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(54) Electrical machine and method for mounting an electrical machine

(57) The object of the invention relates to an electrical machine (100), in particular a generator or a starter mechanism as a starter, for starting a combustion engine, comprising a connection assembly (200) for a force transmitting connection of two components of the connection assembly (200) having a bayonet locking (210) with an axial distance limitation (220) for preventing an unintentional unlocking of the bayonet locking (210), wherein said axial distance limitation (220) is formed as an adjustable stop that is adjustable at least in axial direction (A). Further the object of the invention relates to a method for mounting said electrical machine (100)

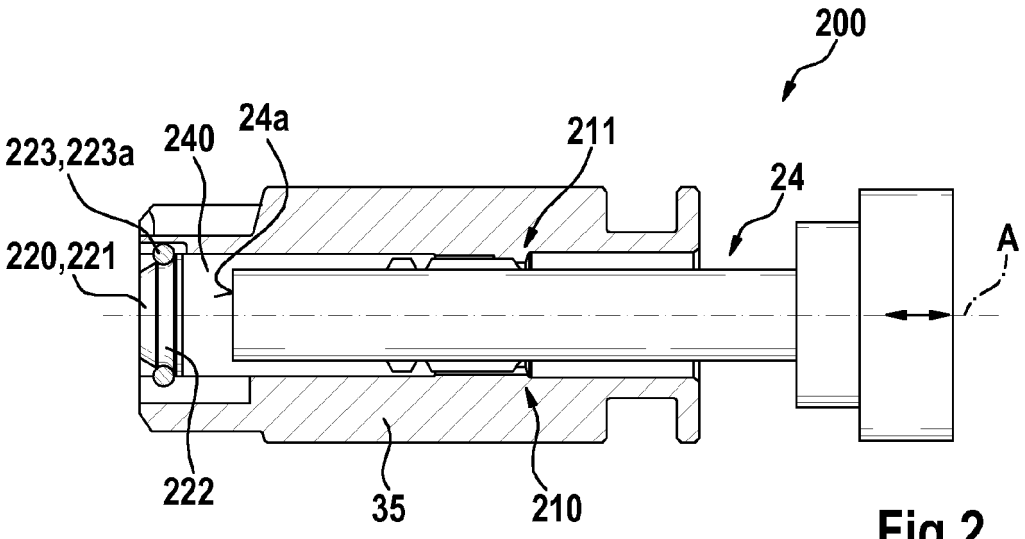

Fig.2

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Description

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

[0002] Additionally the invention relates to a method for mounting an electrical machine, in particular a generator or a starter mechanism as a starter, for starting a combustion engine, according to the preamble of claim 9.

Prior Art

[0003] The present inventions starts out from a starter, in particular from a coaxial starter, for starting a combustion engine, in particular for motor and/or utility vehicles and a connection assembly for a force transmitting connection of two components of the connection assembly, as for example a push-on pinion connection for mounting a put-on pinion on a corresponding shaft 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. In particular an object of the present invention is a motor vehicle starter having an electric motor and an engaging system, for example according to a free ejective starter or a -type starter.

[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. Those cars and vehicles comprise a starter pinion that is put on a pinion shaft, wherein the starter pinion is driven from the pinion shaft by a positive connection, in particular by a serration. Those starters are for example known as free ejective starters. In particular starters for start-stop-applications comprise this kind of push-on pinions, wherein such starters are arranged as nose-type starters. Usually an axial fixing of this kind of starters is formed by a spring-lock washer or retainer or a combination of retainer and stop ring. During mounting such pinions are put on the pinion shaft against a compression spring and in the following the retainer is mounted such that the compression spring forces the pinion against the retainer. By this the compression spring improves the track-in or engaging behavior and reduces a front side wear of the pinion and a gear ring. Further it is well known that those kinds of connections are realized by a bayonet locking. For preventing an unintentional unlocking of the bayonet locking an axial distance limitation is arranged. The well known axial distance limitation is formed as a washer having an U-shape, which after realizing the bayonet locking, is arranged on the pinion shaft between the components to connect. When the pinion shaft together with the U-shaped washer is rotating with high speed there is an unbalanced mass due to the asymmetric form of the washer. Due to that unbalanced mass and due to the high rotational speed of the pinion shaft, also called driven shaft, the washer tends to dismantle from the shaft such that a safe axial distance limitation is no longer guaranteed and the bayonet locking may unlock unintentionally.

Disclosure of the Invention

[0007] 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 an electrical machine, in particular a generator or a starter mechanism as a starter, for starting a combustion engine, comprising a connection assembly for a force transmitting connection of two components of the connection assembly having a bayonet locking with an axial distance limitation for preventing an unintentional unlocking of the bayonet locking, wherein said axial distance limitation is formed as an adjustable stop that is adjustable at least in axial direction, a small-sized and flexible axial distance limitation is realized. The axial distance limitation may be used for different connection assemblies having different geometries, especially different length. Due to the adjustable stop being adjustable in an axial direction the stop matches to all kind of connection assemblies having different length. The adjustable stop is limited with regard to its width in axial direction but is adjustable with regard to its position relatively to one or both of the components. By this a safe axial limitation is guaranteed. In particular the electric machine or electrical machine is formed as a starter motor having a bayonet locking for realizing a pinion stop function. The bayonet locking and the dependent bayonet design are based on three main characteristics. First an internal spline on the starter motor pinion and/or in the overrunning clutch (short: ORC) that has half of the teeth specified for its diameter. Second an external spline at the driven shaft or pinion shaft has corresponding spline geometry in a front area that has half of the vacancies specified for its diameter. Third, after an assembly another component is used to prevent the internal spline to hit the back end of course.

[0008] The bayonet locking and/or the bayonet design according to the present invention improve the system balancing and the strength regarding high speed conditions. Further the bayonet locking does not depend on the position of the ORC inside the starter. The assembly process can also be improved. Instead of using washers on the back part of the pinion a fixed stopper is used on the front part of the driving shaft. Thus an improved balancing and an improved strength against high speed con-

ditions are realized. Further the solution is not dependant on the ORC position inside the starter motor. The assembly process is improved. Additionally the number of components is reduced. Last but not least the stop component can be designed to also perform a sealing function. The stop, stopper, or locker can be designed in several ways, which means that the assembly process is more flexible. In one embodiment the stop is formed as a stop ring or a screw. Thus the stop performs a fixation as well as a sealing function.

