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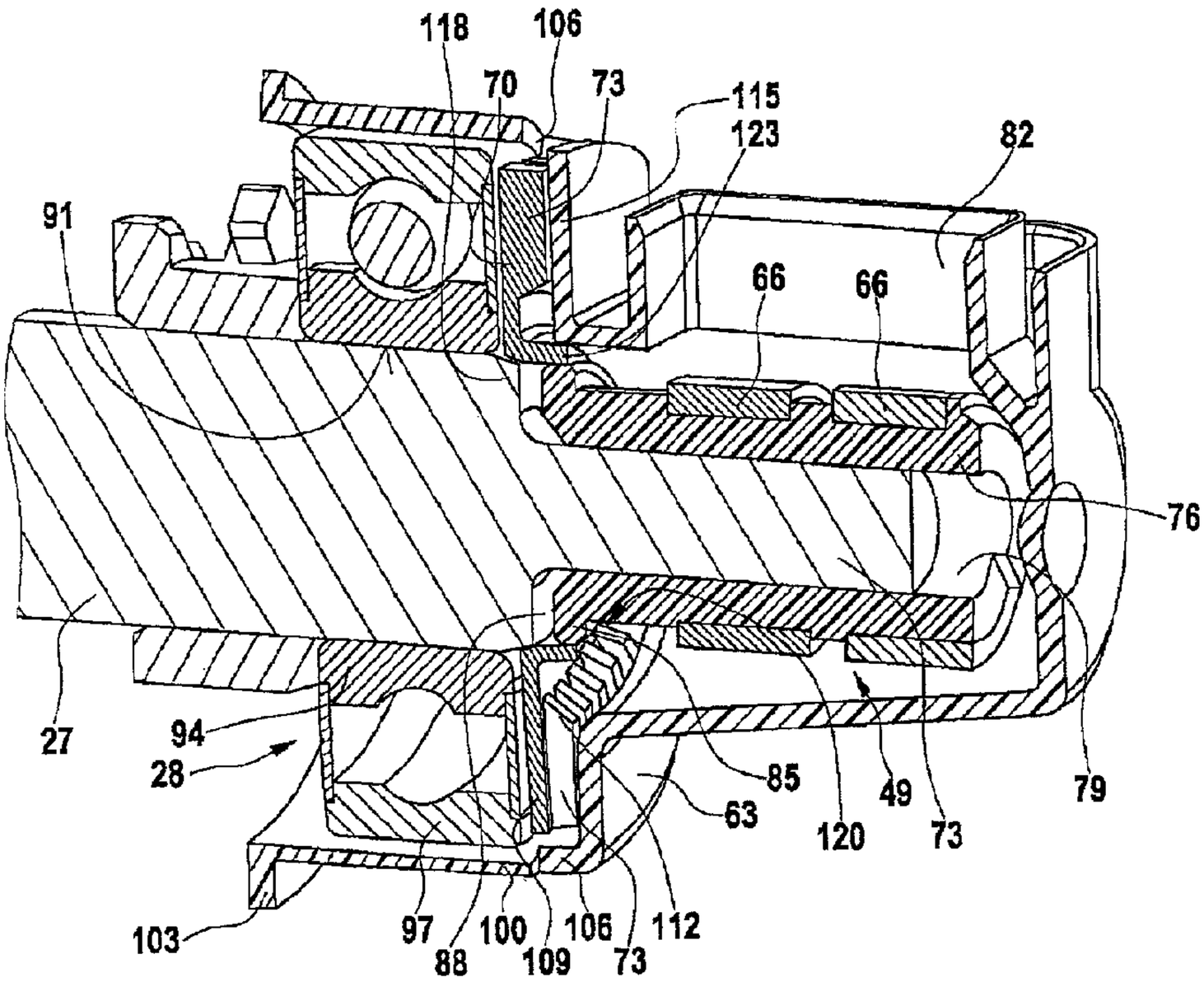


(57) **Abrégé/Abstract:**
Electrical machine, in particular AC generator, having a stator (16) and a rotor (20), wherein the rotor (20) has a conductor arrangement for exciting an electromagnetic field, having a device for transmitting electrical energy to the conductor arrangement, wherein the device for transmitting electrical energy comprises at least one sliding contact and at least one mating contact (66) which is fixed to the rotor, having a fitting sleeve (63) in which a roller bearing (28) for supporting a shaft (27) is preferably arranged, said shaft for the most part encasing the at least one mating contact (66) which is fixed to the rotor, wherein a fan (70) is arranged in the fitting sleeve (63).

Abstract

Electrical machine, in particular AC generator, having a stator (16) and a rotor (20), wherein the rotor (20) has a conductor arrangement for exciting an electromagnetic field, having a device for transmitting electrical energy to the conductor arrangement, wherein the device for transmitting electrical energy comprises at least one sliding contact and at least one mating contact (66) which is fixed to the rotor, having a fitting sleeve (63) in which a roller bearing (28) for supporting a shaft (27) is preferably arranged, said shaft for the most part encasing the at least one mating contact (66) which is fixed to the rotor, wherein a fan (70) is arranged in the fitting sleeve (63).

Description

Electrical Machine

Background Information

German laid-open application DE 19705228 A1 makes known an alternator comprising an assembly composed of rotor and stator, wherein the rotor can be supplied with current by way of the field coil thereof using a slip-ring assembly on the right end of the shaft. Carbon brushes slide on said slip-ring assembly. For protection against external environmental influences, said slip-ring assembly is protected against penetration by water (when the motor vehicle engine is cleaned using a high-pressure cleaning device, for instance) by way of a fitting sleeve. However, it is also desirable to remove particles abraded from the carbon brushes from said fitting sleeve.

Document US 5,625,244 makes known an assembly which generates an air flow through a corresponding fitting sleeve using one of the fans which cool the stator windings. In that particular case it is disadvantageous that the efficiency is unsatisfactory, and that longitudinal slots formed in the bearing section affect the support of the entire electrical machine.

The objective of some embodiments of the invention is thus to create a technical solution for the forced ventilation of a space in which abraded carbon particles accumulate

Advantages of the Invention

The invention according to some embodiments has the advantage that placing a fan in the fitting sleeve results in a particularly effective generation of an air flow or purge air flow in the fitting sleeve. By way of said particularly intensive purge air flow, particles abraded from the carbon brushes can be removed from the slip-ring space in a particularly effective manner. In addition to carrying away the carbon dust or grinding dust, this system reduces the temperature in the slip-ring space. Due to this

temperature reduction of approximately 10°C, the service life of the brushes can be increased by more than 10%.

