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(54) **SERRATION CONNECTION FOR A STEERING ASSEMBLY**

(57) The present application relates to a steering assembly (1) including a serration connection for an automotive vehicle comprising:

- a steering wheel (2) comprising at least one wheel bearing (3) having at least one connection part presenting gear teeth (7) and gear teeth gaps (6) and
 - a steering column (4) comprising a column bearing (5) having at least one connection part presenting gear teeth (7) and gear teeth gaps (6);
- the respective gear teeth (7) and gear teeth gaps (6) of the wheel bearing (3) and of the column bearing (5) being

intended to cooperate together to connect in transmission the steering wheel (2) and the steering column (4); and

wherein
at least one tooth gap (6) of the wheel bearing (3) is at least partially filled with a removable filling material (9); the corresponding area of the column bearing (5), respectively, facing the at least partially filled tooth gap (9), comprises at least one recess (8), and such arrangement is the initial position of the wheel bearing (3).

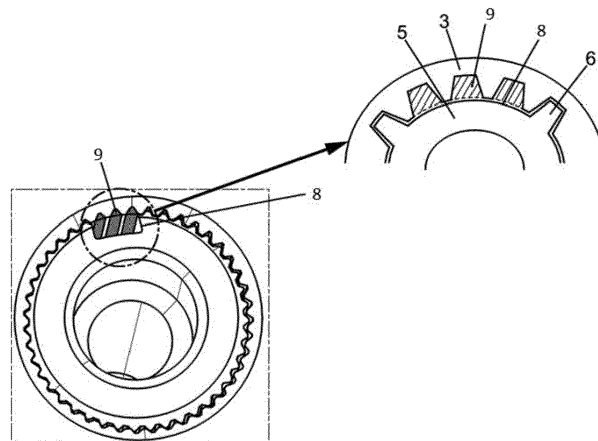


FIG. 4

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Description

Technical Field

[0001] The invention relates to the serration connection of a steering assembly for an automotive vehicle, particularly a truck or the like. This invention also relates to the manufacturing method of producing the steering assembly of the present invention, a method for setting up the steering assembly according to the present invention, and an automotive vehicle equipped with such a system.

State of the Art

[0002] In the field of automotive vehicles, reliable trajectory control is among the prominent safety features required for ensuring smooth and secure traffic on roads. The steering assembly is the part of the vehicle which ensures the link between the steering wheel and the front wheels.

[0003] Therefore, an important part of the manufacture of an automotive vehicle lies in the quality of the production of the components constituting the steering assembly, and another part lies in the assembly of these components, in particular in their orientations.

[0004] It is known that, during the manufacture of the steering assembly, errors can be done by the operator during the connection of the steering wheel with the steering column, which may result in a misalignment of the pieces of the steering assembly. Therefore, the operator must take a certain time in order to be sure to correctly assemble the two pieces, and despite the concentration of the operator, mistakes can happen during this step.

[0005] A shift of the steering assembly may occur in the course of a normal use of the vehicles. This shift causes a misalignment between the wheels and the steering wheel. To correct the misalignment, the operator usually acts on the adjustment devices located at the wheels or take down the whole vehicle, in order to solve the problem. In both cases, the procedures are inconvenient because they keep an operator busy for a long period of time. Furthermore, when there is a problem with the adjustment devices located at the wheels (for example due to rust, or a breaking) the only way to correct the misalignment is to take down the vehicle, which is a heavy and long procedure.

[0006] Therefore, there is a need to find a solution, allowing to improve both the mounting of the steering assembly and of the repair operations thereof.

Objectives of the invention

[0007] In order to solve the problems cited above, the objective of the present invention is to provide a steering assembly and a method for manufacturing the steering assembly which at least enable to:

- reduce the time for manufacturing the steering assembly, and/or
- reduce the number of errors associated to the misalignment of the steering column and the steering wheel during the manufacturing process, and/or.
- improve the reparation process of the steering assembly.

Summary of the invention

[0008] After many researches, the inventors have come to a steering assembly including a serration connection in order to solve the technical problems mentioned above.

