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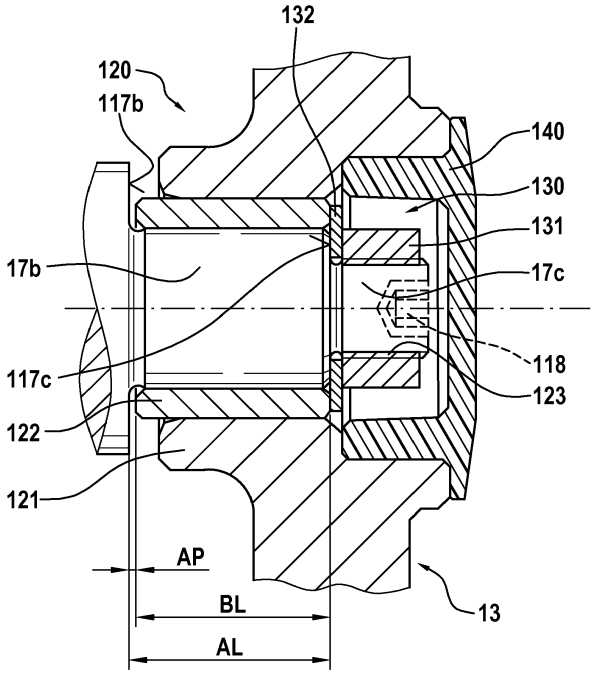
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## (54) Electrical machine and method for manufacturing and/or mounting an electrical machine

(57) The object of the invention relates to a method for manufacturing and/or mounting an electrical machine (100) and an electrical machine (100), in particular a starting mechanism as a starter, for starting a combustion engine, comprising an armature shaft (17), which is at one end floating mounted in an commutator bearing, comprising the steps: moving an armature shaft section (17b), defined by an armature shaft shoulder (117b), into the commutator bearing, so that said armature shaft section (17b) at least partly protrudes from the commutator bearing wherein an abutment device (130) is arranged at and/or on said armature shaft section (17b) and is abutted against one side of the commutator bearing and said armature shaft (17) is moved against and relatively to said abutment device (13), until a desired axial play (AP) between said armature shaft shoulder (117b) and said commutator bearing is reached.

**Fig. 2**




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## Description

**[0001]** The invention relates to a method for manufacturing and/or mounting an electrical machine, in particular a starting mechanism as a starter, for starting a combustion engine, according to the preamble of claim 1.

**[0002]** Additionally the invention relates to an electrical machine, in particular to a starting mechanism as a starter, for starting a combustion engine according to the preamble of claim 5.

## Prior Art

**[0003]** The present invention starts out from a System having a starting mechanism or a starter for starting a combustion engine, in particular for motor and/or utility vehicles according to the generic term of the independent claims

**[0004]** Object of the present invention are starters and starting mechanisms for vehicles having combustion engines comprising an electrical machine having an anchor and a commutator/collector, wherein the anchor has an anchor shaft and a corresponding anchor bearing.

**[0005]** Starter motors having a starting relay for vehicles with combustion engines are well known from prior art. Such starter motors comprise generally a direct current electric motor for starting the combustion engine.

**[0006]** Starting mechanisms known from prior art comprise a free wheel gear(-box) having a rotatable pinion, which is supported with clearance. Corresponding starters for passenger cars and utility vehicles are well known.

**[0007]** Starter motors are items of mass production which are not used continuously, but only occasionally, that is, when an internal combustion engine is to be started. Consequently, the production of starter motors is frequently not subject to close tolerance manufacturing processes, since the motor should be inexpensive to make. The operating conditions under which the motor has to function require only highly intermittent duty applications, however, a very high degree of reliability. The usual type of starter motor has a shaft on which an armature is positioned, the windings of which are connected to a commutator. In manufacture, it is frequently difficult to compensate for tolerances of the armature assembly - that is, shaft, armature structure and commutator - and particularly the longitudinal extent of the armature assembly in relation to the frame structure of the starter motor. It has been proposed to compensate for longitudinal play or tolerances by compensating for such tolerances upon assembly of the entire starter motor. The commutator bearing is formed with a projecting abutment, extending towards the commutator. The length of all the parts and components which influence axial tolerances is measured, and then a compensating disc is selected, the thickness of which permits only the desired longitudinal excursion of the commutator shaft but no more. This overall length which has to be measured is the distance between the commutator bearing and the motor support bearing opposite the commutator, usually an intermediate bearing, which, in turn, is dependent on the length of the housing of the motor. The length of the housing of the motor is subject to tolerances. Additionally, the distance from the abutment surface or edge on the motor housing to the matching abutment at the inside of the commutator bearing must be determined, considering, additionally, such sealing elements as may be provided, as well as the overall length of the shaft of the starter. Depending on the measured amounts, a compensating or spacer disc or washer is then selected which is placed between the commutator bearing and the end of the drive shaft; after this insertion, the starter is completely assembled together.

**[0008]** Starter motors have thus axial play for the free rotation of Armature. Basically this axial play distance will be derived from dimension and tolerances of other sub assembly components like drive end shield, planetary gear train, pole housing, commutator end shield and brush holder. The axial play is found to be between 0.05 to 1.75 mm. It is necessary to maintain the desired axial play in the starter motor to avoid functional problems like brush wear, commutator end shield failure, bush displacement in the commutator end shield, planetary gear failure and problem of noise. If the axial play is more, the starter could present functional problems as noise, loss of power and also loss of function. There are some methods used previously to maintain the desired axial play, by using individual shims depends the variation in axial play and split washer positioned in armature shaft groove and placed between commutator bush and brush plate.

**[0009]** DE 10 2011 075 653 A1 shows a motor. The motor has a drive shaft rotatable mounted at a bearing in a starter housing. A longitudinal clearance compensator is provided for reduction of an axial clearance, and comprises a spring fixing element that holds the shaft opposite to a housing component in a defined axial position. The fixing element is arranged in a region of the bearing. The fixing element causes force, which pulls the shaft with a commutator toward to a bearing cap. The fixing element is designed as a ring connection plate in a disk shape.

**[0010]** DE 32 16 448 A1 shows a starter. To permit manufacture of starter components with substantial tolerance, while maintaining the axial play of the armature of the starter within tight tolerances, and permit adjustment of the tolerance of the axial play after assembly of the starter component together, an end face of the shaft projects beyond the respective end bearing, which is retained a housing projecting beyond the bearing by the distance of an adjustment plug slightly smaller than the longest shaft - in the light of tolerances - of the starter. An axial play compensation spacer in form of a washer or disc, a ring or a centrally held ball is placed between the end face of the plug and the end face of the shaft, the plug being formed with an abutment surface which engages an engagement surface at the outside of the housing adjacent the bearing. The plug is threaded in the

direction of rotation, so that, upon once being securely seated, it will remain securely seated, thus maintaining the position of the shaft in axial direction.

