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(54) **Tartóelrendezés egy vezértengely köszörüléshez és eljárás a vezértengely köszörülésére**

ACCOMMODATING ASSEMBLY FOR THE GRINDING OF A CAMSHAFT AND METHOD FOR GRINDING THE CAMSHAFT

Description

The present invention relates to a receiving arrangement for receiving a camshaft, wherein the camshaft comprises a shaft body with functional elements, which shaft body extends along an axis of rotation, and wherein a gearwheel is mounted on the shaft body, wherein a receiving body is provided, by means of which the camshaft can be at least partially received for the purposes of performing a grinding machining process. The invention also relates to a method for the grinding machining of a camshaft by way of a receiving arrangement of said type, and the invention relates to a camshaft that can be received in a receiving arrangement according to the present invention.

PRIOR ART

EP 2 354 477 A2 presents a camshaft with a rolling bearing which comprises a rolling bearing insert and a rolling bearing outer ring which, on its outer circumference, has a fixing element. Said fixing element is suitable for fixing the rolling bearing radially and axially in a bearing receptacle of a motor vehicle cylinder head. It is thereby sought to provide an improved rolling bearing arrangement and a rolling bearing installation apparatus, wherein the rolling bearing installation apparatus makes it possible for the rolling bearing component to be kept free from dirt during the grinding of the cams. The formation of a receiving arrangement of the camshaft during the grinding machining thereof is however not disclosed.

DE 10 2005 034 777 B3 presents a camshaft which can be received in a receiving arrangement, such that the camshaft can be subjected, in a receiving arrangement, to a grinding machining process. Here, a shaft body is proposed, on which functional elements of the camshaft and a gearwheel are mounted, and it is specified that the functional elements, in particular an interference-fit bearing seat, can be produced in one grinding machining process. It is however a disadvantage that the shrink-fitting of the gearwheel onto the shaft body results in a position error of the toothing of the gearwheel relative to the machined interference-fit bearing seat. In a single chucking set-up of the camshaft, mutually accurate grinding machining can be realized only between the interference-fit bearing seat and the functional elements, for example a cam element. However, since the production of the toothing of the gearwheel takes place before the shrink-fitting of the gearwheel onto the shaft body, it is not possible to adhere to narrow position tolerances and true running accuracy between the toothing of the gearwheel on the shaft body and the pressing bearing seat and other functional elements. This often gives rise to relatively short service lives of the gearwheels of camshafts, or the simple pressing of gearwheels onto the shaft body in order to produce the camshaft is often not possible, because the pressing gives rise to excessively large position deviations between the toothing of the gearwheel and the functional elements produced by way of a grinding machining process, such as bearing elements and cam elements.

DISCLOSURE OF THE INVENTION

It is an object of the invention to improve a receiving arrangement in order to overcome the disadvantages described above. In particular, the receiving arrangement should be of simple design and permit a high level of position accuracy between the gearwheel mounted on the shaft body and the functional elements. Furthermore, it is sought to specify a method for the grinding machining of a camshaft in a receiving arrangement of said type, which method yields an accurate position tolerance of the toothing of the gearwheel relative to the functional elements. Consequently, it is also the object of the invention to specify a camshaft which can be received and machined in a receiving arrangement of said type and by way of a method of said type.

Proceeding from a receiving arrangement as per the preamble of Claim 1, proceeding from a method as per the known features of Claim 8, and proceeding from a camshaft as per the preamble of Claim 10, the object is achieved by way of the respectively characterizing features. Advantageous refinements of the invention are specified in the respectively dependent claims.

The invention encompasses the technical teaching whereby the gearwheel has a receiving means, onto which the receiving body can be engaged and by way of which it is made possible for the camshaft to be received by the receiving body.

By means of the receiving arrangement according to the invention for receiving a camshaft, it is made possible to perform grinding machining of the camshaft, which results in minimal concentricity errors and position tolerances between the toothing of the gearwheel and the functional elements. The receiving means on the gearwheel can form a geometric grinding center, which may already have served as a grinding center for the production of the toothing during the production of the gearwheel, or which is at least jointly produced during the production of the toothing, in particular in one machining chucking set-up. In a variant in which the gearwheel is produced as a sintered component, the receiving means may serve in the same way as a reference geometry, which likewise has a correspondingly high accuracy with respect to the toothing and is formed, in the sintering process, with narrow tolerances with respect to the geometry of the receiving means.