[0009] In a first object of the invention, it is proposed a steering assembly including a serration connection for an automotive vehicle comprising:

- a steering wheel comprising at least one wheel bearing having at least one connection part presenting gear teeth and gear teeth gaps and
- a steering column comprising a column bearing having at least one connection part presenting gear teeth and gear teeth gaps ; the respective gear teeth and gear teeth gaps of the wheel bearing and of the column bearing being intended to cooperate together to connect in transmission the steering wheel and the steering column ;

and wherein

at least one tooth gap of the wheel bearing is at least partially filled with a removable filling material;

the corresponding area of the column bearing , respectively, facing the at least partially filled tooth gap, comprises at least one recess, and such arrangement is the initial position of the wheel bearing.

[0010] Hence, only one position allows the operator to assemble the steering column and the steering wheel together. Therefore, these pieces can be quickly assembled with the right alignment. As a result, the time for manufacturing the steering assembly is reduced, and the accuracy of the alignment of the pieces is significantly improved.

[0011] As the filling material of the tooth gap of the wheel bearing can be removed, it is possible for the operator to simply correct a misalignment by:

- taking off the steering wheel,
- removing the filling material, and
- finally mounting the steering wheel by shifting it at least one notch according to the angle to be corrected.

Therefore, the operator has a very fast and convenient way of setting the angle of the steering assembly without

requiring to act on the adjustments devices located at the wheels, or deconstructing the whole vehicle.

[0012] The steps of filling and removing the material from the tooth gap are very simple and fast. Therefore, these steps do not extend the construction time of the vehicle and thus they do not increase the cost of production of the vehicle.

[0013] In another aspect of the present invention, when the number of filled tooth gap is higher than one, the filled teeth gaps can be adjacent to each other.

[0014] In another aspect, the number of filled teeth gap can be of one or more.

[0015] The amount of filled teeth gaps can be comprised between 1% and 50% preferably between 2% and 30%, even more preferably between 6% and 20% of the total number of teeth gaps.

[0016] In another aspect, the bearing connection part may be an internal part of the wheel bearing.

[0017] In another aspect, the bearing connection part may be an external part of the column bearing.

[0018] In another aspect, the removable filling material may be a polymeric resin.

[0019] In another aspect, the polymeric resin may comprise one or more resin components selected from the group comprising a polyorganosiloxane, a polyimide, a styrene-based resin, a polyolefin-based resin, a polyoxyalkylene-based resin, a polyester-based resin, a polyvinyl chloride-based resin, a polycarbonate-based resin, a polyphenylene sulfide-based resin, a polyamide-based resin, an acrylate-based resin, an epoxy-based resin, and a fluorine-based resin.

[0020] In a specific embodiment of the present invention, the polymeric resin is a polyamide 6,6.

[0021] The removable filling material is selected such as it adheres to aluminum, magnesium and/or steel. The filling material is then sufficiently attached to the selected tooth gap so that the connection between the wheel bearing and the column bearing can be done efficiently at the right position. Furthermore, the filling material can be easily removed after the mounting process.

[0022] In another aspect, a steering wheel may be provided for a steering assembly according to the present invention.

[0023] In another aspect, a steering column which may include a column bearing for a steering assembly according to the present invention may be provided.

[0024] In another object of the present invention, a method for producing a steering assembly according to the present invention is proposed which may comprises the steps of:

- a) implementing a steering wheel and a steering column according to the present invention;
- b) preparing a liquid precursor composition of a hardened filling material;
- c) filling at least one tooth gap of the wheel bearing with the liquid precursor composition of step b);
- d) hardening the liquid precursor composition filled

in the tooth gap ;

e) inserting into each other the wheel bearing and the column bearing such that the recess faces the tooth gap filled with the hardened filling material.

[0025] In another aspect of the method of the present invention, when the number of filled tooth gap is higher than one, the filled teeth gaps can be adjacent to each other.

[0026] In another aspect of the method of the present invention, a cleaning step can be realized before the step a). This cleaning step allows to remove the impurities present on the surface of the wheel bearing or the column bearing and thus improves the adhesion of the removable filling resin.