[0009] 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.

[0010] In one embodiment a first component of said components of the connection assembly has a housing or a space for accommodating a second component of said components of the connection assembly for forming the connection assembly. A first component is for example a pinion, especially a starter or a starter motor pinion. A second component is for example a pinion shaft, also called driven shaft. The first component is put on the second component so that the second component is at least partly arranged in said first component. The inner geometry of said housing of the first component corresponds at least partly to a corresponding outer geometry of said second component accommodated in said housing. The housing is defined by a circumferential wall. Preferably the circumferential wall is formed as a cylindrical tube extending in axial direction.

[0011] In another embodiment the first component has a bottom limiting the housing, wherein the bottom is formed as said adjustable stop. The bottom is thus adjustable in an axial direction to adjust the length of said housing. The bottom functions as a stopper for said second component. So the bottom limits the housing in axial direction, preferably at an end face of the housing.

[0012] In still another embodiment the housing is formed as a tube having openings at a front end and a rear end, preferably only at a front end and a rear end of the first component, which is formed as a appendix or a pinion shaft or shorter as a pinion. The pinion shaft or driven shaft is inserted from the front end. The adjustable stop is located at the rear end. The pinion shaft is cylindrical. At its outer circumference there is an external spline forming several teeth. The housing is cylindrical. At its inner surface directed to the shaft there is an internal spline forming several teeth. The splines form a kind of spiral wherein adjacent teeth of the internal spline form paths for guiding teeth of the external spline. Some of the paths are limited in one direction such that a movement of the teeth of the external spline along these paths is limited. At this position the bayonet locking is in an operation position. For dissolving the components the shaft has to be moved in a reverse direction. For locking this movement, the axial distance limitation is arranged. Thus by having the axial distance limitation a locking of the bayonet locking is realized. The axial distance limitation has to be adjusted to the inserted shaft.

[0013] Therefore in one further embodiment the adjustable stop is arranged in said tube, in particular at the rear end of said tube. As the adjustable stop is adjustable in an axial direction after insertion of the shaft the adjustable stop is moved in direction of the front end of the shaft until contact is reached or only a small gap is reached, such that a locking of the bayonet locking is realized. By arranging the adjustable stop inside the tube a small-sized solution is realized. Additionally no radial fixation is required as this fixation is done by the circumference of the tube.

[0014] Additionally in one embodiment the housing and/or the adjustable stop comprises locking means for locking the adjustable stop in an operating position. For preventing an unintentional unlocking of the bayonet locking, locking means are realized. That locking means may be from a kind of positive locking or form-fit, non-positive or force-fit, and/or locking by adhesive force, material engagement, integrally joint and/or substance locking. In one embodiment the locking means are self-locking means. In another embodiment additional means are arranged, for example glue. The locking means are in one embodiment arranged as one-way locking means that is locking means that are inseparable or not reversibly unlockable. In another embodiment the locking means are reversibly unlockable. The locking means may be formed as adjustable locking means that may be at least in one way adjustable in an axial direction.

[0015] Also in one embodiment the housing and/or the adjustable stop comprises unlocking preventing means for preventing an unintentional unlocking of the adjustable stop from an operating position. Especially in case the locking means are arranged as reversible locking means additional unlocking preventing means may be disposed. The unlocking preventing means may be integrally formed with the locking means, e.g. as a thread. In another embodiment the unlocking preventing means may be formed separately from the locking means. Unlocking preventing means may be formed as resin, for example as microencapsulated resin that firmly bonds housing and locking means. Of course the unlocking preventing means and/or the stop may be connected with the front end of the shaft. The locking means and/or the unlocking means may be integrally formed. Thus the locking means and/or the unlocking means may be formed by a deformation element which deforms when in operation position which is the position such that a bayonet locking is realized.

[0016] In yet another embodiment the means comprise at least one of the following: a self locking mechanism, a thread means, a press fit means, a glue means, a deformation means and/or any combination of the aforementioned.

[0017] The method according to the present invention having the features of the corresponding main claim or of the dependent claims compared to the prior art have the advantages that by having a method for mounting an

electrical machine, in particular a generator or a starter mechanism as a starter, for starting a combustion engine, comprising a connection assembly for a force transmitting connection of two components of the connection assembly having a bayonet locking with an axial distance limitation for preventing an unintentional opening of the bayonet locking, comprising the steps: arranging of the axial distance limitation with the connection assembly, wherein after the connection assembly is arranged in an operating position, said axial distance limitation is moved in an axial direction such that the bayonet locking is locked in said operating position for preventing an unintentional unlocking of the connection assembly.

[0018] In one embodiment said axial distance limitation is axially locked such that during operation of said electrical machine said connection assembly is locked.

[0019] The second component of the connection assembly is put in the housing of the first component, rotated around the length axis and moved against the direction of insertion until reaching a stopper. Thus the connection assembly is in an operating position. For unlocking the connection assembly first movement in direction of insertion is required. When this movement is blocked unlocking is prevented. For unintentionally unlocking the axial distance limitation is arranged. After realizing the connection assembly in an operation position the axial distance limitation is arranged. Arrangement is done by moving the axial distance limitation in direction towards the second component in an axial direction. The axial distance limitation is placed inside the housing so that it is secured in a radial direction by the housing. Further, after reaching the operation position such that the bayonet locking is locked the axial distance limitation is fixed in this position, e.g. by suitable locking means. As the axial distance limitation is placed inside the housing the axial distance limitation my have a symmetric geometry. Thus the axial distance limitation, formed as an adjustable stop, being at least adjustable in axial direction, is formed symmetrically. A fixation of the adjustable stop may be by welding, gluing, screwing, bonding, and the like.

