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(54) **A washing machine provided with improved driving unit between pulley and drum shaft**

(57) The present invention relates to a washing machine provided with a rotating drum, a drum shaft (A) provided with an ending pin (1), a pulley (3), and an improved driving unit disposed between the pulley (3) and the drum shaft (A), wherein motion is transmitted from

the pulley (3) to said ending pin (1) by means of frictional coupling provided by a washer (5), disposed between a bearing (2) mounted on said shaft (A) and the pulley hub, which is subject to a locking compression pressure against said washer (5) by means of ordinary tightening means screwed onto the ending pin (1) of said shaft (A).

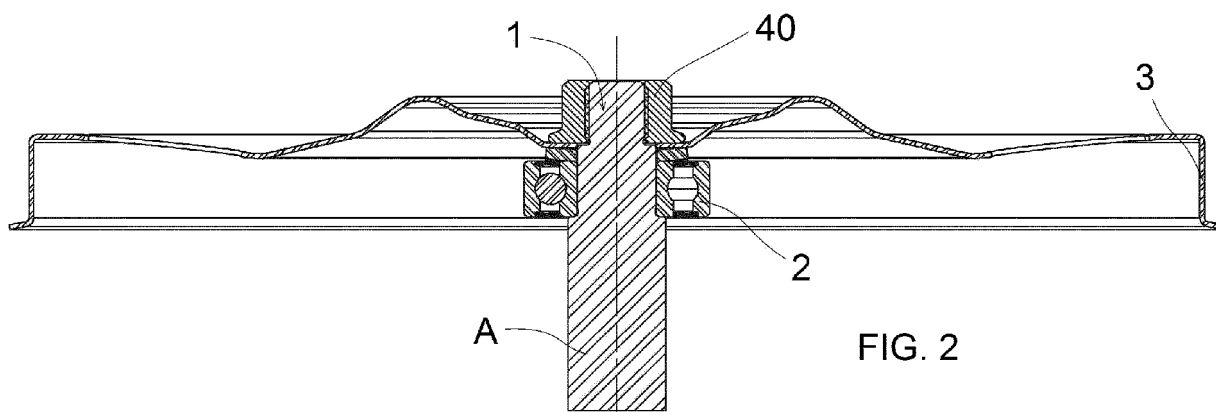


FIG. 2

Description

[0001] The present patent application for industrial invention relates to a washing machine provided with improved driving unit between pulley and drum shaft.

[0002] The peculiarities and advantages of the present invention will become evident after a short description of the prior art and its main drawbacks.

[0003] As it is known, washing machines comprise a cylindrical drum that rotates around a horizontal axis inside a tub that can be accessed from the front or the top to load laundry.

[0004] In order to rotate the drum, the drum is provided on the back with a shaft with horizontal axis adapted to be driven into rotation by a suitable electrical motor mounted on the back of the washing machine.

[0005] The back end of the drum shaft is inserted into a hole obtained on the tub that houses the drum and then engaged into the hub of a cross fixed on the back wall of the tub.

[0006] Said drum shaft ends at the front end with an ending pin that is inserted into the hub of a pulley. A driving belt engages the pulley and is actuated by the geared motor of the washing machine to drive the pulley and the drum shaft into rotation.

[0007] Within such a traditional technology a first important requirement is to obtain perfect coupling between the drum shaft and the pulley hub, in order to prevent mutual sliding between these two parts.

[0008] It is understood that, in lack of a stable rigid coupling, undesired clearance would easily occur between the pulley hub and the drum shaft, generating noisy dangerous vibrations.

[0009] For such a reason, said ending pin of the drum shaft must be provided with two opposite planar sides, as well as a threaded ending section.

[0010] The pulley hub must be centrally provided with a housing adapted to exactly receive said shaped ending pin of the drum shaft with male-female coupling.

[0011] The next operation to be carried out from the outside of the pulley is the screwing of a nut that is engaged into said threaded ending section of the ending pin of the drum shaft. After completing said coupling between nut and pin, the nut is rigidly engaged against the external side of the pulley hub, thus firmly locking the pulley on the drum shaft.

