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(54) **Expansion mandrel for coils**

(57) The present invention relates to an expansion gripper comprising a hollow shaft (2) at one end of which there is produced a hub (3), a sleeve (5) mounted to slide along an axis (X) on said hub (3) with a first inner portion (6) and a second outer portion (7), mutually coaxial, a liner (8) connected integral with the hub (3), provided with a plurality of through openings (9) adapted to house inserts (10) that act as gripping elements of the gripper,

said second portion (7) being provided with through openings (14) adapted to house the same number of rolling means (13) interposed between the outer surface of said hub (3) and the lower surface of said inserts (10), said surfaces being provided with profiles (11, 12) adapted to cooperate with said rolling means (13) to control the movement of said inserts (10) from a closed position in which they retract inside the contour of the liner (8) to an open position in which they project from said liner (8).

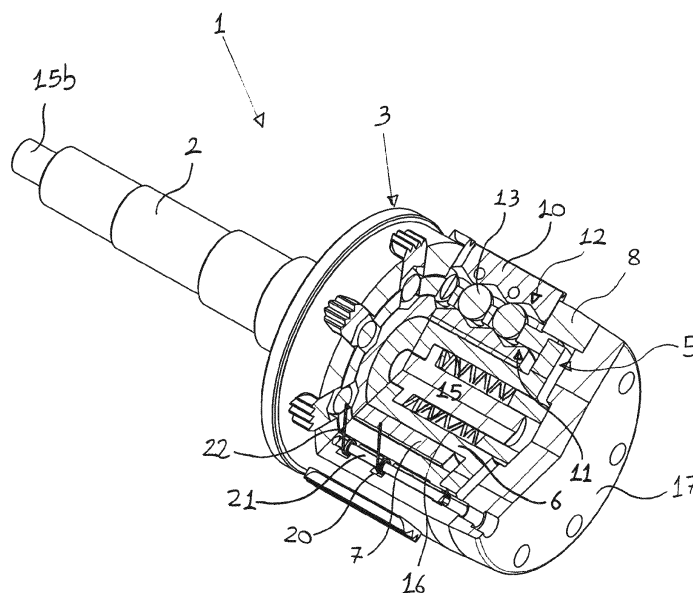


Fig. 1

## Description

**[0001]** The present invention relates to an expansion gripper or chuck for supporting reels such as those used, for example, on printing machines or on laminating machines. In detail, the invention relates to an expansion gripper comprising a cylindrical body provided with a plurality of elements movable radially from a position in which they are retracted inside the profile of the gripper body and a position in which they are extracted to engage the tubular support of a reel.

**[0002]** In industry there is often the need to wind thin sheets or films of a variety of materials, such as paper, sheets of plastic material, food grade paper, etc., in large reels.

**[0003]** To form the reel, one end of the sheet to be wound is fastened to a tubular element (core) mounted on special supports which is rotated about its own axis.

**[0004]** The problem posed in these cases is that of firmly constraining this tubular element, often made of cardboard or similar materials, to the rotating support.

**[0005]** The same problem is posed inside machines that instead use said reels to perform the opposite operation, such as printing machines, where these large reels are unwound, or machines in which both operations are performed, such as laminating machines.

**[0006]** Various types of supports for reels of film for the aforesaid purposes exist on the market.

**[0007]** Some of these comprise a shaft, which can be inserted into the tubular reel support, provided with an external shell produced in several separate parts, each forming a circular sector, which can translate in radial direction.

**[0008]** In practice, said sectors are movable from a retracted position, in which they are positioned close to one another, to an extracted position, in which they are pushed outward, by mechanical or pneumatic means, so as to engage the internal surface of the tubular core on which the film is wound.

**[0009]** Another type instead comprises a pair of supports, each placed at one end of the tubular core, said supports being constituted by expansion grippers provided with movable gripping elements that are extracted from the profile of the gripper to engage the internal surface of the tubular core.

**[0010]** An example of a gripper of this kind is described in the Italian utility model No.269208 by the same applicant.

**[0011]** In detail, said gripper comprises a plurality of gripping elements movable radially from a position in which they are retracted inside the profile of the gripper body to a position in which they are extracted to engage the tubular core of a reel, said elements being constituted by cylindrical inserts arranged along the circumference of the gripper body and being operated by a supporting shaft of the gripper sliding axially with respect thereto, and which has, for each series of gripping elements a truncated-cone shaped section in contact with the lower

part of each insert, also shaped, so as to control extraction thereof during axial translation.

**[0012]** Although functional, devices with this configuration have some limits or drawbacks.

**[0013]** In fact, almost all expansion grippers produced for these applications are of the normally closed type, i.e. with the gripping elements in the retracted position when the gripper is not activated.

**[0014]** Extraction of said elements takes place following an external force control using electric or pneumatic actuators.

**[0015]** To maintain the grip of the gripper on the reel, these actuator means must therefore be maintained constantly activated.

**[0016]** This configuration is preferred as it enables the maximum thrust of the actuator means to be limited, which is calculated on the basis of the thrust force that must be exerted by the gripping elements.

**[0017]** However, in the case of a fault in the actuators or in an emergency, the gripper could retract when the reel is still rotating, causing problems of safety or malfunction of the machine on which it is installed.

**[0018]** However, due to their configuration, prior art devices are not suitable for use as normally open devices.

**[0019]** In fact, unlike the former, these latter are provided with elastic thrust means with a degree of preload, which enable the gripping elements to engage the tubular element with the necessary force. The greater the preload of these elastic means is, the higher the gripping force of the gripper will be.

