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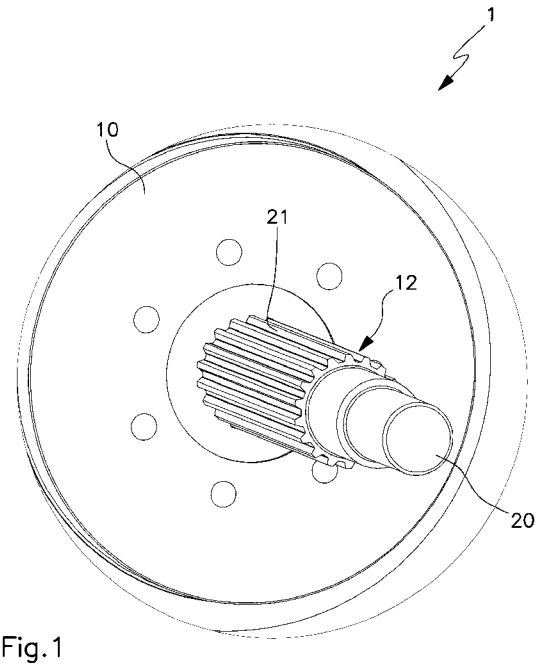

Fig.1

(57) Abstract: The method for making a precision coupling between a pump shaft and a hollow member comprises the steps of prearranging a hollow member (10, 100) comprising a substantially cylindrical central cavity (2) and intended to be coupled with a substantially cylindrical pump shaft (20). At its central cavity (2) a ribbed profile (11, 110, 111) is made comprising a plurality of protrusions (12) comprising a determined number of centering protrusions (12a) and a remaining number of transmission protrusions (12b).

METHOD FOR MAKING A PRECISION COUPLING BETWEEN A PUMP SHAFT AND A HOLLOW MEMBER, AND HOLLOW MEMBER AND PUMP SHAFT MECHANICAL COUPLED TOGETHER

Technical Field

[01] The present invention concerns a method for making a precision coupling between a pump shaft and a hollow member or hub of a pump member.

Background Art

[02] It has been known that for transmitting in an efficient way high torques between a pump shaft of a pump member and a hollow member or hub, usually an impeller, means for mechanical connection of the type of the keys are used.

[03] Furthermore, for very high torques, connections of the type of ribbed profiles are used. Such connections are substantially equal, from a functional point of view, to a series of multiple keys, distributed on the external circumference of the shaft and, correspondently, on the circumference of the internal cavity of the hub. Therefore, the connection through ribbed profile is able to ensure an efficient transmission of high torques.

[04] For example, international patent application WO 2010/141490 discloses a connection between shaft and hub through involute ribbed profile. The specific described profile is shaped so as to improve the distribution of the stresses resulting from the applied torque.

[05] The connection through ribbed profiles has anyway some drawbacks which can arise in case the centering of the involved mechanic members is not precise enough. Hence, in such case, the perfect balancing of the rotating members can be compromised, thus producing radial dynamic forces which can compromise the reliability and the safety of the apparatus in which such mechanical coupling is used.

[06] In order to overcome such drawbacks, usually the coupled ribbed profiles are produced with a high degree of precision, so as to produce a coupling with a reduced play at the inner diameter of the shaft, that is at the foot of the tooth, or at the external diameter of the shaft, that is at the head of the tooth, or, as well, at the sides. Anyway, such solutions for solving the centering problem result expensive, since they require mechanical processing having a high degree of precision of profiles with a complex shape, usually on both the shaft and the hub. Such processing, in particular, requires the use of suitable cut tools per se expensive, and complex mechanical working.

[07] Moreover, it is to be observed that the same centering solutions are not suitable to be used in coupling between shaft and impeller of centrifugal pumps. For such uses, in fact, the aggressiveness of the working environment, full of water, can create encrustations on the coupled mechanic parts, which make difficult or even impossible the required disassembly of the parts in case of maintenance.

Disclosure

[08] The task of the present invention is that of solving the aforementioned problems, by devising a method for making a precision coupling between a pump shaft and a hollow member or hub, which enables a reliable functioning, by optimizing the balancing of the mechanical parts.

[09] Within such task, it is a further scope of the present invention that of providing a hollow member or hub coupled with a pump shaft of a pump member, ensuring an optimal functioning in every field of use.

[10] A further scope of the invention is that of providing a mechanical coupling comprising a hollow member and a pump shaft, which allows a reliable and safe functioning in a centrifugal pump.

[11] The cited scopes are attained according to the present invention by the method for making a precision coupling according to claim 1, as well as by the hollow member coupled with the pump shaft according to claim 9.

[12] The method for making a precision coupling between a pump shaft and a hollow member or hub allows to obtain any degree of precision required for the coupling, thus minimizing the manufacture costs.

[13] As a matter o facts, according to a feature of the invention, the method provides to limit the required precise manufacturing for coupling to a first number of protrusions of the ribbed profile, thus creating centering protrusions having a degree of precision such as to produce, for the coupling, a determined play, reduced with respect to a bigger coupling play.

[14] A second remaining number of protrusions of the ribbed profile has the main task of transmitting the force, by means of a different transmission sizing, suitable to produce on the pump shaft the cited bigger play, with a lower degree of precision. In practice, for transmission protrusion it is possible to use a less accurate manufacturing process, thus less expensive.

[15] More precisely, the method provides to prearrange a hollow member provided with a substantially cylindrical central cavity and to make at said central cavity a ribbed profile comprising a plurality of distributed protrusions, preferably involute teeth. The above mentioned step of making the ribbed profile provides to apply a centering sizing, destined to obtain the degree of precision required for the coupling, at the cited first number of centering protrusions and a transmission sizing, different and preferably less precise, for the said remaining transmission protrusions.

[16] In practice, the above mentioned centering sizing is preferably located in determined zones of the centering protrusions, for obtaining limitedly to such zones a coupling with reduced play such as to ensure the correct and efficient centering between the pump shaft and the hollow member or hub both in static and dynamic conditions.

[17] The zones corresponding to the remaining transmission protrusions have a transmission sizing, provided for producing a coupling with play bigger than the cited reduced play.

[18] The cited centering sizing is preferably provided at the foot of the centering protrusions.

[19] Moreover, the method according to the invention provides to apply, in the production step of the above mentioned zones of the centering protrusions, a grade of centering tolerance more precise that the one applied at the same zones of the remaining number of protrusions, mainly destined to the force transmission.