[0012] Such an assembly technique between pulley and drum shaft has proved rather unsatisfactory in case of pulleys made of press-bent plate, wherein the hub for coupling with the ending pin of the shaft is reduced to a hole with very small depth of approximately 1.0-1.5mm equal to the low thickness of the plate.

[0013] The first problem with pulleys made of press-bent plate is the impossibility to use an ordinary nut to tighten the pulley on the shaft. As a matter of fact, although screwed until the end of its travel, the nut cannot tighten the pulley hub because of the low thickness of the press-bent plate pulley.

[0014] Such a first problem has been solved using expensive tightening nuts characterized by a bell-shaped flange that protrudes towards the pulley and tightens the pulley before the nut reaches the end of its screwing travel along the threaded ending section of the pulley shaft.

[0015] For a better illustration of the prior art, reference is made to Fig. 1, which shows the driving unit provided with said special nut.

[0016] Referring to Fig. 1, the washing machine comprises a shaft (A) with end provide with ending pin (1). The ending pin (1) comprises:

- a proximal section (1a) for coupling with a bearing (2) provided with inner ring (2a);
- an intermediate section (1b) for coupling with a pulley (3); and
- an externally threaded distal section (1c) for coupling with a special tightening nut (4).

[0017] The nut (4) is provided with a bell-shaped flange (4a) protruding towards the pulley (3) and adapted to tighten the pulley (3) against the side of the inner ring (2a) of the bearing (2).

[0018] In order for such a coupling to work, the nut (4) must be tightened with very high torque values in order to prevent the pulley (3) from slipping against the inner ring (2a) of the bearing (2).

[0019] Moreover, the hard smooth surface of the bearing rings does not favor the frictional grip of the pulley (3) on the inner ring (2a) of the bearing.

[0020] Additionally, the contact surface between pulley (3) and inner ring (2a) of the bearing (2) is reduced, basically consisting in a narrow annular crown.

[0021] In order to avoid the slightest slipping between pulley (3) and inner ring (2a) of the bearing, it is necessary to suitably shape the hub of the pulley (3), which practically consists in a hole sheared on the plate.

[0022] More precisely, said hole sheared on the pulley must be provided with a diametrically opposite pair of rectilinear parallel sections, adapted to be exactly conjugated with an opposite pair of planar sides obtained on the intermediate section (1b) of the ending pin (1) of the shaft (A).

[0023] DE10052586 discloses a front-loading washing machine comprising a drum shaft supported by axially spaced radial bearings connected to the shaft. More precisely, the shaft is provided with a first end connected to the drum and provided with a pin whereon radial bearings are revolvingly mounted, and with a second end provided with an axially adjustable tightening screw for cooperating with a spring.

[0024] The purpose of the present invention is to remedy the aforesaid drawbacks, providing an inexpensive effective realization of the driving unit between pulley and shaft of washing machine drums when said pulley is made of press-bent plate.

[0025] Another purpose of the invention is to achieve the aforementioned object without making any modifica-

tion of the ending pin of the drum shaft and without using special expensive nuts or tightening bolts.

[0026] These purposes have been achieved by the invention of the present patent application, the main innovative characteristics of which are described in the first of the attached claims.

[0027] The washing machine of the invention comprises:

- a shaft with a first end whereon a washing machine drum is mounted, and a second end with ending pin;
- a pulley with hub mounted on said ending pin of the shaft;
- a bearing coupled with a proximal section of the ending pin; and
- a driving unit between pulley and drum shaft; said driving unit comprising:
- screw tightening means coupled with a distal section of the ending pin and adapted to tighten the hub of the pulley on the ending pin, and
- a washer disposed between bearing and pulley and provided with hole engaged by the ending pin of the shaft.

[0028] Said washer (5) has a total height measured according to a parallel direction to the longitudinal axis of the shaft such that said screw tightening means interfere with the pulley before they reach the end of their screwing travel along the distal section of the ending pin.

[0029] The peculiarity of the washing machine of the invention consists in the fact that the pulley is made of press-bent plate and the washer has an anti-rotational profile, in correspondence of its hole, that can be conjugated with an anti-rotational profile obtained on an intermediate section of the ending pin between the proximal section and the distal section of the ending pin.