## Disclosure of the Invention

**[0011]** According to the present invention the electric machine and the method for mounting an electric machine having the features of the corresponding main claim or of the independent claims compared to the prior art have the advantages that by having a method for manufacturing and/or mounting an electrical machine, in particular a starting mechanism as a starter, for starting a combustion engine, comprising an armature shaft, which is at one end floating mounted in an commutator bearing, comprising the steps: moving an armature shaft section, defined by an armature shaft shoulder, into the commutator bearing, so that said armature shaft section at least partly protrudes from the commutator bearing, wherein an abutment device is arranged at and/or on said armature shaft section and is abutted against one side of the commutator bearing and said armature shaft is moved against and relatively to said abutment device, until a desired axial play between said first armature shaft shoulder and said commutator bearing is reached, an axial play of the armature shaft is fixed to a desired value.

**[0012]** Starter motors have an axial play for the free rotation of an armature shaft. Basically this axial play distance will be derived from dimension and tolerances of other subassembly components like a drive end shield or bearing shield, a planetary gear train, a pole housing, a commutator end shield or housing cover and/or a brush holder. The axial play according to prior art may vary between 0.05 to 1.75 mm. According to the invention the desired axial play in the starter motor is fixed to a give value to avoid functional problems like brush wear, commutator end shield failure, bush displacement in the commutator end shield, planetary gear failure and problems of noise. Further the invention provides that the axial play is out of the desired range so that the starter does not present functional problems as noise, loss of power and also loss of function. With the invention the lifetime of the brush wear is improved by fixing the axial play of armature shaft to the desired value, in particular between 0.20 to 0.6 mm, by maintaining a bush seating distance of armature shaft on the commutator end shield side. With this the brush wear is minimized, the power loss during lifetime is minimized, commutator end shield failure is prevented, bush displacement in commutator end shield and/or Planetary gear failure is prevented and noise is minimized.

**[0013]** By the measures of the dependent claims advantageous embodiments and benefits of the devices described in the main claims and the independent claims are realized.

**[0014]** In one embodiment moving the abutment device is in opposite direction to moving the armature shaft and/or the armature shaft shoulder. When mounting the armature shaft the back end of the armature shaft is positioned into the commutator bearing. The commutator bearing comprises a collar in which a bush is press fitted. Thus the back end of the armature shaft is positioned inside the bush. A first armature shaft section is seated in the bush wherein another armature shaft section of the back end protrudes from this bush. On this protruding, second armature shaft section, which has a diameter smaller than the armature shaft section seated in the bush, the abutment device is seated and/or guided. The abutment device is moved along the second armature shaft section until it reaches the commutator bearing that is the bush. Thus a side of the abutment device facing towards the bush is arranged flush with the corresponding side of the bush. When the abutment device is positioned in that flush position to the bush, the armature shaft is moved towards the abutment device until a desired axial play is reached. To stop movement of the armature shaft in the direction of the abutment device the armature shaft has a stop surface. In this case the stop surface is formed by a second armature shaft shoulder which defines the second armature shaft section. This second armature shaft shoulder abuts against the abutment device and thus the second shoulder is arranged flush with the abutment device and the corresponding size of the bush or commutator bearing. The movement of the abutment device is in one direction towards the bush. The movement of the armature shaft is in the opposite direction towards the bush.

**[0015]** In a further embodiment axial moving said abutment device and/or said armature shaft shoulder is realized by rotating said armature shaft. The axial movement of the abutment device along the armature shaft and/or the axial movement of said armature shaft towards the abutment device may be done in various ways, for example by a translational movement. In one embodiment the abutment device and the armature shaft are coupled, in particular by a screw joint. The second armature shaft section comprises a threaded part on which a corresponding part of the abutment device, a nut device is arranged. By rotation the armature shaft the nut device is moved on the threaded part towards the bush.

**[0016]** To realize that screw-motion in one embodiment rotating of the abutment device is blocked by an anti-rotating device. Thus the nut device does not follow the rotational motion of the armature shaft but moves axial towards the bush. The anti-rotating device is temporarily arranged until the desired axial play is fixed. After mounting the abutment device and fixing the axial play the anti-rotating device is removed so the abutment device may follow the rotational movement of the armature shaft during operation without dissolving.

**[0017]** The electrical machine according to the present invention having the features of the corresponding main claim or of the dependent claims compared to the prior art has the advantages that by having an electrical machine, in particular a starting mechanism as a starter, for starting a combustion engine, comprising an armature

shaft, which is at one end floating mounted in an commutator bearing, comprising at least one armature shaft section defined by an armature shaft shoulder, at least partly protruding from the commutator bearing, wherein means for performing the method according to any of the proceeding claims are provided, for realizing a desired axial play between the first armature shaft shoulder and the commutator bearing, an desired axial play can be securely fixed. In a preferred embodiment the armature shaft comprises a first armature shaft section having a second armature shaft section.

**[0018]** The electrical machine is in one embodiment a starting mechanism as a starter. The starter comprises an electro motor having a rotor and a stator. The starter further comprises an armature shaft, driving shaft or anchor shaft, which is float-mounted. In radial direction the armature shaft is supported by a bush, in particular a bush made by sintering. The bush circumferential supports the armature shaft. In axial direction the armature shaft is limited by said abutment device. The abutment device abuts against the bush, which is preferably press-fitted into a cover of the starter. The bush and/or the cover form the commutator bearing. For housing the bush the cover has a collar in which the bush is press-fitted. The armature shaft protrudes from the commutator bearing with a back end. The back end comprises a first armature shaft section, defined by a first armature shaft shoulder, and a second armature shaft section, defined by a second armature shaft shoulder. The first armature shaft section corresponds to the bush. The second armature shaft section has a diameter which is smaller than the diameter of the first armature shaft section. Fixing the armature shaft in axial direction is realized by the abutment device. The abutment device comprises a nut. In one embodiment the abutment device further comprises a washer, arranged next to the nut and the bush. The second armature shaft section comprises a threaded section corresponding to thread of the nut. The nut is screwed on the second armature shaft section.

**[0019]** Thus in one embodiment said means comprise an abutment device moveable coupled to the protruding armature shaft section. More precisely the abutment device or rather the nut is arranged on the threaded part of the second armature shaft section for a screw-motion.

**[0020]** In another embodiment said abutment device comprises a screw coupling having at least one threaded nut and at least one corresponding threaded section or threaded part or portion formed at said armature shaft section. By rotating the armature shaft the rotational movement is transformed into a translational movement of the nut. Thus by rotating the armature shaft the nut is moved towards the bush.

**[0021]** In still another embodiment said commutator bearing comprises a bush surrounding said armature shaft section. The bush is made by sintering. Further the bush is press-fitted into a collar of the cover thus forming the commutator bearing.

**[0022]** In another embodiment said abutment device has an outer dimension being greater than an internal dimension of said bush so that said abutment device abuts against said bush at least in a ready for use status. In particular the washer of the abutment device has a greater outer dimension. The washer is in axial direction situated between the bush and the nut. When axial moving the nut towards the bush without axial moving the armature shaft the washer is clamped between the nut and the bush.

**[0023]** In a further embodiment said armature shaft comprises a second armature shaft section defined by a second armature shaft shoulder. This second armature shaft comprises the threaded part or section on which the nut is screwed. When mounting the starter the nut is screwed on the second armature shaft section until it reaches the bush. Preferably the washer is arranged between the second armature shaft shoulder and the nut.