[0020] Correspondingly in one embodiment said axial distance limitation is axially locked such that during operation of said electrical machine said connection assembly is locked. The locking may be done by any means. For example the locking may be realized in a way that the locking is not reversible. In another embodiment the locking is reversible.

Short description of the drawings

[0021] Embodiments of the invention are 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 a connection assembly of a pinion on a driven shaft formed as a bayonet locking with an embodiment of an axial distance limitation,

Fig. 3 in more details a cross-sectional view a connection assembly of a pinion on a driven shaft according to Fig. 2 with another embodiment of an axial distance limitation,

Fig. 4 in a cross-sectional view a pinion of a connection assembly with an embodiment of an axial distance limitation

Fig. 5 in a cross-sectional view a detail A of Fig. 4 showing more detailed the axial distance limitation,

Fig. 6 in a cross-sectional view the detail A of Fig. 4 showing another embodiment of the axial distance limitation,

Fig. 7 in a cross-sectional view the detail A of Fig. 4 showing another embodiment of the axial distance limitation similar to Fig. 6,

Fig. 8 in a cross-sectional view the detail A of Fig. 4 showing another embodiment of the axial distance limitation similar to Fig. 6 and 7,

Fig. 9 in a cross-sectional view the detail A of Fig. 4 showing another embodiment of the axial distance limitation similar to Fig. 5,

Fig. 10 in a cross-sectional view the detail A of Fig. 4 showing another embodiment of the axial distance limitation similar to Fig. 5 and 9,

Fig. 11 in a cross-sectional view the detail A of Fig. 4 showing another embodiment of the axial distance limitation similar to Fig. 5, 9, and 10,

Fig. 12 schematically in a cross-sectional view and a longitudinal section the connection assembly according to Fig. 2 in a first mounting step,

Fig. 13 schematically in a cross-sectional view and a longitudinal section the connection assembly according to Fig. 2 in a second mounting step,

Fig. 14 schematically in a cross-sectional view and a longitudinal section the connection assembly according to Fig. 2 in a third mounting step,

Fig. 15 schematically in a cross-sectional view and a longitudinal section the connection assembly according to Fig. 2 in a fourth mounting step,

Fig. 16 schematically in a cross-sectional view and

a longitudinal section the connection assembly according to Fig. 2 in a fifth mounting step,

Description of one preferred embodiment

[0022] 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 collar is formed, which is directed to an outside of the starting device. Inside the collar a bearing area is formed in which a back end 17a of an anchor 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 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).

[0023] 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.

[0024] 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.

[0025] Fig. 2 to 16 show in different views and different level of details a connection assembly 200 formed as a bayonet locking 210 comprising a first element formed as a pinion 35 and a second element formed as a pinion shaft or driven shaft 24. The pinion 35 is formed integrated with the inner ring 34 of the free wheel gear 33 i.e. as a one-parted piece. Same or similar elements are referenced by same reference numerals. A detailed description of already described pieces or elements is omitted.

[0026] Fig. 2 shows in a cross-sectional view the connection assembly 200 of the pinion 35 on the driven shaft 24 formed as a bayonet locking 210 with an embodiment of an axial distance limitation 220. The axial distance limitation 220 is formed as an adjustable stop that is adjustable in axial direction A. The axial distance limitation 220 comprises a stop ring 221. The stop ring 221 has a surrounding groove 222. Further the axial distance limitation 220 comprises locking means 223 formed as a retaining ring 223a. The retaining ring 223a engages in said surrounding groove 222 of the stop ring 221. Further the retaining ring 223a is in contact with an inner circumferential wall of the pinion 35. As shown in Fig. 2 the inner circumferential wall has a surrounding groove in which the retaining ring 223a rests. By this the stop ring 221 is locked or fixed in axial direction A. The stop ring 221 serves as stopper when getting in contact with a front face 24a of the driven shaft 24. The position of the axial distance limitation 220 is located inside the pinion 35 such that an axial distance of the pinion 35 relatively to the driven shaft 24 is limited in a way the bayonet locking 210 may not open unintentionally and the driven shaft 24 cannot move out of the space 240 inside the pinion 35 defined by its inner circumferential wall. Said axial distance limitation 220 is formed (rotational-) symmetrically with regard to axis A so that there is no unbalance. The space 240 is formed as a through-going opening extending along the axial direction A. In this case the space 240 is formed as a cylindrical through-going opening.

[0027] Fig. 3 shows in more details a cross-sectional view a connection assembly 200 of the pinion 35 on a driven shaft 24 according to Fig. 2 with another embodiment of an axial distance limitation 220. In this Fig. adjacent pieces or elements of the free wheel gear 33 like the annulus ring 37 or the engaging spring 39 are shown. An essential difference between fig.2 and fig. 3 is the embodiment of the axial distance limitation 220. While in fig. 2 the axial distance limitation 220 is formed as a stop ring 221 fixed with separate locking means 223 in fig. 3 the axial distance limitation 220 is formed as a screw 226 having an external thread 226a. Accordingly the corresponding part of the circumferential wall where the axial distance locking 220 is located has an internal thread 226b for engaging with the external thread 226a. In this

fig. the driven shaft 24 contacts with its front face 24a the axial distance locking 220 such that there is no axial movement of the driven shaft 24 in direction towards the axial distance locking 220. As will be described later the is also no axial movement of the driven shaft 24 away from the axial distance locking 220 because of the bayonet locking 210.

[0028] Fig. 4 to 11 show several embodiments of the axial distance limitation 220. Fig. 4 shows in a cross-sectional view a pinion 35 of the connection assembly 200 with a first embodiment of an axial distance limitation 220 marked with detail B. The axial distance limit 220 is shown in detail in Fig. 5. On a circumferential wall surrounding the space 240 for housing the driven shaft 24 spline-like teeth 211 of the bayonet locking 210 are formed.

[0029] Fig. 5 shows in a cross-sectional view a detail B of fig. 4 showing more detailed the axial distance limitation 220. As easily may be seen by this fig. axial limitation distance 220 is formed as a screw 226 having the external thread 226a engaging with the internal thread 226b of the pinion 35, similar to the embodiment shown in fig. 3. The screw 226 is formed as a self-locking or self-impeding screw such that locking means 223 are integrated in said screw 226.