[0027] Another object of the present invention lies in an alignment method for setting up a steering system including the steering assembly according to the present invention;

wherein

(i) the wheel bearing and the column bearing may be disconnected by withdrawal from each other;

(ii) the hardened filling material may be removed from the adjacent teeth gaps;

(iii) the wheel bearing and the column bearing may be inserted into each other so as to shift by at least one step the teeth gaps from their initial position.

[0028] The steering assembly of the present invention allows thanks to the alignment method cited above, to simply correct a misalignment of the steering assembly. As a result, the said method renders possible, to correct a potential shift without having to operate on the adjustment devices for the wheels but simply on the steering wheel, which is more convenient, and takes fewer time. For example, in the case of the rusting (or the breaking) of the adjustment devices located at the wheels, it would be impossible for the operator to correct the misalignment with at this location of the car. Therefore, the operator would have to deconstruct the whole vehicle in order to reset the alignment of the steering assembly. Therefore, the method of the present invention improves the process to repair the steering assembly of the vehicle by giving an alternative allowing to simply reset the alignment of the steering assembly even if the adjustment devices located at the wheels are damaged without deconstructing the whole vehicle.

[0029] Another object of the present invention lies in a motorized vehicle in which the steering system comprises the steering assembly according to the present invention.

Brief Description of Drawings

[0030] Other features, details and advantages will be shown in the following detailed description and on the figures, on which:

Fig. 1

[Fig. 1] Figure 1 is an exploded diagram of the column and the steering wheel of the steering assembly according to the present invention.

Fig. 2

[Fig. 2] Figure 2 comprises a perspective view (right side) of the wheel bearing according to an embodiment of the invention and a detailed perspective view (left side) of the wheel bearing (right).

Fig. 3

[Fig. 3] Figure 3 comprises a perspective view of the wheel bearing and the column bearing according to an embodiment of the invention (left side), and a detailed front view of the connection between the teeth gaps of the wheel bearing and the gear teeth of the column bearing according to an embodiment of the invention (right side).

Fig. 4

[Fig. 4] Figure 4 comprises a perspective view of the wheel bearing and the column bearing according to an embodiment of the invention (left side), and a detailed front view of the filled teeth gaps of the wheel bearing and the recess of the column bearing according to an embodiment of the invention (right side).

Description of the figures.

[0031] The present disclosure will now be described more fully hereinafter with reference to the accompanying drawings, in which currently preferred embodiments of the disclosure are shown. This disclosure may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. These embodiments are rather provided for thoroughness and completeness, and fully convey the scope of the disclosure to the skilled addressee. In the figures, the same references denote identical or similar elements. For sake of clarity, various elements may not be represented at scale.

[0032] The spatial referential for the terms "upper" and "lower" used hereinafter used in reference to Fig. 1, is given by Fig. 1 wherein right end corresponds to the top and left end to the bottom.

[0033] Fig. 1 represents an exploded diagram of the steering assembly 1 according to the present invention. This steering assembly comprises two main pieces, namely a steering wheel 2 and a steering column 4 which are reversibly bound together through two complementary connecting elements. These latter are a wheel bearing 3 and a column bearing 5 which are respectively part of the lower region of the steering wheel 2 and part of the upper region of the steering column 4.

[0034] Fig. 2 represents in its right part a perspective view of the steering wheel 2 including its wheel bearing

3 according to an embodiment of the invention, whereas the left part of Figure 2 is a detailed perspective view of the wheel bearing 3 shown on the wheel 2 of the right part of Figure 2. As shown on this detailed view, the wheel bearing 3 is an inner gear ring having teeth gaps 6. In the detailed perspective view of the wheel bearing 3, three teeth gaps 6 located at the upper region of the wheel bearing 3 are filled with the removable filling material 9.