**[0024]** In yet another embodiment at least one anti-rotation device is at least temporarily provided so that said abutment device is blocked against any rotational movement during mounting said abutment device and/or said armature shaft. The nut is screwed on the second armature shaft section by rotating the armature shaft. Therefore the armature shaft comprises a torx at its front face. For preventing that the nut follows the rotational movement of the armature shaft said anti-rotation device is provided. The anti-rotation device preferably is arranged in a corresponding accommodation in the cover. The anti-rotation device has a through going hole to permit admission to the torx. So after placing the nut on the second armature device section the cover is closed, the anti-rotation device is placed in and/or at a through going hole of the cover to engage with the nut and the cover is mounted by screws to the housing of the starter. Then by rotating the armature shaft by means of a torx and a corresponding tool the nut moves on the second armature shaft section towards the bush. When reaching the bush during further rotation of the armature shaft the armature shaft will be drawn to the bush. This axial movement of the armature shaft while rotating the armature shaft stops when the second armature shaft shoulder reaches the abutment device. There might be some glue or other means for preventing dissolving of the nut. After ending axial movement of the abutment device and the armature shaft the anti-rotating device is removed and the cover or rather the through going hole is close by an end cap.

## Short description of the drawings

**[0025]** One Embodiment of the invention is depicted in the following drawings and described in detail in the accompanying description. The drawings show:

Fig. 1 in a cross-sectional view an electrical machine formed as a starting device,

Fig. 2 in a cross-sectional view an extract from the

electrical machine at the back end of the armature shaft,

Fig. 3 a perspective view of an armature shaft,

Fig. 4 two perspective views of a cover

Fig. 5 a perspective view of an abutment device comprising a washer and a nut,

Fig. 6 two perspective views of an end cap,

Fig. 7 two perspective views of an anti-rotating device,

Fig. 8 a perspective view of an extract from the electrical machine at the back end of the armature shaft with anti-rotating device, and

Fig. 9 in a cross-sectional view the extract according to Fig. 8.

**Description of one preferred embodiment**

**[0026]**

Fig. 1 shows in a cross-sectional view an electrical machine 100 formed as a starting device or starter having a relay 42 arranged as a switching relay or an engagement relay. A starter housing 10 of the starting device comprises a cylindrical housing part 11 and a housing cover or lid 13, which are connected to each other by screws (not shown). The cylindrical housing part 11 is at the back side closes by said cover 13. In a central area of the cover 13 a hub or (driving) collar 121 is formed, which is directed to an outside of the starting device. Inside the collar 121 a bearing area is formed in which a back end 17a of an anchor shaft, armature shaft or driving shaft 17 of an electrical starter motor 18 is supported. An anchor of said electrical starter motor 18 is enumerated by reference number 19. Radial outside of the anchor 19 several (Permanent-) magnets 20 of the electrical starter motor 18 are arranged at a wall of said housing part 11. A front end of said anchor shaft 17 is supported by a diameter reduced end area 22 of a blind hole 23 of a coaxial output shaft or a driven shaft 24. The back end of said driven shaft 24 is supported by a bearing shield 25, by which the housing part 11 is closed, and a hub or collar 26 formed at said bearing shield 25. The driving shaft 17 has a gearing 28 (sun gear) close to it's end directing to the bearing shield 25, in which planet gears 29 engage which also cog with an exterior, fixed annulus gear 30 of a planetary gear 31 (=reduction gear).
A planetary carrier 12 drives the driven shaft 24 on which a free-wheel gear 33 is arranged. An inner ring 34 of said free-wheel gear 33 has an appendix 35 (pinion gear or just pinion) at which external teeth 36 are formed. An outer ring 37 of the free-wheel gear 33 is connected to the driven shaft 24 by a steep thread 38. A so-called engaging spring 39 acts on said ring 37. By axial movement of the free-wheel gear 33 the external teeth 36 may engage with an annular gear 40 of a combustion engine for initiating a starting process. This happens by means of said (engagement-) relay 42, in which during switching-on a current a magnet anchor via an appendix 43 deviates a lever 44 that moves by a connecting member 45, arranged between two disks 46, the free-wheel gear 33 to the left. The lever 44 is a two-armed lever that is rotatable supported in a bearing 49, fixed relatively to the housing, by pins 48. As this process is not further relevant for the invention it is only shortly described.
The driving shaft 17 is at it's back end 17a secured in axial direction by a fixing mechanism. A brush plate 53 abuts on the cover 13, which is mounted to the cover 13 by screws. The brush plate 53 is formed as a one part brush plate 53. Brush holders, especially made of plastics, are mounted at the brush plate 53. Carbons are located in said brush holders, which abut by spring force at a commutator 63 that is arranged at the driving shaft 17. Carbons are connected to a cable shoe by pigtails. The cable shoe is connected to the relay 42 by a contact 68. Pigtails penetrate a sealing 70 located in an opening in the housing part 11. The brush plate 53 is mounted to the cover 13 by screws 62.

Fig. 2 shows in a cross-sectional view an extract from the electrical machine 100 at the back end 17a of the armature shaft 17. The back end 17a comprises a first armature shaft section 17b and a second armature shaft section 17c. The first armature shaft section 17b is defined by a first armature shaft shoulder 117b. The second armature shaft section 17c is defined by a second armature shaft shoulder 117c. The second armature shaft section 17c is adjacent to the first armature shaft section 17b. The second armature shaft section 17c has a smaller diameter than the first armature shaft section 17b. The first armature shaft section 17b is supported in a commutator bearing 120. The commutator bearing 120 is integrated formed in the cover 13. For supporting the armature shaft 17 the commutator bearing 120 comprises a collar 121. In this collar 121 a bush 122 is press-fitted. The bush 122 is made by sintering. The bush 122 functions as a floating bearing for the armature shaft 17. Therefore the first armature shaft section 17b is located inside the bush 122 so this section 17b is surrounded by the bush 122. The second armature shaft section 17c protrudes from the bush 122. The second armature shaft section 17c has a threaded part 123. On this threaded part an abutment device 130 is arranged. The abutment de-

vice 130 comprises a nut 131. The nut 131 is screwed on the the threaded part 123. Further the abutment device 130 comprises a washer 132. The washer 132 surrounds the second armature shaft section 17c. In ready-to-use status the washer 132 is adjacent to and/or abuts at bush 122 and second armature shaft shoulder 117c. Thus the second armature shaft shoulder 117c is arranged flush to the corresponding side of the bush 122. Adjacent to and/or abutting at the washer 132 is the nut 131. The cover 13 comprises a through going hole which forms an access to a torx 118 at the front face of the armature shaft 17. The through going hole is closes by an end cap 140. The end cap 140 is arranged at and/or in a through going hole of the cover 13. In this example the axial length BL of the bush 122 is shorter than the axial length of the first armature shaft section AL. When the second armature shaft shoulder 117c is flush with the bush 122 an axial play AP is formed. By choosing the axial length BL and the axial length AL this axial play AP is defined. Due to the abutting arrangement of bush 122, abutment device 120 and second armature shaft shoulder 117c this axial play AP can be securely set up. Due to the screw joint of nut 131 and armature shaft 17 this axial play AP is fixed. Mounting can be done by rotating the armature shaft 17 by means of the torx 118 and a corresponding tool reaching through the through going hole of the cover 13.

