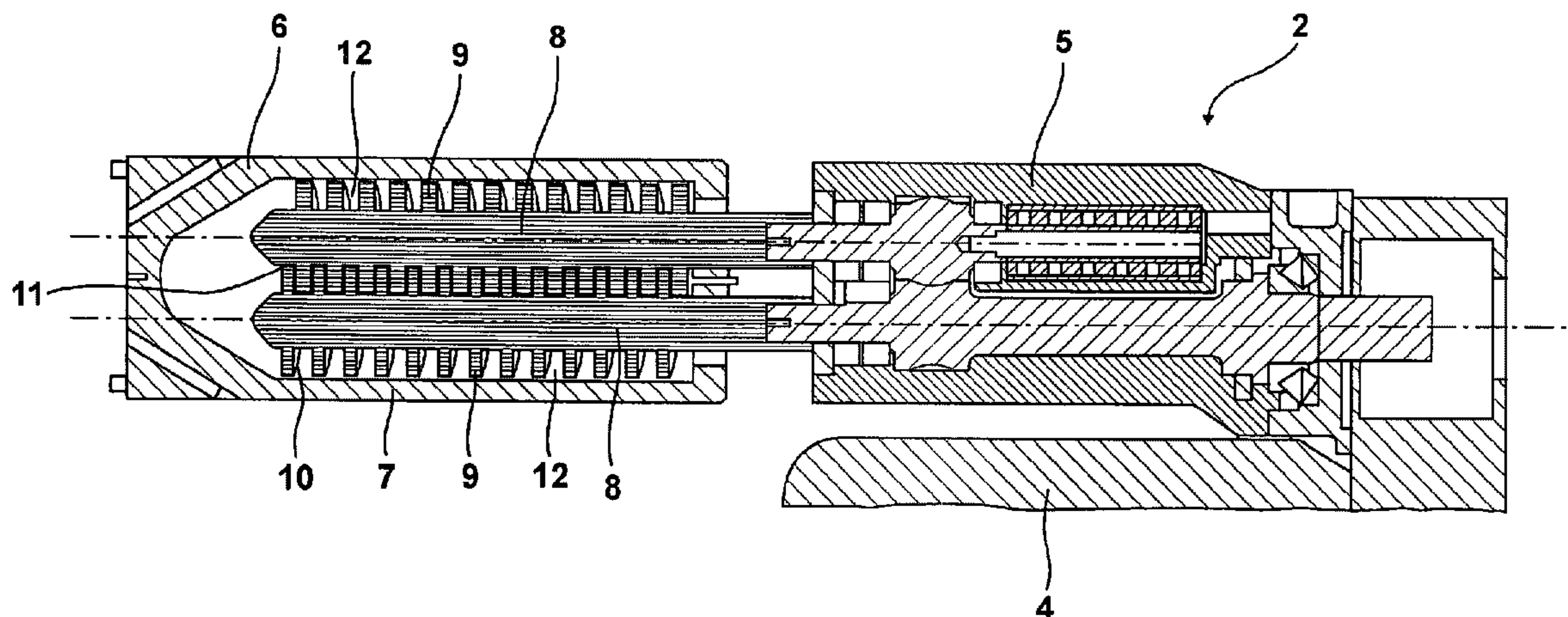




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(54) **Titre : DISPOSITIF SERVANT A FABRIQUER DES GRANULES SYNTHETIQUES, DES PROFILS EXTRUDES OU DES PIECES MOULEES ET POMPE A MASSE FONDUE POUR CE DISPOSITIF**
(54) **Title: A DEVICE FOR MANUFACTURING SYNTHETIC GRANULES, EXTRUDED PROFILES OR MOLDED PARTS AND MELT PUMP THEREFOR**



(57) **Abrégé/Abstract:**

The object of the invention is a device for manufacturing synthetic granules, extruded profiles or molded parts, with a screw machine for producing a plastic melt, with a melt pump (2) for building up pressure in order to press the plastic melt through a tool and with the tool for creating the granules, the extruded profile or the molded part, wherein the melt pump (2) is designed to be detached from the screw machine and has its own drive (5). Creating such a device for manufacturing synthetic granules, extruded profiles or molded parts, in which the screw machine does without a pressure increase unit is achieved by the transfer of the plastic melt from the screw machine to the melt pump (2) occurring at normal pressure or almost normal pressure.

Abstract:

The object of the invention is a device for manufacturing synthetic granules, extruded profiles or molded parts, with a screw machine for producing a plastic melt, with a melt pump (2) for building up pressure in order to press the plastic melt through a tool and with the tool for creating the granules, the extruded profile or the molded part, wherein the melt pump (2) is designed to be detached from the screw machine and has its own drive (5). Creating such a device for manufacturing synthetic granules, extruded profiles or molded parts, in which the screw machine does without a pressure increase unit is achieved by the transfer of the plastic melt from the screw machine to the melt pump (2) occurring at normal pressure or almost normal pressure.

**A DEVICE FOR MANUFACTURING SYNTHETIC GRANULES,
5 EXTRUDED PROFILES OR MOLDED PARTS AND MELT PUMP
THEREFOR**

10 The present invention relates to a device for manufacturing synthetic granules, extruded profiles or molded parts and a melt pump therefor for building up pressure with a fluid medium, more specifically with plastic melt, by pressing the medium through a tool.

15 In order to manufacture synthetic parts a plastic melt is first produced from different basic materials in a screw machine in a polymerization process. It shall be understood that synthetic parts also refer to such parts that are manufactured from renewable primary products such as for example proteins. Such a screw machine can be a compounder, an extruder, a screw kneader or
20 a similar device for manufacturing a plastic melt.

A screw machine, in which different basic materials are mixed and kneaded by means of synchronous worm shafts until a fluid plastic melt is produced, is known for example from EP 0 564 884 A1

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In order to manufacture synthetic granules, which are then processed in plastic injection molding machines for example, the plastic melt is pressed through a tool, here a perforated disc, at up to 30 bar. In order to manufacture a plastic profile or a plastic molded part, the plastic melt must be pressed in an

extrusion process through a corresponding extrusion or molding tool at up to 300 bar.

As known from EP 0 564 884 A1, the plastic melt can be transferred from the screw machine to a gear pump such as known for example from DE-OS 38 42 988 and from there pressed through the tool, in order to obtain the desired granules, profile or molded part.

However, a disadvantage of a separate gear pump is that its production is expensive, amongst others due to having its own drive and its own required controls. Another problem of the gear pump with a distinct or separate drive is that more specifically at low rotation speeds up to 50 rpm, a design inherent pulsation is generated and a significant admission pressure thus bears against the pump inlet. The gear pump is indeed sealed when the teeth of adjacent gears meet, but during the transfer of the plastic melt to the tool not all the plastic melt is pressed through the tool. This remaining plastic melt is then brought back by the gears to the opening of the pump inlet, where a corresponding admission pressure buildup occurs. But since this admission pressure is not regular but appears only at pulsating intervals, a pulsation occurs. In order to overcome this pulsating admission pressure, the melt must be transferred at a corresponding pressure, which requires a sufficient pressure buildup at the end of the screw machine.

Instead of the gear pump, a single screw pump with a distinct drive is also frequently used. But in a single screw pump also there is a design inherent significant admission pressure at the pump inlet, which must be overcome by the screw machine.

Thus using a gear pump or a single screw pump is only advantageous in that the pressure raising unit of the screw machine can be made smaller, but

completely dispensing with the possibility of increasing the pressure is not possible because the generated admission pressure must still be overcome.

Another disadvantage of the gear pump and the single screw pump is that
5 once the operation is ended plastic melt remains between the gears or in the screw channel and the gear pump or the single screw pump must be cleaned in a laborious manner.

EP 0 564 884 A1 teaches integrating the gear pump into the screw machine,
10 so that a single drive drives the worm shafts with the gear pump attached thereon. This is advantageous in that the gear pump is operated with the same high rotation speed as the worm shafts and the pulsation is thus reduced to a minimum.

15 A two screw extruder with an integrated screw pump is known from EP 1 365 906 B1, in which two screw elements causing a pressure increase are attached to the synchronous worm shafts. Due to a specific screw design, chambers are formed between the screw elements, which allow a volumetric force-feed of the plastic melt, so that a pressure buildup is achieved. However
20 it is then necessary in the screw machine according to EP 0 564 884 A1, as well as in the two screw extruder according to EP 1 365 906 B1 to increase the size of the drive of the entire arrangement, since the drive must now provide force and energy for the pressure increase and for the mixing and kneading process simultaneously. Thus a much stronger electric motor and
25 correspondingly reinforced gears, shafts, housings, etc. must be provided.

In the screw machine according to EP 0 564 884 A1 and in the two screw extruder according to EP 1 365 906 B1, the integrated gear pump and the screw elements causing the pressure increase have the same rotation speed
30 as the worm shafts used for mixing and kneading. Achieving a homogeneous plastic melt requires a high rotation speed. However, in the gear pump as well

as in the screw elements causing the pressure increase, this high rotation speed generates high friction, which results in a high force and energy expenditure and a high generation of heat. The heat is thereby transmitted to the plastic melt, but this can lead to a disturbance or in extreme cases to damage of the plastic melt. Therefore, the application spectrum of an integrated gear pump and of the special screw elements is limited. This problem is attenuated by the fact that depending on the plastic melt used, an individually adapted gear pump or individually configured screw elements are used. These friction losses also impact the drive and the entire arrangement, which must have a correspondingly bigger size. This however leads to high equipment-related expenditure and high installation costs.

The invention is thereby based on the finding that integrating a pressure increase unit into a screw machine is only possible with an increased equipment-related expenditure and above all that compromises must be made with regard to the pressure increase unit and to the screw machine, so that none of these components can be designed optimally.

Another finding is that when operating a screw machine with a pressure increase unit, too much undesired friction heat is generated which is complicated to counteract.

Based on this, the object of the present invention is to create a device for manufacturing synthetic granules, extruded profiles or molded parts, in which the screw machine does without a pressure increase unit.

At the same time, this requires however that a pressure increase unit, here a melt pump, must be created that avoids the disadvantages of the gear pump or the single screw pump mentioned above, and thus more specifically reduces the pulsation and the admission pressure to a minimum.

In the context of solving this object, it has been discovered that a force-feed of the fluid medium causes the medium to be permanently transported away from the inlet opening of the melt pump, which results in the absence of an admission pressure at the inlet opening.