[0035] As shown in Fig. 3 and 4, the column bearing 5 is an outer gear hub presenting outwardly extended gear teeth 7 on its exterior face and designed such as each gear tooth 7, corresponds and has a complementary shape to a tooth gap 6 of the wheel bearing 3, to make it possible the wheel bearing 3 and the column bearing be in mesh. The column bearing 5 is also characterized in that it is provided with a recess 8 in place of outwardly extended gear teeth 7. This recess 8 faces the teeth gaps 6 of the wheel bearing 3, filled with the removable filling material 9.

[0036] Therefore, according to the specific structures of the wheel bearing 3 and the column bearing 5, only one angular position is possible to connect the column bearing 5 with the wheel bearing 3 as shown in Fig. 4.

25 Example of an implementation of the process for manufacturing the steering assembly according to the present invention.

[0037] Step a) implementing steering wheel 2 and steering column 4 as those above described in reference to figures 1-4

b) preparing a liquid precursor composition of a hardened filling material

35 c) filling at least one tooth gap 6 of the wheel bearing 3 with the liquid precursor composition of step b);

d) hardening the liquid precursor composition filled in the teeth gaps 6;

40 e) inserting into each other the wheel bearing 3 and the column bearing 5 such that the recess 8) faces the teeth gaps 9 filled with the hardened filling material.

[0038] During the step b), the raw material used as a removable filling material is melted at a temperature corresponding to the fusion temperature of the removable filling material in order to obtain a liquid form of the removable filling material which is the liquid precursor composition. In this example, a polyamide having a viscosity number comprise between 100 to 150 cm³/g (according to ISO 307, 1157, 1628) and a melting point comprise between 200 and 300°C (according to ISO 11357-1/-3), is used as the raw material of the removable filling material and is melted at a temperature of between 200 to 300°C.

[0039] For example, the commercial product polyamide 6,6 Zytel® 103HSL BKB080 from Dupont has been used as the polyamide during the step b).

[0040] During the step c), in order to cast the liquid precursor composition in the specifically chosen three teeth gaps 6 of the wheel bearing 3 of this example, an appropriate jig hiding the not to be filled teeth gaps, is used and set up on the wheel bearing 3. The liquid precursor composition is poured and casted in the non-hidden teeth gaps 6 of the wheel bearing 3.

[0041] During the step d), the liquid precursor composition is then dried (for example by air) and after at least few seconds the jig is removed. The three teeth gaps 6 are filled with the hardened removable filling material 9, and the so-transformed wheel bearing 3 is the wheel bearing of the present invention.

List of reference signs

[0042]

steering assembly: 1.
steering wheel: 2.
wheel bearing: 3.
steering column: 4.
column bearing: 5.
teeth gaps: 6.
gear teeth: 7.
recess: 8.
filling material: 9.

Claims

1. Steering assembly (1) including a serration connection for an automotive vehicle comprising:

- a steering wheel (2) comprising at least one wheel bearing (3) having at least one connection part presenting gear teeth (7) and gear teeth gaps (6) and
- a steering column (4) comprising a column bearing (5) having at least one connection part presenting gear teeth (7) and gear teeth gaps (6);

the respective gear teeth (7) and gear teeth gaps (6) of the wheel bearing (3) and of the column bearing (5) being intended to cooperate together to connect in transmission the steering wheel (2) and the steering column (4); and

wherein
at least one tooth gap (6) of the wheel bearing (3) is at least partially filled with a removable filling material (9);
the corresponding area of the column bearing (5), respectively, facing the at least partially filled tooth gap (9), comprises at least one recess (8), and such arrangement is the initial position of the wheel bearing (3).