Fig. 3 shows a perspective view of the armature shaft 17. The armature shaft 17 has the back end 17a. The back end 17a comprises the first armature shaft section 17b and the second armature shaft section 17c. The first armature shaft section 17b is adjacent to the second armature shaft section 17c. The second armature shaft section 117c is axial limited by the front face in which axially the torx 118 for screwing is formed. The second armature shaft section has the threaded part 123 suitable arranged for the nut 131. The second armature shaft section 17c is limited by the second armature shaft shoulder 117c.

Fig. 4 shows two perspective views of the cover 13. The cover 13 has a through going hole 13a forming an access to the inner part of the starter. The through going whole 13a is arranged coaxially to the armature shaft 17. At the outer side of the cover an accommodation 13b for accommodating an end cap and/or an anti-rotating device 150 is formed. The through going whole 13a is surrounded by the bush 122, which is press-fitted in the collar 121 of the cover 13

Fig. 5 shows a perspective view of an abutment device 130 comprising the washer 132 and the nut 131. The washer 132 has a ring shape. The outer diameter of the washer 132 is larger than the inner diameter of the bush 122. The nut has an outer diameter and/or dimension smaller or equal than an inner diameter of the bush 122. The inside thread of the nut 131 corresponds to the outside thread of the threaded part 123 of the second armature shaft section 17c for a screw joint.

Fig. 6 shows two perspective views of an end cap 140. The end cap 140 corresponds to the accommodation 13b of the cover 13 thus the end cap 140 my be clipped to the cover 13 for covering the through going hole 13a. The end cap 140 is formed as a plastic cap.

Fig. 7 shows two perspective views of the anti-rotating device 150. The anti-rotating device 150 comprises an accommodation 151 for the nut. Thus the shape of the accommodation 151 corresponds to the outer shape of the nut 131. At the outer shape the anti-rotating device has two wing-like protrusions 152. The corresponding accommodation 13a has two corresponding recesses to accommodate these protrusions and thus prevent any rotating movement of the anti-rotating device 150.

Fig. 8 shows a perspective view of an extract from the electrical machine 100 at the back end 17a of the armature shaft 17 with the anti-rotating device 150. The anti rotating device 150 is arranged at the outside of the cover 13 protruding through the through going whole 13a at least partly to the inside. The nut 131 is arranged in the accommodation 152. By using a torx wrench with the torx 118 of the armature shaft 17 the armature shaft 17 can be rotated. Due to the anti-rotating device 150 and the screw joint of the nut 132 and the armature shaft 17 the nut 131 moved towards the bush 122 when rotating the armature shaft 17. When the nut 131 reaches the washer 132 and the washer 132 and/or the nut 131 reaches the bush 122 axial movement of the abutment device 130 stops and axial movement of the armature shaft 17 towards the abutment device 130 starts. The axial movement of the armature shaft 17 stops when the second armature shaft shoulder 117c reaches the abutment device 130.

Fig. 9 shows in a cross-sectional view the extract according to Fig. 8 in a ready-to-use situation. The abutment device 13 abuts the bush 122. The second armature shaft shoulder 117c abuts the abutment device 13. The desired axial play AP is fixed.

**[0027]** Shortly summarized the improvement comprises an abutment device 130 having a washer 132, a nut 131 and further a provision for the nut 131, that is a threaded portion 123 in the armature shaft 17 that together control the axial play AP of the armature to the desired value. Further a plastic cap 140 is provided to cover the

rotational parts and to avoid water ingress. There is an additional anti-rotating device 150 that is a fixture tool to hold the nut 131 for tightening. By controlling the axial play AP by using the washer 132 and the nut 131 the axial play AP can be fixed irrespective of variations in the dimensions and geometry, dimensions and/or tolerances of individual sub-assemblies and its components in the starter motor. The washer 132 and the nut 131 hold the armature shaft 17 in position with the desired value of axial play AP against the bush 122 and/or bus length BL in the commutator end shield 13. The desired axial play AP is the dimensional difference between the bush seating distance, that is the axial length of the first armature shaft section 17b and the bush length BL , the former being the higher value. The regular assembly process of a starter motor will be continued till the commutator end shield or cover 13 is tightened with rest of the starter housing, for example the bearing shield 25. Then the washer 132 will be assembled from the commutator end shield side. The commutator end shield 13 has the opening (through going whole 13a) for inserting the washer 132 and the nut 131. Before inserting the nut 131, the assembly fixture tool that is the anti-rotating device 150 is placed in the commuter end shield 13 to arrest the rotation of the nut 131 during mounting. The provision or accommodation 13b to locate the fixture tool is provided in the commutator end shield. After placing the nut 132 in the fixture tool, the armature shaft is screwed by using the torx 118for screwing at the end of armature shaft 17. By intend rotation of the armature shaft 17 moves the nut 131 till it reaches the surface of bush 122 placed in the commutator end shield 13. Once the movement of the nut 131 is restricted by the bush surface, the armature shaft 17 shifts towards the commutator end shield side till the armature shaft 17 face or rather the second armature shaft shoulder 117c reaches the washer face. Thus the washer 132 and the nut 131 are locked with the armature shaft 17 and the resultant gap between the commutator end shield bush 122 and the armature shaft 17 (shoulder 117b) is the desired axial play AP. Then the fixture tool is removed and the starter motor is closed at the commutator end shield side by the plastic cap 140 and glued. Finally the axial play AP achieved is as the desired value for which the bush seating distance (axial length of the first armature shaft section 17b) of the armature shaft 17 is designed.

## Claims

1. Method for manufacturing and/or mounting an electrical machine (100), in particular a starting mechanism as a starter, for starting a combustion engine, comprising an armature shaft (17), which is at one end floating mounted in an commutator bearing (120), comprising the steps: moving an armature shaft section (17b, 17c), defined by an armature shaft shoulder (117b, 117c), into the commutator bearing (120), so that said armature shaft section (117c) at least partly protrudes from the commutator bearing (120), **characterized in, that** an abutment device (130) is arranged at and/or on said armature shaft section (117c) and is abutted against one side of the commutator bearing (120) and said armature shaft (17) is moved against and relatively to said abutment device (130), until a desired axial play (AP) between said armature shaft shoulder (117b) and said commutator bearing (120) is reached.

2. Method according to claim 1, **characterized in, that** moving the abutment device (130) is in opposite direction to moving the armature shaft (17).

3. Method according to claim 1 or 2, **characterized in, that**
axial moving said abutment device (130) and/or said armature shaft shoulder (117b) is realized by rotating said armature shaft (17).

4. Method according to one of the proceeding claims 1 to 3, **characterized in, that**
rotating of the abutment device (130) is blocked by an anti-rotating device (150).