Due to the arrangement of the fan blades, which extend away from a fan plate of the fan, it is possible to design a fan which is particularly robust against centrifugal forces, very particularly in the hub region. If a plate region which is part of the fitting sleeve is disposed axially opposite the free ends of the fan blades, the efficiency of the fan is improved considerably. Outlet openings for the purge air in the fitting sleeve, which are disposed radially outside of the fan, result in a particularly effective removal of the purge air and the dust particles carried therein. If the fan has an outer diameter that is smaller than the largest diameter of a roller bearing disposed in the fitting sleeve, a relatively simple design of the fitting sleeve results, since this makes it possible to avoid using so-called cross slides at this point when manufacturing the fitting sleeve using a casting method. It is provided that the fan is centered by a shaft section and/or a section of an insulator, the insulator carrying the at least one mating contact which is attached to the rotor. This arrangement enables the fan to be centered easily on the rotor shaft. To avoid having to design the fan to be too bulky, most particularly in the hub region thereof, it is provided that a sleeve section which rests on the insulator is integrally formed on a radial inner wall of the fan.

According to a further embodiment of the invention, the fan shields the roller bearing against contamination by way of the fan plate thereof. Furthermore, it is provided that the fitting sleeve has an opening through which purge air can enter. This opening can be disposed e.g. in a side region of the fitting sleeve or a frontal region or transition region between sides and frontal region (of the end of the fitting sleeve facing away from the roller bearing). This opening can also be a gap which forms in an opening of the fitting sleeve in that the tubular brush holder of the brush carrier is inserted into said opening, and said gap enables ventilation to take place. To prevent slip from occurring between the fan and the rotor shaft, said fan is attached to the rotor by way

of an integral connection (bonding, friction welding) or a form-locked or non-positive connection.

In some embodiments, the invention provides an electrical machine, in particular an AC generator, comprising a bearing plate, comprising a stator and a rotor, wherein the rotor has a conductor arrangement for exciting an electromagnetic field, having a device for transmitting electrical energy to the conductor arrangement, wherein the device for transmitting electrical energy comprises at least one sliding contact and at least one mating contact which is attached to the rotor, wherein the bearing plate has a hub having a bore, and having a fitting sleeve, which is seated with a fitting ring section in the hub, wherein a roller bearing for supporting a shaft is disposed in the fitting ring section, wherein this shaft largely encloses the at least one mating contact which is attached to the rotor, wherein a fan is disposed in the fitting sleeve.

Description

Brief Description of the Figures:

Figure 1 shows a longitudinal cross section of an electrical machine which is designed as an alternator in this case,

Figure 2 shows a longitudinal cross section of the slip-ring space (first embodiment),

Figure 3 shows a partial longitudinal cross section of a fitting labyrinth with tubular brush holders inserted,

Figure 4 shows a second embodiment, in a longitudinal cross section,

Figure 5a shows the fitting sleeve of the second embodiment, in a sectional detail view,

Figure 5b shows a schematic representation of a cover of the open end of the fitting sleeve through a region of the protective cap,

Figure 6 shows a spacial view into the fitting sleeve depicted in figure 5, comprising various components disposed therein.

Disclosure of the Invention

Figure 1 shows a cross section of an electrical machine 10 which is designed in this case as a generator or an alternator for motor vehicles. Electrical machine 10 includes e.g. a two-piece housing 13 which is composed of a first end shield 13.1 and a second end shield 13.2. End shield 13.1 and end shield 13.2 enclose a stator 16 which is composed of a substantially annular stator core 17; a stator winding 18 is inserted into the slots of stator core 17, which point radially inwardly and extend in the axial direction. Annular stator 16 surrounds – by way of the radially inwardly oriented, slotted surface thereof – a rotor 20 which is designed as a claw-pole rotor. Rotor 20 is composed e.g.

of two claw-pole plates 22 and 23, on the outer circumference of which axially extending claw-pole fingers 24 and 25 are disposed. Claw-pole plates 22 and 23 are situated in rotor 20 such that axially extending claw-pole fingers 24 and 25 thereof alternate with one other around the circumference of rotor 20. This results in intermediate spaces – which are required for the magnetic fields – between claw-pole fingers 24 and 25, which are magnetized in opposite directions. These intermediate spaces are referred to as claw-pole intermediate spaces. Rotor 20 is rotatably supported in respective end shields 13.1 and 13.2 by way of a shaft 27 and a roller bearing 28 located on each side of the rotor.

Rotor 20 has two axial end faces, on each of which a fan 30 is mounted. Fan 30 is composed mainly of a plate-shaped or disk-shaped section, out of which fan blades extend in a known manner. Fans 30 are used to enable air to be exchanged between the outside of electrical machine 10 and the interior of electrical machine 10 by way of openings 40 in end shields 13.1 and 13.2. To this end, openings 40 are provided mainly on the axial ends of end shields 13.1 and 13.2, through which cooling air is drawn into the interior of electrical machine 10 by fans 30. This cooling air is accelerated radially outwardly by the rotation of fans 30, thereby enabling it to pass through winding overhang 45 which is permeable to cooling air. Winding overhang 45 is cooled by way of this effect. After the cooling air passes through winding overhang 45 or flows around winding overhang 45, it travels radially outwardly through openings 41 which are shown here in figure 1.

A protective cap 47, which protects various components against environmental influences, is shown on the right side in figure 1. For example, said protective cap 47 covers a slip-ring assembly 49 which supplies excitation current to an excitation winding 51. A heat sink 53, which acts as a positive heat sink in this case, is located around slip-ring assembly 49. A plate 54 functions as the negative heat sink. A connecting plate 56 is disposed on heat sink 53 and is used to connect negative diodes, which are disposed in plate 54, and positive diodes – which are not shown in this illustration – in heat sink 53, thereby forming a bridge circuit which is known *per se*.

A hub 60, which has a cylindrical inner circumference and therefore a bore, is disposed in end shield 13.2, on radial inner side thereof. A fitting sleeve 63 is situated in this bore and is used to accommodate brush-side roller bearing 28 therein. The details will be explained with reference to figure 2. This fitting sleeve has not only this actual fitting ring section which is situated directly in hub 60, but also a sleeve-shaped cap which is integrally formed on said fitting ring section which encloses mating contacts 66 which are attached to the rotor 20 and are slip rings in this case. A mating contact, which is not depicted here and is typically also referred to as a brush, slides on mating contact 66 which is attached to the rotor. Moreover, a fan 70 is disposed in fitting sleeve 63, which drives purge air located in fitting sleeve 63 and thereby expels grinding dust produced by abrasion of the sliding contacts out of the interior of fitting sleeve 63.