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According to the invention in a first aspect, there is provided a device for manufacturing synthetic granules, extruded profiles or molded parts with the features of a screw machine (1) for producing a plastic melt, with a melt pump (2) for building up pressure for pressing the plastic melt through a tool (3) and
 10 with the tool (3) for creating the granules, the extruded profile or the molded part, the melt pump (2) being designed to be detached from the screw machine (1) and having a distinct drive (5), with the transfer of the plastic melt from the screw machine (1) to the melt pump (2) occurring at normal pressure or almost normal pressure. According to a second aspect, there is provided a
 15 melt pump for building up pressure with a fluid medium, more specifically a plastic melt, for pressing the medium through a tool, more specifically for a device afore-mentioned, with a compressor (6) that comprises an inlet and an outlet opening, as well as at least two conveyor screws (8, 108, 208, 308) disposed in a common housing (7), wherein screw flights (9, 209, 309)
 20 provided on the conveyor screw (8, 108, 208, 308) are configured in such a manner that a force feed of the medium occurs and wherein the conveyor screws (8, 108, 208, 308) are drivable by their own drive (4). The above mentioned devices and melt pumps are proposed as a technical solution to this object. Advantageous developments of this device and this melt pump can
 25 be gathered from additional features described herein.

A device designed according to this technical teaching and a melt pump designed according to this technical teaching are advantageous in that due to the melt being force-fed in the melt pump, there is no noteworthy admission
 30 pressure at the inlet opening of the melt pump, so that the melt can transition without pressure from the screw machine to the melt pump.

Only the forces required for transport of the plastic melt, for example for overcoming the inertia of the melt, the friction, etc. must be applied by the screw machine and can lead to a slight pressure increase depending on the composition of the melt. Such forces can however be applied by the screw of
5 the screw machine itself, so that a pressure increase device in the screw machine can be dispensed with. This in turn is advantageous in that a screw machine can be operated without a pressure increase device with a smaller drive, here a smaller electric motor, and where appropriate a smaller drive, a smaller screw, a smaller housing and other smaller components, since the
10 forces to be transferred are now much smaller. This leads to a significant reduction of the manufacturing costs of the screw machine. This also involves a reduction of energy costs.

Furthermore, leaving out the pressure increase device creates the advantage
15 that the screw machine is now consistently designed for mixing the basic materials and for producing the plastic melt, which improves the efficiency and thus the cost-effectiveness of the screw machine.

Another advantage is that after separating the melt pump from the screw
20 machine, the melt pump can be constructed and designed solely for achieving an effective pressure increase.

Surprisingly, it has turned out that when constructing and operating a prototype of a device according to the invention, the sum of the electrical
25 power of the drives of the screw machine and of the melt pump was smaller than the electrical power of a corresponding device according to the prior art. Thus, by separating the screw machine and the melt pump, a reduction of the energy costs for manufacturing the synthetic granules, the extruded profiles and the molded parts was achieved in addition to a reduction of the
30 manufacturing costs of the device (due to smaller components).

In an advantageous embodiment, the conveying screws are configured in such a manner that the ratio of the outer diameter relative to the core diameter is 2. Depending on the type of plastic melt a ratio between D_a and D_i between 1.6 and 2.4 can also be chosen. Thereby a great delivery volume is achieved
5 with a relatively thin and thus cost-effective screw.

In another advantageous embodiment, the screw flights have a rectangular or trapeze-shaped thread profile. That way a good force feed of the melt is achieved, more specifically when the flank angle (also called profile angle) is
10 chosen between 0° and 20° . The design of the screw flights should be adapted to the melt to be used; for example a profile angle of 0° has proved to be of value when processing Polyethylene (PE), whereas PVC can be better processed with a profile angle of 13° .

15 In another preferred embodiment, the screw flight has a plane surface, which also contributes to a cost-effective production.

Due to the configuration of the screw flight with a plane flank, a flank angle of 0° and a plane surface, the screw flight has a rectangular cross-section. More
20 specifically when the interval of the screw flights after each pitch corresponds roughly to the width of the screw flight, a uniform gap between flights is achieved, which is reduced to a minimum, by which the corresponding screw chamber is sealed off. This seal allows for a high pressure buildup on the tool, more specifically on the perforated disc.

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In another advantageous embodiment, two conveyor screws are disposed above each other, i.e. vertically relative to each other. This is advantageous in that the inlet opening can be arranged centrally relative to the conveyor screws, so that the incoming melt is well captured by both conveyor screws
30 and a high filling degree is achieved. This is moreover advantageous in that the inlet opening can be disposed laterally on the melt pump, so that a radial

inlet and a radial outlet of the medium occur. This in turn allows for an angled arrangement of the melt pump relative to the screw machine, the advantage being that the total length of the device is reduced. The melt pump can for example be set up at an angle of 45° relative to the screw machine, which
5 leads to saving a lot of space.

In another advantageous embodiment, the melt pump is designed in such a manner that the conveyor screws rotate at rotation speeds between 30 rpm and 300 rpm, preferably at rotation speeds between 50 rpm and 150 rpm,
10 depending on the type of the plastic melt. This is advantageous in that, at least in most cases, the chosen rotation speed lies above the rotation speed of a gear pump or a single screw pump, so that in the context of the force-feed of the melt due to geometry, the melt is conveyed without a pulsation. An advantage of a rotation speed limited to a maximum of 300 rpm is that the
15 shear of the polymer chains occurring a high rotation speed is avoided.

In another embodiment, a gear is disposed between the compressor and the advantageously electrical drive, by way of which the conveyor screws are synchronously drivable. A reciprocal, geometrically accurate interlock of the
20 screw flights is possible due to the synchronization. Thereby, the second screw is advantageously not moved along by a mechanical forced coupling as in geared pumps from the prior art but rather directly driven, so that high friction with the known disadvantages of high energy consumption and an inevitably associated temperature increase is avoided. This also makes it
25 possible to operate the conveyor screws so that they rotate in opposite directions. The synchronization by way of the gear is furthermore advantageous in that drive forces also can be introduced directly into both conveyor screws, in order to achieve a better force distribution.

30 In another preferred embodiment, the screw flights of both conveyor screws engage with each other in such a manner that the flight gap remaining at the

narrowest place forms a gap seal. This gap seal prevents on the one hand the reflux of the medium and increases the force feed and on the other hand acts as overpressure compensation. The force feed generates a high pressure buildup and at the same time the pressure compensation prevents damage to the medium, more specifically when the gap seal is adapted to the medium to be processed. The same advantages also apply to the housing gap.

Another advantage is that the two conveyor screws can be driven with a comparatively low output, which leads to a smaller drive motor and a lesser energy consumption.

In another preferred embodiment, a number of screw chambers, in which the medium is contained, are formed between the housing and the conveyor screws or their screw flights. Thereby, the screw chambers are designed to be quasi closed in accordance with the gap seal of the screw and/or housing gap, so that the desired pressure can be built up but that in case of a (locally) excessive pressure a certain compensation of the pressure occurs.

In a preferred embodiment, a screw chamber extends along the pitch of a screw flight. The beginning and the end of the screw chamber is thereby located at the intersection of the two conveyor screws, i.e. in the plane that is defined by the axes of the two conveyor screw. This is advantageous in that the medium hereby occupies a defined place and is not mixed with another medium. At the same time, this allows for an efficient pressure build up on the perforated disc.

In another preferred embodiment a housing gap is formed between the screw flight and the casing, and a screw gap is formed between the screw flight and its adjacent conveyor screw, which both form a gap seal, so that the medium is substantially held in the respective screw chamber, without a significant reflux of the medium occurring through the gaps (gap seal) into an adjacent

rearward screw chamber. This is advantageous in that a seal is achieved between the screw chambers, which allow for a high pressure in each screw chamber and a pressure of more than 400 bar and up to 600 bar on the perforated disc.

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In yet another preferred embodiment, the housing gap and/or the screws gap has a width of between 0.05 mm and 2 mm. The width of the gap and thus the size of the gap seal ultimately depend on the medium to be processed and its additives. A gap of 0.5 mm has proven advantageous for highly filled plastics with a calcium carbonate proportion of 80% and a pressure of 500 bar on the perforated disc.

10

In a preferred embodiment, with a length/diameter ratio of the conveyor screw of 2 to 5, preferably 3.5, the melt pump achieves a pressure of more than 250 bar and up to 600 bar on the perforated disc. This is advantageous in that the melt pump can be manufactured at low cost and used in a space-saving manner.

15

Yet another advantage is that a quick pressure buildup is achieved due to the cooperation of the two accurately interlocking conveyor screws with the correspondingly configured screw flights on the one hand and to the force-feed on the other hand, so that with a relatively short construction of the melt pump, high pressures are achieved, the retention period in the melt pump is small and that the thermal and mechanical damage to the melt is thus small

25

Other advantages of the device according to the invention and the melt pump according to the invention can be gathered from the enclosed drawings and the embodiments described in the following. According to the invention, the afore-mentioned features and those developed in the following can also be used individually or in any combination of each other. The mentioned

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embodiments must not be understood as an exhaustive enumeration but rather as examples. In the drawings:

- Fig. 1 shows a top view of a device according to the invention in a schematic representation with a first embodiment of a melt pump according to the invention;
- Fig. 2 shows a sectional lateral view of the melt pump according to fig. 1,
- Fig. 3 shows a sectional lateral view of a second embodiment of a melt pump according to the invention, in a section along the line III – III in fig. 5a;
- Fig. 4 shows a sectional lateral view of the melt pump according to fig. 3, in a section along the line IV – IV in fig. 5b;
- Fig. 5a/b shows a sectional view of the view pump according to fig. 3, in a section along the line V – V in fig. 3;
- Fig. 6 shows a lateral view of a conveyor screw of a third embodiment of a melt pump according to the invention;
- Fig. 7 shows a front view of the conveyor screw according to fig. 6;
- Fig. 8 shows a sectional lateral view of the conveyor screw according to fig. 6, in a section along the line VIII – VIII in fig. 6;
- Fig. 8a shows an enlarged detail according to the circular line VIIIa in fig. 8;
- Fig. 9 shows a perspective view of a conveyor screw of a fourth embodiment of a melt pump according to the invention;

Fig. 10 shows a lateral view of the conveyor screw according to fig. 9;

Fig.11 shows a top view of the conveyor screw according to fig. 9;

5

Fig. 12 shows a front view of the conveyor screw according to fig. 9.