Here, the gearwheel may also or alternatively perform other or further functions, and may for example serve as a sensor wheel or be in the form of a sprocket or belt pulley. In the context of the present invention, the gearwheel need not be formed in one piece, and the receiving means may for example also be formed on a sleeve which is pressed together with the gearwheel.

If the camshaft is at least partially received by way of the receiving means on the gearwheel, and if at least one of the functional elements in said receptacle is machined by grinding, then the grinding center for the production of the toothing and the grinding center for the grinding machining of the functional elements coincide, giving rise to minimal concentricity errors of the toothing of the gearwheel relative to the functional elements.

The receiving means may be formed by a collar with a conical recess, wherein the collar is integrally formed on the gearwheel at the hub side and concentrically about the axis of rotation. Here, the receiving body may have

a receiving formation which is of complementary form to the conical recess of the collar and which can be engaged onto the conical recess of the collar, and which thus forms encircling areal contact. Here, the receiving body may surround the receiving means or be inserted into the receiving means, wherein both possibilities yield the desired result whereby the camshaft is at least partially received by the receiving body. It is also possible for the receiving means or the receiving body to have an encircling edge, for example a bevel, which bears against the conical contour at the inside or outside and thus forms linear contact.

The fact that the camshaft is only partially received arises from the fact that, during a grinding machining process of a camshaft, the latter must basically be received, so as to be rotatable about its axis of rotation, by way of at least two centering tips, analogously to the principle of a clamping chuck and a tailstock sleeve of a turning machine. Here, the receiving body replaces one of the centering tips, and the camshaft is received, by way of the receiving body, on the receiving means of the gearwheel, wherein a further receptacle may be provided on the other end of the camshaft. Here, it is firstly possible for the conical recess to be formed at the inside in the collar, or the conical recess may be formed on the collar at the outside. The receiving body may be of correspondingly complementary form, and the receiving body may comprise an internal cone or an external cone. Here, the alternative embodiment of the receiving means is basically also in the form of an internal cylindrical surface or external cylindrical surface, and the receiving body comprises an external cylindrical surface of complementary form or an internal cylindrical surface, wherein a receiving fit must have correspondingly narrow tolerances. In the same way, the recess may also be formed by a spherical contour.

In a refining embodiment, the shaft body may, in terms of its longitudinal extent in the direction of the axis of rotation, protrude axially beyond the position of the gearwheel on said shaft body, such that the gearwheel is received on the shaft body so as to be spaced apart from the axial end of said shaft body. Consequently, the receiving body may be formed, at least in sections, with a cavity which is open at the end side and in which the end of the shaft body can be received. In particular in the case of protruding shaft ends, it has hitherto only been possible for camshafts to be received, by means of a centering tip for the grinding machining process, by way of the shaft body. This however yields a concentricity error of the toothing of the gearwheel on the shaft body, because the connection of the gearwheel to the shaft body is commonly in the form of an interference fit, giving rise to increased position tolerances. Owing to the special design of the receiving body with a cavity, it is however achieved, despite a protruding shaft end, that the camshaft is received by way of the receiving means on the gearwheel, such that the receiving arrangement according to the invention can be implemented even in the case of camshafts with protruding shaft ends.

It is furthermore advantageously possible for the camshaft to be in the form of an assembled camshaft, wherein the shaft body, the gearwheel and preferably also the functional elements are formed as individual parts and are joined onto the shaft body. Alternatively, it is however also possible for the camshaft to be produced as a solid camshaft, onto which the gearwheel is retroactively mounted, and for a grinding machining process of the functional elements of the camshaft, which are formed in one piece and materially integrally

with the shaft body, to be performed in the same way by way of the receiving arrangement according to the invention.

The invention also relates to a method for the grinding machining of a camshaft in a receiving arrangement for receiving the camshaft, wherein the camshaft comprises a shaft body with functional elements, which shaft body extends along an axis of rotation, and wherein a gearwheel is mounted on the shaft body. Here, the method comprises at least the steps of providing a receiving body for at least partially receiving the camshaft, providing the gearwheel, which has a receiving means, receiving the camshaft by engaging the receiving body onto the receiving means, and grinding the at least one functional element. The engagement of the receiving body on the receiving means may in this case be realized in particular by virtue of the receiving body being inserted, with centering action, into the receiving means.