[20] In practice, while the centering mechanical function is given to the cited zones of the selected number of centering protrusions, made with a higher degree of precision, the remaining number of protrusions mainly has a drawing or force transmission function and then can be made with a lower degree of precision.

[21] It is to be underlined that the use of the connection through ribbed profile, being able to distribute the drawing dynamic action on a plurality of radial protrusions, enables the mechanical coupling according to the invention to transmit high torques, thus minimizing the notching effects.

[22] Moreover, thanks to the particular differentiated sizing of the ribbed profile of the hollow member, it is possible to make, easily and in a relatively economic way, a coupling between ribbed profiles with high degree of precision, according to the unified ISO tolerances. This is enabled by limiting the more expensive precision manufacturing to a reduced number of protrusions of the hollow member. The method according to the invention then allows to make couplings between ribbed profiles with reduced costs with respect to the known methods, having the same degree of precision required by the coupling.

[23] Moreover, the centering protrusions, made through the centering sizing and preferably with the cited centering grade of tolerance, are preferably distributed in a way substantial homogeneous around the central cavity of the hollow member.

[24] The said centering protrusions then result to be preferably opposed to one another about the said central cavity, so as to ensure an optimal static and dynamic balancing and preventing undesired radial actions to arise during the functioning.

[25] According to a particular aspect of the invention, the number of the centering protrusions is equal to one quarter of the total number of protrusions provided for the ribbed profile of the hollow member, so as to optimize the steadiness and efficiency of the mechanical coupling in which the hollow member is used.

[26] According to a particular aspect of the invention, the hollow member according to the invention can be coupled with a full member or standard shaft, made with a lower degree of precision, obtaining as well the degree of precision desired for the coupling, thanks to the presence of respective centering protrusions. Such degree of precision of the profile of

the shaft is preferably not higher than the average grade of tolerance, according to the ISO tolerance system. Also for this reason, the overall cost results to be reduced, at the same degree of precision for the coupling.

[27] A feature of the invention consists in the fact that the coupling made according to the method object of the invention can be easily assembled or disassembled. In fact, it is possible to provide that the coupling of the protrusions or teeth of the hollow member made with the said transmission sizing, is made with a play such as to ensure the easy disassembly of the parts, in any work condition, without affecting the functioning of the force transmission.

[28] The coupling according to the invention is really advantageous to be used in a centrifugal pump, in particular for the connection of a pump shaft with one or more impellers.

[29] The method according to the invention and the mechanical coupling made through it, thus, allow to make an efficient centering and an ever easy disassembly in the difficult working conditions in which the pumping members work, usually full of water and thus exposed to encrustations and other sedimentations, for example of oxidable metal means, which can compromise the correct functioning as well as the disassembly of the rotating members.

[30] The method according to the invention and the mechanical coupling made through it then allow an easy coupling of one or more impellers on the pump shaft. This is mainly due to the fact that only a part of the of the protrusions of the ribbed profile of the impeller is destined to produce a reduced play suitable to ensure the correct centering, while the remaining part is destined to ensure a bigger play, suitable for disassembling and drawing of the coupled members.

[31] The invention is particularly advantageous for embodiments in which high forces are involved and in which the coupling between pump shaft and each impeller axially extends for a considerable tract of the pump shaft. For example, it occurs when more impellers must be coupled in series with the same shaft. Also in such case, in fact, the method according to the invention allows to ensure a correct centering and an efficient transmission, by limiting the zones of the ribbed profile having the centering function and requiring higher precision.

[32] Finally, according to a further aspect of the invention, it is possible to provide that the hollow member shapes a joint comprising a first ribbed profile on one side and a second ribbed profile on the opposed side of the relative central cavity. Such profile, having double ribbed profile, results to be particularly advantageous for coupling, on one side a first shaft, for example a motor shaft, and on the other side a second shaft, for example a pump shaft, of a same pump member.

Description of Drawings

[33] Details of the invention shall be more apparent from the detailed description of a preferred embodiment of the mechanical coupling suitable to be made through the method according to the invention, illustrated for indicative purposes in the attached drawings, wherein:

[34] figures 1 and 2 respectively show a perspective view and a front view of a mechanical coupling according to the invention;

[35] Figures 3 and 4 respectively show a perspective and an axial cross-view of a hollow member made according to the invention;

[36] Figure 5 shows an axial cross-section view of a centrifugal pump in which the mechanical coupling according to the invention is used;

[37] Figures 6 to 8 respectively show a front, axial cross-section view according to the plane VII-VII indicated in figure 6, and perspective view of a hollow member made according to a further embodiment of the invention;

[38] Figure 9 shows a centrifugal pump in which the hollow member used in figures 6 to 8 is used.

Best Mode

[39] With particular reference to such figures, the mechanical coupling according to the invention has been indicated for more clarity in its entirety with 1.

[40] The mechanical coupling 1 comprises a hollow member 10 and a full member 20 suitable to be coupled for allowing the transmission of a torque. The hollow member 10 or hub shapes a central cavity, on which internal surface a ribbed profile 11 is provided comprising a series of radial protrusions 12 distributed about the same central cavity 2.

[41] The full member 20 shapes a conjugated ribbed profile 21 comprising a corresponding series of conjugated radial protrusions 22 distributed on its external surface.

[42] As an example, in the case illustrated in figures from 1 to 4, the ribbed profile 11 of the hollow member 10 or hub comprises eighteen protrusions 12, preferably shaped by involute teeth. In correspondent way, in the same case the conjugated grooved profile 21 of the full member 20 or pump shaft comprises eighteen conjugated protrusions 21 of the same type, that is involute teeth.

[43] Anyway, the ribbed profiles 11, 21 which are destined to shape the mechanical coupling according to the invention can be provided with a different number of protrusions of teeth, as well as with a profile of different shape, provided that it is suitable for the transmission of the force.

[44] Each protrusion 12 shapes different zones, each suitably sized according to the kind of coupling to be made. More precisely each protrusion 12 or tooth has a foot zone 13 at the concavity of the profile 11 and a head zone 14, at the convexity of the profile.

[45] The ribbed profile 11 of the hollow member 10 thus provides a differentiated sizing and, preferably, differentiated grades of tolerance for the protrusions 12. More precisely, a selected part corresponding to a determined number of protrusions 12a has, at least for a respective zone 13a, a centering sizing. The remaining part or number of protrusions 12b has instead, for the corresponding zone 13b, a transmission sizing (see figure 2).