Therefore, an electrical machine 10 is shown, in particular an alternator, comprising a stator 16 and a rotor 20, wherein rotor 20 has a conductor arrangement designed as an excitation winding 51 in this case for exciting an electromagnetic field in the rotor, having a device for transmitting electrical energy to the conductor arrangement, wherein the device for transmitting electrical energy comprises at least one sliding contact designed as a brush (graphite brush, carbon brush), and at least one mating contact which is attached to the rotor. In the aforementioned embodiment, the mating contact attached to the rotor is designed as a slip ring. Another embodiment can be designed as a commutator having lamella distributed around the circumference, in a direct current machine, for example. Furthermore, electrical machine 10 comprises a fitting sleeve 63 in which aforementioned roller bearing 28 is preferably disposed to support a shaft 27, and which largely encloses the at least one mating contact 66 which is attached to the rotor. A fan 70 is disposed in fitting sleeve 63.

A longitudinal cross section of the slip-ring assembly is shown in figure 2. Likewise shown is how this slip-ring assembly and roller bearing 28 are enclosed by fitting sleeve 63. Shaft 27 comprises, on the end thereof facing away from the electromagnetic part of rotor 20, a segment 73 on which a contact section 76 of slip-ring assembly 49 is disposed. Contact section 76 has a central bore 79 situated on segment 73 at least in a non-positive manner. Contact section 76 retains – by way of insulating plastic material

thereof – two mating contacts 66 which are attached to the rotor and are located radially underneath an opening 82. Opening 82 is formed in fitting ring 63 and is used to accommodate a tubular brush holder – which is not depicted here – of a brush carrier, thereby enabling sliding contacts disposed in the brush carrier or the tubular brush holders thereof to establish contact with mating contacts 66. An electrical conductor extends out of the radial inner circumference of each of the mating contacts 66 shown here, and is routed to the left inside the insulator material and underneath the roller bearing, i.e. radially inside the inner race of the roller bearing. Contact section 76 is oriented by way of a collar section 85, which is oriented toward the left in figure 2 toward the electromagnetic part of rotor 20, in the direction toward a contact surface 88 of shaft 27, and can rest against same.

A shaft section, which is designed as seat 91 for roller bearing 28, abuts contact surface 88 in the direction facing away from slip rings 66. Roller bearing 28 rests by way of inner race 94 thereof on seat 91; outer race 97 thereof is supported radially outwardly on fitting ring section 100 and in hub 60. Fitting ring section 100 rests by way of collar 103 thereof on end shield 13.2, see also figure 1, of the inner side of end shield 13.2. Fan 70, with fan blades thereof, is disposed between bearing 28 and contact section 76. Openings 106 are disposed in fitting sleeve 63 radially, and possibly offset slightly in the axial direction, outside of fan 70, and are distributed around the entire circumference of fitting sleeve 63 at this point. By way of fan blades 73, fan 70 distributes air that it has conveyed out of the interior of fitting sleeve 63, through openings 106 radially outwardly or substantially nearly radially outwardly, and thereby removes abraded dust particles. Fan blades 73 extend away from a fan plate 109. A plate region 115 which is part of fitting sleeve 63 is disposed axially opposite free ends 112 of fan blades 73. This arrangement results in a considerable improvement in the fan efficiency.

Fan 70 has an outer diameter which is smaller than the largest diameter of roller bearing 28 disposed in fitting sleeve 63. Fan 70 shields roller bearing 28 against contamination by way of fan plate 109 thereof.

As shown in figure 2, fan 70 is centered by a shaft section 118 and a section of the insulator – namely collar section 85 – and on the radial outer side thereof in this case. In this case, the insulator is the plastic portion or plastic region of contact section 76. As an alternative, fan 70 could also be centered either only by shaft section 118 or only by collar section 85 of the insulator.

A sleeve section 123 is integrally formed on fan 70, on radial inner edge 120 thereof, and rests on the insulator, i.e. the insulation material of contact section 76.

Fitting sleeve 63 has an opening, which is depicted in figure 1, through which purge air can enter. Figure 2 shows the alternative, in which opening 82 is provided as the opening through which purge air enters. Tubular brush holders 129 of a brush carrier are preferably inserted into opening 82, and a gap through which purge air flows is disposed between the tubular brush holder and opening 82. The tubular brush holder is labelled with reference numeral 129 in figure 3. Brushes 128 extend into opening 82. Fan 70 is attached to the rotor using an integral connection, a form-locked connection, or a non-positive connection.

Fan 70 maintains a certain distance from roller bearing 28. This is important in order to remove any fluid from the intermediate space that may entered said intermediate space, by way of the centrifuge effect. If the distance is too small, it is impossible or difficult to remove the fluid which travels toward the ball bearing and fan due to the capillary effect. Suitable distances between ball bearing 28 and fan 70 which operates as centrifugal disk are > 0.3 mm. The distance of the outer blade diameter should be sized such that air flow is optimized while maintaining a short distance to the inner diameter of fitting ring 63. This changes penetration by fluid when generators rotate. Typical distances between outer diameter, fan, and inner diameter encapsulation are between 1 mm and 2 mm. The purpose of the fan is to create permanent suction in the slip-ring space.

Cooler air is suctioned through the regulator-fitting ring-labyrinth (gap 130), cools the slip rings specifically, and exits the slip-ring space at the openings of the fitting ring. These outlet openings are formed parallel to the fan outer diameter, in order to immediately remove any fluid – that may have entered – from the encapsulation by way

of the centrifuge effect. The number of blades should be selected such that the highest possible flow rate is ensured. A typical number of blades is between 6 and 30. The holes in the fitting ring are circumferential, that is, they are disposed around the entire circumference of 360°. It is thereby ensured that fluid that reached the interior will be forced out, in all installation positions. In addition, these openings should be provided at the greatest outer diameter of the fitting ring. It is thereby ensured that fluids will be forced out completely.

As shown in a second embodiment in figure 4, plate region 115 can also be disposed, as an alternative, at a greater distance from fan blades 73 (greater than in the first embodiment). To attain high fan efficiency, given such a distance, fitting sleeve 63 preferably extends by way of an end 116 – which is similar to a pipe socket and is directed toward roller bearing 28 – of the sleeve-shaped cap axially closer to fan blades 73 than the axial distance between plate region 115 and fan blades 73. Fitting sleeve 63 has outlet openings 106 for purge air, which are used for the discharge of air moved by fan 70, wherein outlet openings 106 are disposed radially outside of fan 70, or are offset radially relative to fan 70. Pipe socket-type end 116 hinders entry by fluids through outlet openings 106 when the electrical machine is idle, for instance. Pipe socket-type end 106 can have a continuous annular design or can be interrupted at a few points, see also figure 5, for instance, which shows an interruption 140.