**[0020]** Their configuration generally provides for transformation of a movement in axial direction into a movement in radial direction, obtained by means of sliding of two inclined surfaces; however, this generates a friction force between said surfaces proportional to the preload of the elastic means.

**[0021]** This makes it necessary to use actuator means, to take the gripper from the open position to the closed position, provided with a much higher maximum force (i.e. oversized) with respect to those used in grippers of normally closed type.

**[0022]** The object of the present invention is to produce a normally open expansion gripper that requires a limited force to take it from the open position to the closed position.

**[0023]** In detail, the object of the present invention is to produce an expansion gripper in which the gripping elements are moved by low friction sliding means.

**[0024]** The aforesaid objects are achieved by an expansion gripper comprising a hollow shaft, at one end of which there is produced a hub, a sleeve mounted to slide along an axis on said hub with a first inner portion and a second outer portion, mutually coaxial, a liner connected integral with the hub, provided with a plurality of through openings adapted to house inserts that act as gripping elements of the gripper, said second portion being provided with through openings adapted to house the same number of rolling means interposed between the outer

surface of said hub and the lower surface of said inserts, said surfaces being provided with profiles adapted to co-operate with said rolling means to control the movement of said inserts from a closed position in which they are retracted inside the outline of the liner to an open position in which they project from said liner.

**[0025]** Further characteristics and advantages will be more apparent from the indicative, and therefore non-limiting, description of an example of a preferred but not exclusive embodiment of the invention, as shown in the accompanying figures wherein:

- Fig. 1 is a partly sectional perspective view of a gripper in open position, according to the invention;
- Fig. 2 is a partly sectional perspective view of a gripper in closed position, according to the invention;
- Fig. 3 is an exploded perspective view of a gripper according to the invention;
- Fig. 4 is a sectional view of a gripper in open position according to the invention;
- Fig. 5 is a sectional view of a gripper in closed position according to the invention;
- Figs. 6a, 6b and 6c are respectively a perspective, a side sectional and a front sectional view of the shaft of the gripper according to the invention;
- Fig. 7 is a perspective view of the second portion of the sleeve of the gripper according to the invention;
- Figs. 8a and 8b are respectively a perspective and side view of an insert of the gripper according to the invention;

**[0026]** With reference to the accompanying figures, the expansion gripper, indicated as a whole with 1, comprises a hollow shaft, at one end of which there is produced a hub 3, preferably with a cylindrical section, defining a cavity 4, also preferably cylindrical (Fig.3).

**[0027]** On said hub 3 there is mounted, to slide along the axis X of the shaft 2, a sleeve, indicated as a whole with 5. Said sleeve 5 has two cylindrical and coaxial portions produced in two parts integral with each other, or produced in a single element. In detail, said sleeve comprises a first inner portion 6 sliding in contact with the inner surface of the cavity 4 and a second outer portion 7 sliding in contact with the outer surface of the hub 3.

**[0028]** A liner 8, connected integral with the hub 3, is placed around said second outer portion 7 of the sleeve 5.

**[0029]** In practice, the second outer portion 7 of the sleeve 5 slides between the outer surface of the hub 3 and the inner surface of the liner 8.

**[0030]** Said liner 8 is provided with a plurality of through openings 9 which define the same number of seats adapted to house inserts, indicated as a whole with 10, which act as gripping elements of the gripper.

**[0031]** Said inserts 10 are movable radially, sliding in the seats 9, from a closed position, in which they retract inside the contour of the liner 8, to an open position, in which they project from said liner 8 to engage a tubular core of a reel (not shown in the figure).

**[0032]** According to a preferred embodiment, said inserts 10 have a parallelepiped shape elongated in the direction X and tapered at the ends.

**[0033]** Preferably, the upper surface of said inserts 10 is provided with knurling or the like to promote friction on the surface of the tubular core of the reel.

**[0034]** Said inserts 10 are preferably arranged on the liner 8 spaced angularly equidistant from one another and their number can vary according to the dimensions of the gripper; preferably at least 4 inserts are provided, spaced equidistant from one another by 90 degrees.

**[0035]** One feature of the invention is that of providing for movement of said inserts 10 from the closed position to the open position, and vice versa, through low friction rolling means.

**[0036]** According to a preferred variant, said rolling means comprise a plurality of balls 13 adapted to cooperate with profiles 11 and 12 produced respectively on the outer surface of the hub 3 and on the lower surface of the inserts 10.

**[0037]** In more detail, said profiles comprise ridges 11a and 12a, alternated with recesses 11b and 12b.

**[0038]** According to a preferred embodiment, on the outer surface of the hub 3 and on the lower surface of the inserts there are produced a plurality of adjacent incisions, having a conical profile, which define said ridges and recesses.

**[0039]** The balls 13 are instead housed in the same number of through openings 14, produced in the second portion 7 of the sleeve 5.

**[0040]** Following sliding of said sleeve 5 along the axis X, said balls 13 can be in contact with the profiles 11 and 12 aligned with the ridges 11a and 12a or aligned with the recesses 11b and 12b.

**[0041]** In particular, when the balls 13 are aligned with the ridges 11a and 12a their dimension is such as to thrust the inserts 10 beyond the outer surface of the liner 8, i.e. in the open position.