The gearwheel may be provided with a toothing, wherein the receiving means and the toothing are produced with a common geometrical machining center, and wherein the gearwheel is only subsequently pressed or shrink-fitted onto the shaft body.

The invention is also directed to a camshaft having a shaft body comprising multiple functional elements, wherein the shaft body extends along an axis of rotation, and wherein a gearwheel is mounted on the shaft body, and it is provided that the gearwheel has a receiving means into which a receiving body can be engaged and by way of which it is made possible for the camshaft to be received by the receiving body, so as to provide a receiving arrangement for the grinding machining of at least one of the functional elements. Here, the engagement of the receiving body onto the receiving means may be realized in particular by virtue of the receiving body being inserted into, or engaging around, the receiving means.

According to the invention, the receiving means is formed by a collar which is integrally formed on the gearwheel at the hub side and concentrically around the axis of rotation and which has a conical recess or conical formation. If the collar forms a conical formation, the receiving body may have a conical recess of correspondingly complementary form, such that alternatively, the receiving body may engage around the conical formation of the collar, whereby it is likewise the case that the camshaft can be received in the grinding center of the toothing of the gearwheel.

According to a further advantageous embodiment of the camshaft, the shaft body may, in terms of its longitudinal extent in the direction of the axis of rotation, protrude axially beyond the position of the gearwheel on the shaft body, such that the gearwheel is received on the shaft body so as to be spaced apart from the axial shaft end of said shaft body. The camshaft may be in the form of an assembled camshaft, wherein the shaft body, the gearwheel and preferably also the functional elements are formed as individual parts and are joined together.

PREFERRED EXEMPLARY EMBODIMENT OF THE INVENTION

Further measures which improve the invention will be presented in more detail below together with the description of a preferred exemplary embodiment of the invention on the basis of the figures, in which:

figure 1 shows an exemplary embodiment of a receiving arrangement for receiving a camshaft, in a cross-sectional view, and

figure 2 shows a perspective view of a gearwheel having a toothing and having a shaft passage for being received on the shaft body of a camshaft.

Figure 1 shows an exemplary embodiment of a receiving arrangement 1 having an exemplary embodiment of a camshaft 10, and the method according to the invention for the grinding machining of the camshaft 10 can be performed by means of the exemplary embodiment of the receiving arrangement 1 that is shown.

The camshaft 10 is only partially shown, and comprises a shaft body 11 which is in the form of a hollow shaft, and by way of example, two functional elements 12 are arranged on the shaft body 11. A first functional element 12 forms a bearing element 20 for the mounting of the camshaft 10 in the cylinder head of an internal combustion engine, and a further functional element 12 is, for example, in the form of a cam element 24. The bearing element 20 is shown, by way of example, as a single ring-shaped element that has been pushed onto the shaft body 11, and the bearing element 20 may also be formed by a section of the shaft body 11. For example, the section of the shaft body 11, and also the outer circumferential surface of the bearing element 20 or of the cam element 24, may be subjected to a grinding machining process in order for the camshaft 10 to be mounted, so as to be rotatable about the axis of rotation, in associated bearing shells in the cylinder head of the internal combustion engine.

As a further element, a gearwheel 14 is mounted on the shaft body 11, and the gearwheel 14 is fastened to the shaft body 11 by way of an interference fit 23. The gearwheel 14 may serve for example for the drive of the camshaft 10 or for the rotatable coupling of a further camshaft, and the gearwheel 14 has a toothing 21 which forms the termination of the gearwheel 14 at the outer circumference. The gearwheel 14 has, in this case, a seat on the shaft body 11, said seat being axially spaced apart from the shaft end 25 in the direction of the axis of rotation 13. Consequently, the shaft end 25 protrudes axially, in the direction of the axis of rotation 13, beyond the seating position of the gearwheel 14 on the shaft body 11.

The receiving arrangement 1 is formed by a receiving body 15 for receiving the camshaft 10, and the receiving body 15 may for example be a constituent part of a grinding machining center, and is shown merely in schematic form. The receiving body 15 has a receiving formation 18 which interacts with a receiving means 16, such that the camshaft 10 is at least partially received, so as to be rotatable about the axis of rotation 13, by way of the receiving body 15. The fact that the camshaft 10 is only partially received arises from the fact that a further receptacle for the camshaft 10 is provided along the axis of rotation 13, for example at the opposite end with respect to the shaft end 25 of the shaft body 11, in a manner which is not shown, and the further receptacle may for example be in the form of a turning center, in particular in the form of a tailstock sleeve.