[0030] Fig. 6 shows in a cross-sectional view the detail B of Fig. 4 showing another embodiment of the axial distance limitation 220. In this embodiment the axial distance limitation 220 is formed as stop ring 221 having the circumferential or surrounding groove 222 in which the retaining ring 223a serving as locking means 223 is seated. The retaining ring 223a is also arranged in a circumferential or surrounding groove of the inner wall of the pinion 35 such that an axial locking is realized.

[0031] Fig. 7 shows in a cross-sectional view the detail B of Fig. 4 showing another embodiment of the axial distance limitation 220 similar to Fig. 6. The axial distance limitation 220 is similar to that shown in Fig. 6 but has additionally a disc-like deformation element 229 serving as additional locking means 223. The deformation element 229 is pressed in the space formed in the pinion 35. By this the deformation element 229 is seated press-fitted in the space 240 and serves as axial locking means 223.

[0032] Fig. 8 shows in a cross-sectional view the detail B of Fig. 4 showing another embodiment of the axial distance limitation 220 similar to Fig. 6 and 7. Main difference between the embodiments of fig. 6 and 7 and that of fig. 8 is, that the locking means 223 is realized by glue, adhesive, weld 223b and the like.

[0033] Wherein fig. Fig. 5 to 8 show axial distance limitations 210 comprising a stop ring 221 fig. 9 to 11 show axial distance limitations 220 comprising the screw 226.

[0034] Fig. 9 shows in a cross-sectional view the detail B of Fig. 4 showing another embodiment of the axial distance limitation 220 similar to Fig. 5. The axial distance limitation 220 is formed as screw 226 having interference 228. The screw 226 may be locked through that interference 228 or with a self-curing resin, for example a microencapsulated epoxy. Alternatively a separate blocking member may be used.

[0035] Fig. 10 shows in a cross-sectional view the detail B of Fig. 4 showing another embodiment of the axial distance limitation 220 similar to Fig. 5 and 9. Additionally the axial distance limitation 220 compared to that in Fig. 9 comprises a deformation element 229 similar to that shown in fig. 7. The disc-like deformation element is press-fitted in the space 240 for axial locking the screw 226.

[0036] Fig. 11 shows in a cross-sectional view the detail B of Fig. 4 showing another embodiment of the axial distance limitation 220 similar to Fig. 5, 9, and 10. Similar to fig. 8 the axial distance limitation 220 is integrally joint to the pinion 35 by weld, glue, adhesive 223b or the like.

[0037] In the following with regard to fig. 12 to 16 mounting of the connection assembly 200 is described. On the right part of each figure the ring-shaped circle symbolize the end of the pinion 35. The farther right elements of the right part of the figures symbolize the mounting procedure. As can be seen by the figures, the pinion 35 in fig. 12 to 15 does not have any axial distance limitation 220. In fig. 16 the axial distance limitation 220 is inserted. The distance of the ring-shaped circle to the remaining elements of the right part symbolize the distance of the front sided or front face 24a of the driven shaft 24 to the end of the pinion 35, where the axial distance limitation 220 is inserted.

[0038] Fig. 12 shows schematically in a cross-sectional view and a longitudinal section the connection assembly 200 according to Fig. 2 in a first mounting step. In this step or condition the driven shaft 24 is partly inserted into the space 240 for housing the driven shaft 24 during operation, wherein the pinion 35 and the driven shaft 24 are axial not in contact with each other. The space 240 is not closed by an axial distance limitation 220. Guiding elements 35b of the pinion 35 in form of spline-like teeth 211 form an internal guiding path 35c. Guiding elements 24b formed as spline-like teeth of the driven shaft 24 form a counter guiding path 24c. Counter impacts 24d limit alternating counter guiding paths 24c, such that one counter guiding path 24c is open in direction towards pinion 35 and an adjacent counter guiding path 24c is locked in directions towards pinion 35. One rotation path 24e exists for connecting the counter guiding paths 24c with each other crosswise direction that is in a circumferential direction. In the step shown in fig. 12 guiding elements 35b start to slide between the counter impacts 24d in the counter guiding path 24c, such that the guiding paths 24c and 35c are engaging. Guiding paths 35c are spaced towards each other twice as far as the counter guiding paths 24c.

[0039] Fig. 13 shows schematically in a cross-sectional view and a longitudinal section the connection assembly 200 according to fig. 2 in a second mounting step. In this step the driven shaft 24 is completely inserted into space 240. A pinion offset 35a and a driven shaft offset

24a forming a stopper is in contact with each other. The guiding elements 35b are moveable in a circumferential direction along the rotational path 24e. A rotational movement is shown in fig.14.

[0040] Fig. 14 shows schematically in a cross-sectional view and a longitudinal section the connection assembly 200 according to Fig. 2 in a third mounting step. Driven shaft 24 is rotated relatively to pinion 35 in circumferential direction around axial direction A. In this step of rotation guiding elements 35b are moved along rotation path 24e until the engage or slide into next counter guiding path 24c. Next or adjacent counter guiding path 24c is limited in opposite direction to the direction of insertion by a counter stopper 24d. Movement of guiding elements 35b in direction toward counter impact 24d is shown in fig. 15.

[0041] Fig. 15 shows schematically in a cross-sectional view and a longitudinal section the connection assembly 220 according to Fig. 2 in a fourth mounting step. Guiding elements 35b are moved along counter guiding path 24c in direction towards counter impact 24d. Corresponding to that driven shaft 24 is moved in opposite direction towards direction of insertion until a space for insertion of axial distance limitation 220 is given. When sufficient space for arranging axial distance limitation 220 is realized, axial distance limitation is inserted, as shown in fig. 16.

[0042] Fig. 16 shows schematically in a cross-sectional view and a longitudinal section the connection assembly 220 according to Fig. 2 in a fifth mounting step. Axial distance limitation 220 is inserted and adjusted in axial direction A. Axial distance limitation 220 is finally locked for operating the connection assembly 200. Locked axial distance limitation 220 prevents a movement of driven shaft 24 against direction of insertion such that bayonet locking 210 is securely locked.