**[0042]** Alternatively, said rolling means can comprise rollers arranged with their axis perpendicular to the axis X of the shaft 2 so as to be able to roll on said profiles 11 and 12 following translation of the second portion 7 of the sleeve 5.

**[0043]** Said translation of the second portion 7 of the sleeve 5 is controlled by a rod 15 that operates to oppose the force of elastic means, indicated with 16 in the figure.

**[0044]** In detail, said rod is integral with the first portion 6 of the sleeve 5 through which it also draws the second portion 7.

**[0045]** The elastic means 16 are instead interposed between a cover 17, connected integral with one end of the liner 8, and the bottom 18 of the first inner portion 6 of the sleeve 5.

**[0046]** By pressing on the bottom 18 of the first portion 6, said elastic means ensure that the second portion 7 also remains in a retracted position in which the balls 13 are aligned with the ridges 11a and 12a of the profiles 11 and 12, so that the inserts 10 are projecting from the

outer surface of the liner 8, i.e. in open position.

[0047] According to a preferred embodiment, said elastic means 16 comprise an assembly of spring washers, positioned inside the first portion 6 of the sleeve, which ensure high rigidity and low cost.

[0048] The rod 15, mounted sliding inside the shaft 2, extends from the cavity 4 of the hub 3 to beyond the end of said shaft to be able to be operated from the outside on a projecting portion 15b thereof.

[0049] Preferably said rod 15 is also provided with a stop 19 interposed between the elastic means 16 and the bottom 18 of the inner portion 6 of the sleeve 5.

[0050] In this way, by exerting a force on the portion 15b of the rod 15 along the axis X directed toward the hub 3, the stop 19 compresses said elastic means 16 against the cover 17, drawing the sleeve with it toward said cover 17.

[0051] In this way the second portion 7 can also translate to a position in which the balls 13 are aligned with the recesses 11b and 12b of the profiles 11 and 12, and the inserts 10 can thus retract inside in the contour of the liner 8.

[0052] To ensure complete retraction of the inserts 10 from the open position to the closed position, there are provided return means, indicated as a whole with 20, comprising elastic means or the like.

[0053] In detail, said return means 20 comprise torsion springs housed on pins 21 inserted in the liner 8 and arranged parallel to the axis X.

[0054] Said springs are provided with projecting ends 22 housed in seats 23 produced in the sides of the inserts 10 (Fig. 8).

[0055] Said springs 20 are mounted with a preload so that, when the rod 15 is operated and the balls 13 are aligned with the recesses 11b and 12b, these draw the inserts 10 toward the inside of the gripper until they are taken to a position in which they are not projecting from the outer surface of the liner 8.

[0056] With the present invention it is thus possible to produce a system for movement of the inserts that does not require the use of sliding parts subject to high friction forces.

[0057] In particular, movement of the inserts 10 controlled through the balls 13 that cooperate with profiles 11 and 12 of the hub and of the inserts, make it possible reduce the friction in play to a minimum.

[0058] In fact, the balls 13 can roll on said profiles 11 and 12, enabling almost all of the force exerted on the rod 15 to be utilized to compress the elastic means 16.

[0059] The gripper thus produced, normally open, can be taken to the closed position by acting on the rod 15 with a limited force, comparable with that required to operate the normally closed grippers according to the prior art.

[0060] Several changes and variations can be made to the present invention as described and illustrated, all falling within the scope of the inventive concept; moreover, all details can be replaced with technically equivalent

elements.

## Claims

1. An expansion gripper comprising a hollow shaft (2) at one end of which there is produced a hub (3), a sleeve (5) mounted to slide along an axis (X) on said hub (3) with a first inner portion (6) and a second outer portion (7), mutually coaxial, a liner (8) connected integral with the hub (3), provided with a plurality of through openings (9) adapted to house inserts (10) that act as gripping elements of the gripper, said second portion (7) being provided with through openings (14) adapted to house the same number of rolling means (13) interposed between the outer surface of said hub (3) and the lower surface of said inserts (10), said surfaces being provided with profiles (11, 12) adapted to cooperate with said rolling means (13) to control the movement of said inserts (10) from a closed position, in which they retract inside the contour of the liner (8), to an open position, in which they project from said liner (8).
2. The expansion gripper according to claim 1, **characterized in that** said profiles (11, 12) produced respectively on the outer surface of said hub (3) and on the lower surface of said inserts (10) comprise ridges (11a, 12a) alternated with recesses (11b, 12b).
3. The expansion gripper according to claim 1 or 2, **characterized in that** said rolling means (13) are balls.
4. The expansion gripper according to claim 1 or 2, **characterized in that** said rolling means (13) are rollers arranged with their axis perpendicular to the axis (X).
5. The expansion gripper according to claim 3, **characterized in that** said profiles (11, 12) are composed of a plurality of adjacent incisions of conical shape.
6. The expansion gripper according to any one of the preceding claims, **characterized in that** it is provided with elastic means (16) that act on said second portion (7) of the sleeve (5), said elastic means taking said second portion (7) to a position in which the rolling means are aligned with the ridges (11a, 12a) of the profiles (11, 12), i.e. in which the inserts (10) are in the open position.
7. The expansion gripper according to claim 6, **characterized in that** said elastic means (16) are housed in the first inner portion (6) of the sleeve (5), interposed between a bottom (18) of said first portion (6) and a cover (17) integral with the liner (8).