Fig. 1 schematically shows a device for manufacturing synthetic granules, plastic profiles or plastic molded parts with a screw machine 1 for mixing and kneading the basic materials into a plastic melt, a first embodiment of a melt pump 2 according to the invention for compressing the plastic melt and a tool 3, here a perforated disc, through which the plastic melt compressed at 50 bar is pressed, in order to produce the desired synthetic granules. In one embodiment not shown here, an extrusion tool for manufacturing the desired plastic profiles or the desired plastic molded parts is used instead of the perforated disc, wherein a pressure of more than 250 bar must bear against the tool. The screw machine 1 has a longitudinal axis 13 and the melt pump 2 has a longitudinal axis 14.

20

As can be gathered more specifically from fig. 2, the melt pump 2 comprises a drive, here an electric motor 4, a gear 5, and a compressor 6. Two conveyor screws 8 are disposed in parallel in the housing 7 of the compressor 6 and rotate in opposite directions. The conveyor screws 8 are connected to the gear 5, which is connected to the electric motor 4. Each of the two conveyor screws 8 has a substantially radially protruding, screw-shaped circumferential screw flight 9, wherein the screw flight 9 of the one conveyor screw 8 engages with the screw flight 9 of the other conveyor screw 8 in such a manner that a force-feed of the plastic melt occurs. The conveyor screws extend in parallel with the longitudinal axis 14 of the melt pump 2 as seen in Figure 1 in this example.

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In the embodiment shown here and as seen in Figures 1 and 2, the melt pump 1 is disposed relative to the screw machine 2 such that the conveyor screws 8 extend longitudinally at an angle α relative to the longitudinal axis 13 of the screw machine, in order to reduce the space required at the production facility. Angle α is between 15° and 75° in one example, is between 30° and 60° in another example, and is equal to 45° in this example. Axis 13 extends at angle α relative to axis 14.

In the first embodiment of a melt pump 2 according to the invention shown in fig. 2, the two conveyor screws 8 rotate in opposite directions. In order to ensure a correct, reciprocally accurate engagement of the screws with each other, the conveyor screws 8 are permanently coupled via the gear 5, so that a synchronous operation of the screw conveyors 8 is ensured. Both conveyor screws 8 are thereby driven synchronously.

The housing 7 is formed to correspond with the conveyor screws 8 in such a manner that a narrow housing gap 10 remains between the outer edge of the screw flight 9 and the housing 7, which can amount to between 0.05 mm and 2 mm, 0.5 mm in the embodiment shown here.

The radially protruding screw flight 9 and a flank angle on each side of the screw flight 9 of zero degrees with plane flanks and more specifically a plane flight surface results in a screw flight 9 with a rectangular cross-section. At the same time, the distance between adjacent screw flights 9 corresponds to the width of the screw flight 9. As a result, the screw flight 9 of the one conveyor screw 8 precisely fits into the interval of the screw flight 9 of the other conveyor screw 8. Thereby, the screw gap 11 remaining between the screw flights 9 and the conveyor screws 8 is reduced to a minimum and amounts to between 0.05 mm and 2 mm, preferably 0.5 mm. The actually chosen screw

gap 11 depends on the medium used, the screw gap 11 being bigger as the viscosity of the medium increases.

Due to the screw gap 11 being reduced to a minimum, a seal is formed
5 between the adjacent conveyor screws 8, so that a number of screw
chambers 12 are formed between the housing 4, the screw flights 9 and the
conveyor screws 8, wherein each screw chamber 12 is closed by the seal and
the plastic melt contained therein is continuously conveyed. Due to the tight
cogged conveyor screws 8, a reflux of a part of the plastic melt is reduced to a
10 minimum so that the pressure loss is also reduced to a minimum. This is also
referred to as being axially sealed.

In order to achieve a high conveying output the screw chambers 12 are
formed to be comparatively big. This is achieved by high screw flights 9,
15 wherein the ratio of the outer diameter (D_a) to the core diameter (D_i) amounts
to 2.

In order to implement a small construction size of the melt pump 2, the
conveyor screws 8 in the embodiment shown here have a length/outer
20 diameter ratio of 3.5.

The screw chambers 12 formed inside the housing 7 are limited outward by
the housing 7 and laterally by the screw flight 9. In the area in which the screw
flights 9 of neighboring conveyor screws 8 engage with each other, the screw
25 chambers 12 are separated by the sealing effect. Thus, one screw chamber
12 extends along one screw channel.

The design of the width of the housing 10 and/or the screw gap 11 depends
on the materials used. For example, when processing highly filled plastics with
30 a calcium carbonate proportion of 80% at a required pressure of 250 bar, a
width of 0.5 mm has proven to be of value. With a medium having a higher

fluidity, the gap is made smaller, with a medium with a lower fluidity, the gap is made bigger. In case hard particles, fibers or pigments are mixed into the medium, the gap can also be designed to be bigger.

5 Thereby, the housing gap 10 and the screw gap 11 allows for the formation of the quasi closed screw chamber 12, whereby a pressure buildup toward the perforated disc 3 is achieved, amongst others because a significant reflux of the medium is thus prevented.

10 In case the pressure locally exceeds the desired amount, the gap acts as a compensation because some of the plastic melt can then escape into the adjacent screw chamber 12, which lowers the local pressure and prevents obstruction and/or damage. Thus the size of the gap also impacts the pressure compensation.

15

 If a higher pressure is required in the tool 3, the housing gap 10 and the screw gap 11 must be reduced. This also applies to the case in which a highly viscous plastic melt is processed. With a plastic melt of low viscosity, the gap can also be broadened. As a result, the gap must be chosen for each
20 particular case according to the criteria named here. Thereby, a gap width between 0.05 mm and 2 mm has proven to be of value. All the embodiments mentioned here are axially sealed.

 The embodiments of the melt pump 2 with a gap width of 0.5 mm described
25 here can be used particularly advantageously for highly filled plastics, i.e. for plastics with a high solid content, such as calcium carbonate, wood or carbide for example. Thereby, the highly filled plastic has a calcium carbonate proportion of at least 80%.

30 Due to the multiplicity of plastic melts, the flank angles (also called profile angles) can be adapted into any required form. Thereby, it has proven

advantageous, at least with counter-rotating conveyor screws 8, to choose a rectangular thread profile as shown in fig. 2 or a trapeze-shaped thread profile as shown in fig. 8.

5 Rectangular thread profiles as shown in fig. 2 are also used for processing polyethylene (PE).

In the second embodiment of a melt pump 102 according to the invention shown in figs. 3 – 5, the two conveyor screws 108 rotate in the same direction
10 and are driven by a common drive shaft 113. Here too the screw flights of the conveyor screws 108 engage with each other in such a manner that a minimal screw gap remains.

This type of highly filled plastics can be transported and compressed by the melt pump 2, 102 in a material preserving manner, wherein the plastic enters
15 the melt pump 102 at ambient pressure and leaves the melt pump 102 at a pressure of 50 bar to 600 bar, preferably 400 bar. Here too the ratio of D_a to D_i equals 2, in order to achieve a high conveying output.

20 In figs. 6 – 8, a conveyor screw 208 of a third embodiment of a melt pump according to the invention is shown. This conveyor screw 208 is double-threaded and its screw flights 209 are designed with trapeze-shaped cross-section with a flank angle of 13° . This conveyor screw 208 is used in a counter-rotating manner and is used preferably for processing PVC. Here too,
25 axially sealed screw chamber 212 are formed, which achieve a good pressure buildup and a good force-feed. Here too, the ratio of D_a to D_i equals 2.

In figs. 9 – 12, a conveyor screw 309 of a fourth embodiment of a melt pump according to the invention is shown. This conveyor screw 308 is quadruple
30 threaded (A, B, C, D) and its conveyor screws 309 have a rectangular cross-section with a flank angle of 0° . This conveyor screw 308 is used in a counter-

rotating manner and is preferably used for processing a medium containing proteins. Here too, axially sealed screw chambers 312 are formed, which achieve a good pressure buildup and a good force-feed. Here too, the ratio of D_a to D_i equals 2.

Claims:

1. A method of manufacturing synthetic granules, extruded profiles or molded parts using a plastic melt, the method comprising:

producing the plastic melt via a screw machine having a longitudinal axis;

disposing a melt pump relative to the screw machine such that the conveyor screws of the melt pump are at an angle of between 15° and 75° relative to the longitudinal axis of the screw machine;

transferring the plastic melt from the screw machine to the melt pump such that the melt pump receives the plastic melt at normal or almost normal pressure;

increasing pressure of the plastic melt via the melt pump for pressing the plastic melt through a tool, the conveyor screws of the melt pump including screw flights configured in such a manner that a force feed of the plastic melt occurs, the melt pump being designed to be detached from the screw machine and including a separate drive; and

creating via the tool the granules, the extruded profile or the molded parts.

2. A device for manufacturing synthetic granules, extruded profiles or molded parts using a plastic melt, the device comprising:

a screw machine for producing the plastic melt, the screw machine having a longitudinal axis; and

a melt pump to increase pressure of the plastic melt received from the screw machine, the melt pump including conveyor screws, the melt pump being disposed relative to the screw machine such that the conveyor screws are at an angle of between 15° and 75° relative to the longitudinal axis of the screw machine, the conveyor screws including screw flights configured in such a manner that a force feed of the plastic melt occurs, wherein the melt pump is to receive the plastic melt at normal or almost normal pressure, wherein the melt pump presses the plastic melt through a tool to produce the granules, the extruded profiles or the molded parts, and wherein the melt pump is designed to be detached from the screw machine and to include a separate drive.

3. The device according to claim 2, wherein the conveyor screws are at an angle of between 30° and 60° relative to the longitudinal axis of the screw machine.
4. The device according to claim 2, wherein the conveyor screws are at an angle of 45° relative to the longitudinal axis of the screw machine.
5. The device according to any one of claims 2 to 4, wherein the melt pump includes a compressor having an inlet and an outlet opening, and wherein the melt pump includes at least two said conveyor screws disposed in a common housing, the conveyor screws being drivable by their own drive.
6. A melt pump for building up pressure for pressing a plastic melt through a tool, wherein the melt pump is to receive the plastic melt at normal or almost normal pressure, and comprises:

a compressor having an inlet, an outlet opening and a common housing;

and

at least two conveyor screws disposed in the common housing, screw flights provided on the conveyor screws being configured in such a manner that a force feed of the melt occurs, the screw flights having a

rectangular thread profile, the conveyor screws being drivable by their own drive, and each of the conveyor screws being configured in such a manner that the ratio between an outward diameter thereof and a core diameter thereof amounts to between 1.6 and 2.4.