2. The steering assembly (1) according to claim 1, wherein when the number of filled tooth gap is higher than one, the filled teeth gaps are adjacent to each other.
3. The steering assembly according to claim 1 or 2, wherein the bearing connection part is an internal part of the wheel bearing (3).
4. The steering assembly according to anyone of claims 1 to 3, wherein the bearing connection part is an external part of the column bearing (5).
5. The steering assembly (1) according to claim 1 according to anyone of claims 1 to 4, wherein the removable filling material (9) is a polymeric resin.
6. The steering assembly (1) according to claim 5, wherein the polymeric resin comprises one or more resin components selected from the group comprising a polyorganosiloxane, a polyimide, a styrene-based resin, a polyolefin-based resin, a polyoxyalkylene-based resin, a polyester-based resin, a polyvinyl chloride-based resin, a polycarbonate-based resin, a polyphenylene sulfide-based resin, a polyamide-based resin, an acrylate-based resin, an epoxy-based resin, and a fluorine-based resin.
7. A steering wheel (2) for a steering assembly (1) according to anyone of claims 1 to 6.
8. Steering column (4) including a column bearing (5) for a steering assembly (1) according to anyone of claims 1 to 6.
9. A method for producing a steering assembly (1) according to anyone of claims 1 to 6 comprising the steps of:
 - a) implementing a steering wheel (2) and a steering column (4) according anyone of claims 1 to 4
 - b) preparing a liquid precursor composition of a hardened filling material;
 - c) filling at least one tooth gap (6) of the wheel bearing (3) with the liquid precursor composition of step b);
 - d) hardening the liquid precursor composition filled in the teeth gaps (6);
 - e) inserting into each other the wheel bearing (3) and the column bearing (5) such that the recess (8) faces the teeth gaps (9) filled with the hardened filling material.
10. An alignment method for setting up a steering system including the steering assembly (1) according anyone of claims 1 to 6 wherein

(i) the wheel bearing (3) and the column bearing (5) are disconnected by withdrawal from each other;

(ii) the hardened filling material is removed from the adjacent teeth gaps (6);

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(iii) the wheel bearing (3) and the column bearing (5) are inserted into each other so as to shift by at least one step the teeth gaps (6) from their initial position.

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11. A motorized vehicle in which the steering system comprises the steering assembly (1) according to anyone of claim 1 to 7.

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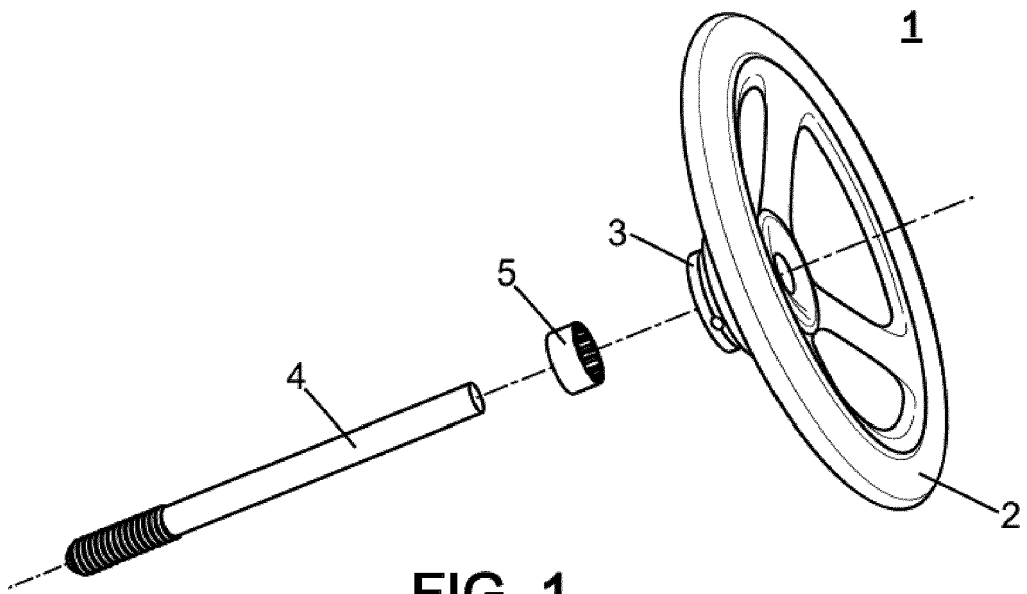