8. The expansion gripper according to claim 6 or 7, **characterized in that** said sleeve (5) is connected integral with a rod (15) housed inside the shaft (2), said rod being able to slide along the axis (X) to oppose the force of said elastic means (16) and taking said second portion (7) of the sleeve (5) to a position in which the rolling means are aligned with the recesses (11b, 12b) of the profiles (11, 12), i.e. in which the inserts (10) are in the closed position.
9. The expansion gripper according to any one of the preceding claims from 2 to 8, **characterized in that** there are provided return means adapted to enable complete retraction of the inserts (10) inside the contour of the liner (8) when the rolling means (13) are aligned with the recesses (11b, 12b) of the profiles (11, 12).
10. The expansion gripper according to claim 9, **characterized in that** said return means comprise torsion springs (20) housed on pins (21) housed in the liner (8) and arranged parallel to the axis (X), said springs being provided with projecting ends (22) housed in seats (23) produced in the sides of the inserts (10).

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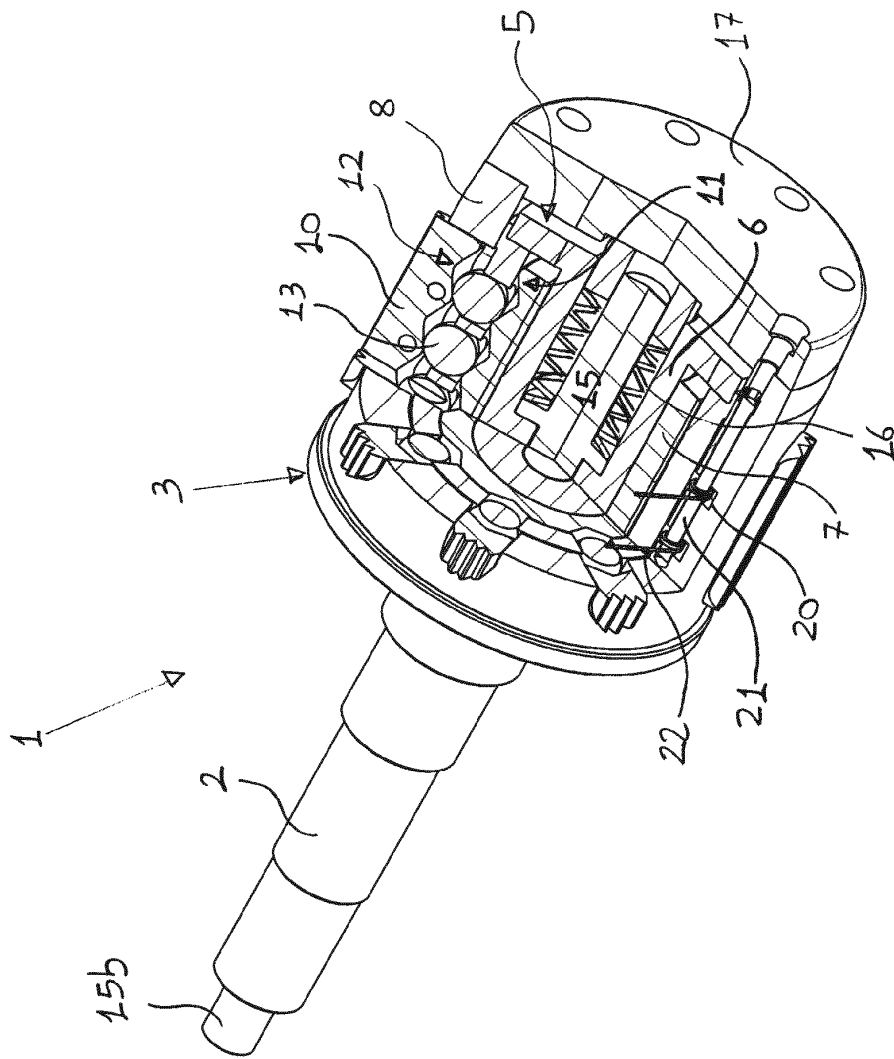