Figure 5 also shows a fitting sleeve 63, the end of the cap – facing away from roller bearing 28 – of which comprises an air inlet opening 143. Fitting sleeve 63, which is designed round at that point in the manner of a pipe, comprises a barrier-type segment 149 disposed slightly after end 146 of fitting sleeve 63, that is, slightly set back from end 146. Segment 149 itself poses a hindrance to potentially penetrating fluids. Very particularly in cooperation with a protective cap 47 – see also figure 1 – which is disposed by way of a well-type or pot-type cap region 150 with gap above air inlet opening 143, figure 5b, access by fluids is hindered, and fitting sleeve 63 is well ventilated.

Two segments 155 extend along an inner wall 152 of fitting sleeve 63. These two segments 155 are used to wipe water away. If water or any other type of fluid is drawn or sprayed in through air inlet opening 143, the surface section of inner wall 152, for example, located above segment 149 becomes wet. Slip-ring assembly 49 is also becomes wet, for instance, and water is slung off by slip-ring assembly 49 which may be rotating. Segments 155 are used to collect (channel) water, or to allow droplets to form on segments 155, thereby enabling them to be drawn or directed away more easily and with greater force by the flow in the direction toward fan 70. The dwell time of the fluid in fitting sleeve 63 is reduced as a result.

CLAIMS:

1. An electrical machine, in particular an AC generator, comprising a bearing plate, comprising a stator and a rotor, wherein the rotor has a conductor arrangement for exciting an electromagnetic field, having a device for transmitting electrical energy to the conductor arrangement, wherein the device for transmitting electrical energy comprises at least one sliding contact and at least one mating contact which is attached to the rotor, wherein the bearing plate has a hub having a bore, and having a fitting sleeve, which is seated with a fitting ring section in the hub, wherein a roller bearing for supporting a shaft is disposed in the fitting ring section, wherein this shaft largely encloses the at least one mating contact which is attached to the rotor, wherein a fan is disposed in the fitting sleeve.

2. The electrical machine according to claim 1, wherein the fitting sleeve has outlet openings for purge air, which are used for the discharge of air moved by the fan, the outlet openings being disposed radially outside of the fan or axially offset relative to the fan.

3. The electrical machine according to claim 1 or 2, wherein the fan comprises fan blades on a fan plate disposed at a distance therefrom.

4. The electrical machine according to claim 3, wherein a plate region which is part of the fitting sleeve is disposed axially opposite to free ends of the fan blades.

5. The electrical machine according to claim 4, wherein the fitting sleeve extends closer to the fan blades, by way of an end of a sleeve-shaped cap directed toward the roller bearing, than the distance by which the plate region is separated axially from the fan blades.

6. The electrical machine according to one of the claims 1 to 5, wherein the fan has an outer diameter that is smaller than the largest diameter of a roller bearing disposed in the fitting sleeve.

7. The electrical machine according to one of the claims 1 to 6, wherein the fan is centered by a shaft section and/or by a section of an insulator, the insulator carrying the at least one mating contact which is attached to the rotor.

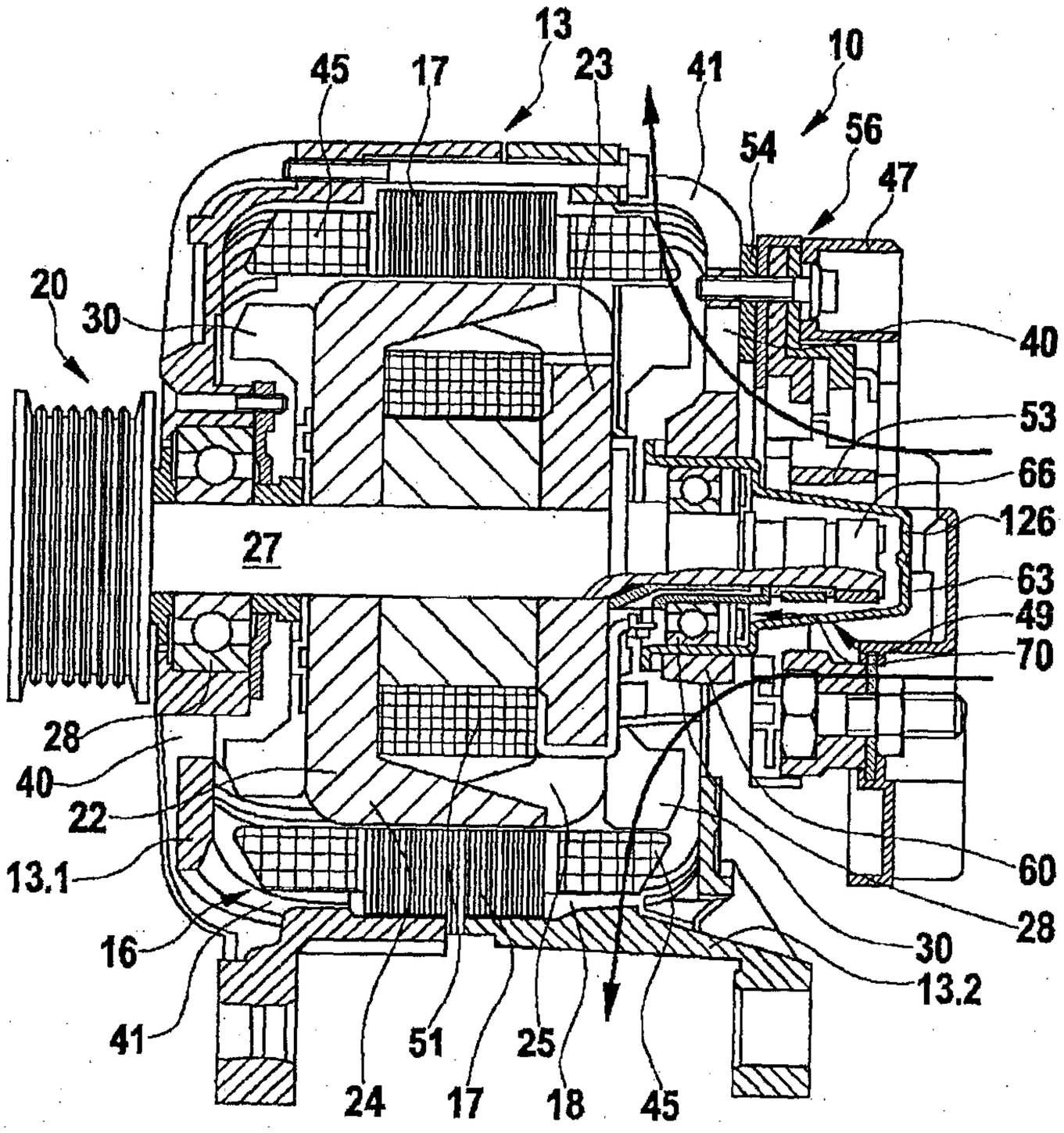
8. The electrical machine according to claim 7, wherein a sleeve section which rests on the insulator is integrally formed on a radial inner edge of the fan.