Claims

1. Electrical machine (100), in particular a generator or a starter mechanism as a starter, for starting a combustion engine, comprising a connection assembly (200) for a force transmitting connection of two components of the connection assembly (200) having a bayonet locking (210) with an axial distance limitation (220) for preventing an unintentional unlocking of the bayonet locking (210),
characterized in, that
said axial distance limitation (220) is formed as an adjustable stop that is adjustable at least in axial direction (A).

2. Electrical machine (100) according to claim 1, **characterized in, that** a first component of said components of the connection assembly (200) has a housing (240) for accommodating a second component of said components of the connection assembly (200) for forming the connection assembly (200).

3. Electrical machine (100) according to claim 1 or 2, **characterized in, that** the first component has a bottom limiting the housing (240), wherein the bottom is formed as said adjustable stop.

4. Electrical machine (100) according to one of the proceeding claims 1 to 3, **characterized in, that**
the housing (240) is formed as a tube having openings at a front end and a rear end.

5. Electrical machine (100) according to one of the proceeding claims 1 to 4, **characterized in, that**
the adjustable stop is arranged in said tube.

6. Electrical machine (100) according to one of the proceeding claims 1 to 5, **characterized in, that**
the housing (240) and/or the adjustable stop comprises locking means (223) for locking the adjustable stop in an operating position.

7. Electrical machine (100) according to one of the proceeding claims 1 to 6, **characterized in, that**
the housing (240) and/or the adjustable stop comprises unlocking preventing means for preventing an unintentional unlocking of the adjustable stop from an operating position.

8. Electrical machine (100) according to one of the proceeding claims 1 to 7, **characterized in, that**
the locking means (223) and/or the unlocking preventing means comprise at least one of the following: a self locking mechanism, thread means, press fit means, glue means, deformation means and or any combination of the aforementioned.

9. Method for mounting an electrical machine (100), in particular a generator or a starter mechanism as a starter, for starting a combustion engine, comprising a connection assembly (200) for a force transmitting connection of two components of the connection assembly (200) having a bayonet locking (210) with an axial distance limitation (220) for preventing an unintentional opening of the bayonet locking (210), comprising the steps:

   arranging of the axial distance limitation (220) with the connection assembly (200), **characterized in, that**
   after the connection assembly (200) is arranged in an operating position, said axial distance limitation (220) is moved in an axial direction such that the bayonet locking (210) is locked in said operating position for preventing an unintentional unlocking of the connection assembly (200).

10. Method according to claim 9, **characterized in, that** said axial distance limitation (220) is axially locked such that during operation of said electrical machine

(100) said connection assembly (200) is locked.

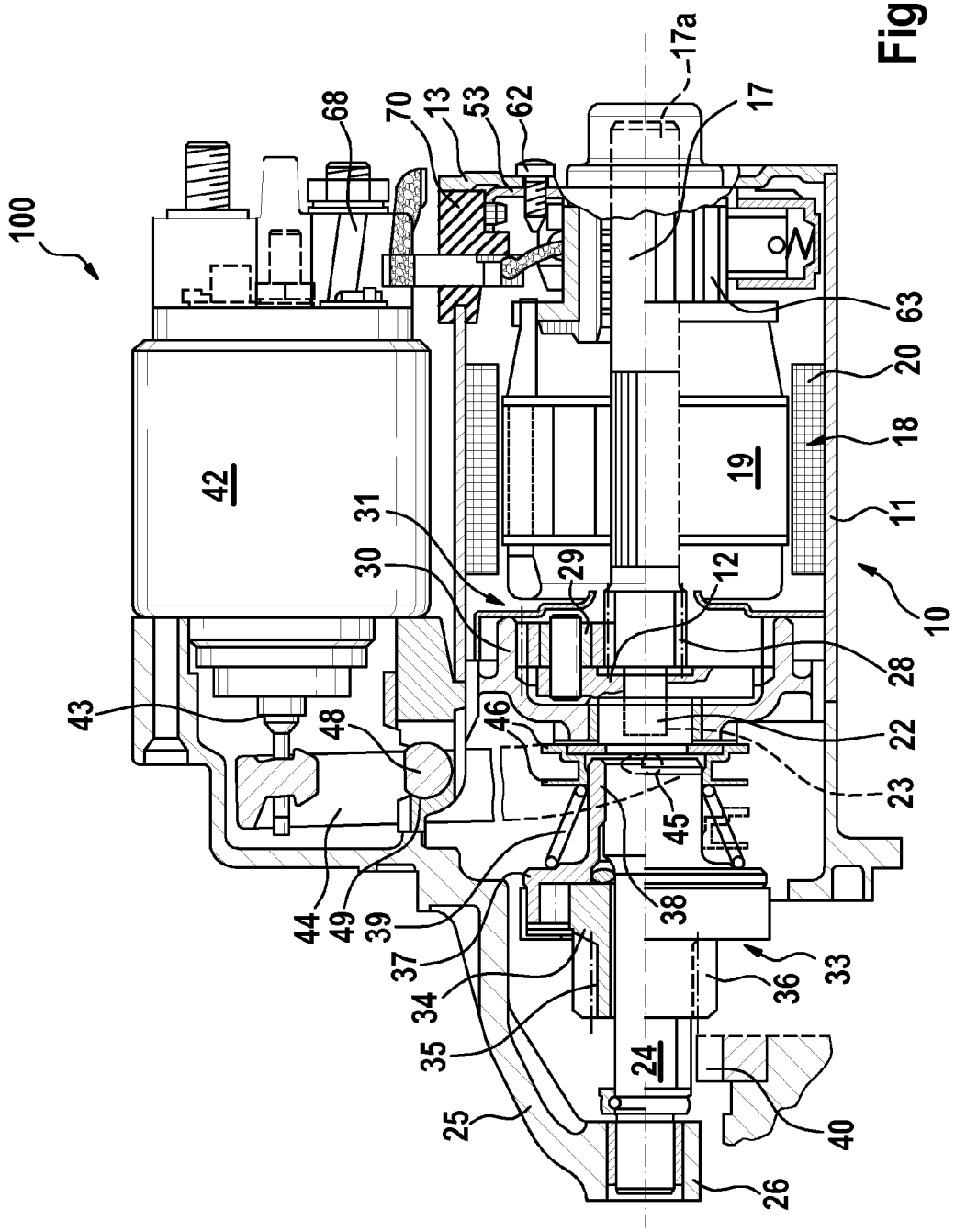
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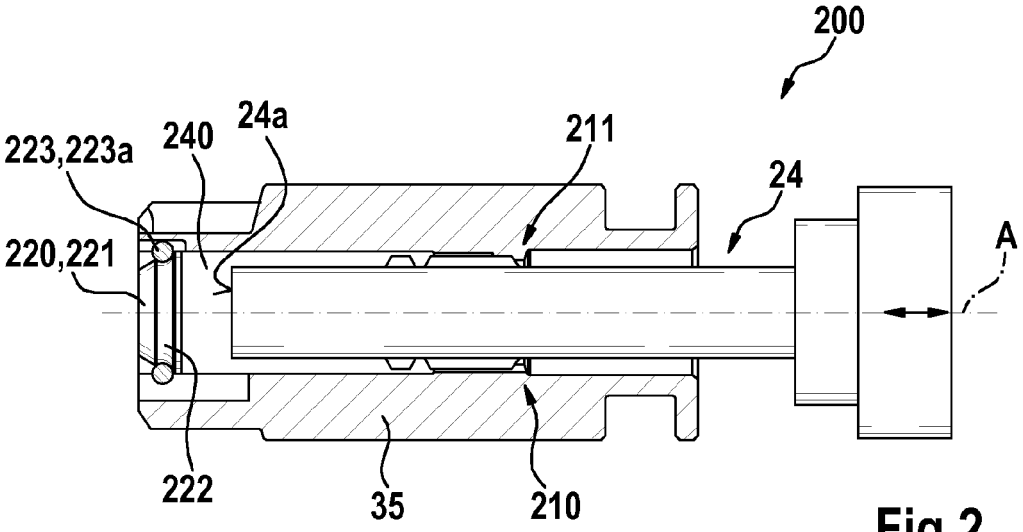
Fig.1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A
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Fig.2