[0030] For explanatory reasons the description of the washing machine of the invention continues with reference to the attached drawings, which only have an illustrative, not limiting value, wherein:

- Fig. 1 is an axial view of a driving unit of a washing machine according to the prior art;
- Fig. 2 is an axial view of the improved driving unit of the washing machine of the invention, sectioned with a plane passing by the axis of the drum shaft;
- Fig. 3 is an enlarged view of a detail of Fig. 2.
- Fig. 4 is an exploded perspective view of an ending pin of the drum shaft and a washer belonging to the driving unit of the washing machine according to the present invention;
- Fig. 5 is basically the same as Fig. 3, except for the fact that it refers to an additional embodiment of the driving unit of the washing machine according to the present invention;
- Fig. 6 is an axial sectional view of the washer of Fig. 4;
- Fig. 7 is an axial sectional of a pulley inserted into the threaded distal section of the ending pin of the

drum shaft.

[0031] Referring to Figs. 2 and 3, the washing machine of the invention comprises a drum (not shown) and a shaft (A) provided with a first end whereon the drum is mounted, and a second end provided with ending pin (1).

[0032] Moreover, the washing machine comprises a bearing (2) mounted on the ending pin, a pulley (3) coupled with the ending pin and a driving unit disposed between pulley (3) and shaft (A). The driving unit comprises a washer (5) mounted on the ending pin and disposed between bearing (2) and pulley (3).

[0033] The pulley (3) has a hub mounted on said ending pin (1) of the shaft. The bearing (2) is coupled with a proximal section (1a) of the ending pin (1) and the washer (5) is provided with a hole (5c) engaged by the ending pin (1).

[0034] Optionally, said washer (5) is of cup type.

[0035] The driving unit of the washing machine also comprises screw tightening means (40; 60) (see Fig. 5 and 7) coupled with a distal section (1c; 1c') of the ending pin (1) of the shaft and adapted to tighten the hub of the pulley (3) on the ending pin (1).

[0036] Referring to Fig. 6, the washer (5) has a total height (H) measured according to a parallel direction to the longitudinal axis of the shaft (A) such that said screw tightening means (40; 60) interfere with the pulley (3) before they reach the end of their screwing travel along the distal section (1c; 1c') of the ending pin (1).

[0037] The peculiarity of the washing machine of the invention consists in the fact that the pulley (3) is made of press-bent plate. The thickness of said plate is 1.0-1.5 mm. The washer (5) has an anti-rotational profile (5a) in correspondence of the hole (5c). The ending pin (1) of the drum shaft is provided with an intermediate section (1b) between the proximal section (1a) and the distal section (1c). The intermediate section (1b) has an anti-rotational profile (6) complementary to the anti-rotational profile (5a) of the washer.

[0038] In view of the above, the anti-rotational profile (5a) of the washer can be conjugated with the anti-rotational profile (6) of the ending pin (1).

[0039] More precisely, the anti-rotational profile (5a) of the washer (5) advantageously comprises a diametrically opposite pair of rectilinear parallel sections (5a) obtained in the hole (5c) of the washer. The anti-rotational profile (6) of the intermediate section of the ending pin (1) comprises an opposite pair of planar sides (6) obtained on said intermediate section (1b) of the ending pin (1) and adapted to be conjugated with the rectilinear parallel sections (5a) obtained in said hole (5c) of the washer.

[0040] According to a first, preferred embodiment of the washing machine of the invention shown in Fig. 3, the screw tightening means (40) of the driving unit comprise a nut (40) and the distal section (1c) of the ending pin (1) is externally threaded, so that the nut (40) can be screwed onto said distal section (1c) of the ending pin to tighten the hub of the pulley (3) against the washer (5).

[0041] Referring to Fig. 4, the washer (5) is provided with surface (5b) facing towards the nut (40). The surface (5b) has an advantageously serrated anti-slip profile that guarantees a perfectly stable grip against the surface of the pulley (3) when the nut (40) is tightened against the hub of the pulley (3).

[0042] The serrated profile can be replaced with any other type of anti-slip surface, such as a beveled or high-roughness surface.