7. A melt pump for building up pressure for pressing a plastic melt through a tool, wherein the melt pump is to receive the plastic melt at normal or almost normal pressure, and comprises:

a compressor having an inlet, an outlet opening and a common housing;
and

at least two conveyor screws disposed in the common housing, screw flights provided on the conveyor screws being configured in such a manner that a force feed of the melt occurs, the screw flights having a trapeze-shaped thread profile, the conveyor screws being drivable by their own drive, and each of the conveyor screws being configured in such a manner that the ratio between an outward diameter thereof and a core diameter thereof amounts to between 1.6 and 2.4.

8. A melt pump for building up pressure for pressing a plastic melt through a tool, wherein the melt pump is to receive the plastic melt at normal or almost normal pressure, and comprises:

a compressor having an inlet, an outlet opening and a common housing;
and

at least two conveyor screws disposed in the common housing, screw flights provided on the conveyor screws being configured in such a manner that a force feed of the melt occurs, the screw flights having a rectangular thread profile, the conveyor screws being drivable by their own drive, and each of the conveyor screws having a length/outer diameter ratio of 2 to 5.

9. A melt pump for building up pressure for pressing a plastic melt through a tool, wherein the melt pump is to receive the plastic melt at normal or almost normal pressure, and comprises:

a compressor having an inlet, an outlet opening and a common housing;
and

at least two conveyor screws disposed in the common housing, screw flights provided on the conveyor screws being configured in such a manner that a force feed of the melt occurs, the screw flights having a trapeze-shaped thread profile, the conveyor screws being drivable by their own drive, and each of the conveyor screws having a length/outer diameter ratio of 2 to 5.

10. The melt pump according to any one of claims 8 to 9, wherein each of the conveyor screws is configured in such a manner that the ratio between an outward diameter thereof and a core diameter thereof amounts to between 1.6 and 2.4.
11. The melt pump according to any one of claims 6 to 10, wherein each of the conveyor screws is configured in such a manner that the ratio between its outward diameter and its core diameter amounts to 2.0.
12. The melt pump according to any one of claims 6 to 11, wherein each of the screw flights has a profile angle of between 0° and 20°.
13. The melt pump according to any one of the claims 6 to 12, wherein the conveyor screws are disposed above one another.

14. The melt pump according to any one of the claims 6 to 12, wherein the conveyor screws are disposed one above the other vertically.
15. The melt pump according to any one of the claims 6 to 14, further including a gear, wherein the drive and the gear are designed for a rotation speed of the conveyor screws of between 30 rpm and 300 rpm.
16. The melt pump according to any one of the claims 6 to 14, further including a gear, wherein the drive and the gear are designed for a rotation speed of the conveyor screws of between 50 rpm and 150 rpm.
17. The melt pump according to any one of the claims 6 to 14, further including a gear provided between the drive and the compressor, by way of which the conveyor screws are synchronously drivable.
18. The melt pump according to any one of the claims 6 to 17, wherein the screw flights and the conveyor screws are configured to correspond to each other and engage with each other in such a manner that between the common housing and the conveyor screws with their screw flights at least one screw chamber is formed, the at least one screw chamber being closed except for a housing gap.

19. The melt pump according to any one of the claims 6 to 17, wherein the screw flights and the conveyor screws are configured to correspond to each other and engage with each other in such a manner that between the common housing and the conveyor screws with their screw flights at least one screw chamber is formed, the at least one screw chamber being closed except for a screw gap.
20. The melt pump according to any one of the claims 6 to 17, wherein the screw flights and the conveyor screws are configured to correspond to each other and engage with each other in such a manner that between the common housing and the conveyor screws with their screw flights at least one screw chamber is formed, the at least one screw chamber being closed except for a housing gap and a screw gap.
21. The melt pump according to any one of the claims 6 to 17, wherein the conveyor screws have an outer contour, wherein the common housing is configured to correspond to the outer contour of the conveyor screws in such a manner that a housing gap remaining between the conveyor screws and the common housing is so small that the housing gap forms a gap seal and wherein the screw flights and the conveyor screws are formed so as to correspond to each other and are disposed so as to engage with each other in such a manner that a screw gap remaining

between the screw flights and the conveyor screws is so small that the screw gap forms a gap seal.

22. The melt pump according to claim 21, wherein the housing gap is chosen depending on the melt in such a manner that the compressor is axially sealed.
23. The melt pump according to claim 21, wherein the screw gap is chosen depending on the melt in such a manner that the compressor is axially sealed.
24. The melt pump according to claim 21, wherein the housing gap and the screw gap are chosen depending on the melt in such a manner that the compressor is axially sealed.
25. The melt pump according to any one of the claims 6 to 24, wherein the conveyor screws are configured to rotate in opposite directions.
26. The melt pump according to any one of the claims 6 to 25, wherein each of the conveyor screws has a length/outer diameter ratio of 3.5.

27. A method of using a melt pump for building up pressure for pressing a plastic melt through a tool, the melt pump including a compressor having an inlet, an outlet opening, a common housing, at least two conveyor screws in the common housing, the method comprising:

configuring the conveyor screws to be drivable by their own drive and to have screw flights with a rectangular thread profile;

providing the plastic melt to the melt pump such that the melt pump receives the plastic melt at normal or almost normal pressure; and

configuring the screw flights of the conveyor screws such that a force feed of the melt occurs.

28. A method of using a melt pump for building up pressure for pressing a plastic melt through a tool, the melt pump including a compressor having an inlet, an outlet opening, a common housing, at least two conveyor screws in the common housing, the method comprising:

configuring the conveyor screws to be drivable by their own drive and to have screw flights with a trapeze-shaped thread profile;

providing the plastic melt to the melt pump such that the melt pump receives the plastic melt at normal or almost normal pressure; and

configuring the screw flights of the conveyor screws such that a force feed of the melt occurs.