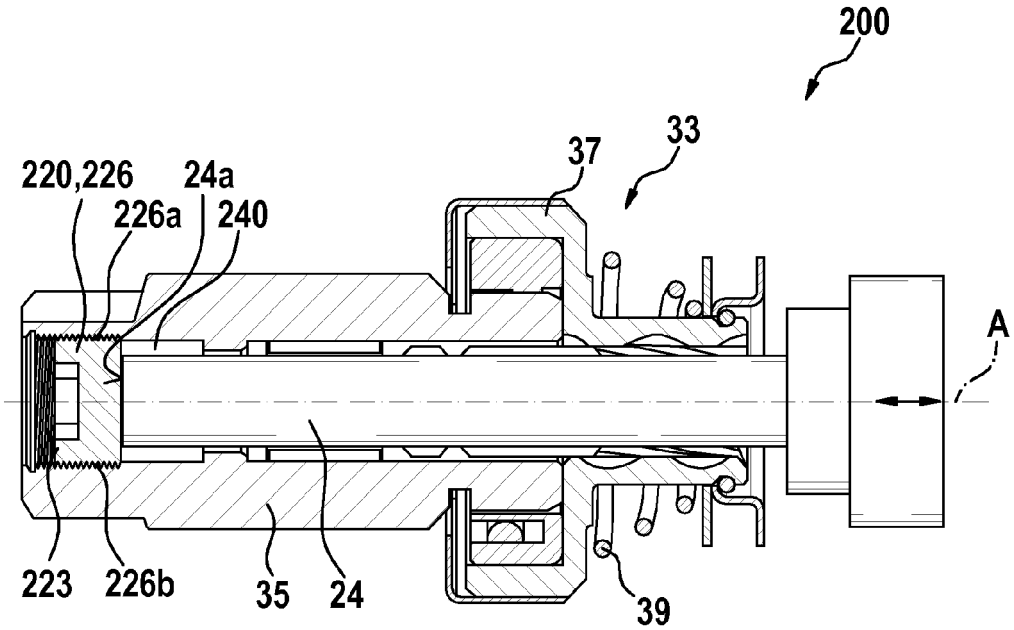
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Fig.3