Fig. 1

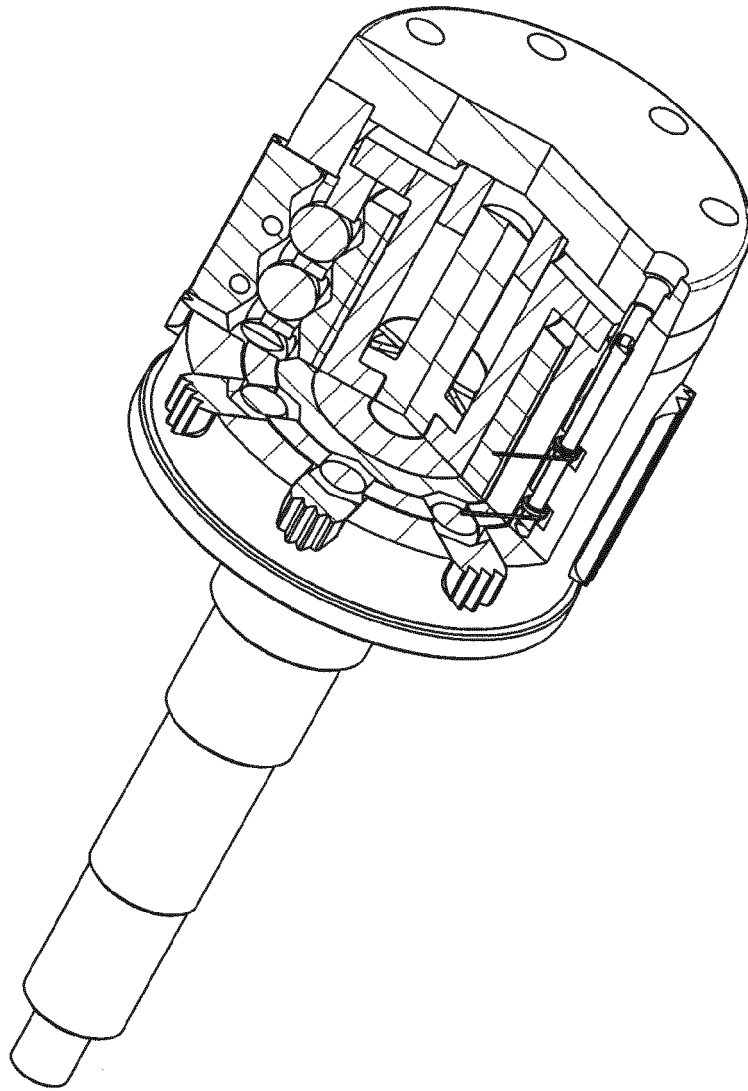


Fig. 2

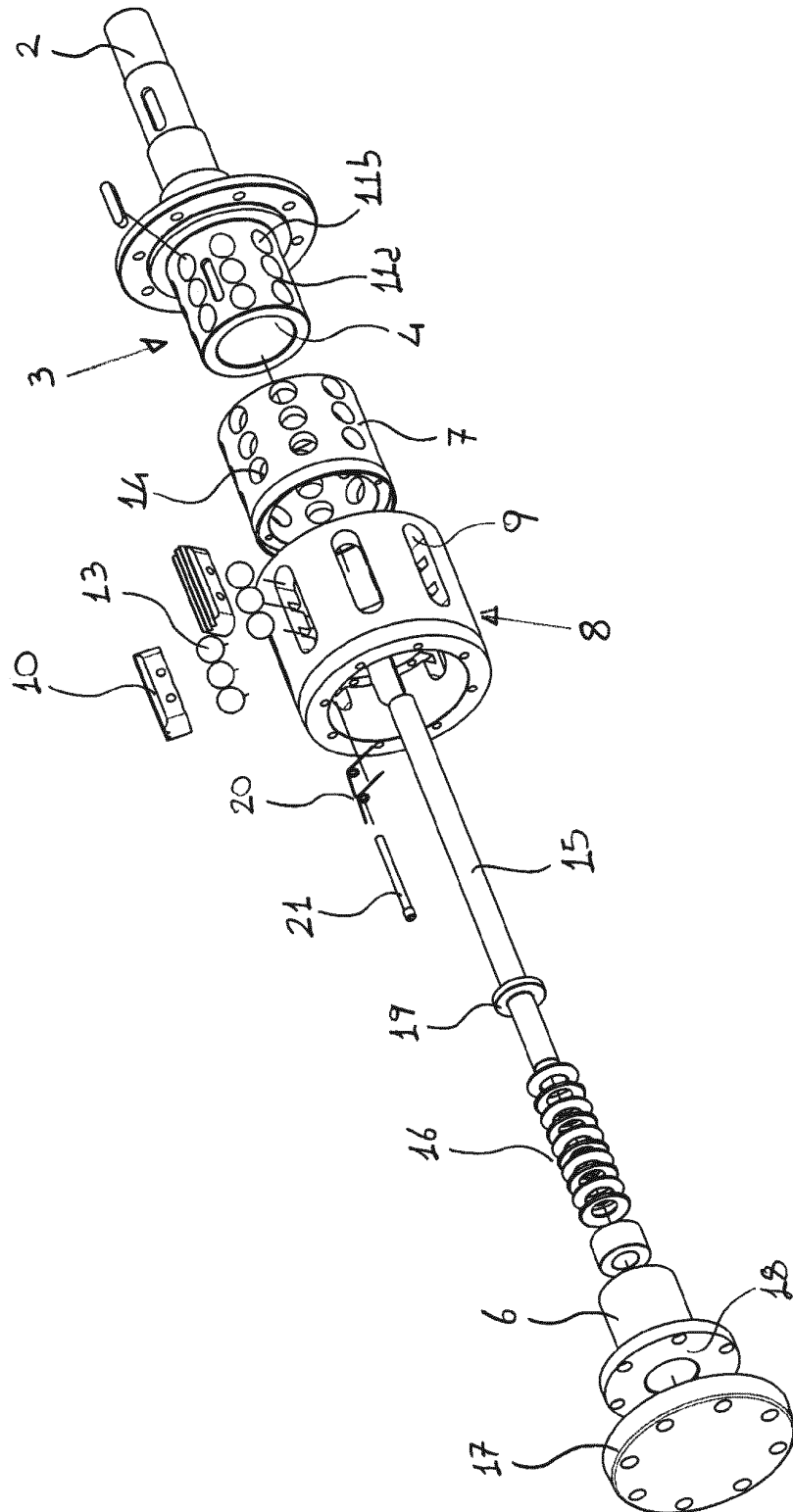


Fig. 3