[46] In the illustrated case, the zones 13a of the centering protrusions 12a of the ribbed profile 11 are the zone of the foot of the tooth. In practice, in order to ensure a correct centering between the full member 20 and the hollow member 10, the centering sizing of the centering zones 13a, corresponding to the size of the diameter of the hollow member 10 at the foot of the protrusions 12a, is such as to produce, when coupling with the corresponding conjugated profile 21 of the shaft 20, a centering play 15a reduced with respect to the coupling play 15b created in the corresponding zones 13b of the remaining protrusions 12b.

[47] The remaining protrusions 12b provide for the corresponding zones 13b at the foot of the tooth a transmission sizing, which is able to make the cited play 15b larger than the reduced centering play 15a. Such larger coupling play 15b is suitable to allow an easy coupling of the hollow member 10 with the full member 20, and an easy disassembly for the maintenance operations, further than, at the same time, an efficient transmission of the torque, with a reduction of the correspondent overall notching effect on the transmission.

[48] In the illustrated case, thus, the zones 13a at the foot of the selected centering teeth 12a are made with a diameter smaller than the zones 13b at the foot of the remaining transmission teeth 12b. The corresponding conjugated profile 21 of the hollow member 20 can instead be of traditional type, that is it can shape a same sizing for the head diameter of the respective conjugated protrusions 22. Therefore, the mechanical coupling 1 shaped by the described hollow member 10 and by the full member 20 has the cited centering play 15a reduced only at the zones 13a and the transmission play 15b larger at the remaining zones 13b (see figure 2).

[49] The zones 13a of the selected centering protrusions 12a are preferably made with a centering grade of tolerance, such as to ensure as a result the reduced centering play 15a having the desired accuracy and precision.

[50] On the contrary, the zones 13b of the remaining transmission protrusions 12b can be made with a different transmission grade of tolerance, having a lesser precision, thus reducing the overall production costs.

[51] With reference to the full member 20 or shaft, uniform size and uniform grades of tolerance can be provided for the corresponding zones of the conjugated protrusions 22, since the centering function is substantially given, according to the invention, to the

centering protrusions 12a of the hollow member 10 and, in particular to the respective zones 13a.

[52] In substance, the accuracy of the mechanical manufacturing and therefore the degree of precision required for the mechanical coupling 1 are concentrated in the zones 13a of the selected centering protrusions 12a, thus reducing the production costs for making the hollow member 10, as well as the costs of the mechanical coupling 1 in its entirely.

[53] In the illustrated case, the centering protrusions 12a are reduced to four, reciprocally opposed with respect to the longitudinal axis of the hollow member 10, so as to ensure the static and dynamic balancing of the overall mechanical coupling 1.

[54] It is preferable that the number of centering protrusions 12a substantially is a number greater or equal to three, or preferably equal to one quarter of the total number of protrusions 12 or teeth. Such proportion allows an optimal balancing of the hollow member 10.

[55] Moreover, it is necessary to observe that the selected zones 13a are preferably located at the foot of the tooth of the ribbed profile. Such circumstance allows to ease mechanical workings, providing a cut tool for the profile, usually a broach, made in traditional way, except for the fact that it provides a differentiated sizing, that is a smaller diameter for the cut protrusions destined to shape the foot of the centering protrusion 12a. In substance, such cut protrusions of the broach are suitably ground on a diameter different with respect to the cut protrusions suitable to make the transmission zones. As a consequence, the so obtained centering zones 13a ensure the required precision for the coupling 1, while the remaining portion of the ribbed profile 11 is mainly destined to perform the force transmission work.

[56] For manufacturing the full member 20 suitable to be coupled with the hollow member 10 it is instead preferable to use ribbed profiles 21 obtained with a grade of tolerance not higher than the average grade of tolerance, uniform for the whole profile and/or anyway normalized. As a consequence, the full member 20 can be easily found on the market, without requiring special manufacturing.

[57] The functioning of the method for manufacturing the mechanical coupling, and of the mechanical coupling itself, according to the invention, are easy to understand from the preceding description.

[58] In a manufacturing step, the hollow member 10 provided with the substantially cylindrical central cavity 2 is prepared. At said central cavity 2 the ribbed profile 11 is made, creating the centering protrusions 12a and the transmission protrusions 12b with a differentiated sizing, as it was previously disclosed.

[59] Then the full member 20 is prepared, provided with a same total number of conjugated protrusions 22 with a substantially undifferentiated sizing.

[60] The hollow member 10 is then coupled with the full member 20. Between the above mentioned members 10, 20 the reduced centering play 15a is created at the centering protrusions 12a of the hollow member while the transmission play 15b is created at the transmission protrusions 12b of the hollow member 10.

[61] The disclosed coupling 1 can then be used for transmitting a torque, for example from the shaft 20 to the hub 10, as it is in case of a pump member, in which the hub 10 carries an impeller. The centering play 15a allows a balanced centering with the required precision, while the transmission play 15b ensures an easy coupling in any condition. High forces can then be transmitted through a plurality of protrusions of the coupled conjugated profiles 11, 21.

[62] According to a preferred embodiment of the invention disclosed in figure 5, the hollow member 10 shapes an impeller suitable to be used in a pump member 30, while the shaft 20 shapes the pump shaft with which one or more impellers 10 are suitable to be coupled. In the illustrated case the pump member 30 comprises a couple of impellers 10 coupled with the same pump shaft 20.

[63] The impellers 10 shape the grooved profile 11 as it was previously described, with a differentiated sizing, at the respective central cavity. The pump shaft 20 shapes the ribbed profile 21 preferably normalized.

[64] The use of the coupling 1 is particularly advantageous in the illustrated case, as it allows to keep an optimal centering even in presence of a full member 20 or pump shaft longitudinally extended and then destined to couple with one or more impellers 10 with the same precision. This is enabled by the fact that the accuracy of the centering is substantially given by the ribbed profile of the impellers 10. Moreover, only one part of such profile, relative to the cited centering protrusions, is sized for the precise centering, while the remaining part is possibly sized with a wider coupling play, for easing the coupling.

[65] According to a further embodiment shown in figures 6 to 9, the hollow member 100 shapes a coupling joint for a couple of full members or shafts 20. The central cavity 2 of the hollow member 100 shapes a first ribbed profile 110, open on a side, and a second ribbed profile 111, open on the opposite side. Therefore the joint 100 can be used for coupling with and centering, on one side, for example through the first ribbed profile 110, the pump shaft 20 of a pump member 300 for example of submerged type and on the other side, through the second ribbed profile 111, the shaft of a motor member, not represented, for operating the pump member 300.