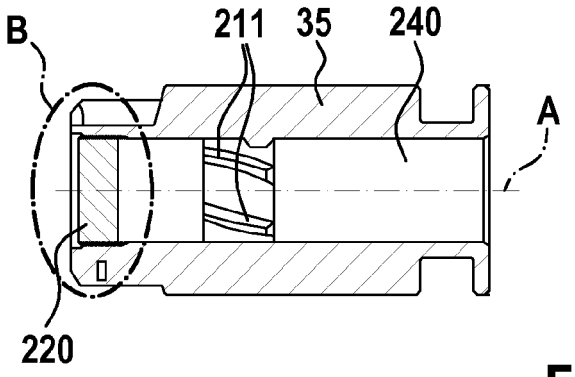


Fig.4

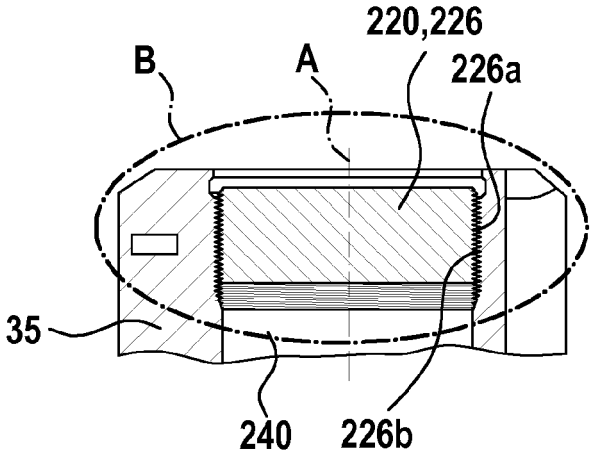


Fig.5

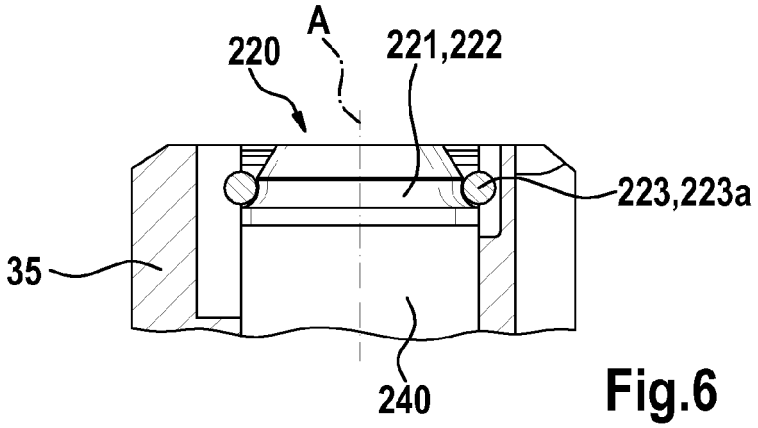


Fig.6

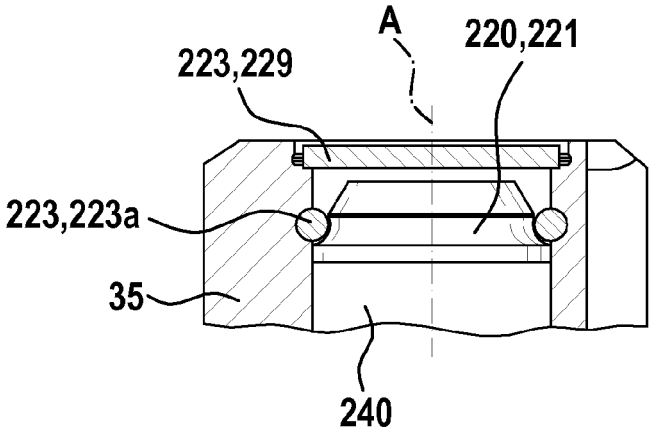


Fig.7

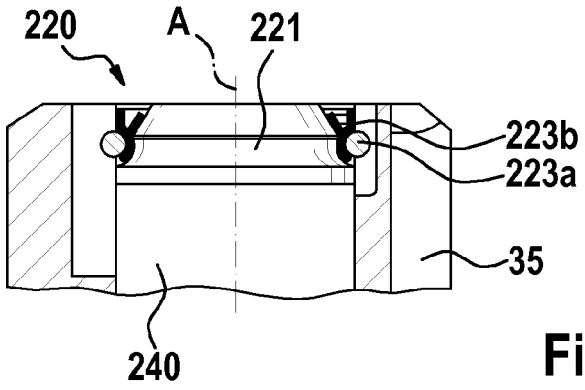


Fig.8

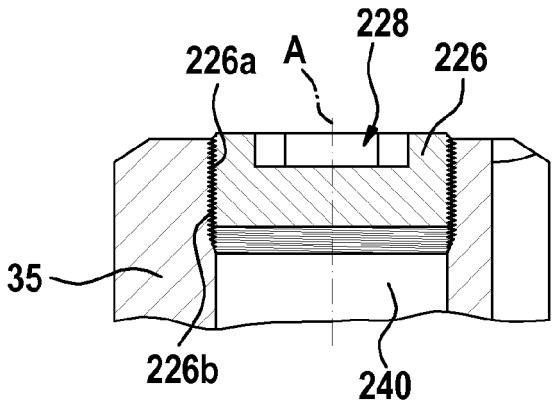


Fig.9

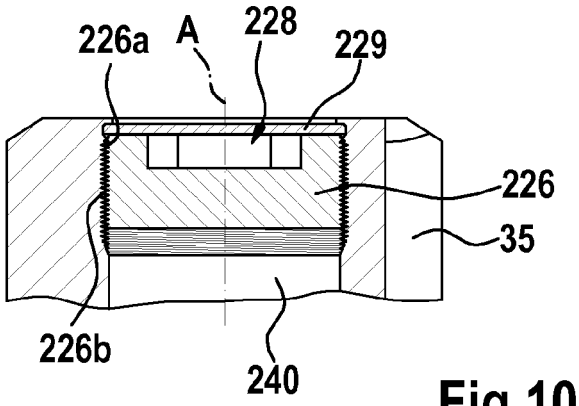


Fig.10

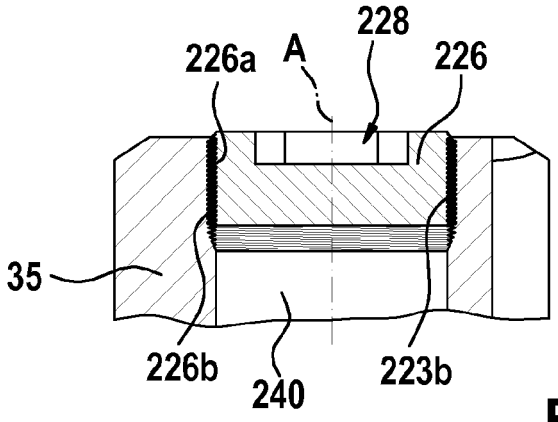


Fig.11

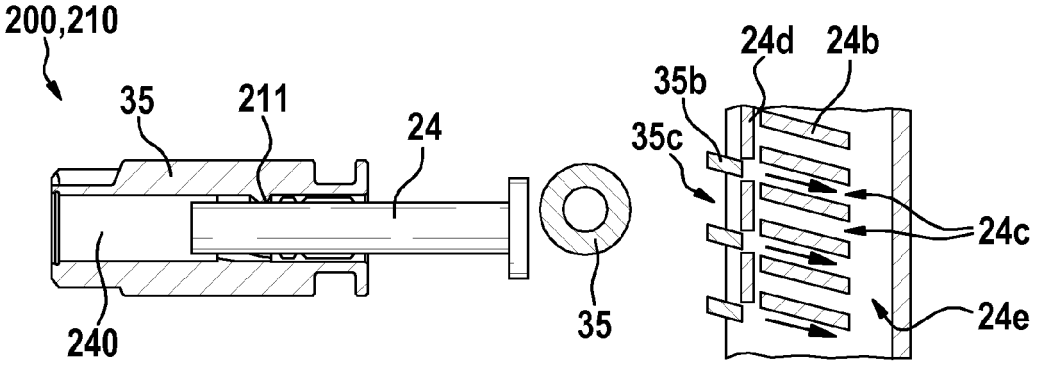


Fig.12

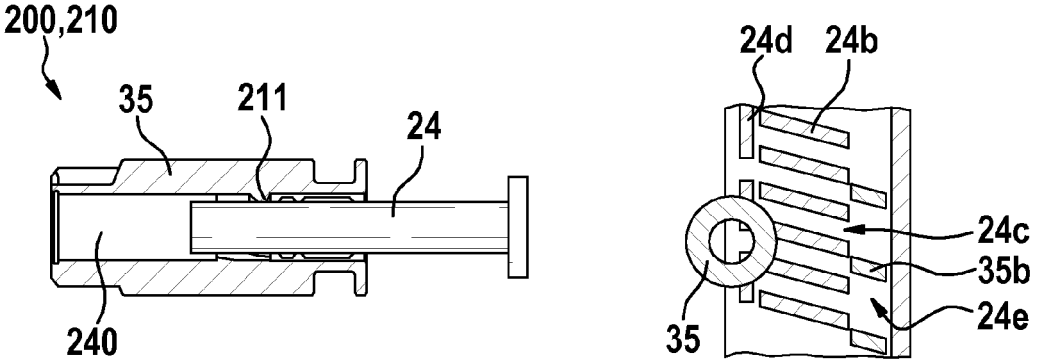


Fig.13

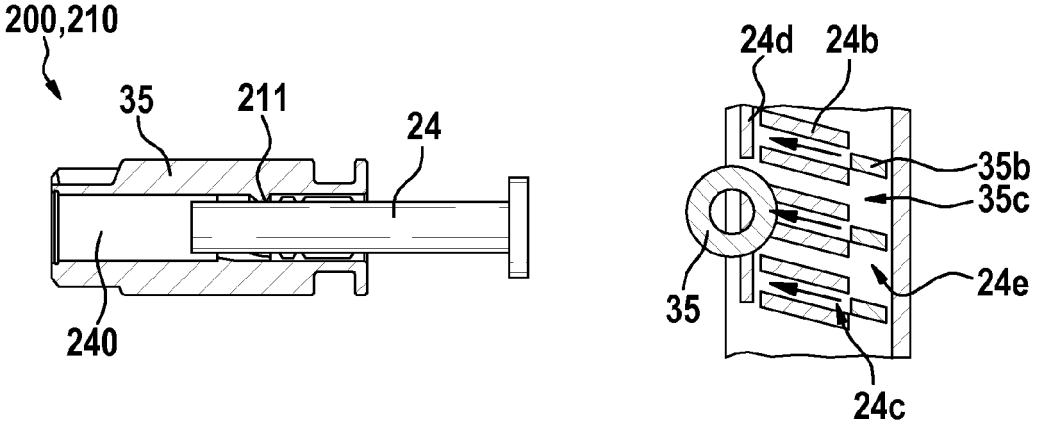