9. The electrical machine according to one of the claims 1 to 8, wherein the fan shields a roller bearing against contamination by way of a fan plate.

10. The electrical machine according to one of the claims 1 to 9, wherein the fitting sleeve has an opening through which purge air enters, and into which preferably one tubular brush holder of a brush carrier extends, wherein a gap through which purge air enters is located between the tubular brush holder and the opening.

11. The electrical machine according to one of the claims 1 to 10, wherein the fan is securely attached to the rotor by way of an integral, form-locked, or non-positive connection.

Fig. 1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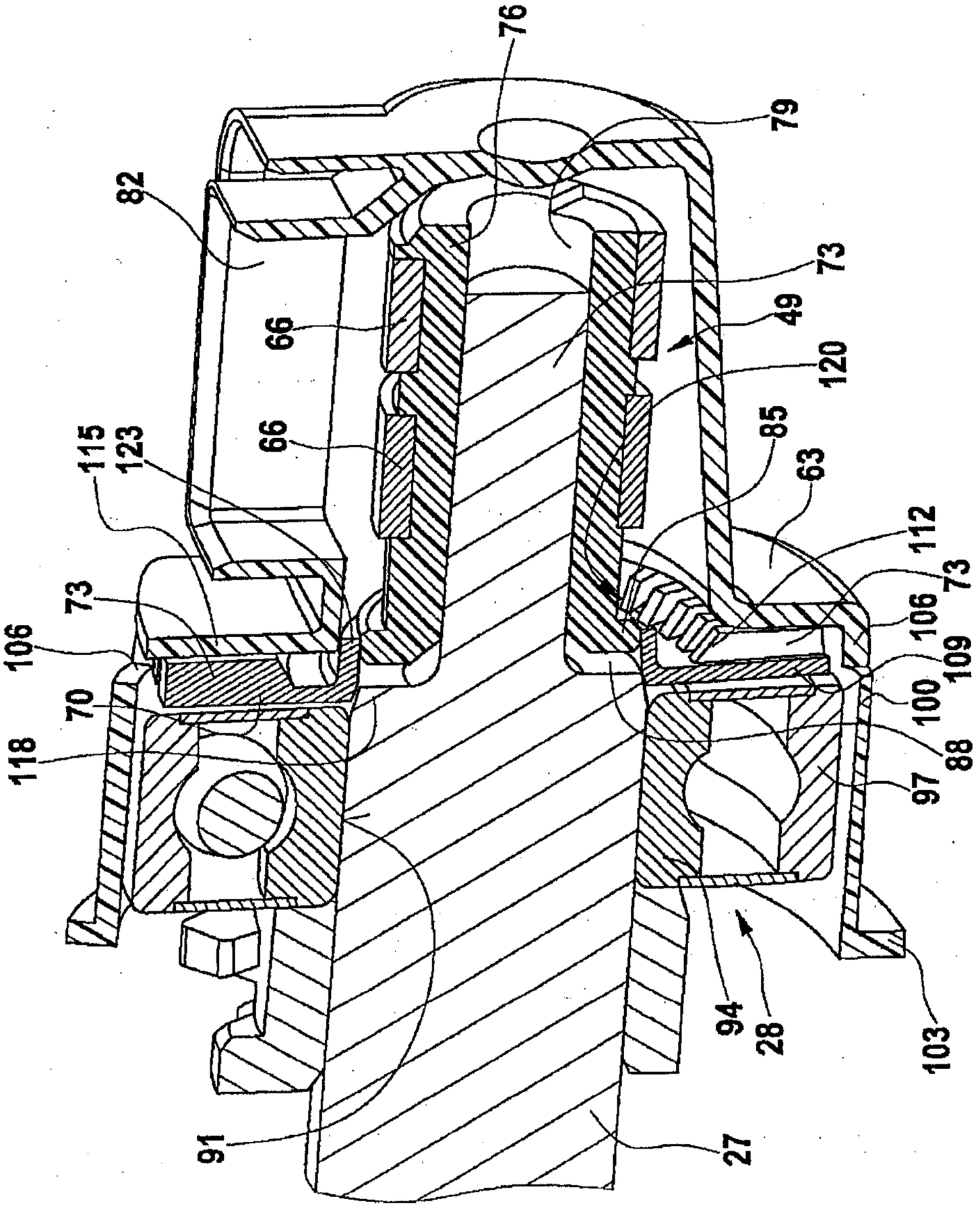
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Fig. 2