FIG. 1

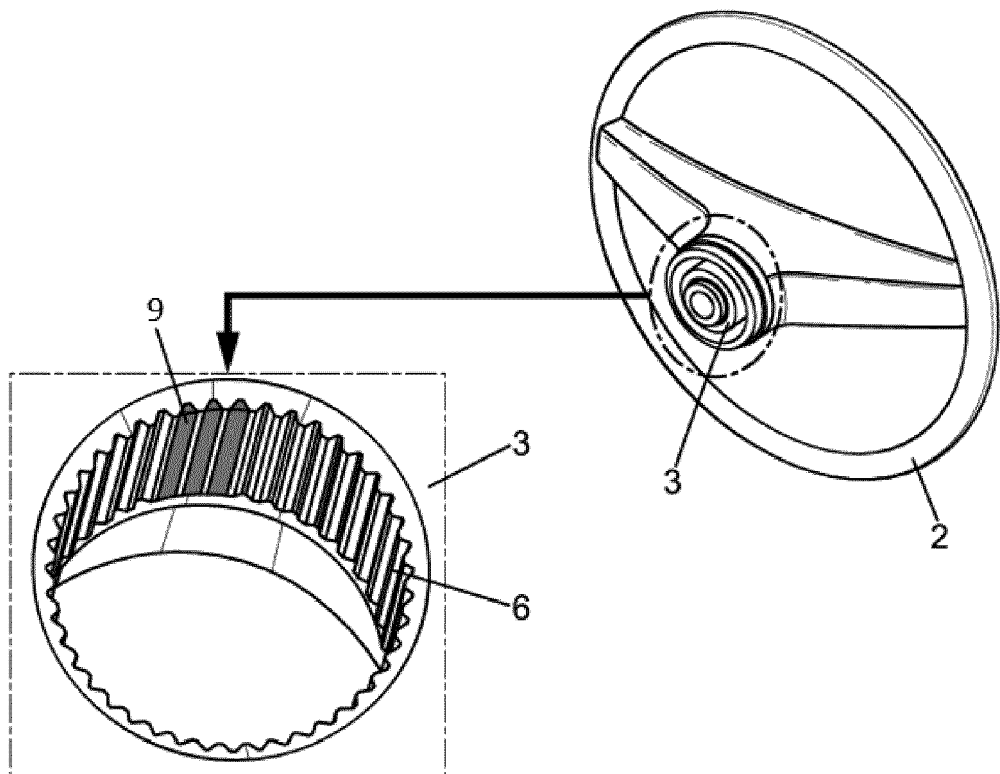


FIG. 2

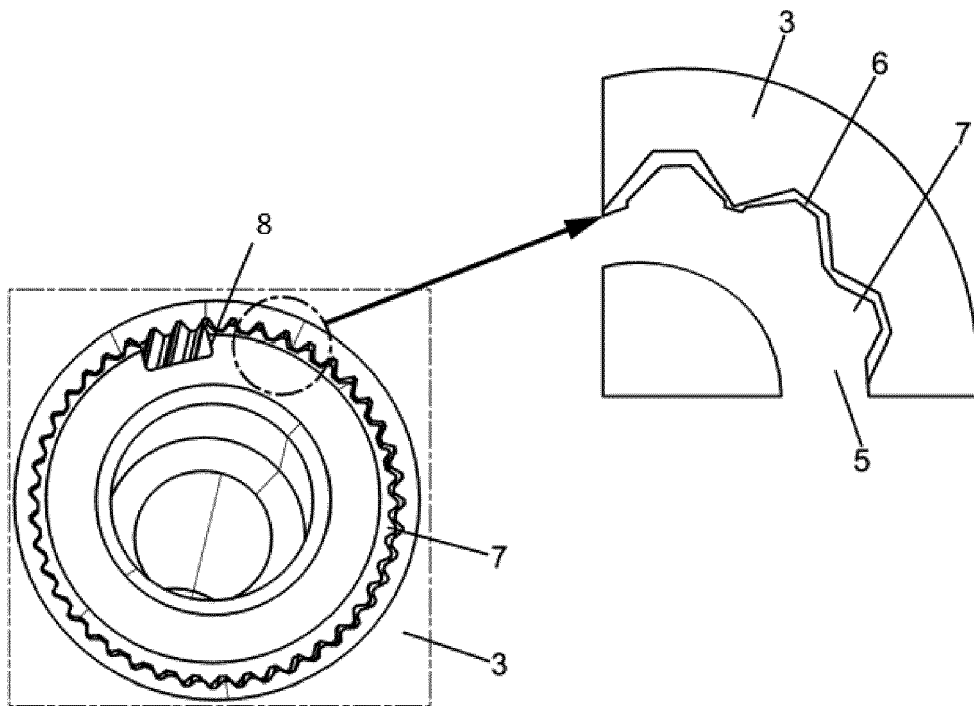


FIG. 3

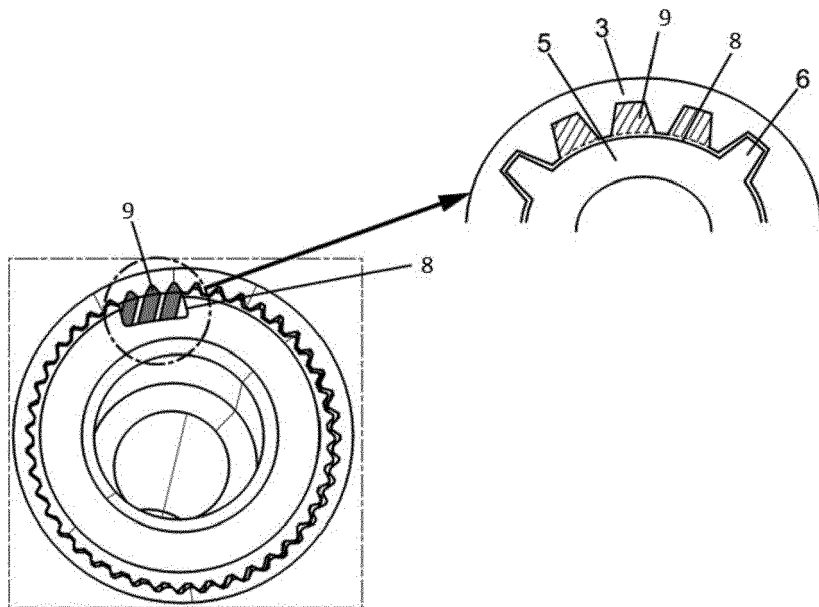


FIG. 4



EUROPEAN SEARCH REPORT

Application Number

EP 21 21 0855

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2009/270185 A1 (MIYAWAKI NAOTO [JP]) 29 October 2009 (2009-10-29)	1-4, 7, 8, 10, 11	INV. B62D1/10
Y	* figures 1, 2, 3, 4, 5 *	5, 6	F16C3/02
A	* paragraphs [0001], [0048] * -----	9	F16D1/06
Y	KR 2017 0037955 A (NITTA CORP [JP]) 5 April 2017 (2017-04-05) * figures 1, 7 * * paragraph [0030] * * The references cited refer to the annexed automated translation of this document. *	5, 6	
A	US 2009/145257 A1 (MIYAWAKI NAOTO [JP] ET AL) 11 June 2009 (2009-06-11) * figure 2 * -----	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			B62D F16C F16D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 26 April 2022	Examiner Frechard, Fabrice
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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26-04-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009270185 A1	29-10-2009	EP 2090493 A1	19-08-2009
		JP 5152548 B2	27-02-2013
		JP 2008120213 A	29-05-2008
		US 2009270185 A1	29-10-2009
		WO 2008056636 A1	15-05-2008

KR 20170037955 A	05-04-2017	CN 106662158 A	10-05-2017
		EP 3176452 A1	07-06-2017
		JP 2016033384 A	10-03-2016
		KR 20170037955 A	05-04-2017
		US 2017138408 A1	18-05-2017
WO 2016017280 A1	04-02-2016		

US 2009145257 A1	11-06-2009	CN 101353050 A	28-01-2009
		EP 2019018 A2	28-01-2009
		JP 2009029301 A	12-02-2009
		US 2009145257 A1	11-06-2009