In order that the shaft end 25 which protrudes beyond the position of the gearwheel 14 does not impede the receiving of the camshaft 10 by way of the receiving body 15, the receiving body 15 has a cavity 19 which is

geometrically designed such that the shaft end 25 protrudes into the receiving body 15, in particular without making physical contact.

The receiving means 16 on the gearwheel 14 is formed by an integrally formed collar 17 with a conical internal recess, and the collar 17 is situated on the gearwheel 14 at the hub side and concentrically about the axis of rotation 13. Here, the collar 17 is formed in one piece with the body of the gearwheel 14, wherein the conical recess for forming the receiving means 16 is produced in a common machining process together with the cutting production of the toothing 21. Consequently, the receiving means 16 in the collar 17 in the form of the conical recess forms the geometrical grinding machining center of the gearwheel 14, such that the toothing 21 has a minimal concentricity error with respect to the receiving means 16.

The receiving formation 18 on the receiving body 15 is formed complementarily to the conical recess in the collar 17, and it is possible in particular for the cone with an external surface of the receiving formation 18 to have the same angle as the cone in the receiving means 16 on the gearwheel 14. In this way, the gearwheel 14 and in particular the toothing 21 can be received on the receiving body 15 with an only minimal concentricity error.

If, in the receiving arrangement 1 that is shown, at least one of the functional elements 12, in particular the bearing element 20 or the outer circumferential surface of the shaft body 11, is subjected to a grinding machining process, it is thus ensured that an only minimal concentricity error arises between the toothing 21 and the surface, which is subjected to grinding machining, of the functional element 12 or the outer circumferential surface of the shaft body 11. As a result, during subsequent use of the camshaft 10, the toothing 21 has minimal tolerance deviations relative to at least one surface, machined by cutting action, of one of the functional elements 12 or relative to the outer circumferential surface of the shaft body 11.

Figure 2 shows, in a perspective view, the gearwheel 14 with the toothing 21 on the outer circumference and with the laterally formed receiving means 16 within a collar 17, wherein the collar 17 is formed in one piece with, and integrally on, the body of the gearwheel 14. At the inside, the gearwheel 14 has a shaft passage 22, and, by way of example, a grooved surface is shown by way of which the gearwheel 14 can be pressed onto the shaft body 11, and the grooved surface may for example form a toothing along the axis of rotation 13 or along the central axis of the gearwheel 14.

In a process of production of the gearwheel 14, which may for example be a cutting, in particular grinding process, the machining of the receiving means 16 is performed in a common chucking set-up together with the production of the toothing 21, and consequently, the receiving means 16 forms a grinding center for the toothing 21, and the formed grinding center in the form of the receiving means 16 serves, for the subsequent grinding machining of the camshaft 10 with the gearwheel 14 pressed onto the shaft body 11, as the reference grinding center for the grinding machining of at least one of the functional elements 12. If the gearwheel 14 is produced as a sintered component, the receiving means 16 may, owing to the sintering process, already exhibit very narrow tolerances relative to the toothing 21 of the gearwheel 14.

The invention is not restricted, in terms of its embodiment, to the preferred exemplary embodiment specified above. Rather, numerous variants are conceivable which make use of the illustrated solution even in embodiments of fundamentally different form. All of the features and/or advantages that emerge from the claims, from the description or from the drawings, including design details or spatial arrangements, may be essential to the invention both individually and in a wide variety of combinations.

List of reference numerals

1	Receiving arrangement
10	Camshaft
11	Shaft body
12	Functional element
13	Axis of rotation
14	Gearwheel
15	Receiving body
16	Receiving means
17	Collar
18	Receiving formation
19	Cavity
20	Bearing element
21	Toothing
22	Shaft passage
23	Interference fit
24	Cam element
25	Shaft end

TARTÓELRENDEZÉS EGY VEZÉRTENGELY KÖSZÖRÜLÉSÉHEZ ÉS ELJÁRÁS A VEZÉRTENGELY KÖSZÖRÜLÉSÉRE

Szabadalmi igénypontok

1. Tartóelrendezés (1), amely egy tartótestből (15) és egy vezértengelyből (10) áll, a vezértengely (10) felvételére, ahol a vezértengelynek (10) egy forgástengely (13) mentén húzódó, funkcionális elemeket (12) tartalmazó tengelyteste (11) van, és ahol a tengelytestre (11) egy fogaskerék (14) van felhelyezve, ahol egy tartótest (15) található, amelynek révén a vezértengely (10) egy köszörülő megmunkálás végrehajtásához legalább részben megtartható,

azzal jellemezve, hogy a fogaskeréknek (14) olyan tartóeszköze (16) van, amelyre a tartótest (15) ráültethető, és amelynek révén lehetséges a vezértengely (10) megtartása a tartótesttel (15).