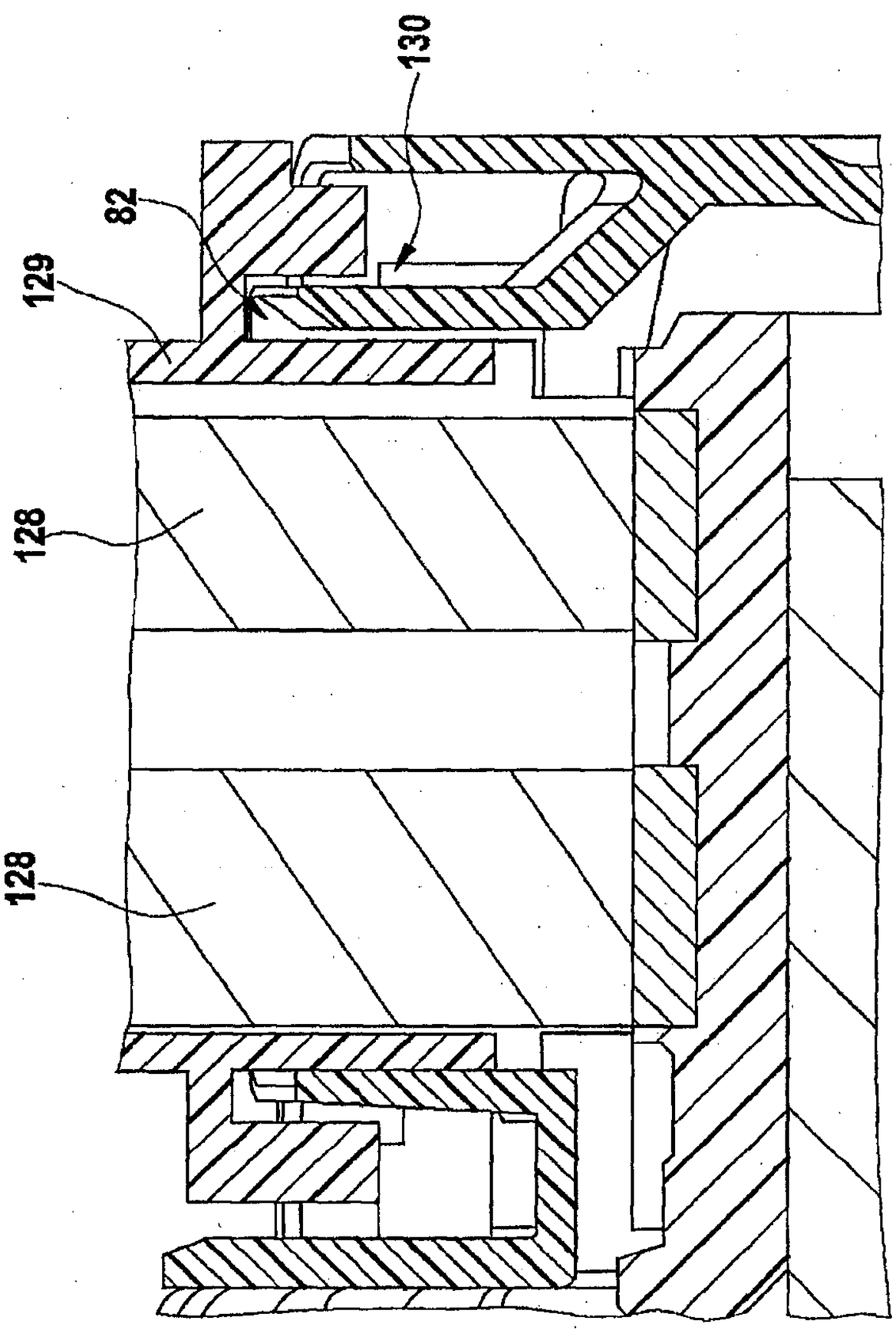


Fig. 3

Fig. 4:

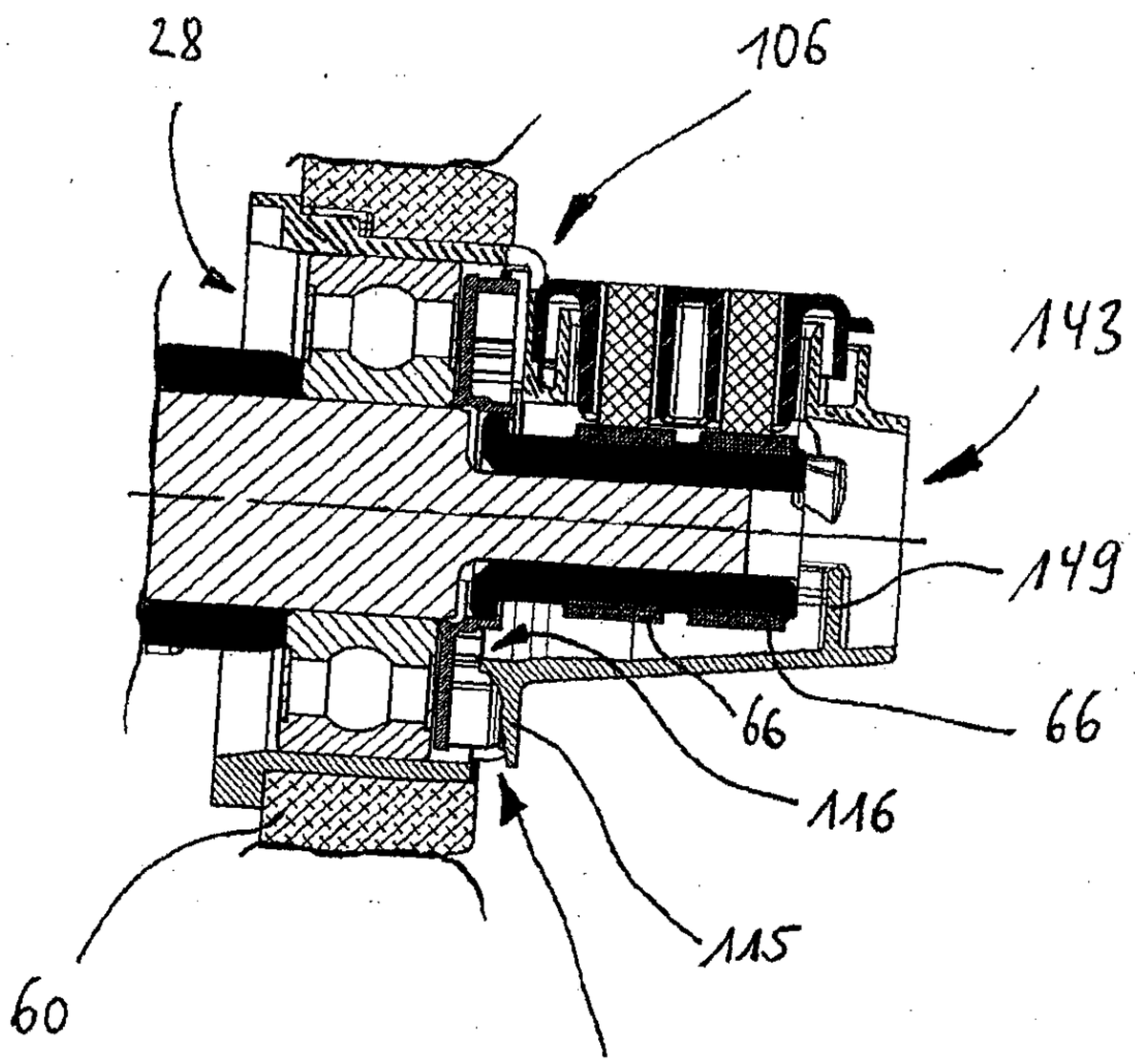
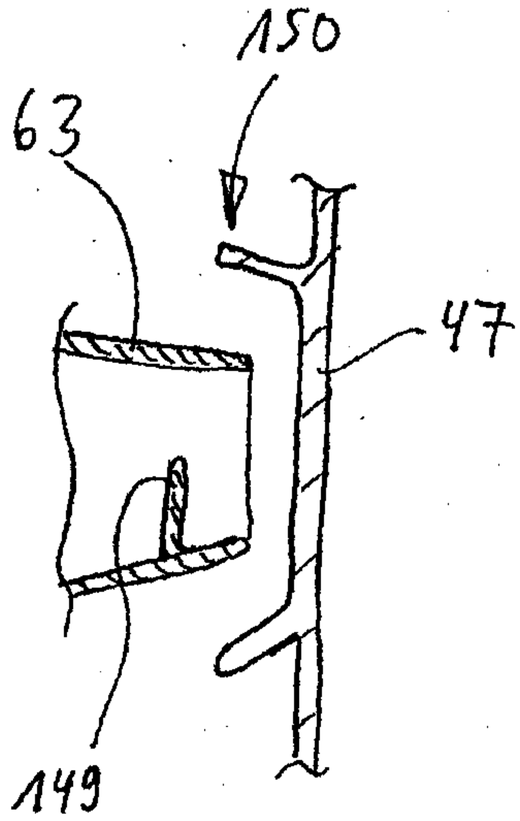