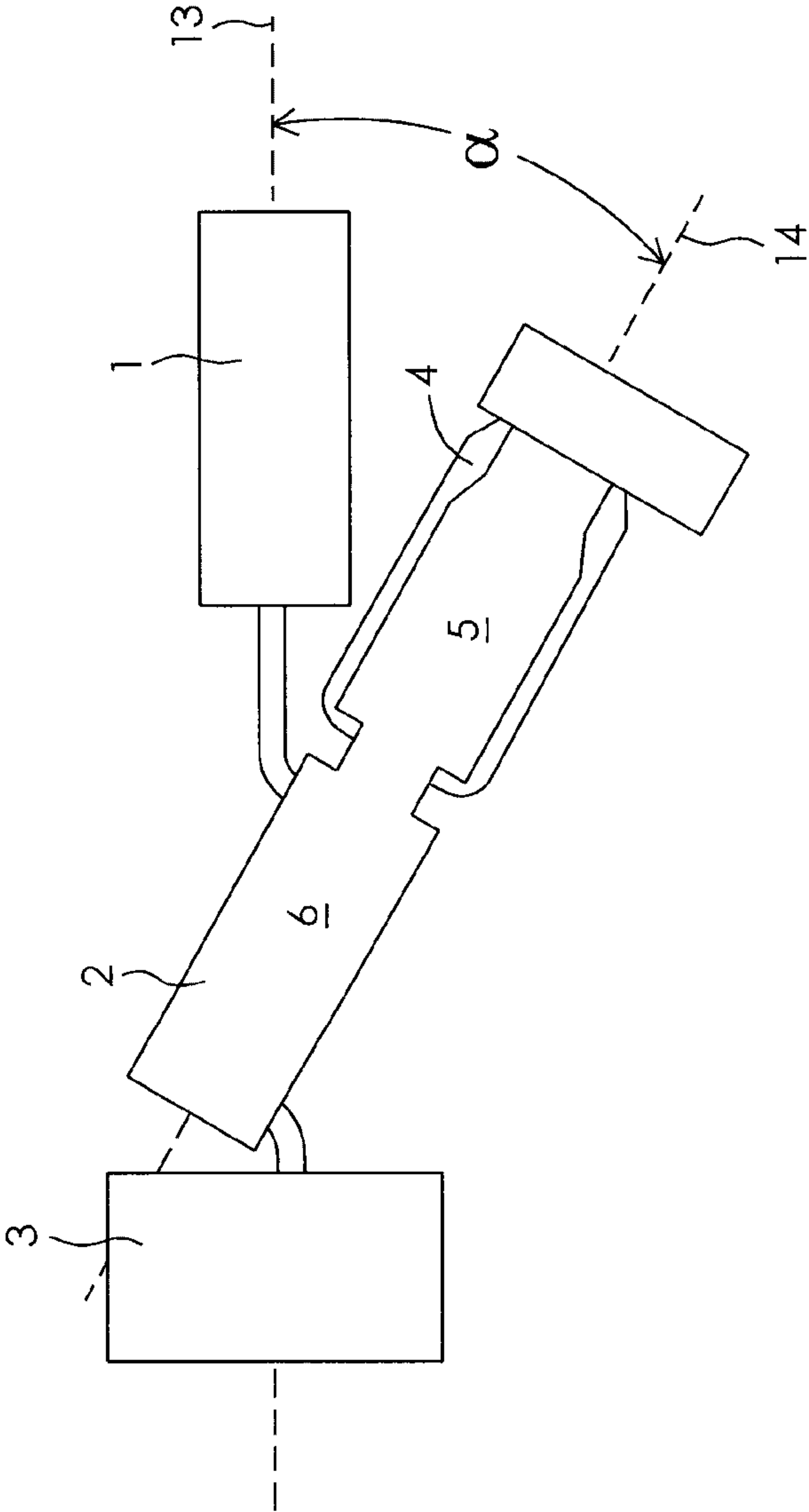


FIG. 1

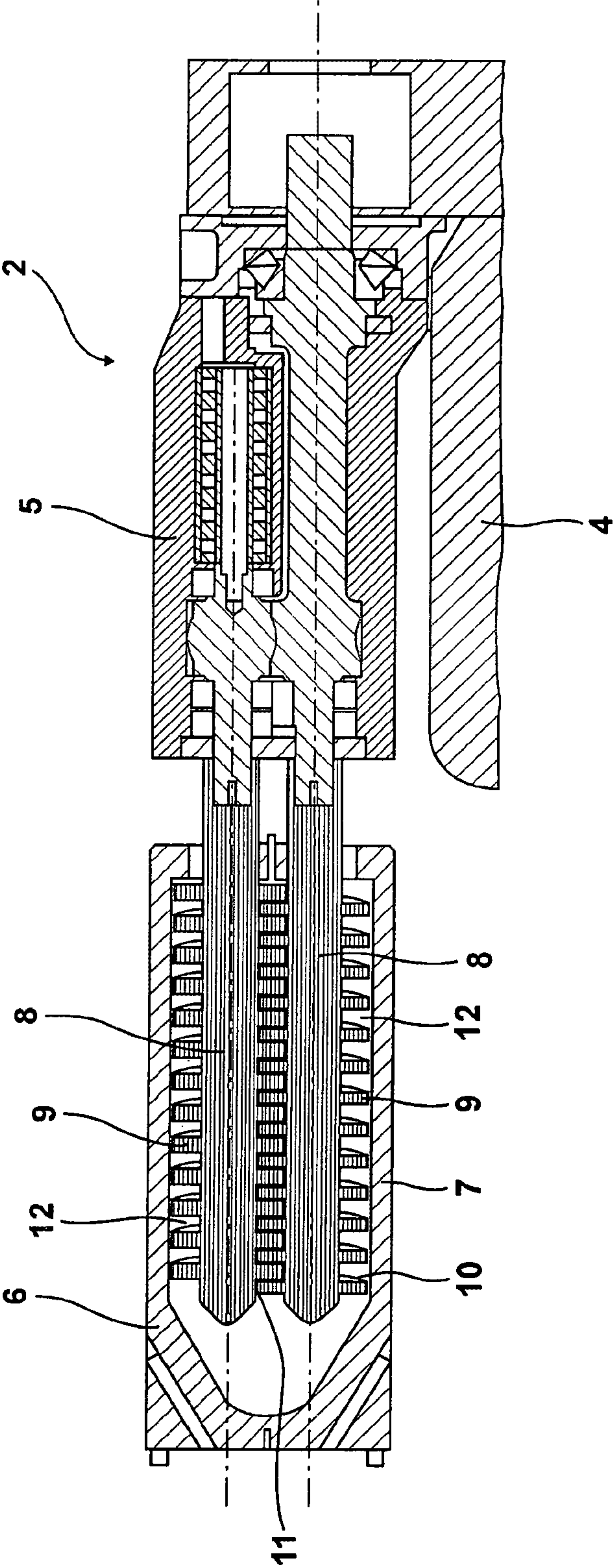


Fig. 2

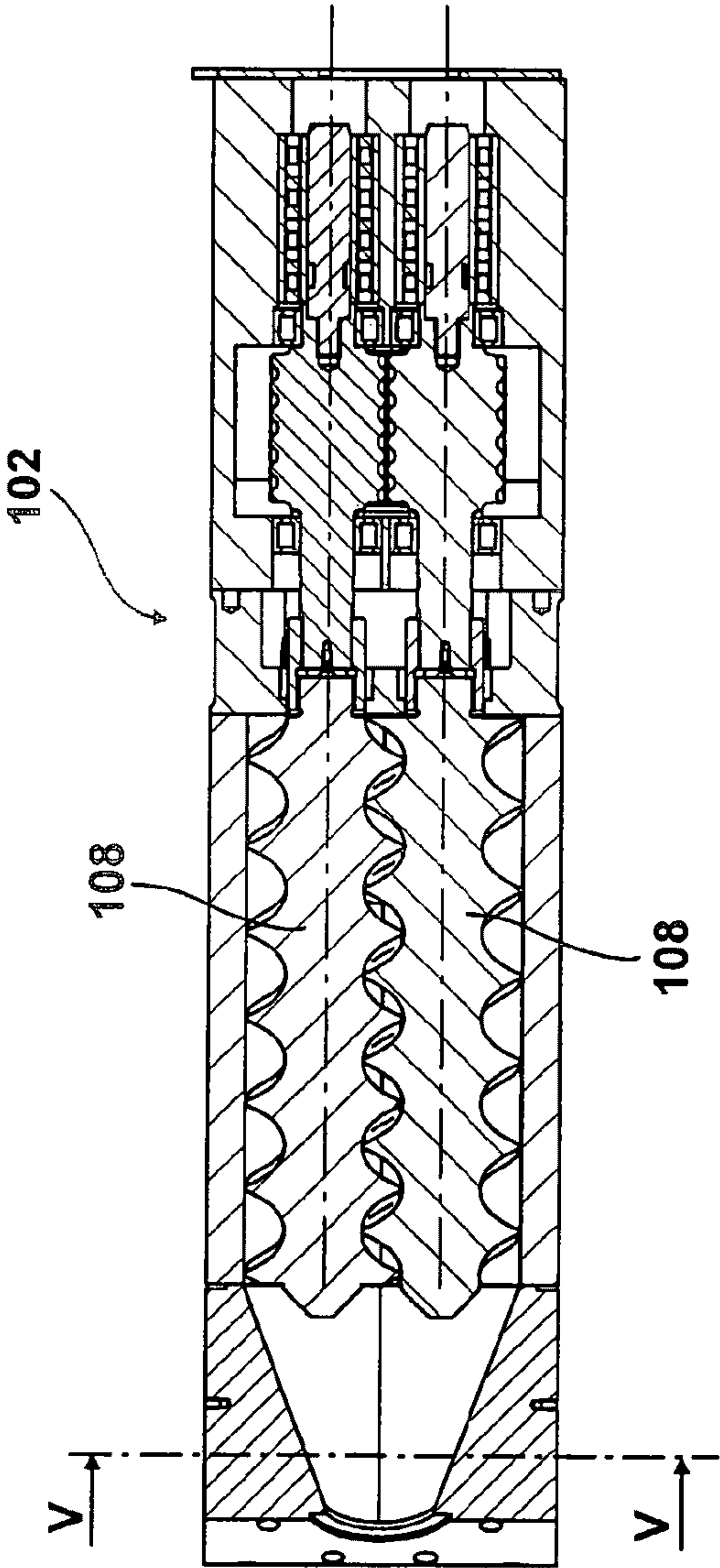


Fig. 3