2. Az 1. igénypont szerinti tartóelrendezés (1), **azzal jellemezve,** hogy a tartóeszközt (16) egy kónuszos kiképzésű perem (17) alkotja, ahol a perem (17) az agy oldalán és koncentrikusan van a forgástengely (13) körül

The invention is not restricted, in terms of its embodiment, to the preferred exemplary embodiment specified above. Rather, numerous variants are conceivable which make use of the illustrated solution even in embodiments of fundamentally different form. All of the features and/or advantages that emerge from the claims, from the description or from the drawings, including design details or spatial arrangements, may be essential to the invention both individually and in a wide variety of combinations.

List of reference numerals

1	Receiving arrangement
10	Camshaft
11	Shaft body
12	Functional element
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18	Receiving formation
19	Cavity
20	Bearing element
21	Toothing
22	Shaft passage
23	Interference fit
24	Cam element
25	Shaft end

TARTÓELRENDEZÉS EGY VEZÉRTENGELY KÖSZÖRÜLÉSÉHEZ ÉS ELJÁRÁS A VEZÉRTENGELY KÖSZÖRÜLÉSÉRE

Szabadalmi igénypontok

1. Tartóelrendezés (1), amely egy tartótestből (15) és egy vezértengelyből (10) áll, a vezértengely (10) felvételére, ahol a vezértengelynek (10) egy forgástengely (13) mentén húzódó, funkcionális elemeket (12) tartalmazó tengelyteste (11) van, és ahol a tengelytestre (11) egy fogaskerék (14) van felhelyezve, ahol egy tartótest (15) található, amelynek révén a vezértengely (10) egy köszörülő megmunkálás végrehajtásához legalább részben megtartható,

azzal jellemezve, hogy a fogaskeréknek (14) olyan tartóeszköze (16) van, amelyre a tartótest (15) ráültethető, és amelynek révén lehetséges a vezértengely (10) megtartása a tartótesttel (15).

2. Az 1. igénypont szerinti tartóelrendezés (1), **azzal jellemezve,** hogy a tartóeszközt (16) egy kónuszos kiképzésű perem (17) alkotja, ahol a perem (17) az agy oldalán és koncentrikusan van a forgástengely (13) körül

a fogaskeréken (14) kialakítva.

3. A 2. igénypont szerinti tartóelrendezés (1), **azzal jellemezve,** hogy a tartótestnek (15) egy a perem (17) kónuszos kialakításával komplementer módon kialakított tartókiképzése (18) van, amely a perem (17) kónuszos kialakítására ültethető.

4. Az 1-3. igénypontok bármelyike szerinti tartóelrendezés (1), **azzal jellemezve,** hogy a tengelytest (11) hosszában a forgástengely (13) irányában axiálisan túlnyúlik a fogaskerék (14) tengelytesten (11) elfoglalt helyzetén, úgy, hogy a fogaskerék (14) a tengelytest (11) tengelyirányú végétől távközzel van aarra felvéve.

5. Az előző igénypontok bármelyike szerinti tartóelrendezés (1), **azzal jellemezve,** hogy a tartótest (15) legalább szakaszosan egy végoldalán nyitott üreggel (189) van kiképezve, amelyben a tengelytest (11) tengelyvége (25) megtartható.

6. Az előző igénypontok bármelyike szerinti tartóelrendezés (1), **azzal jellemezve,** hogy legalább egy funkcionális elem (12) csapágyelemként (20) van kiképezve.

7. Az előző igénypontok bármelyike szerinti tartóelrendezés (1), **azzal jellemezve,** hogy a vezértengely (10) összeépített vezértengelyként (10) van kialakítva, ahol a tengelytest (11), a fogaskerék (14) és előnyösen a funkcionális elemek (12) is egyedi alkatrészekként vannak kialakítva és a tengelytestre (11) ráillesztve.