[66] The use of the coupling 1 according to the invention on each side of the joint 100 is particularly advantageous, since it allows the correct centering of a couple of shafts, for drawing the coupled impellers of the pump shaft 20.

[67] In practice, the embodiment of the invention, the materials used, as well as the shape and dimensions, may vary depending on the requirements.

[68] Should the technical characteristics mentioned in each claim be followed by reference signs, such reference signs were included strictly with the aim of enhancing the understanding the claims and hence they shall not be deemed restrictive in any manner whatsoever on the scope of each element identified for exemplifying purposes by such reference signs.

Claims

1. Method for making a precision coupling between a pump shaft (20, 200) and a hollow member (10, 100) for a pump member (30, 300), **characterized in that** it comprises the steps of:

   a. prearranging a said hollow member (10, 100) comprising a substantially cylindrical central cavity (2) and intended for being coupled with a said pump shaft (20);

   b. making at said central cavity (2) a ribbed profile (11, 110, 111) comprising a plurality of protrusions (12) distributed around said central cavity (2), said protrusions (12) comprising a first number of centering protrusions (12a) made according to a centering sizing and a second number of transmission protrusions (12b) made according to a transmission sizing different with respect to said centering sizing, said centering sizing being suitable to produce in the coupling with said pump shaft (20, 200) a centering play (15a) reduced with respect to a coupling play (15b) produced by said transmission sizing;

   c. prearranging said hollow member (10, 100) for its coupling with said pump shaft (20, 200) carrying on its external surface a conjugate ribbed profile (21) having respective conjugated protrusions (22).

2. Method according to claim 1, **characterized in that** said centering protrusions (12a) having said centering sizing are made with a same centering grade of tolerance, differentiated and more precise with respect to the grade of tolerance provided for the remaining transmission protrusions (12b) of said hollow member (10, 100).

3. Method according to claim 2, **characterized in that** said centering sizing of said centering protrusions (12a) is limited to respective zones (13a) of said centering protrusions (12a).

4. Method according to claim 3, **characterized in that** said zones (13a) having said centering sizing are located at the foot of said centering protrusions (12a) of said hollow member (10, 100).

5. Method according to one of the previous claims, **characterized in that** said centering protrusions (12a) are distributed in a substantially uniform manner around said central cavity (2) of said hollow member (10, 100), so as to ensure the correct balancing of the coupling with said pump shaft (20).

6. Method according to claim 5, **characterized in that** said determined number of centering protrusions (12a) is equal to a number greater or equal to three or substantially one fourth of the total number of protrusions or teeth (12) of the said ribbed profile (11, 110, 111) of said hollow member (10, 100).

7. Method according to one of the previous claims, **characterized in that** said protrusions (12) of said ribbed profile (11, 110, 111) shape teeth with involute profile.

8. Method according to one of the previous claims, **characterized in that** said pump shaft (20) shapes a standardized toothing made with an undifferentiated sizing of said respective conjugated protrusions (22).
9. Hollow member mechanically coupled with a pump shaft (20) of a pump member (30, 300), said hollow member (10, 100) having a substantially cylindrical central cavity (2) shaping a ribbed profile (11, 110, 111) carrying a plurality of protrusions (12) and said pump shaft (20, 200) having a conjugated ribbed profile (21) carrying respective conjugated protrusions (22), **characterized in that** said ribbed profile (11, 110, 111) of said hollow member (10, 100) comprises a first number of centering protrusions (12a) having a centering sizing and a second number of transmission protrusions (12b) having a transmission sizing, different with respect to said centering sizing, said centering sizing producing in the coupling with said pump shaft (20, 200) a centering play (15a) reduced with respect to a coupling play (15b) produced by said transmission sizing, for the centering on said pump shaft (20, 200).
10. Hollow member coupled with a pump shaft according to claim 9, **characterized in that** said centering protrusions (12a) having said centering sizing are made with a same grade of tolerance, different and more precise with respect to the grade of tolerance used for making said remaining transmission protrusions (12b) of said hollow member (10, 100).
11. Hollow member mechanically coupled with a pump shaft according to claim 10, **characterized in that** said centering sizing is provided in respective zones (13a) of said centering protrusions (12a).
12. Hollow member mechanically coupled with a pump shaft according to claim 11, **characterized in that** said zones (13a) of said centering protrusions (12a) are located at the foot of said protrusions (12a).
13. Hollow member mechanically coupled with a pump shaft according to one of the claims 9 to 12, **characterized in that** said first number of centering protrusions (12a) is uniformly distributed around said central cavity (2).
14. Hollow member mechanically coupled with a pump shaft according to one of claims 9 to 13, **characterized in that** said first number of centering protrusions (12a) is equal to a number greater or equal to three or substantially one fourth of the total number of protrusions (12).
15. Hollow member mechanically coupled with a pump shaft according to one of claims 9 to 14, **characterized in that** said protrusions (12) and said conjugated protrusions (22) shape involute teeth.
16. Hollow member mechanically coupled with a pump shaft according to one of claims 9 to 15, **characterized in that** said conjugated ribbed profile (21) of said pump shaft (20, 200) has respective conjugated protrusions (22) made with an undifferentiated sizing.