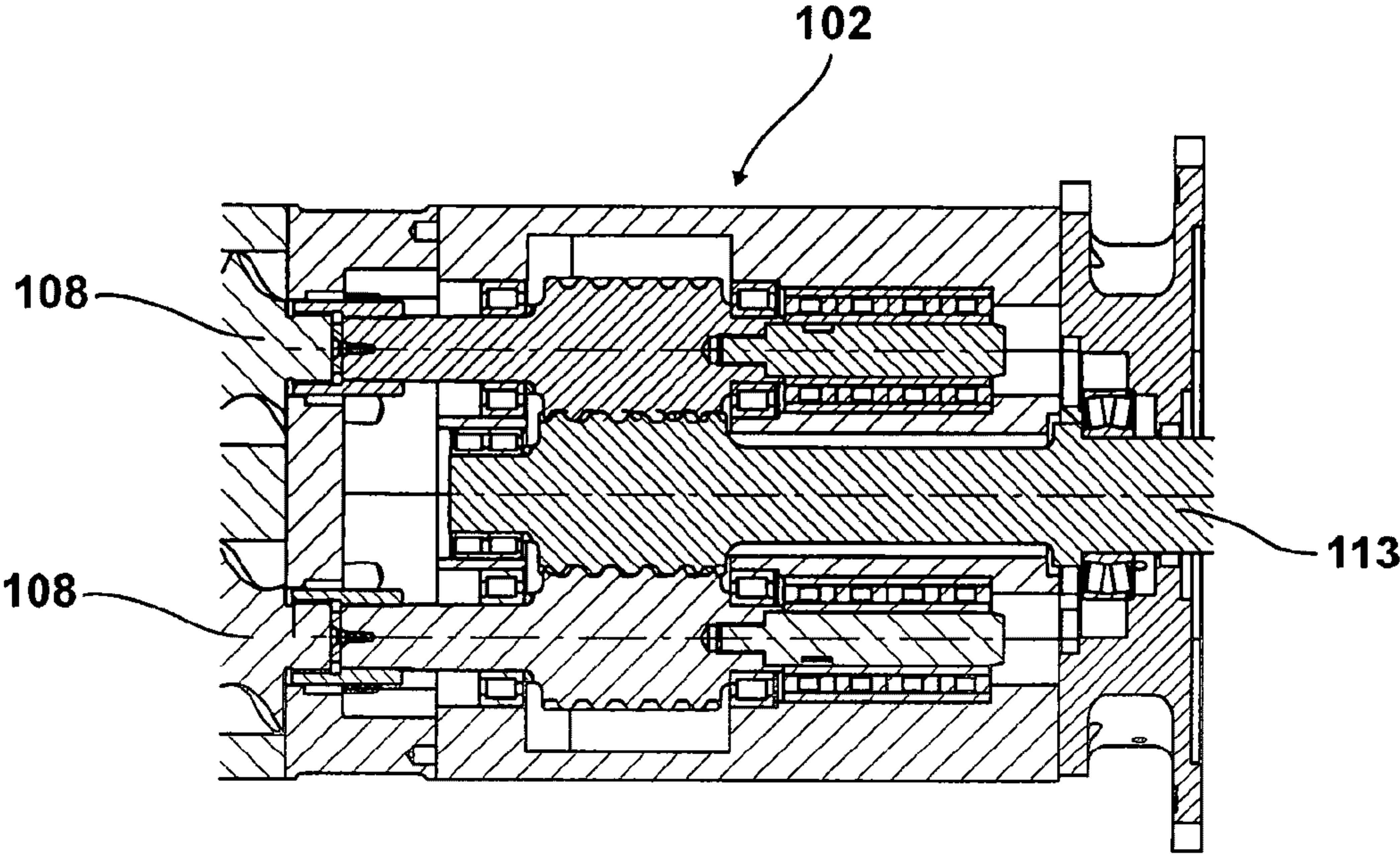


Fig. 4

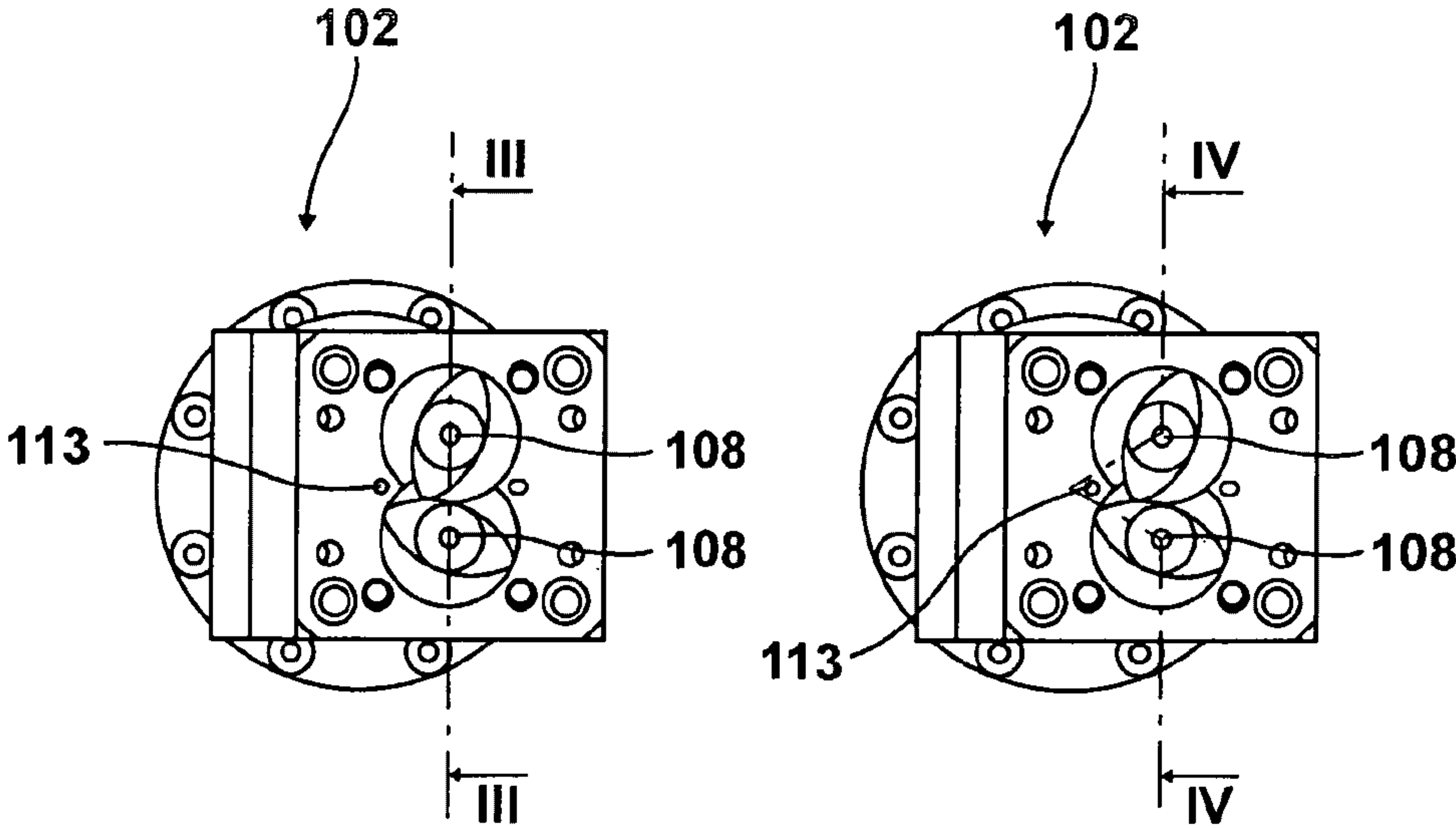


Fig. 5a

Fig. 5b

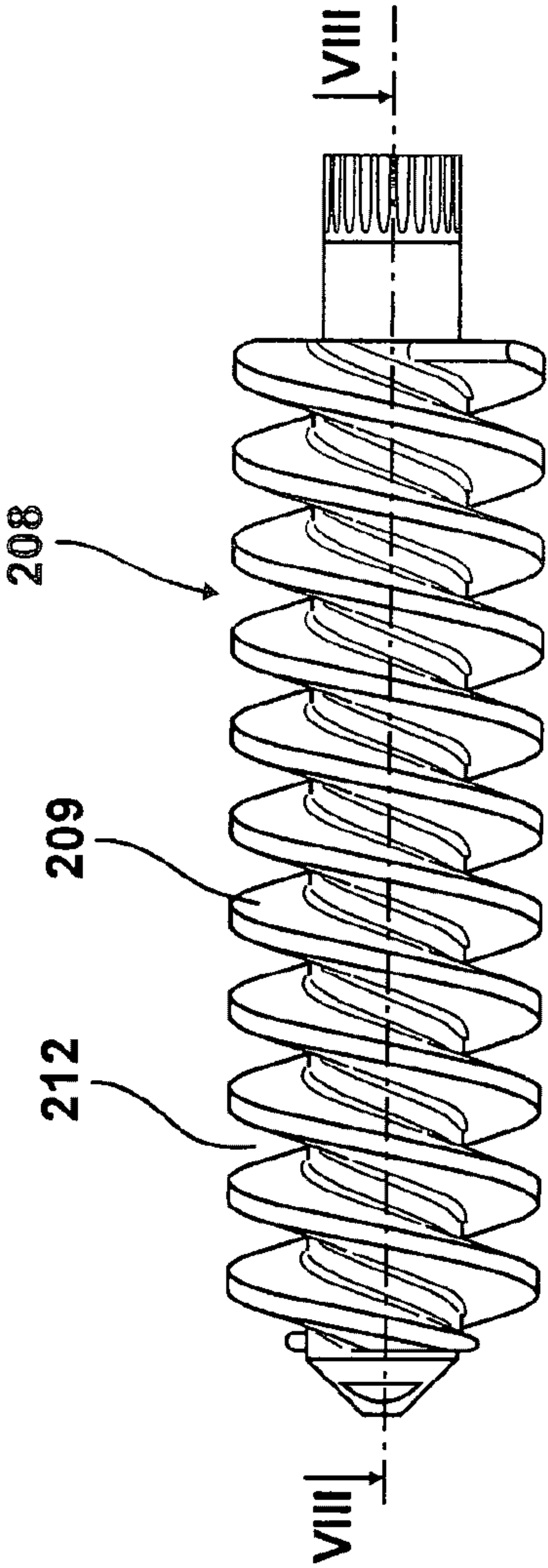


Fig. 6

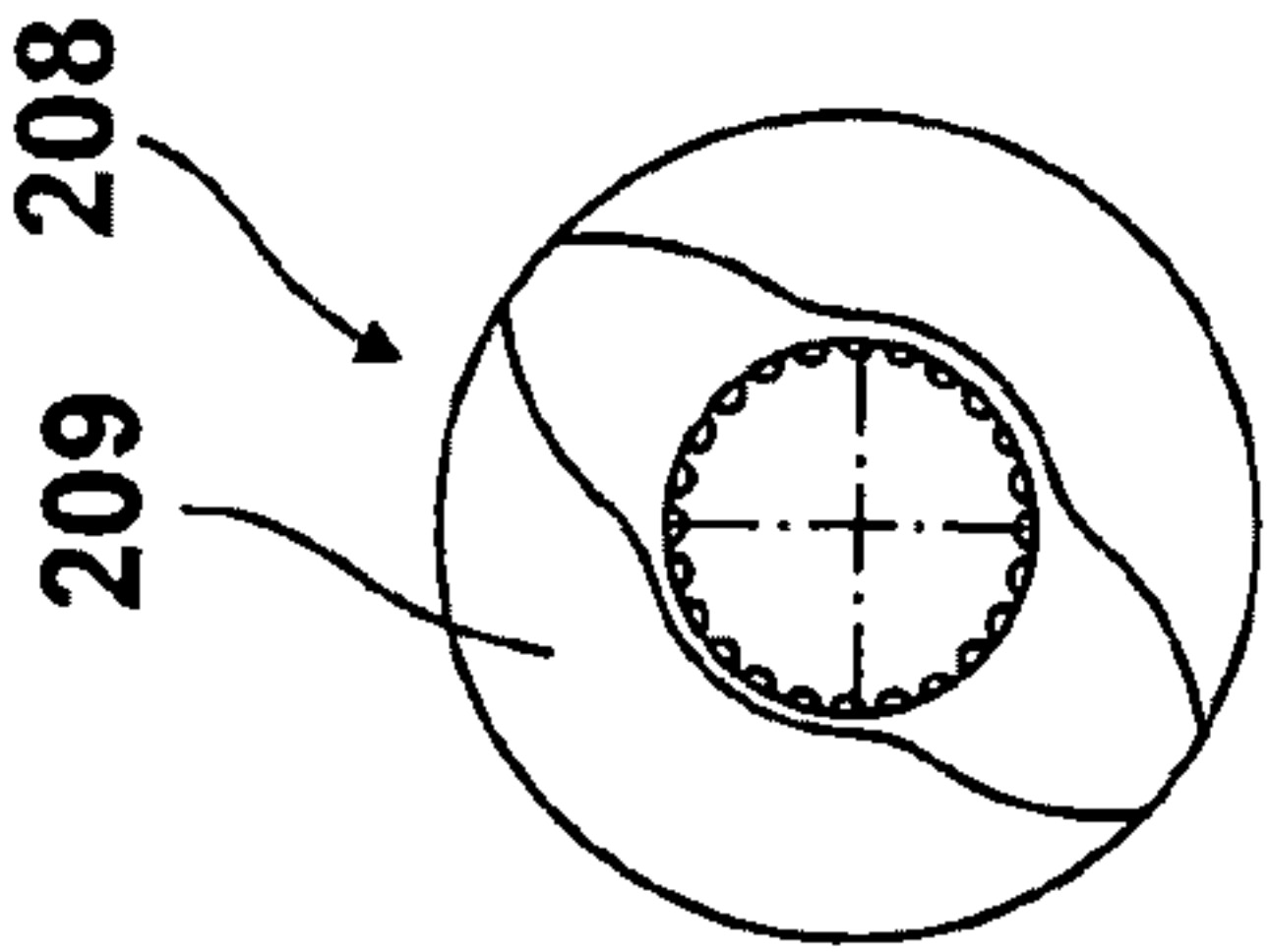