8. Eljárás egy vezértengely (10) köszörülő megmunkálására egy a vezértengelyt (10) felvevő tartóelrendezésben (1), ahol a vezértengely (10) egy forgástengely (13) mentén húzódó, funkcionális elemeket (12) tartalmazó tengelytestet (11) foglal magában, és ahol egy fogaskerék (14) van a tengelytestre (11) felhelyezve, ahol az eljárás legalább a következő lépéseket tartalmazza:

– egy tartótest (15) biztosítása a vezértengely (10) legalább részleges felvételéhez,

– egy tartóeszközzel (16) rendelkező fogaskerék (14) biztosítása,

– a vezértengely (10) megtartása a tartótest (15) tartóeszközre (16) történő felhelyezése útján, és

–a legalább egy funkcionális elem (12) köszörülése.

9. A 8. igénypont szerinti eljárás, **azzal jellemezve,** hogy a fogaskereket (14) fogazással (21) készítjük, ahol a tartóeszközt (16) és a fogazást (21) közös geometriai megmunkálási központtal állítjuk elő, és/vagy hogy a fogaskereket (14) azt követően a tengelytestre (11) felsajtoljuk vagy rázsugorítjuk.

10. Vezértengely (10) egy tengelytesttel (11), amely több funkcionális elemet (12) tartalmaz, ahol a tengelytest (11) egy forgástengely (13) mentén húzódik, és ahol egy fogaskerék (14) van a tengelytestre (11) felhelyezve, **azzal jellemezve,** hogy a fogaskeréknek (14) egy tartóeszköze (16) van, amelyre egy tartótest (15) ültethető, és amelynek révén lehetséges a vezértengely (10) tartótest (15) általi megtartása, hogy a funkcionális elemek (12) legalább egyikének köszörülő megmunkálásához egy tartóelrendezést (1) teremtsünk, ahol a tartóeszközt (16) egy agy oldalon és koncentrikusan a forgástengely (13) körül a fogaskeréken (14) kiképzett perem (17) egy kónuszos kialakítással vagy kónuszos ráformálással alkotja.

11. A 10. igénypont szerinti vezértengely (10), **azzal jellemezve,** hogy a tengelytest (11) hosszában a forgástengely (13) irányában axiálisan túlnyúlik a fogaskerék (14) tengelytesten (11) elfoglalt helyén, úgy, hogy a fogaskerék (14) a tengelytest (11) axiális tengelyvégétől (25) távközzel elválasztottan van a tengelytestre (11) felhelyezve.

12. A 10. vagy 11. igénypont szerinti vezértengely (10), **azzal jellemezve,** hogy a vezértengely (10) összeépített vezértengelyként (10) van kialakítva, ahol a tengelytest (11), a fogaskerék (14) és előnyösen a funkcionális elemek (12) is egyedi alkatrészekként vannak kialakítva és egymással összeillesztve