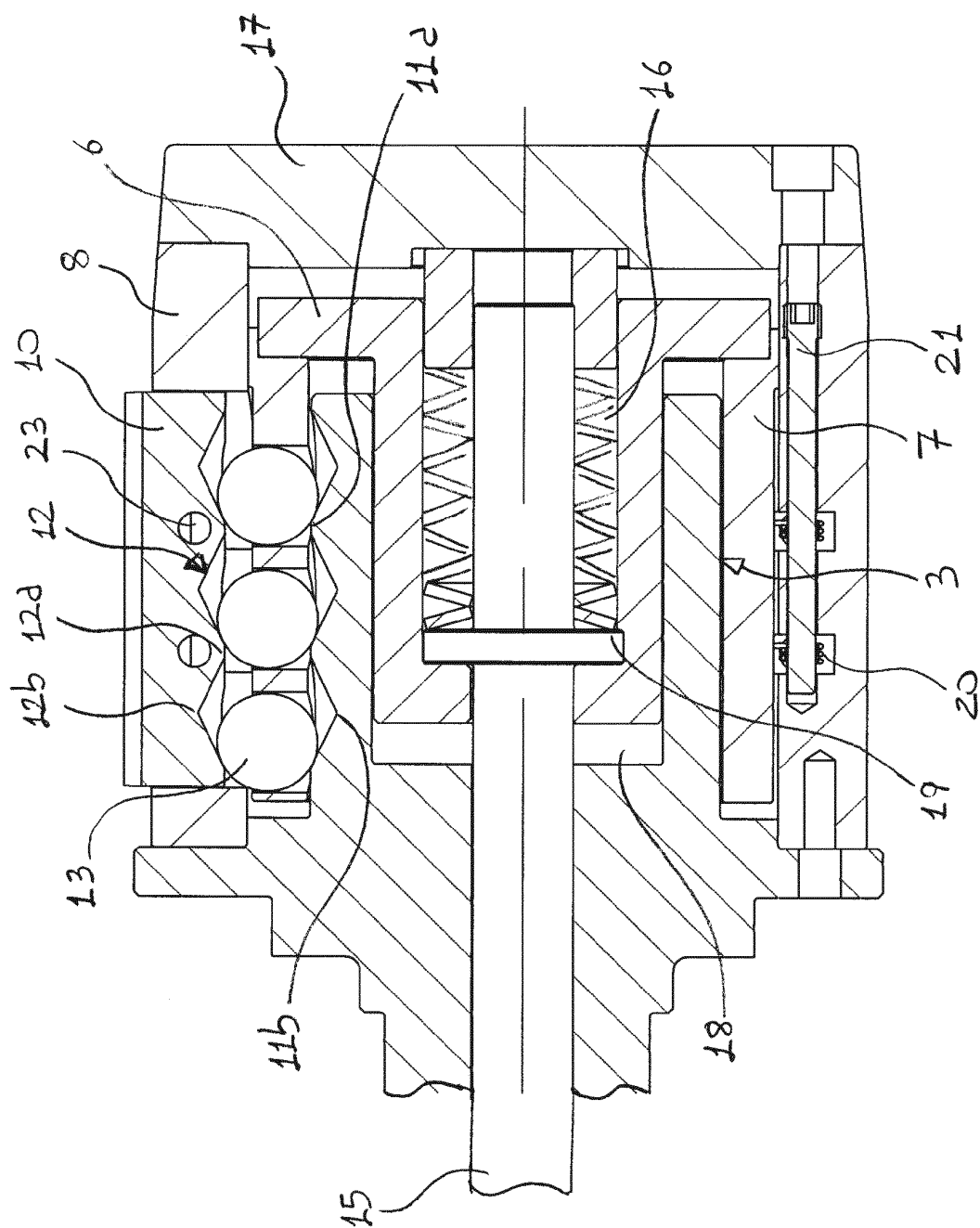


Fig. 4

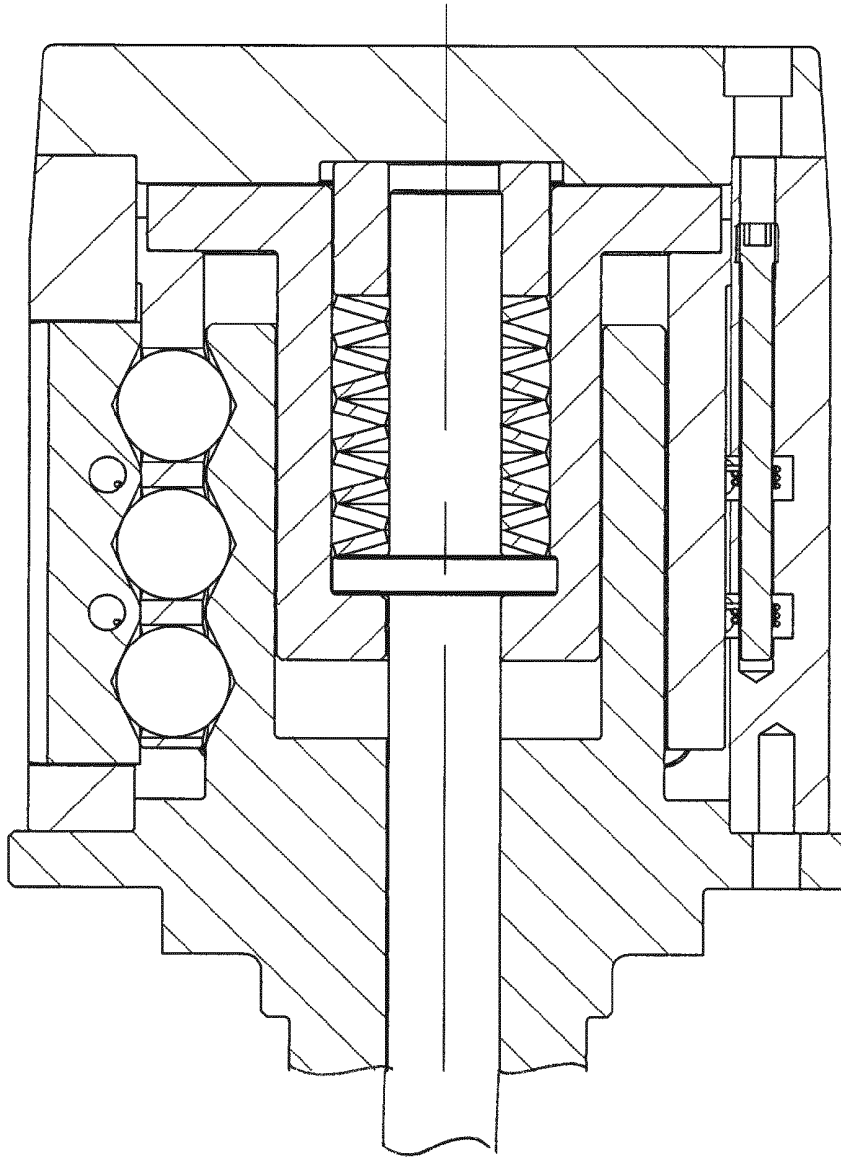


Fig. 5

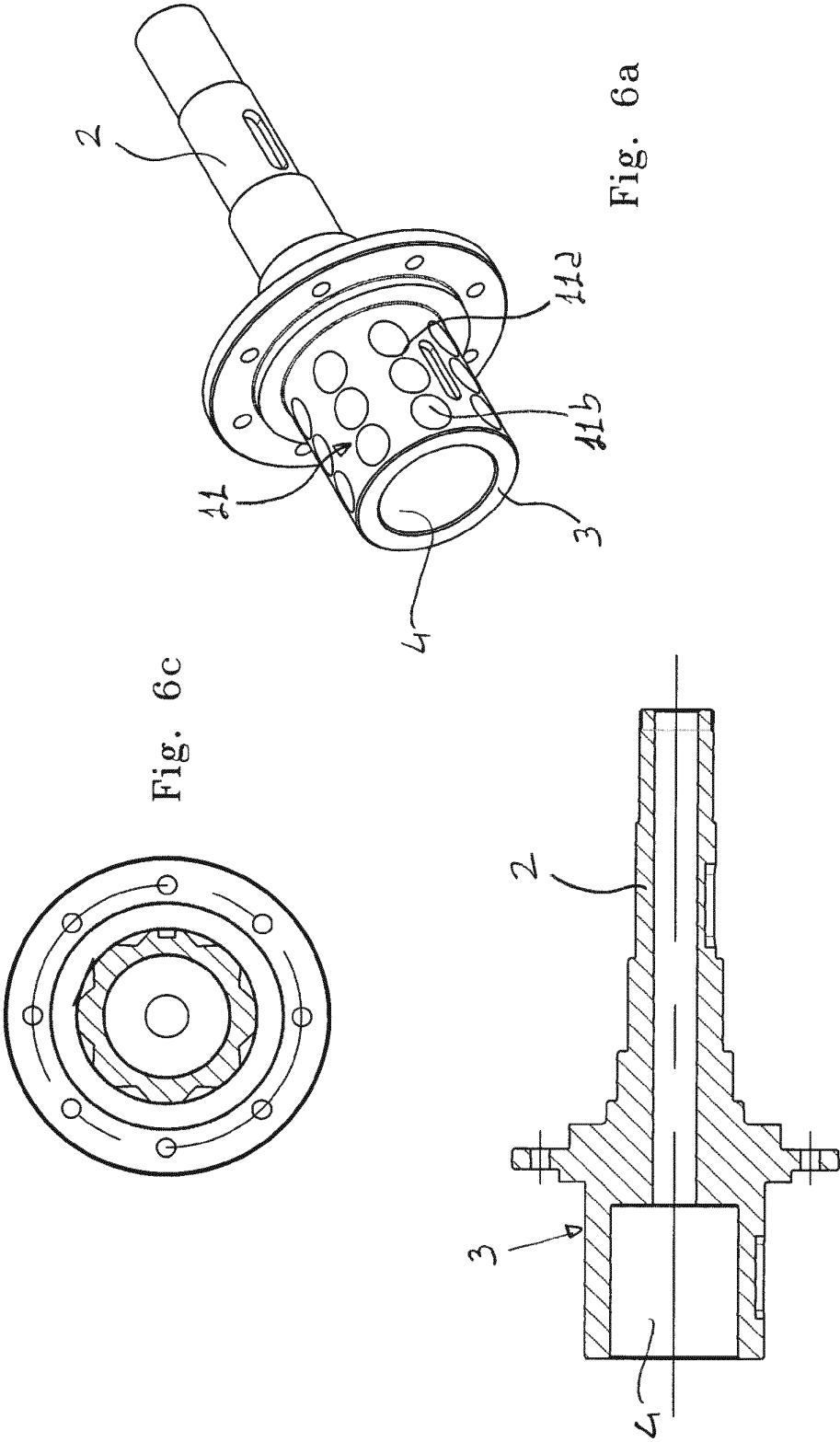