5. Electrical machine (100), in particular a starting mechanism as a starter, for starting a combustion engine, comprising an armature shaft (17), which is at one end floating mounted in an commutator bearing (120), comprising at least one armature shaft section (17b, 17c) defined by an armature shaft shoulder (117b, 117c), at least partly protruding from the commutator bearing (120), **characterized in, that**
means for performing the method according to any of the proceeding claims 1 to 4 are provided, for realizing a desired axial play (AP) between the armature shaft shoulder (117b) and the commutator bearing (120).

6. Electrical machine (100) according to claim 5, **characterized in, that** said means comprise an abutment device (130) moveable coupled to the protruding armature shaft section (17c).

7. Electrical machine (100) according to claim 5 or 6, **characterized in, that** said abutment device (130) comprises a screw coupling having at least one threaded nut (131) and at least one corresponding threaded section (123) formed at said armature shaft section (17c).

8. Electrical machine (100) according to claims 5 to 7, **characterized in, that** said commutator bearing (120) comprises a bush (122) surrounding said armature shaft section (17b).

**9.** Electrical machine (100) according to claims 5 to 8, **characterized in, that** said abutment device (130) has an outer dimension being greater than an internal dimension of said bush (122) so that said abutment device (130) abuts against said bush (122) at least in a ready for use status.

**10.** Electrical machine (100) according to claims 5 to 9, **characterized in, that** said armature shaft (17) comprises a second armature shaft section (17c) defined by a second armature shaft shoulder (117c).

**11.** Electrical machine (100) according to claims 5 to 10, **characterized in, that** at least one anti-rotation device (150) is at least temporarily provided so that said abutment device (130) is blocked against any rotational movement during mounting said abutment device (130) and/or said armature shaft (17).

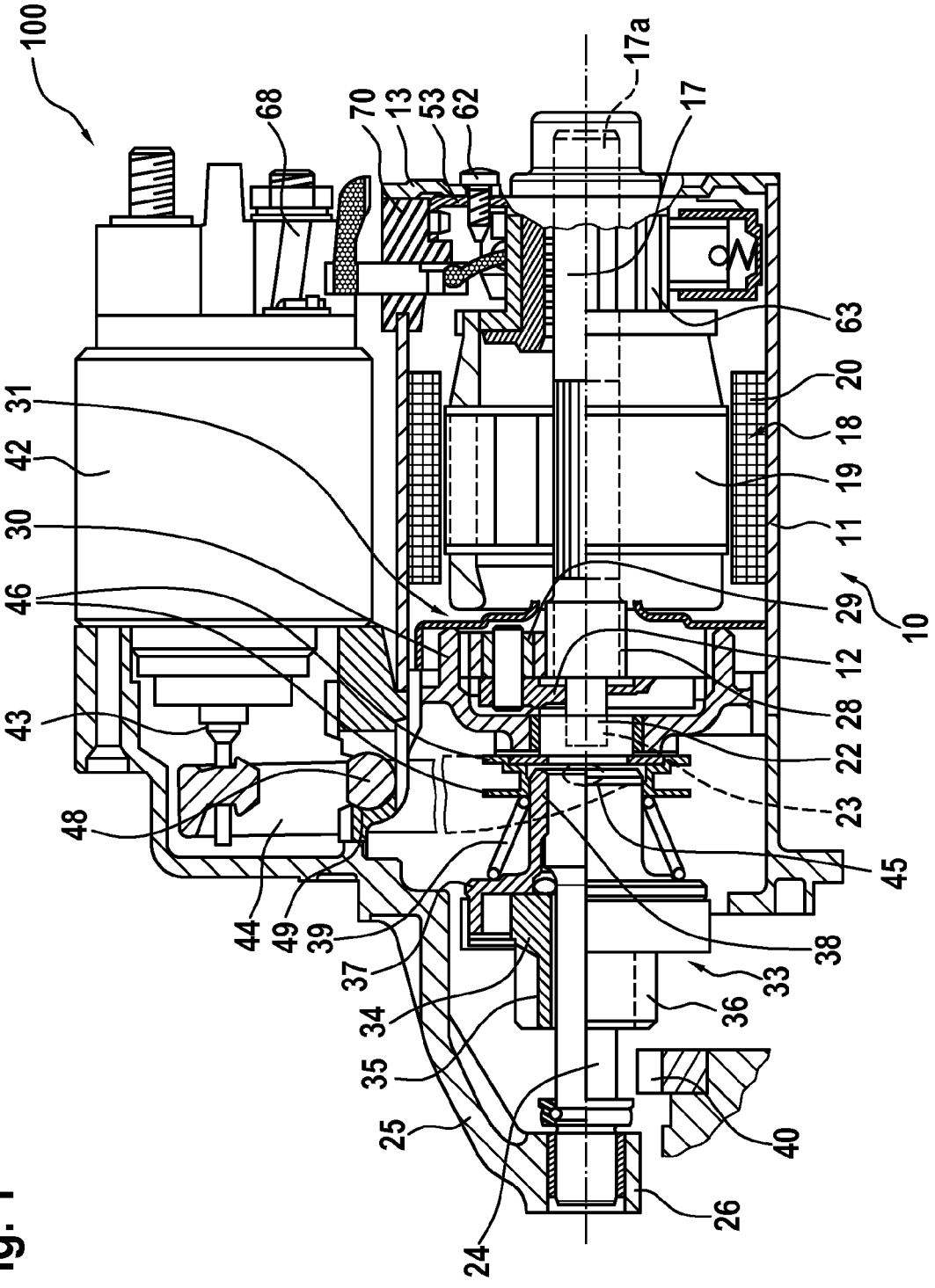
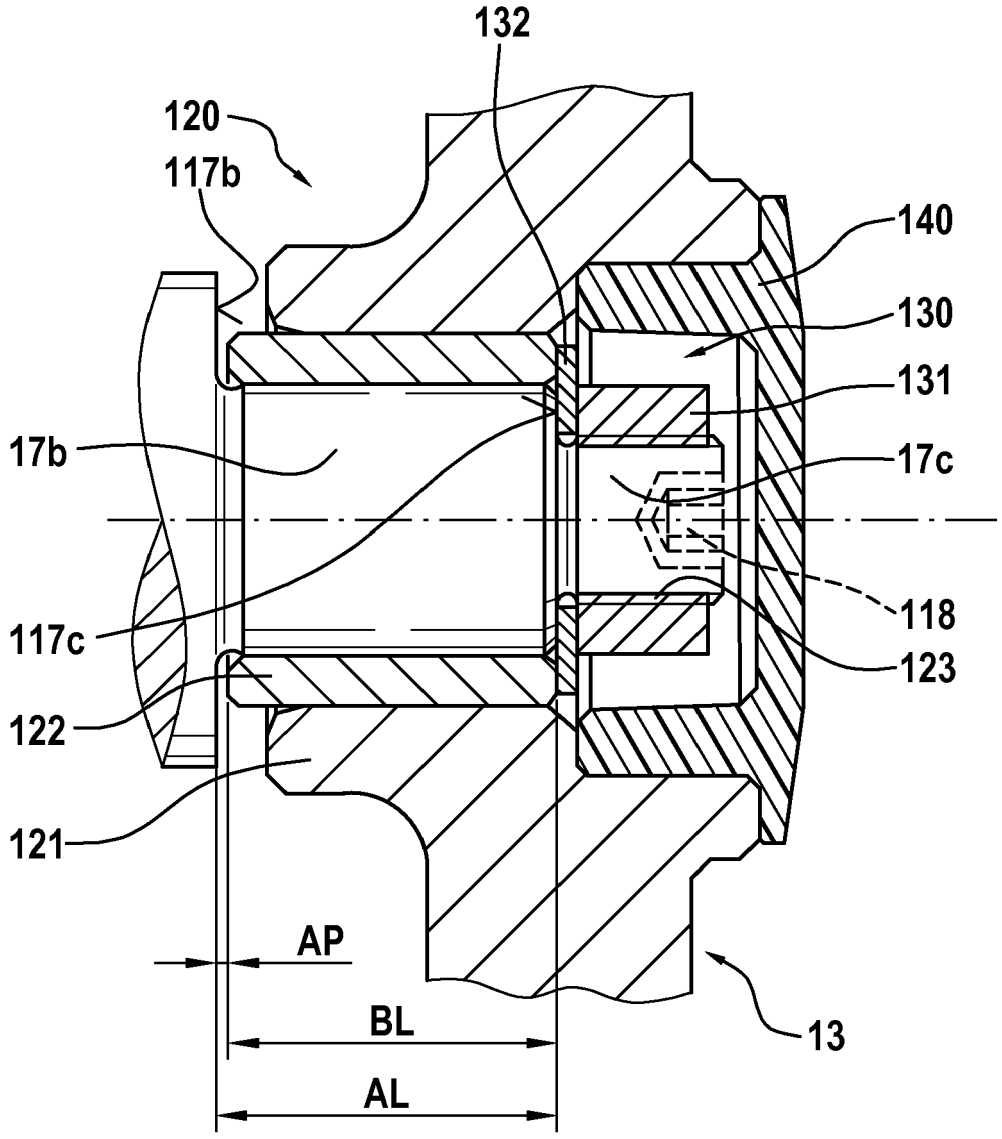