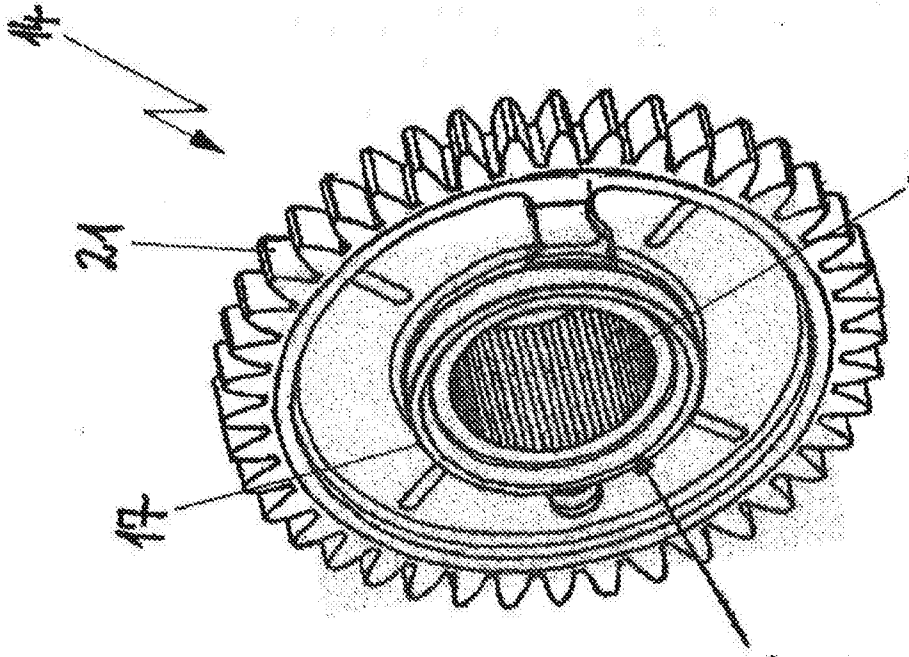

Fig. 2

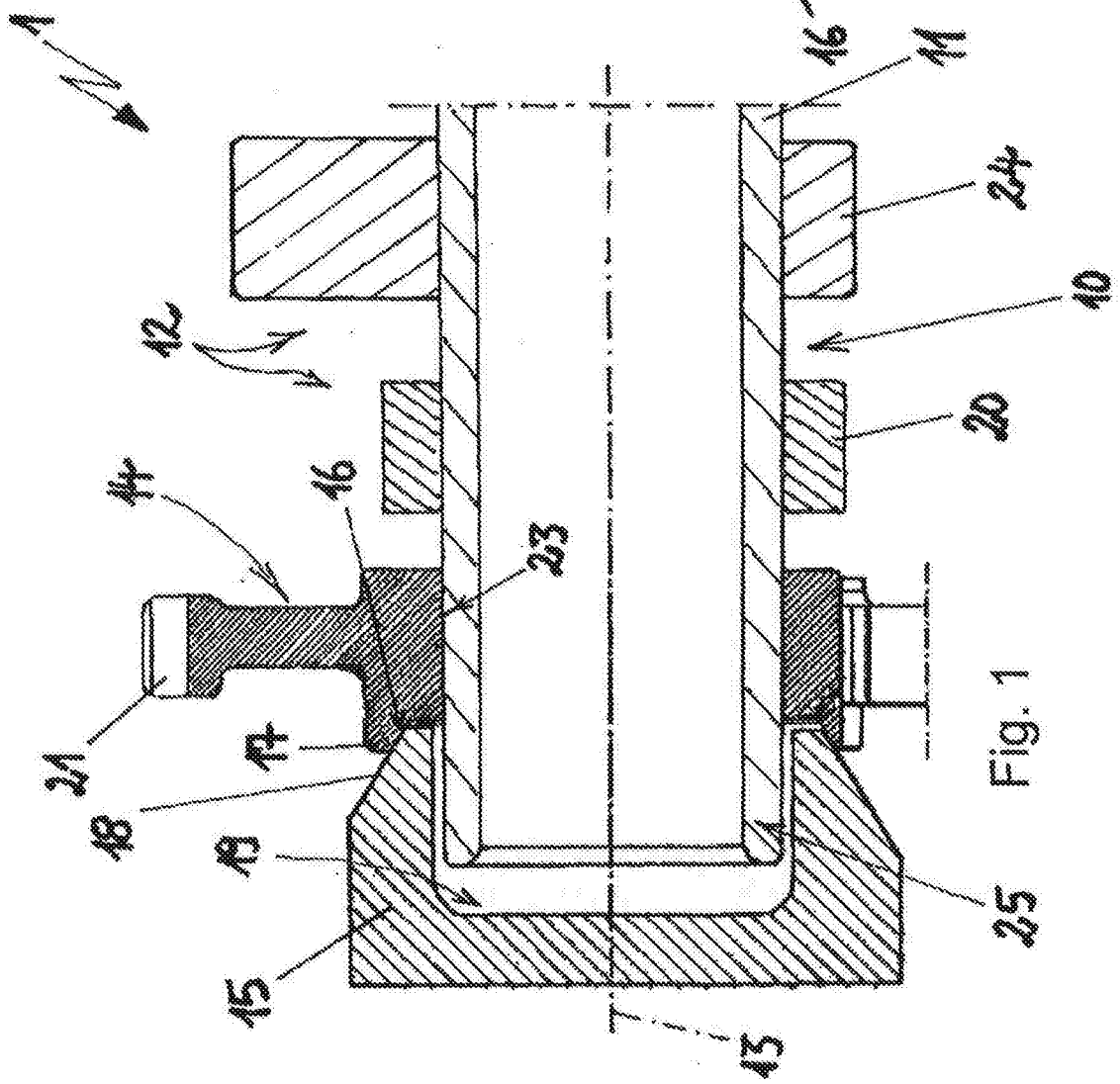

Fig. 1