Fig. 6b

Fig. 6a

Fig. 6c

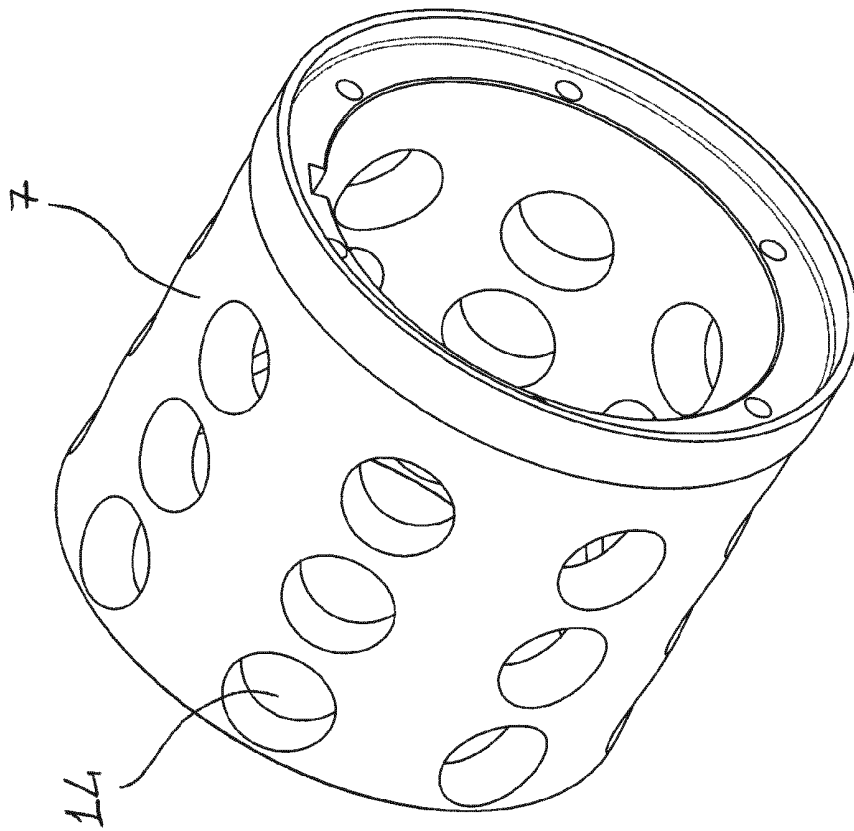


Fig. 7

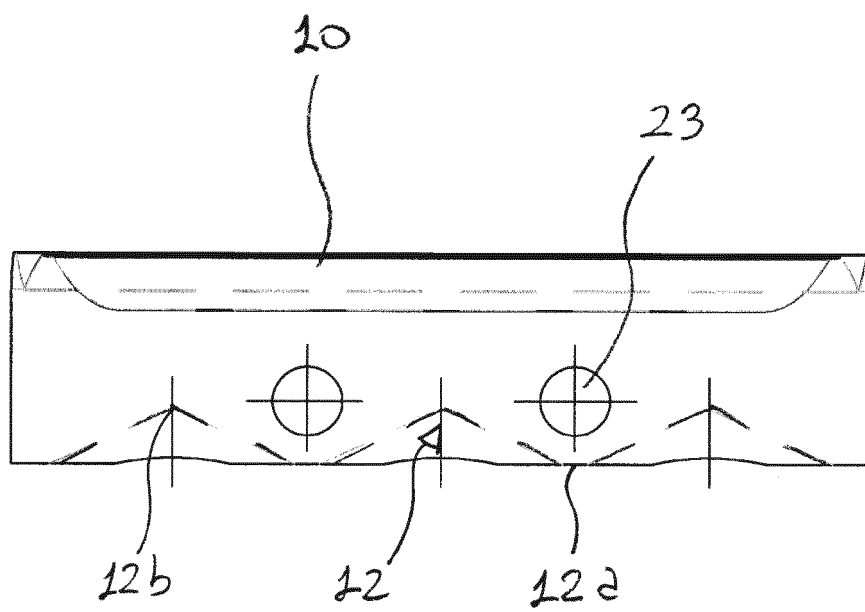
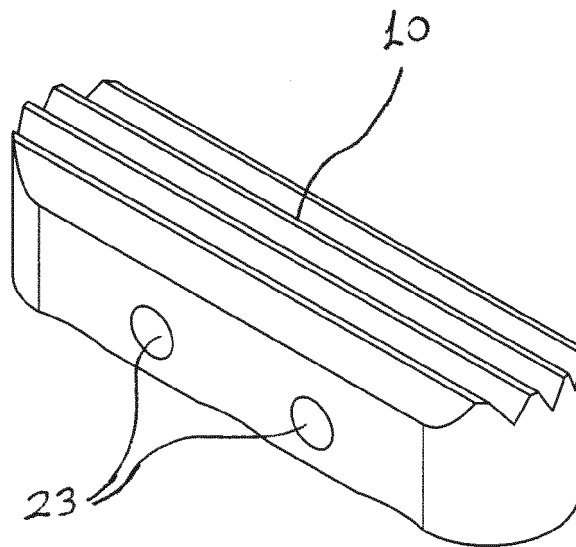


Fig. 8

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- IT 269208 [0010]