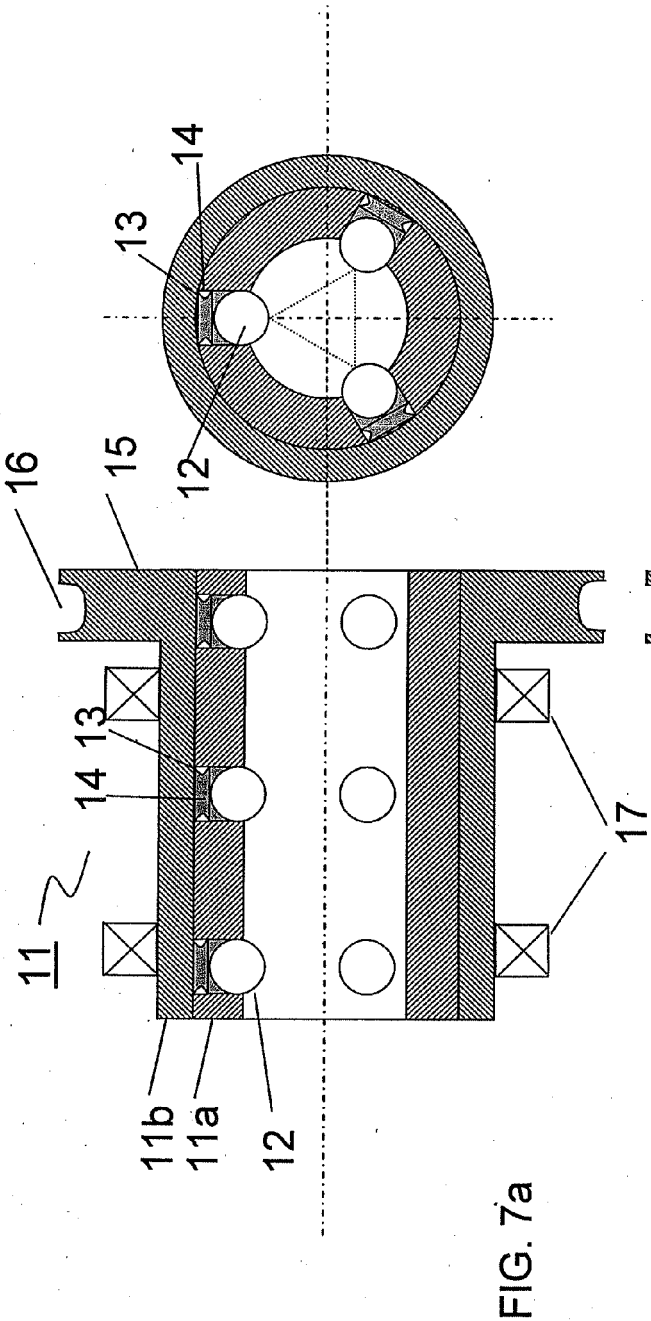

FIG. 7a

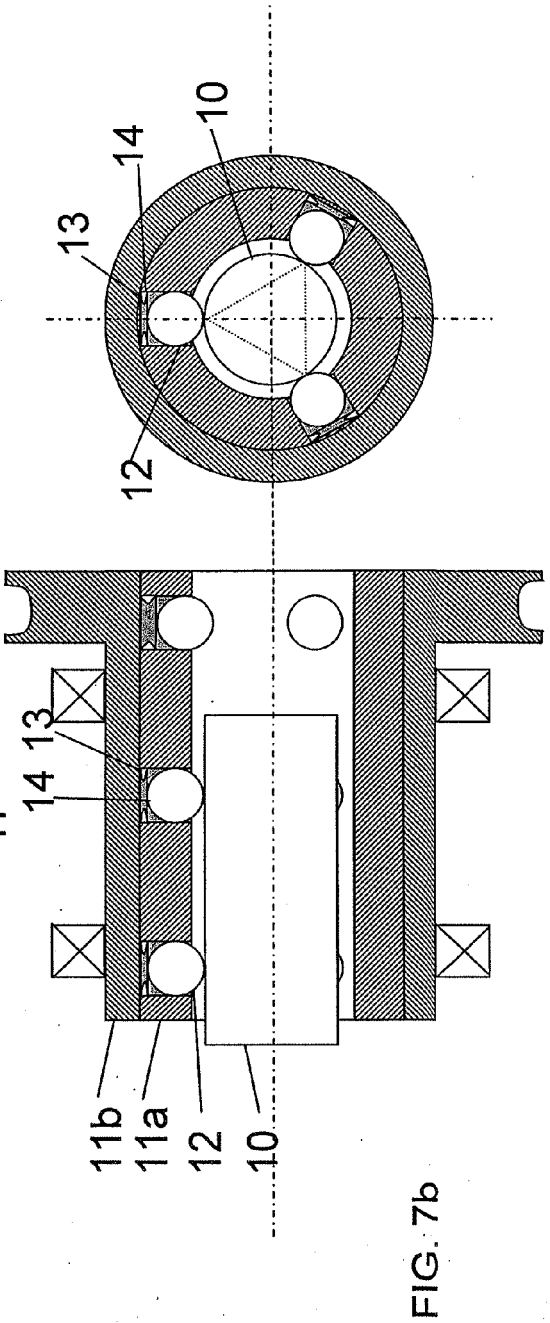

FIG. 7b

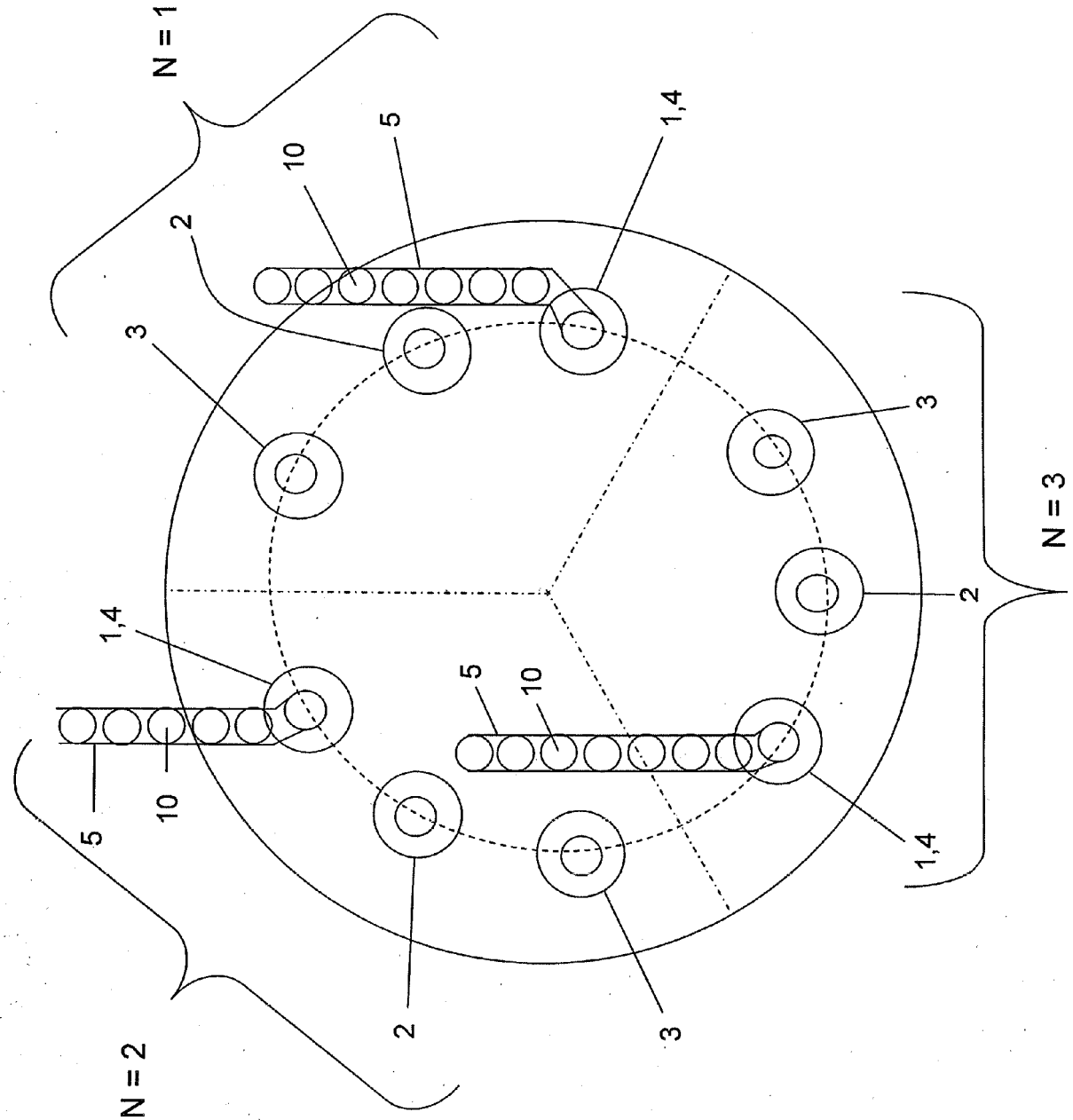

FIG. 8

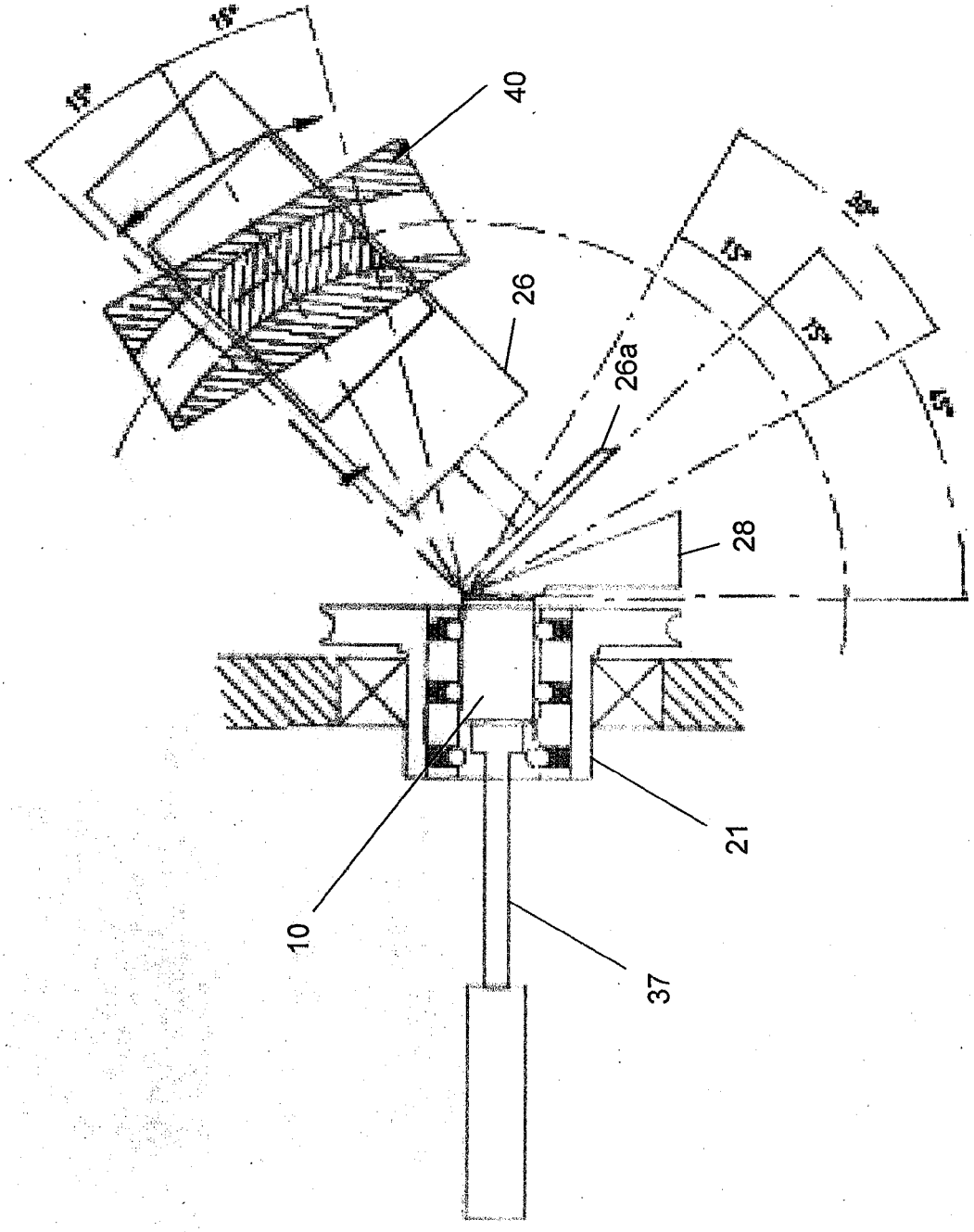

FIG. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 08 17 2201

DOCUMENTS CONSIDERED TO BE RELEVANT

	Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
7	A	WO 03/004367 A (PROCEL PTY LTD [AU]; MATHESON NORMA CATHERINE [AU]) 16 January 2003 (2003-01-16) * the whole document *	1-8	INV. B26D3/16 B26D7/06 B65D39/00
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7	A,D	WO 2004/020299 A (NUKORC PTY LTD [AU]; DOLLING BRIAN [AU]) 11 March 2004 (2004-03-11) * the whole document *	1-8	

TECHNICAL FIELDS SEARCHED (IPC)
B26D
B65D

3 ~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
Munich	17 November 2009	Wimmer, Martin

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

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Application Number
EP 08 17 2201

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

see additional sheet(s)

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 08 17 2201

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-8

   Apparatus for chamfering the end of a cylindrical stopper comprising two chamfering stations. The apparatus is capable of chamfering a stopper on two sides.

   ---

2. claims: 9-13

   A barrel for holding and positioning a cylindrical stopper by resilient balls. The barrel has a simple construction for holding cylindrical objects.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 17 2201

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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17-11-2009

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

REFERENCES CITED IN THE DESCRIPTION

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