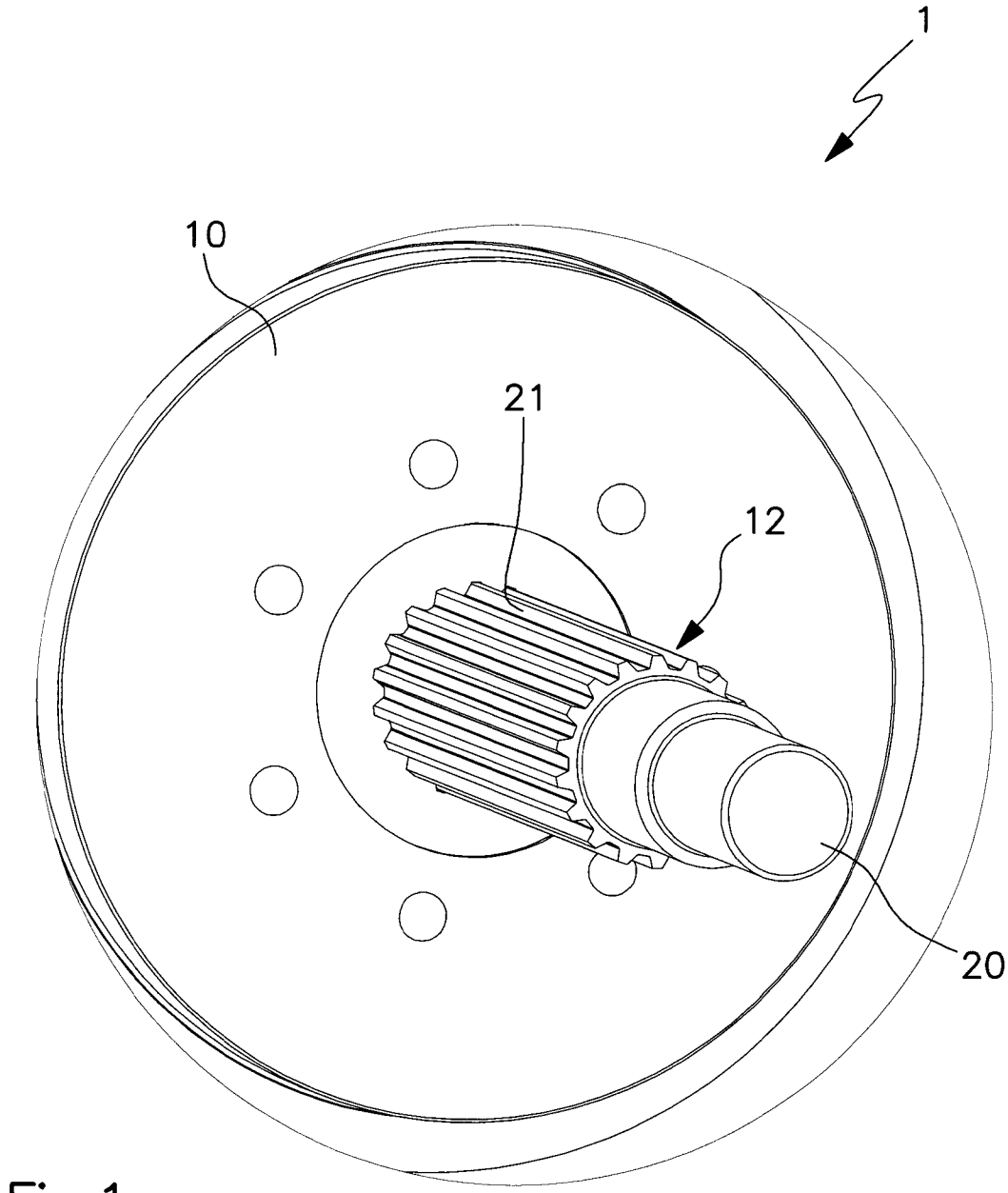

Fig.1

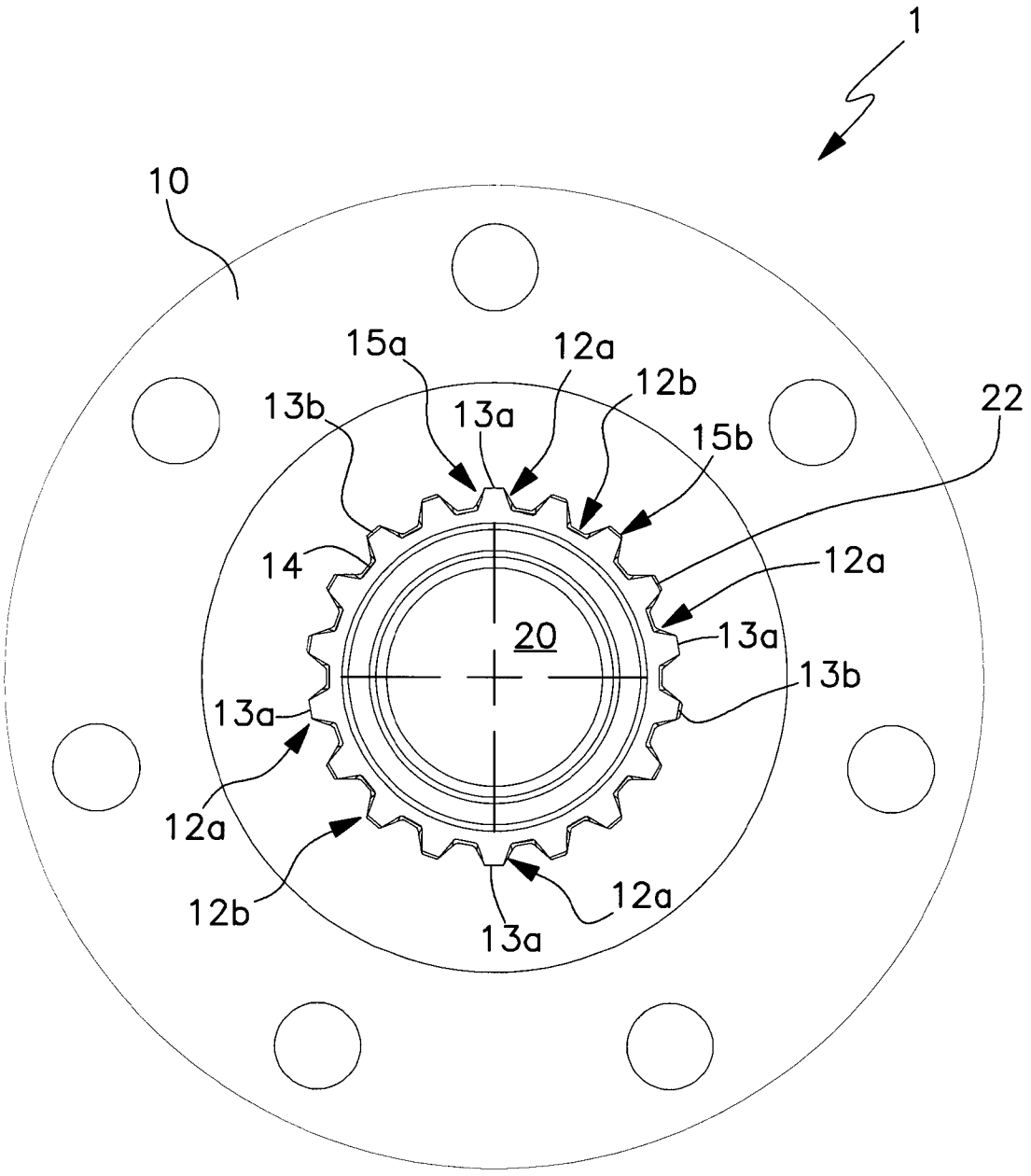
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Fig.2