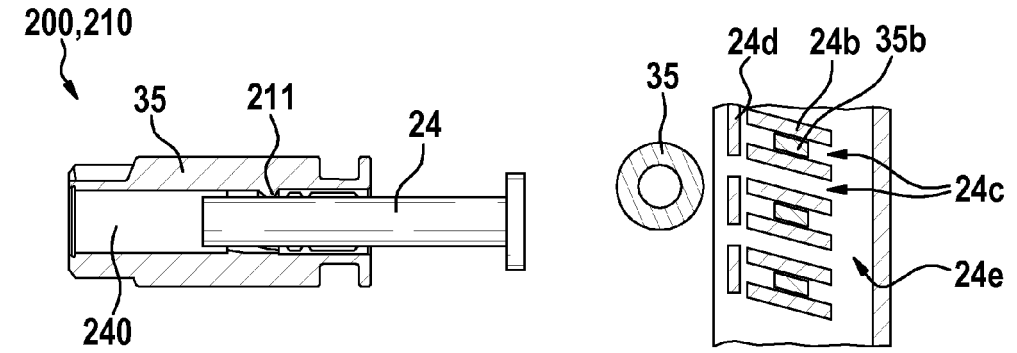


Fig.14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211
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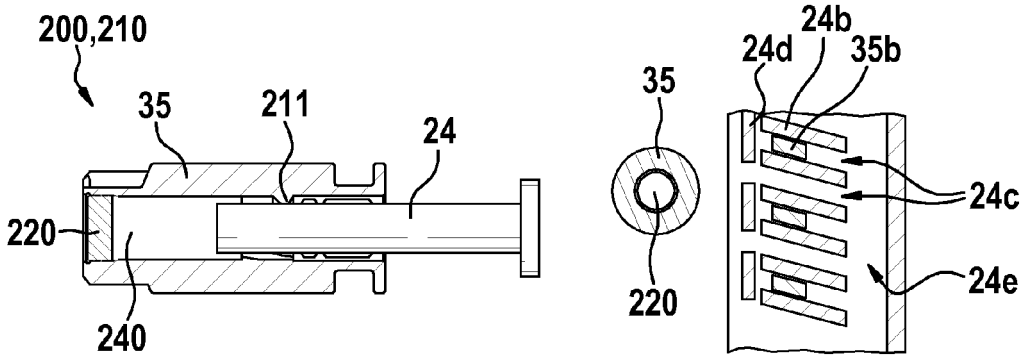
35b
24c
24e

Fig.15


200,210
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24b
24d
35b
24c
24e
220

Fig.16

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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 September 2013	Ulivieri, Enrico

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