Fig. 7

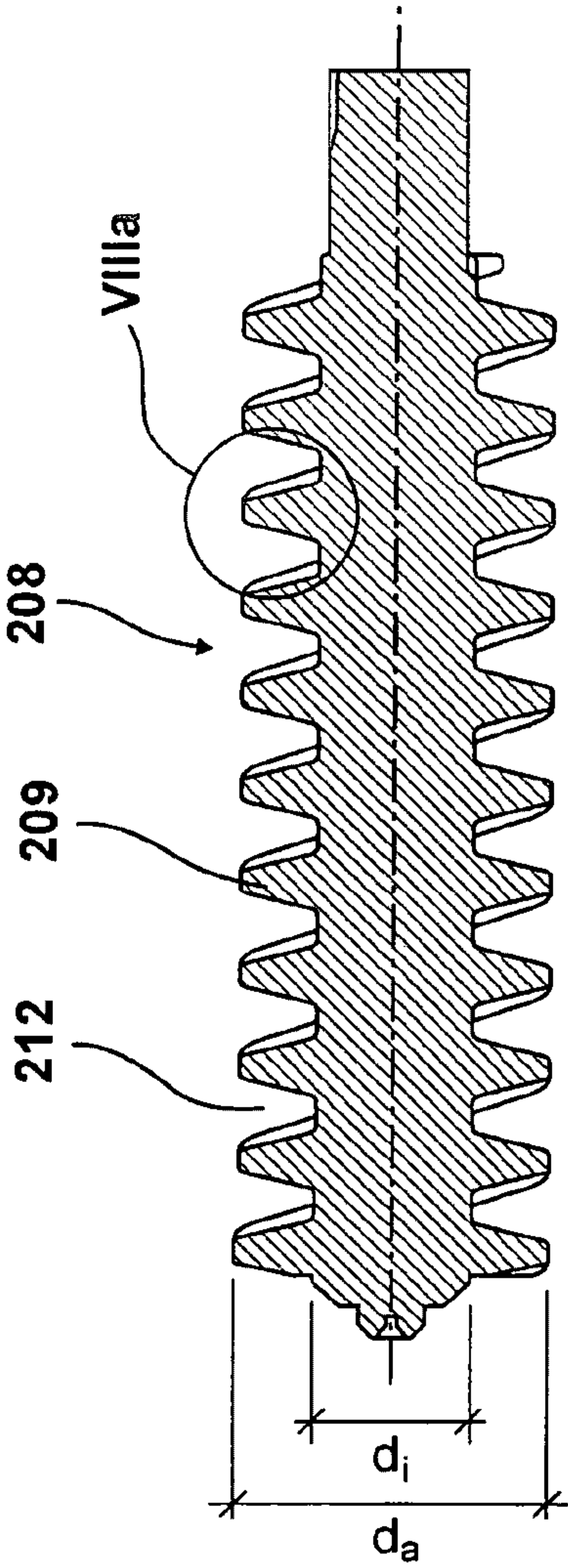


Fig. 8

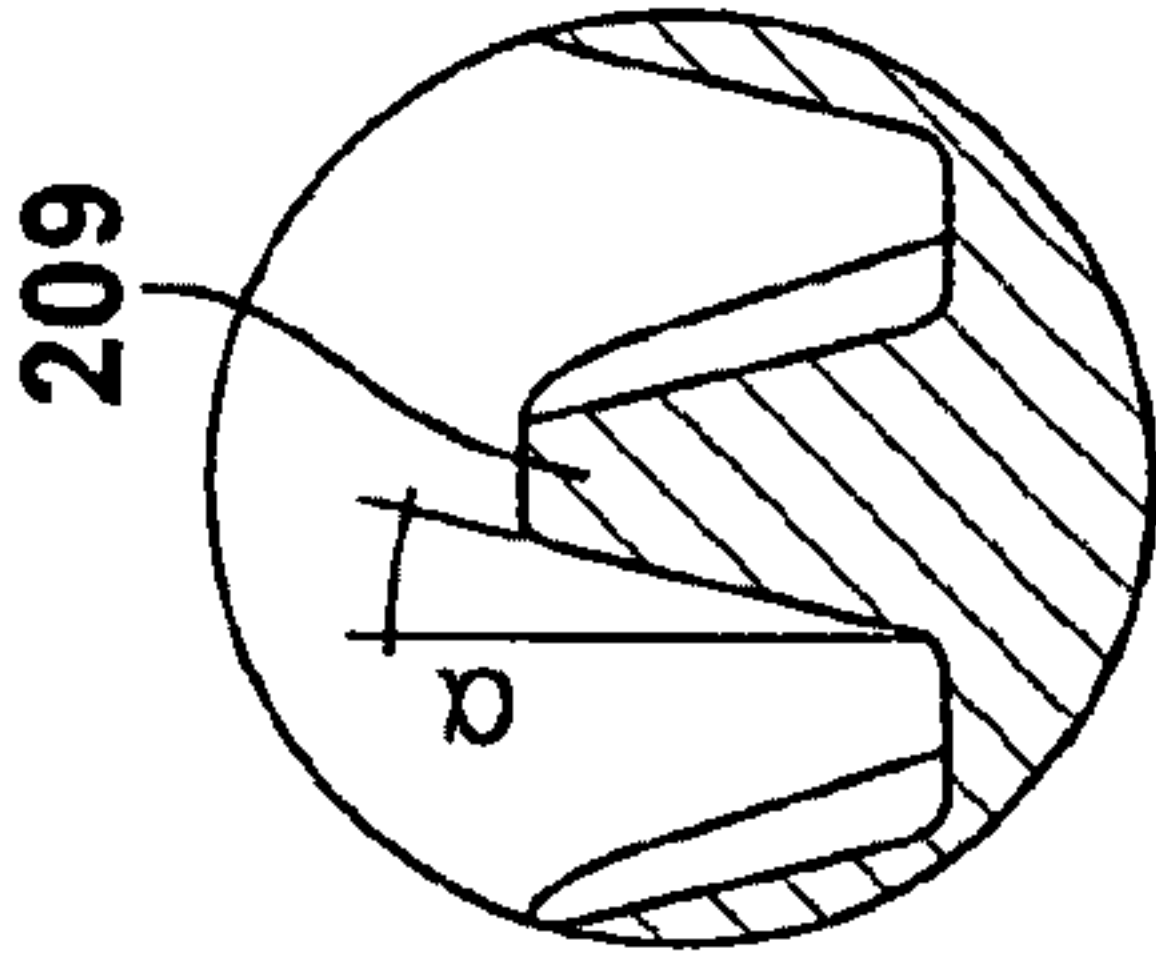


Fig. 8a

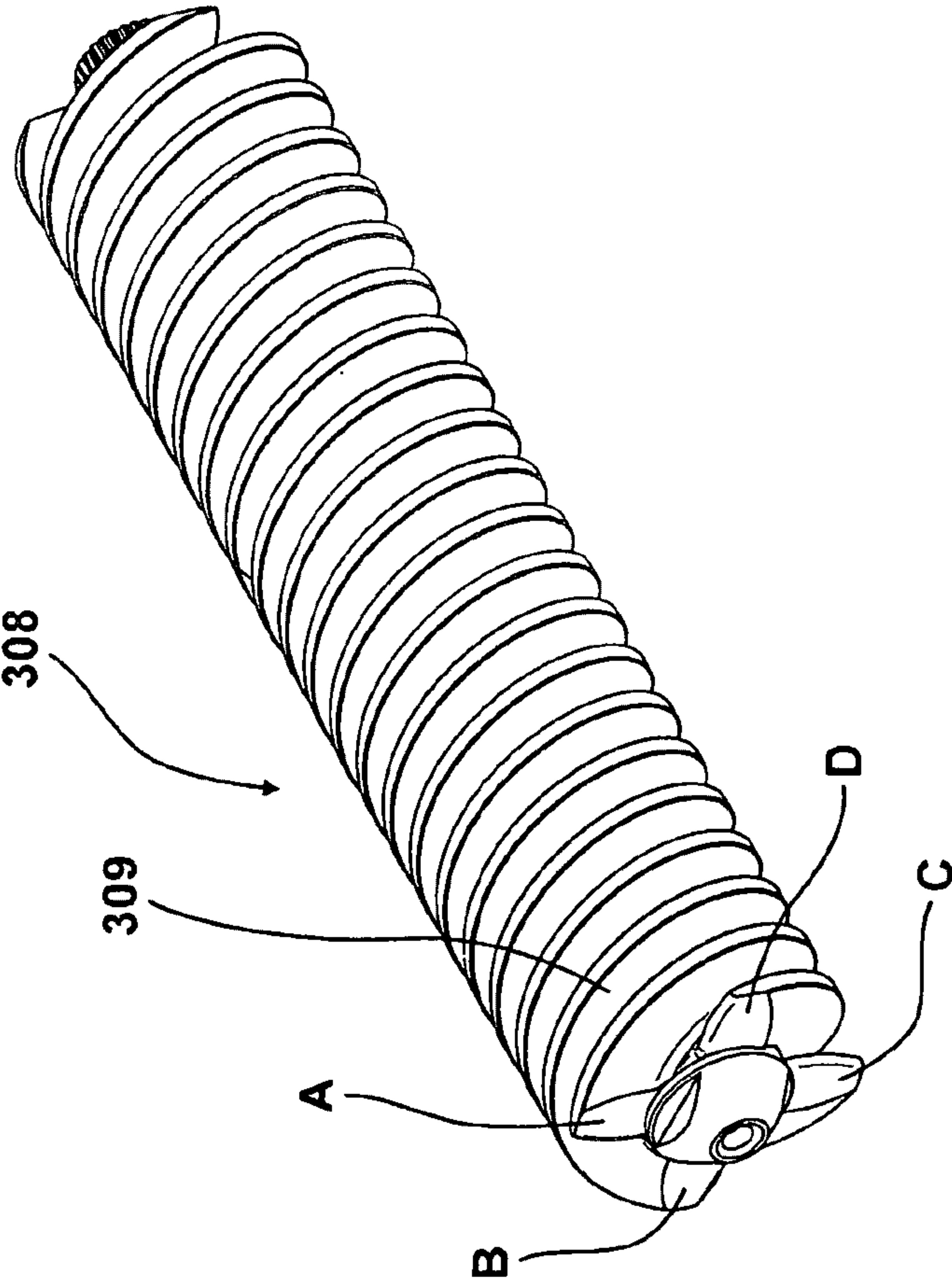