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Fig. 1

Fig. 2



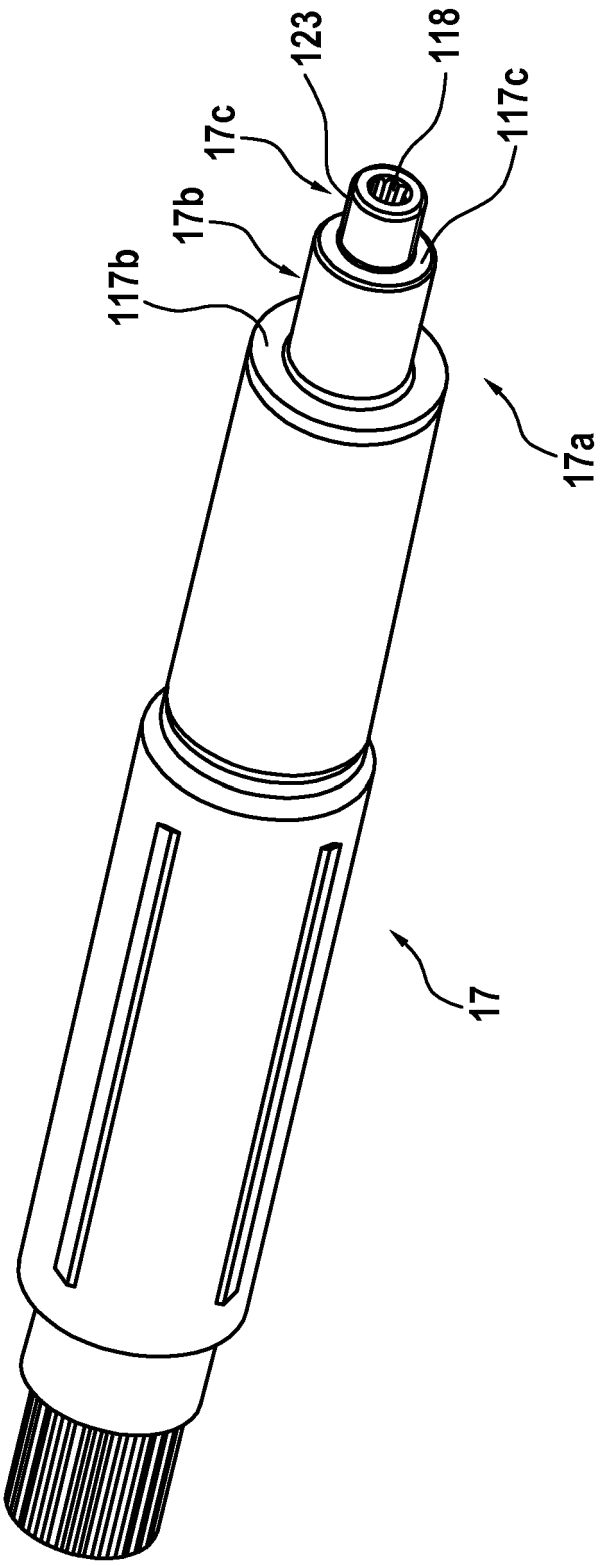



Fig. 3

Fig. 4

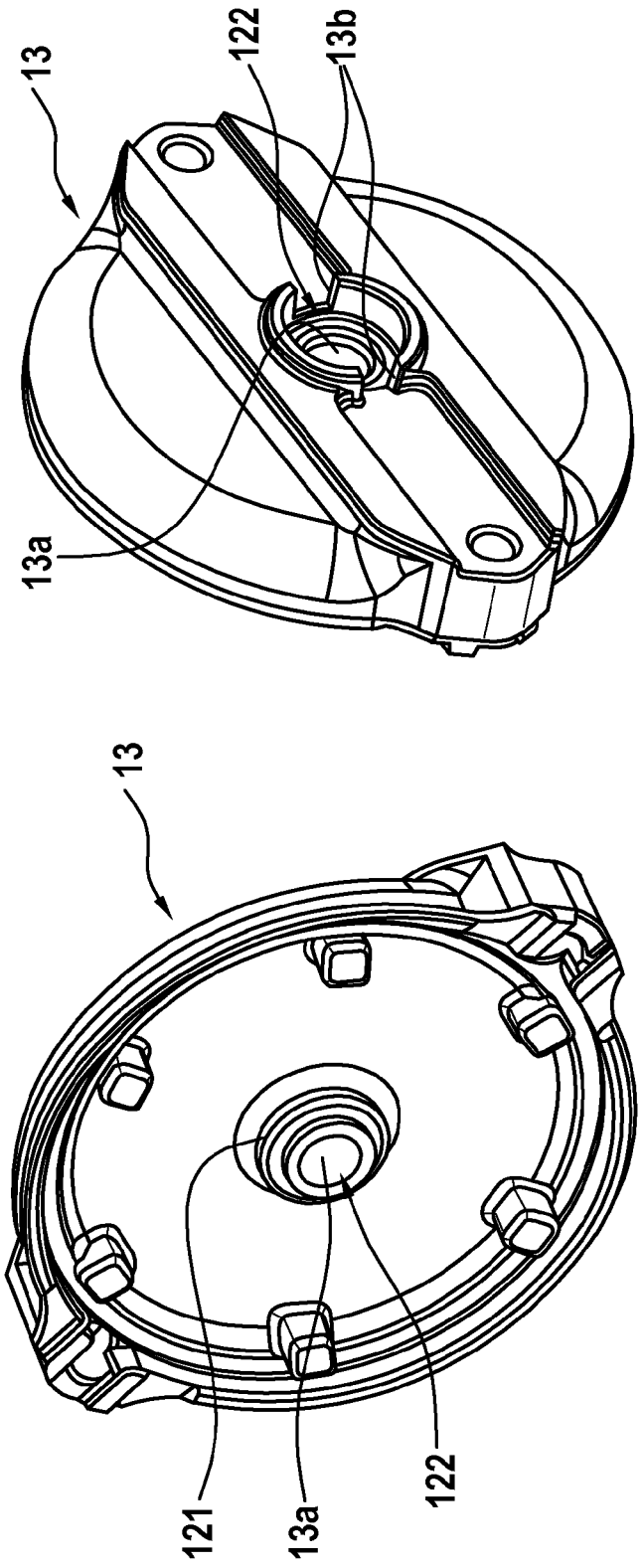


Fig. 5

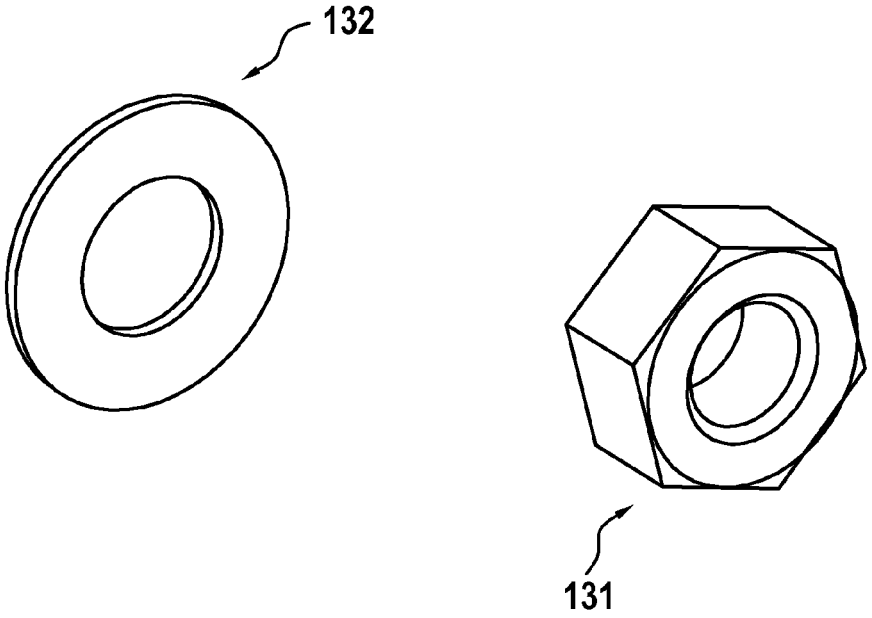



Fig. 6