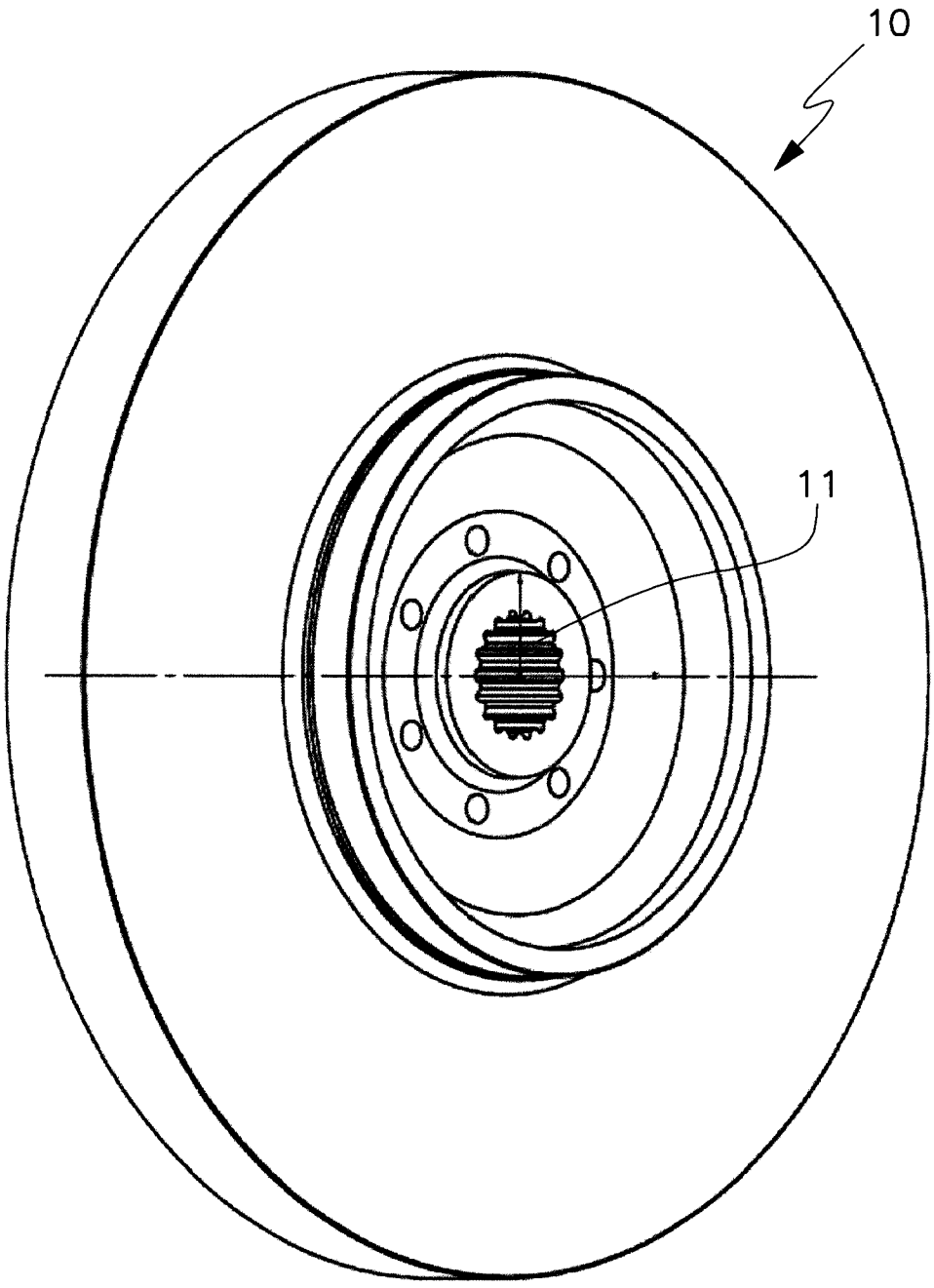
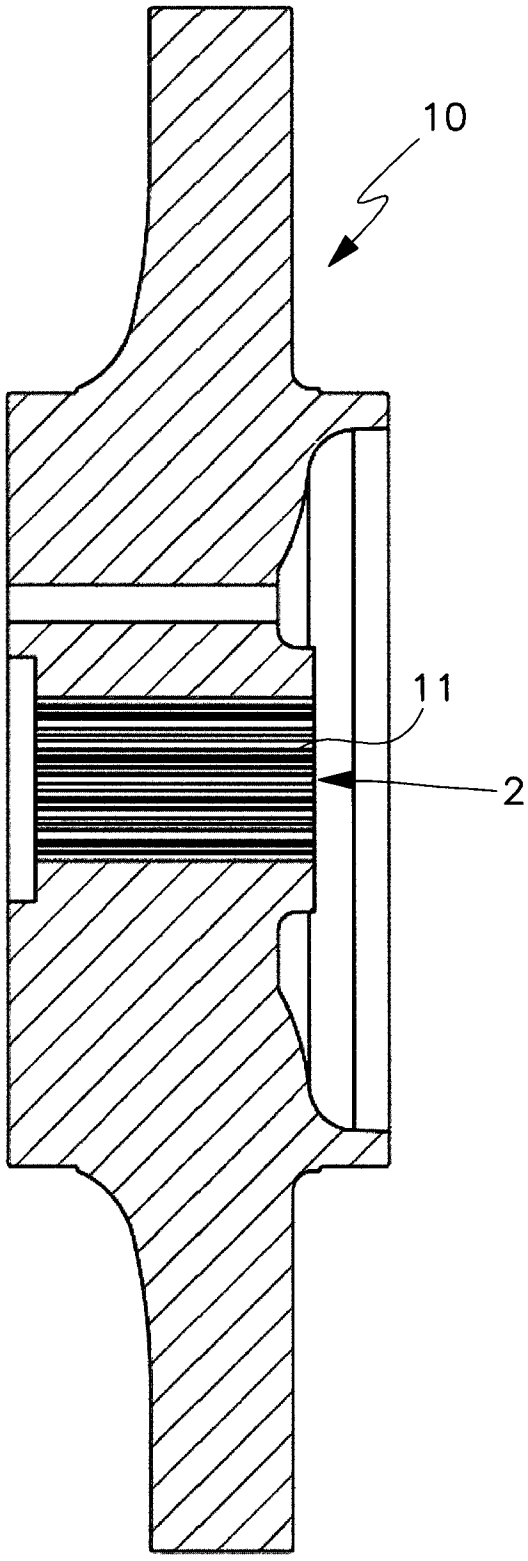