Fig. 5b:



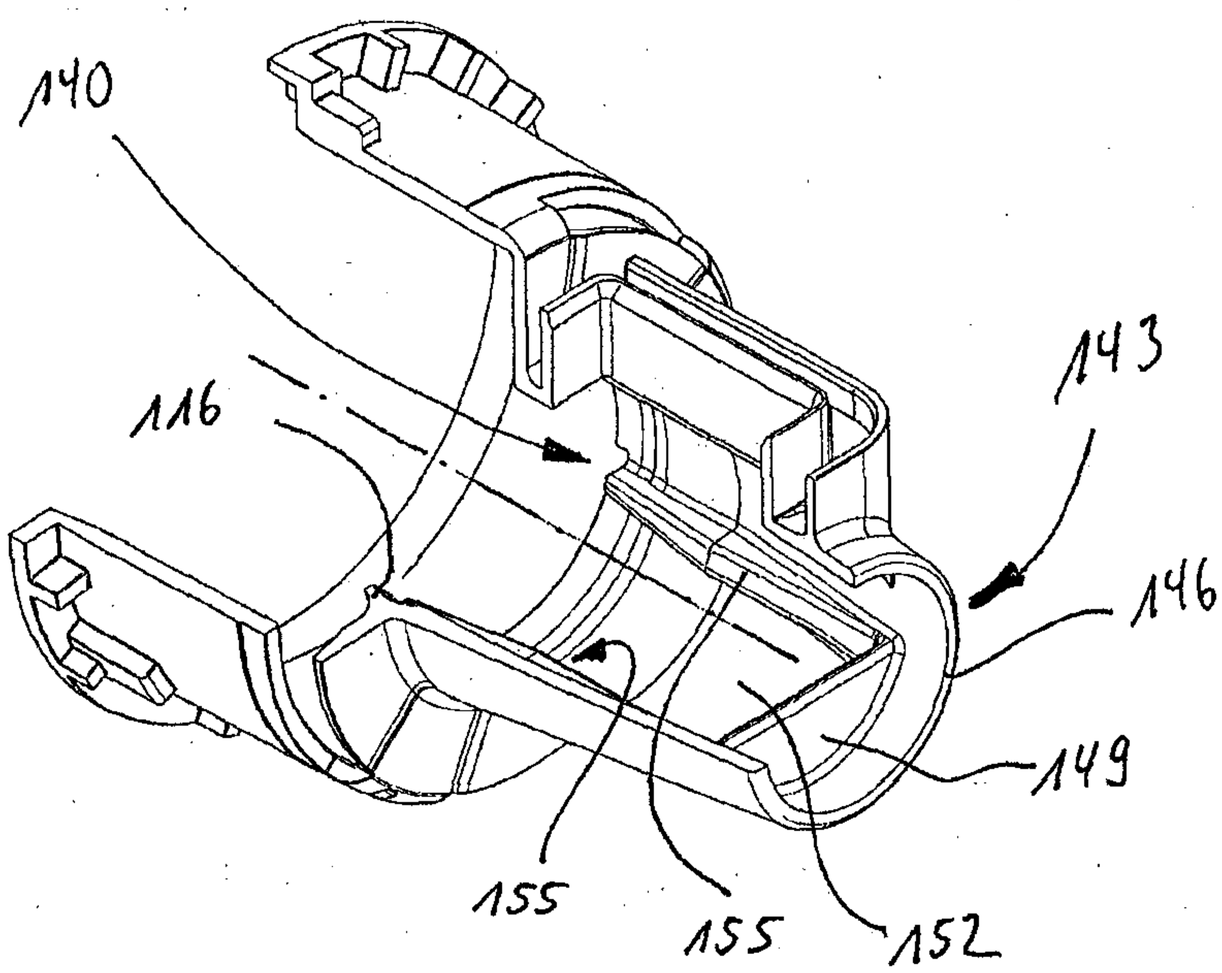


Fig. 5a:

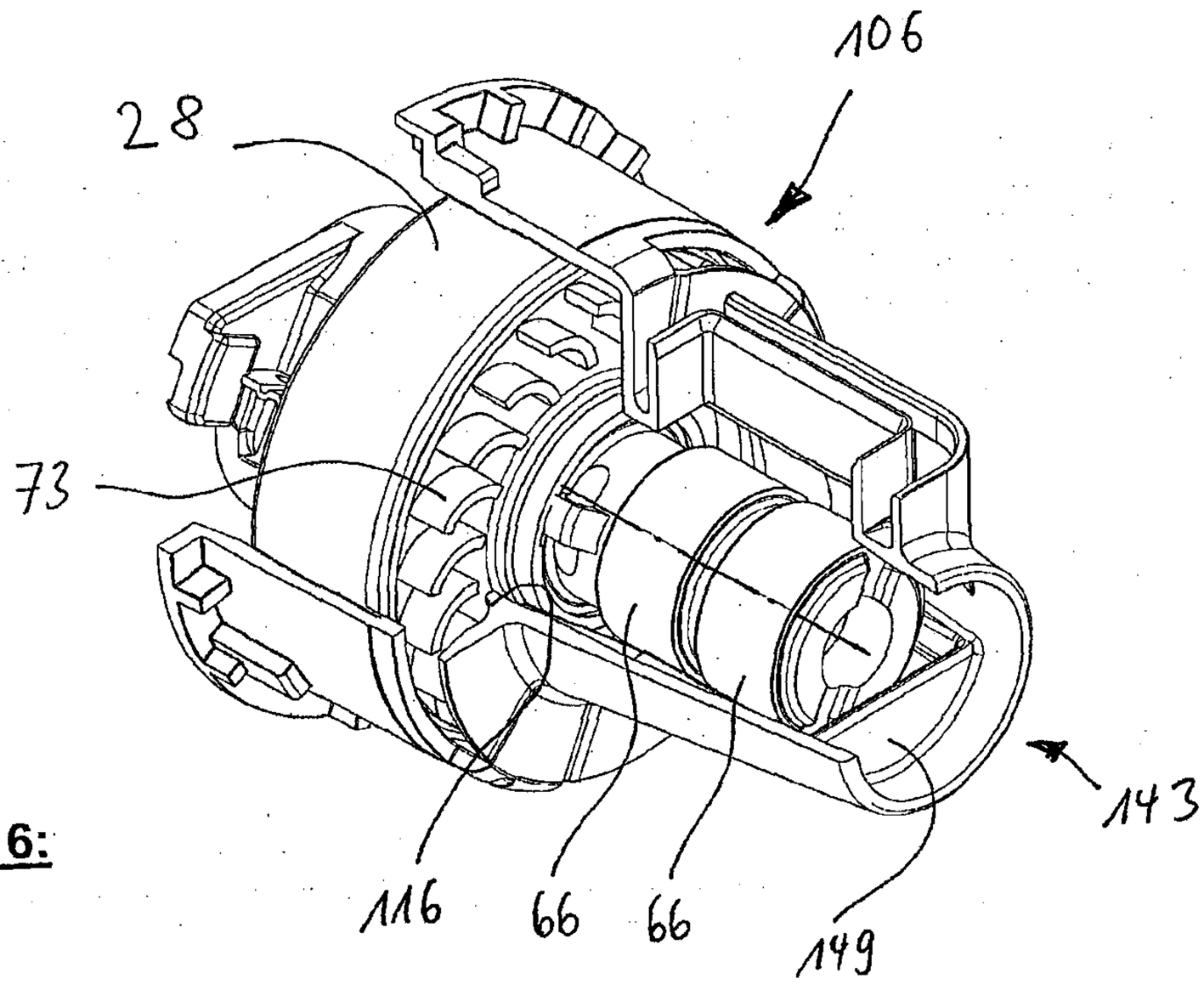
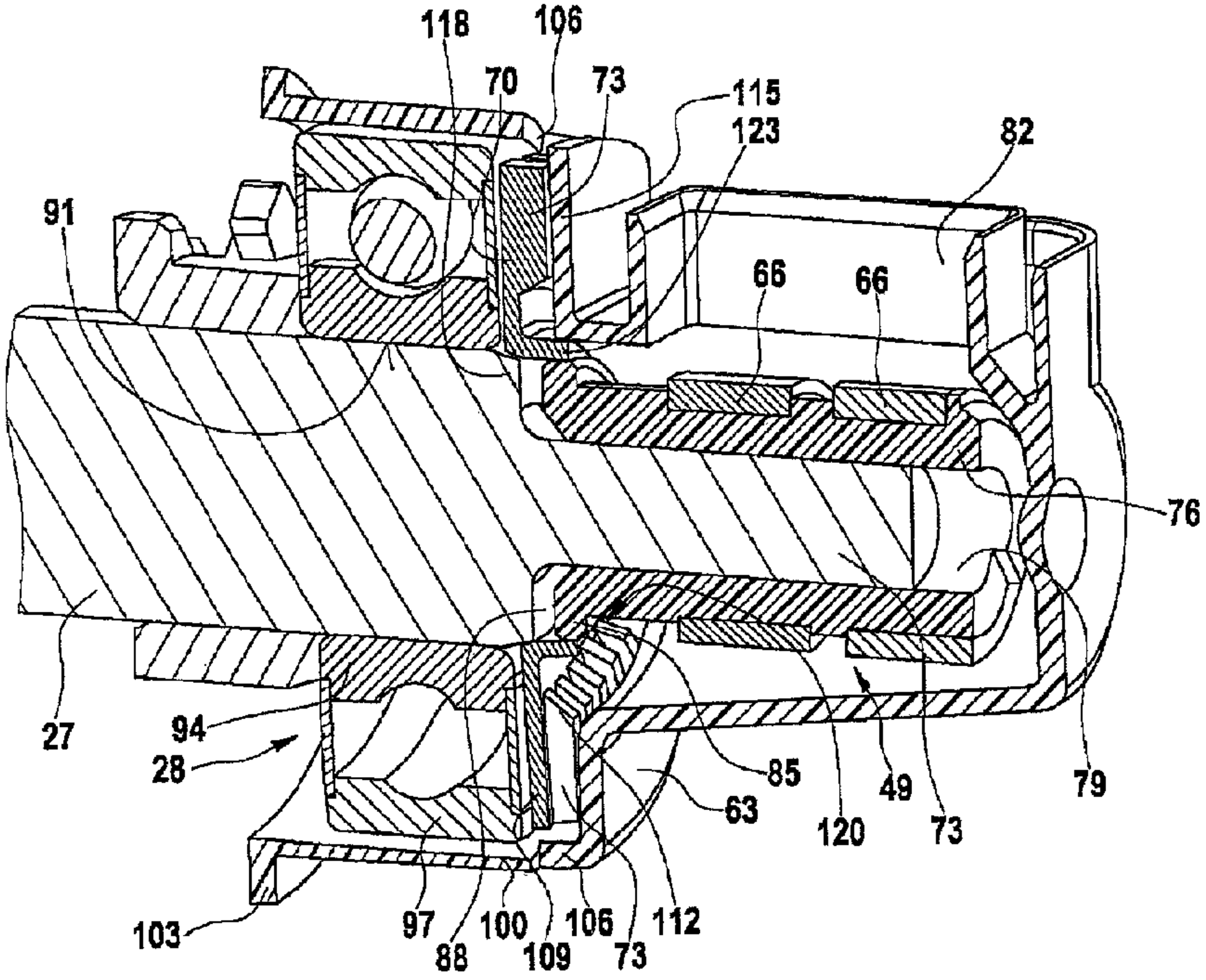


Fig. 6: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