Fig. 9

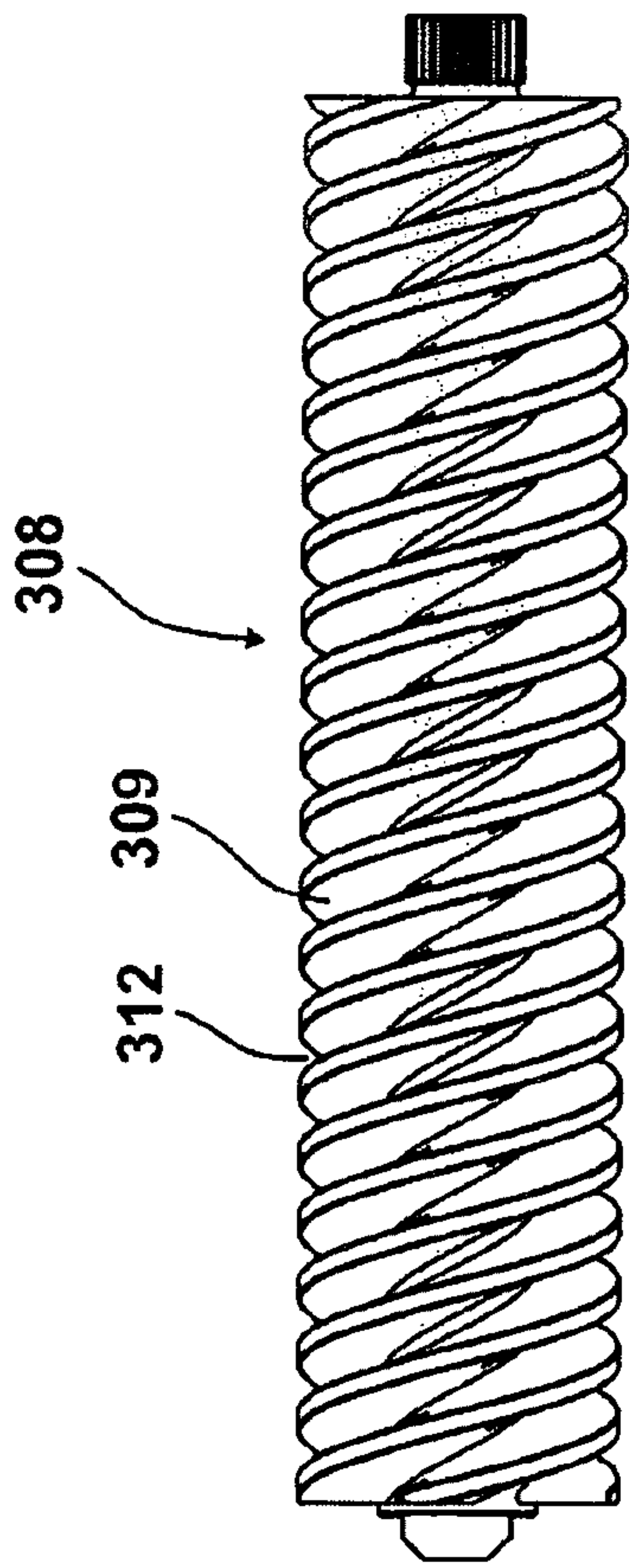


Fig. 10

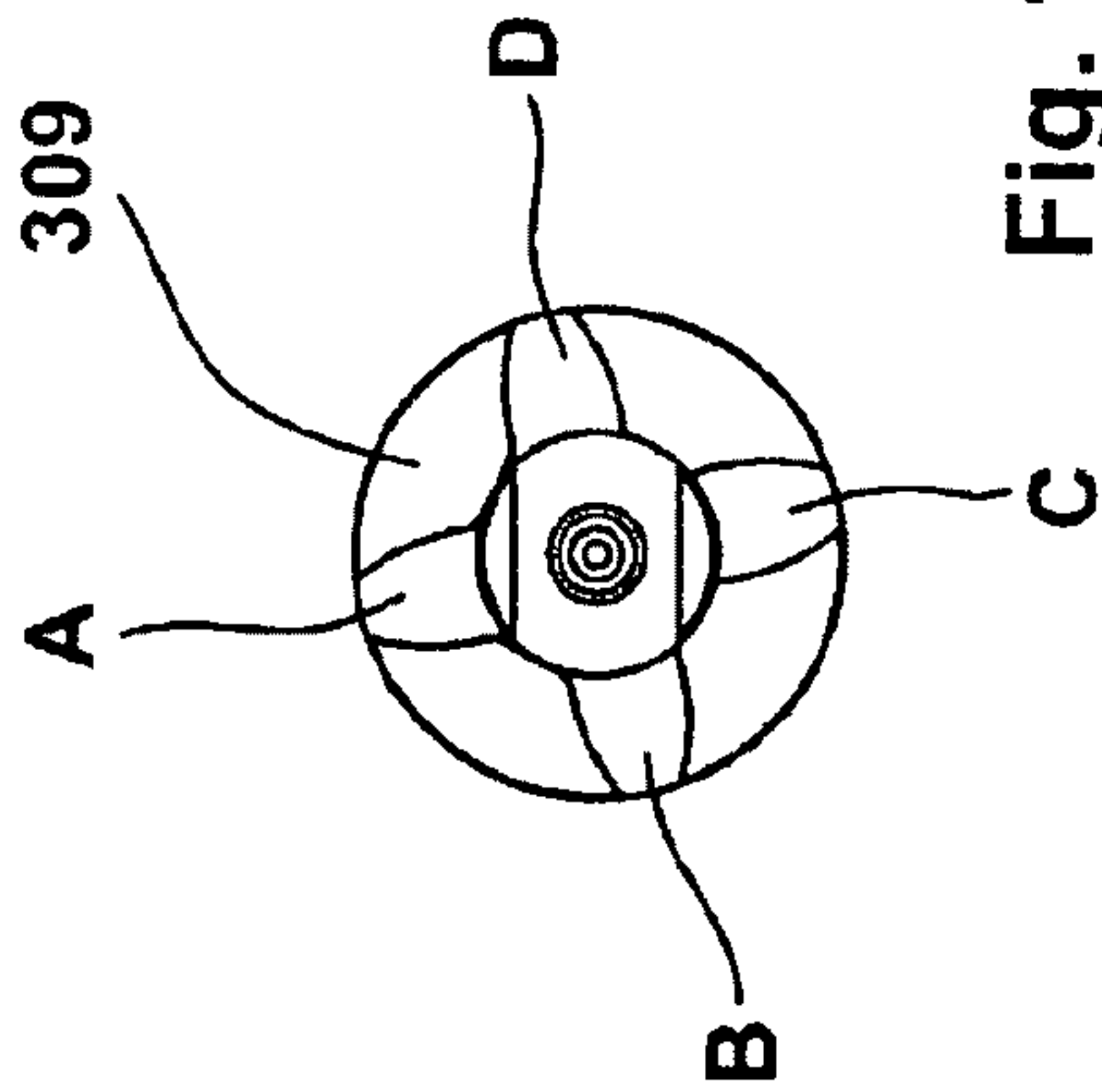


Fig. 12

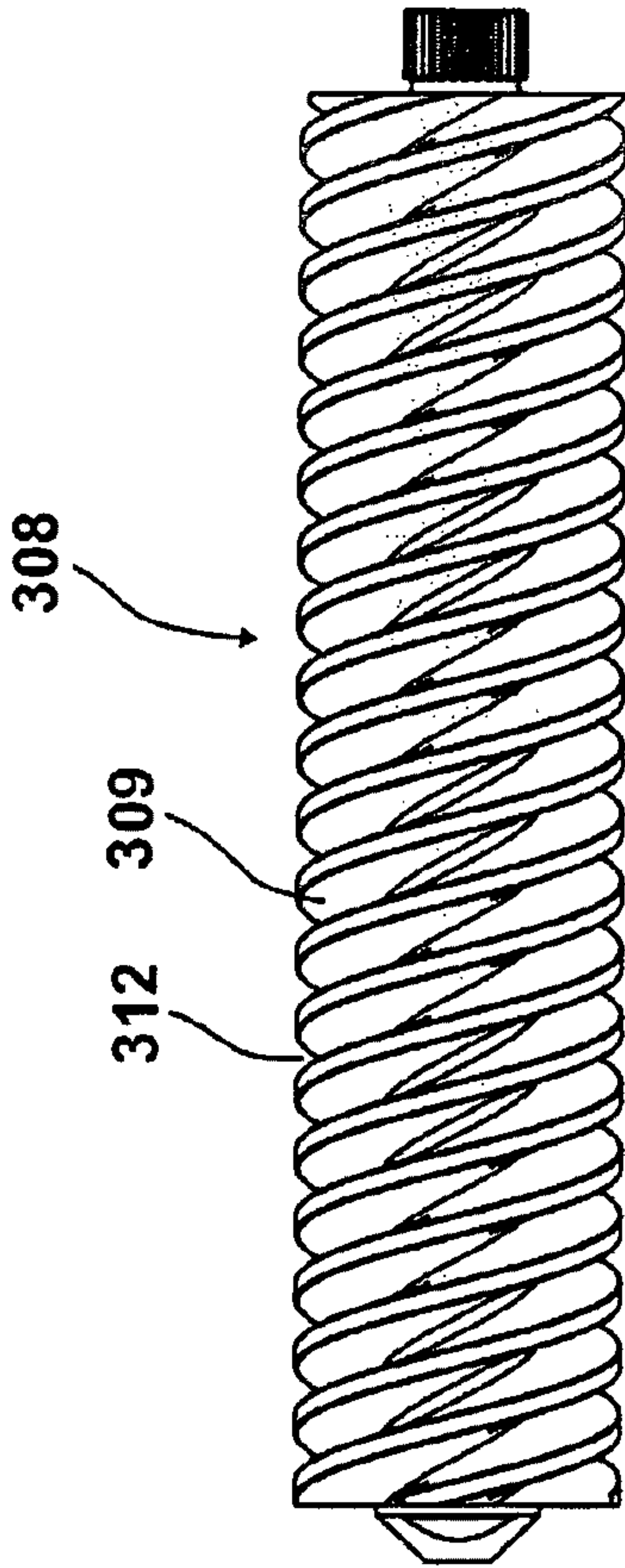


Fig. 11