Fig.3

Fig.4



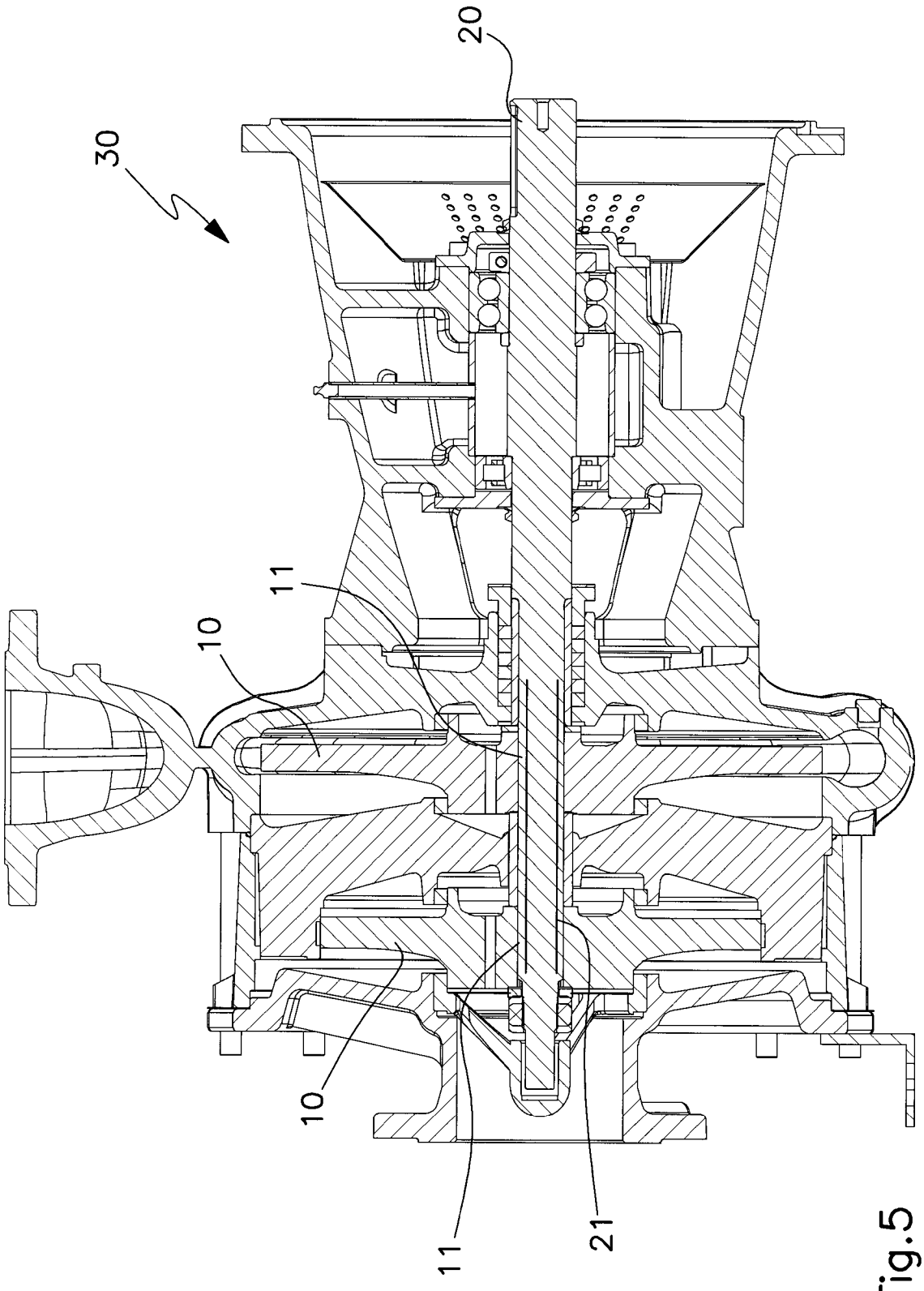
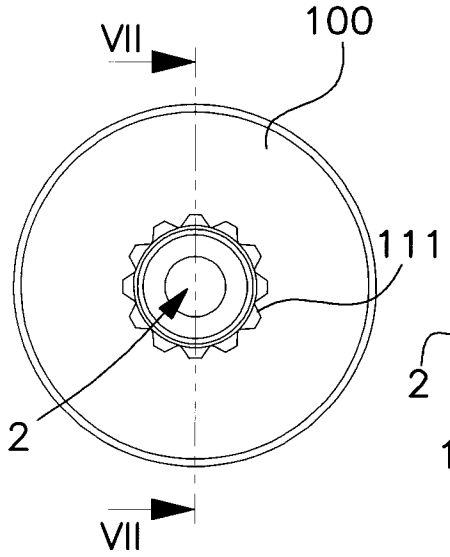