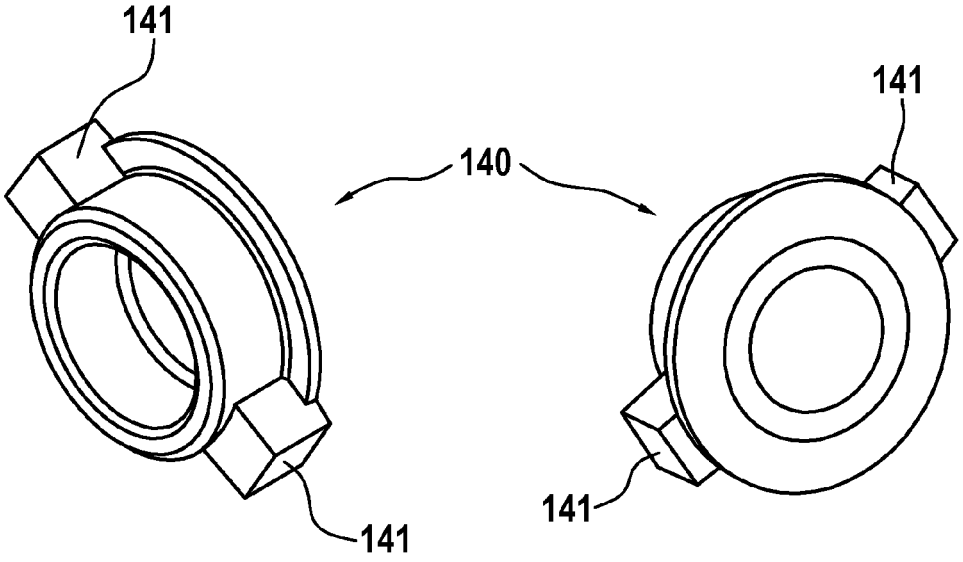


Fig. 7

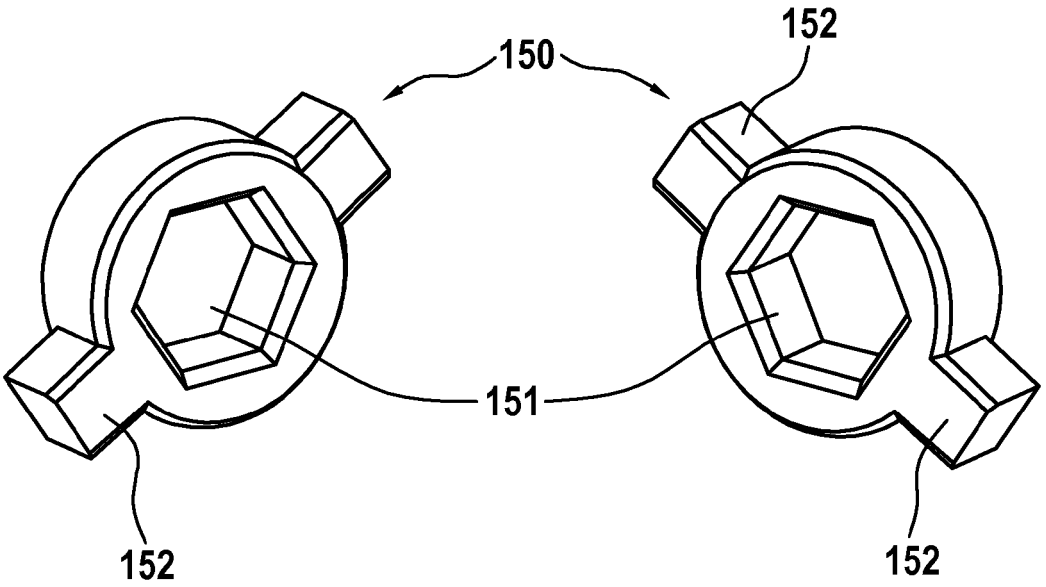


Fig. 8

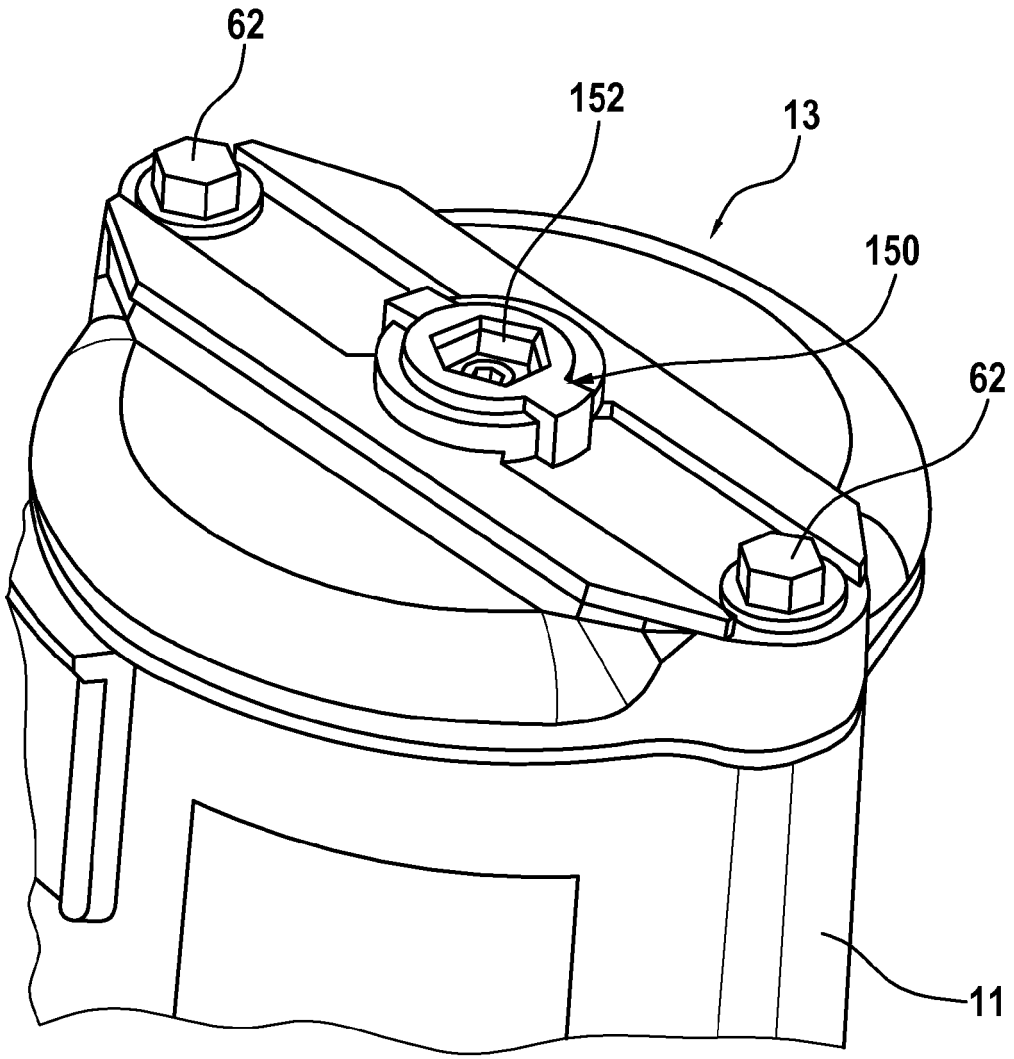
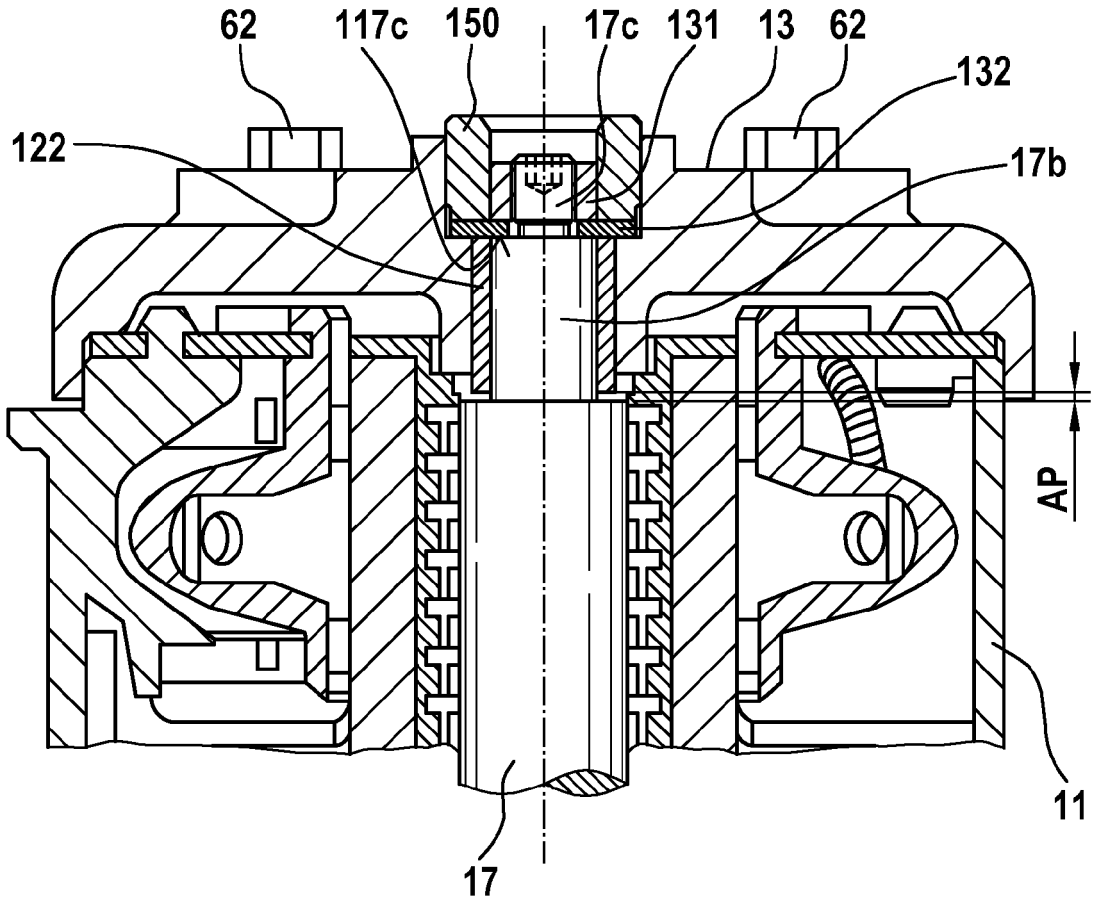


Fig. 9



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Application Number
EP 13 15 9249

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|---|---|---|
| The Hague | 30 September 2013 | Van der Staay, Frank |

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