Fig.5

Fig.6



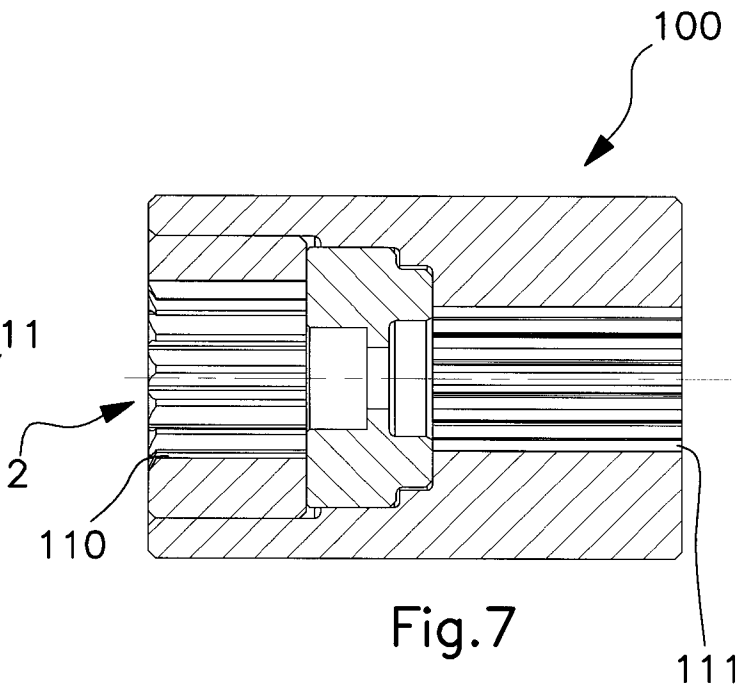


Fig.7

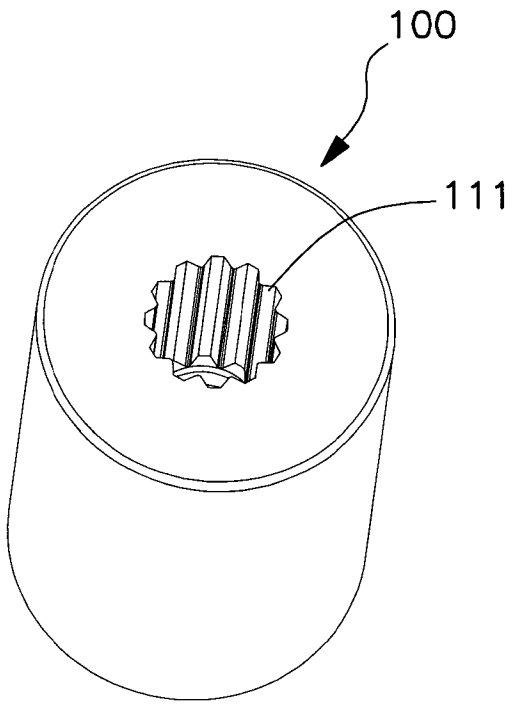


Fig.8

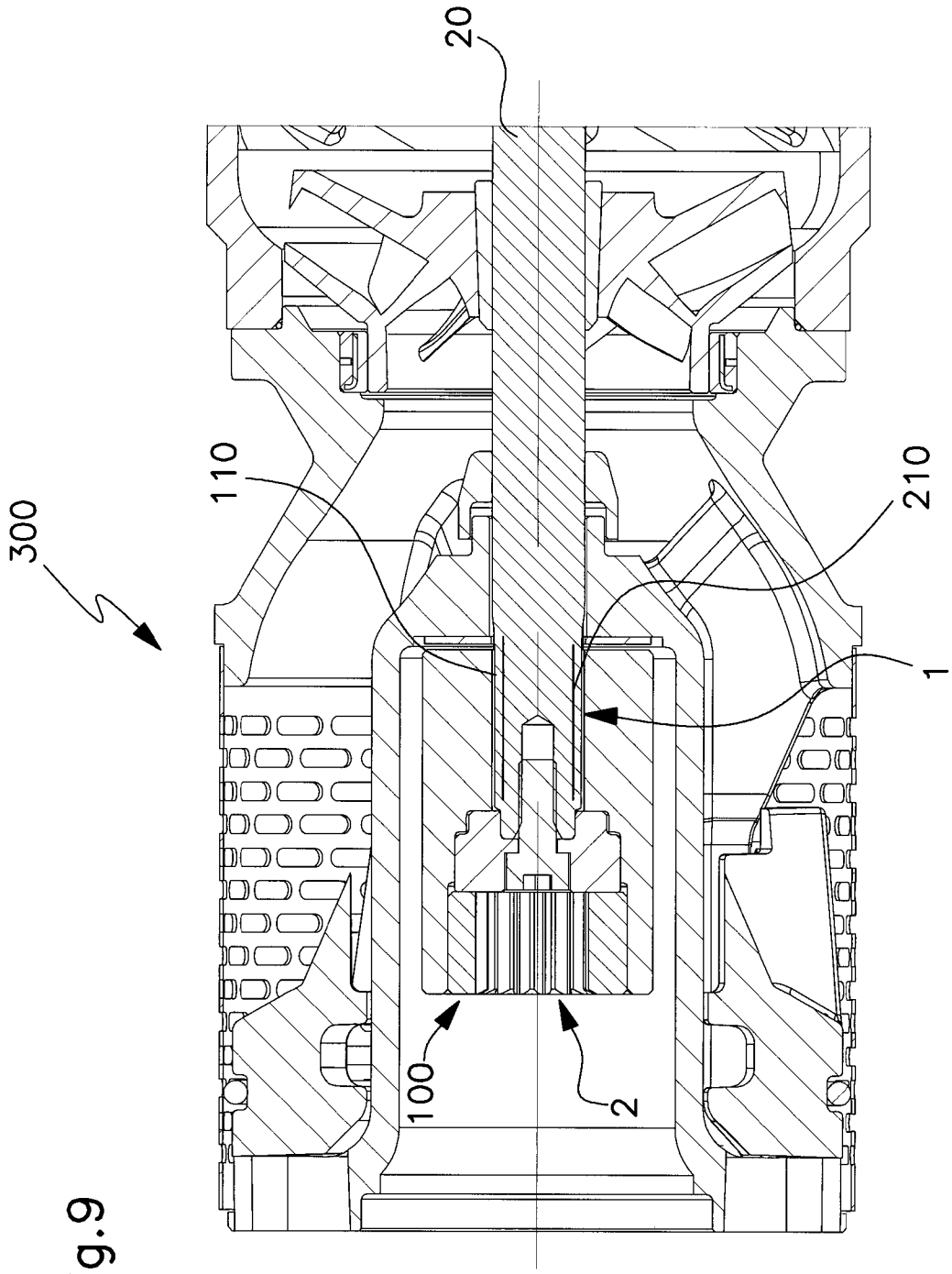


Fig.9

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/059591

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16D1/10
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP H11 108070 A (TOYOTA MOTOR CORP) 20 April 1999 (1999-04-20) figures 1a,1b	1-16
A	WO 2009/029574 A1 (GKN DRIVELINE NORTH AMERICA [US]; HAHN STEVEN C [US]) 5 March 2009 (2009-03-05) figures 5-7	1
X	EP 1 900 951 A1 (AICHI MACHINE IND [JP]) 19 March 2008 (2008-03-19) figure 4	9-15
A	GB 668 092 A (WEDEVAGS BRUKS AKTIEBOLAG) 12 March 1952 (1952-03-12) figure 1	1,9

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 June 2014	01/07/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Pecquet, Gabriel

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2014/059591

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GB 668092 A	12-03-1952	NONE	