[0043] In any case, because of said serrated profile, the motion of the pulley (3) is transmitted to the ending pin (1) of the shaft by means of safe, reliable frictional coupling that avoids the need for the anti-rotational shaping of the hub of the pulley (3). In such a case, the hub of the pulley is provided with an ordinary circular hole (30) adapted to be coupled with the distal section (1c) of the ending pin (1), as shown in Fig. 7.

[0044] According to the present invention, the contact surface between pulley (3) and washer (5) is higher than the contact surface between pulley (3) and inner ring (2a) of the bearing of a washing machine according to the prior art, as shown in Fig. 1.

[0045] Fig. 5 illustrates a second embodiment of the washing machine of the present invention, wherein said screw tightening means comprise a tightening bolt (60) with head (60b) and stem (60a). The distal section (1c') of the ending pin is provided with a threaded axial hole (F), into which the stem (60a) of the tightening bolt (60) is screwed, in such manner that the head (60b) of the tightening bolt tightens the pulley (3) against said washer (5).

[0046] In addition to acting as spacer between the hub of the pulley (3) and the bearing (2), the washer (5) also prevents the loosening of the nut (40) or tightening bolt (60).

Claims

1. A washing machine comprising:

- a shaft (A) having a first end whereon a washing machine drum is mounted, and a second end provided with ending pin (1),
- a pulley (3) with hub mounted on said ending pin (1) of the shaft;
- a bearing (2) coupled with a proximal section (1a) of the ending pin; and
- a driving unit between pulley (3) and shaft (A), said driving unit comprising:
 - screw tightening means (40; 60) coupled with a distal section (1c; 1c') of the ending pin and adapted to tighten the hub of the pulley (3) on the ending pin (1), and
 - a washer (5) provided with a hole (5c) engaged by said ending pin (1), said washer (5) being disposed between said bearing (2) and pulley (3); said washer (5) having a total height (H),

measured according to a parallel direction to the longitudinal axis of the shaft (A) such that said screw tightening means (40; 60) interfere with the pulley (3) before they reach the end of their screwing travel along the distal section (1c; 1c') of the ending pin (1).

characterized in that

said pulley (3) is made of press-bent plate; and said washer (5) is provided, in correspondence of its hole (5c), with an anti-rotational profile conjugable with an anti-rotational profile (6) obtained on an intermediate section (1b) of the ending pin (1), between the proximal section (1a) and the distal section (1c) of the ending pin.

2. The washing machine of claim 1, **characterized in that** said anti-rotational profile (5a) of the washer comprises a diametrically opposite pair of rectilinear parallel sections (5a) obtained in said hole (5c) of the washer, and said anti-rotational profile (6) of the intermediate section of the ending pin comprises an opposite pair of planar sides (6) obtained in correspondence of said intermediate section (1b) of the ending pin (1), wherein said rectilinear parallel sections (5a) obtained in said hole (5c) of the washer are adapted to conjugate with said opposite pair of planar sides (6) obtained in correspondence of said intermediate section (1b) of the ending pin (1).
3. The washing machine of any one of the preceding claims, **characterized in that** said washer (5) has a surface (5b) facing towards said screw tightening means (40; 60) provided with anti-slip profile.
4. The washing machine of claim 3, **characterized in that** said anti-slip profile of the surface (5b) of the washer is (5) serrated.
5. The washing machine of any one of the preceding claims, **characterized in that** said screw tightening means comprise a nut (50) and said distal section (1c) of the ending pin is externally threaded, in such manner that the nut (40) can be screwed on said distal section (1c) of the ending pin to tighten the hub of the pulley (3) against said washer (5).
6. The washing machine of any one of the preceding claims 1 to 4, **characterized in that** said screwing tightening means comprise a tightening bolt (60) with head (60b) and stem (60a) and said distal section (1c') of the ending pin is provided with an axial threaded hole (F), into which the stem (60a) of the tightening bolt (60) is screwed so that the head (60b) of the tightening bolt tightens the pulley (3) against said washer (5).
7. The washing machine of any one of the preceding claims, **characterized in that** said washer (5) is of

cup type.

8. The washing machine of any one of the preceding claims, **characterized in that** said plate of the pulley has thickness of 1.0-1.5 millimeters.

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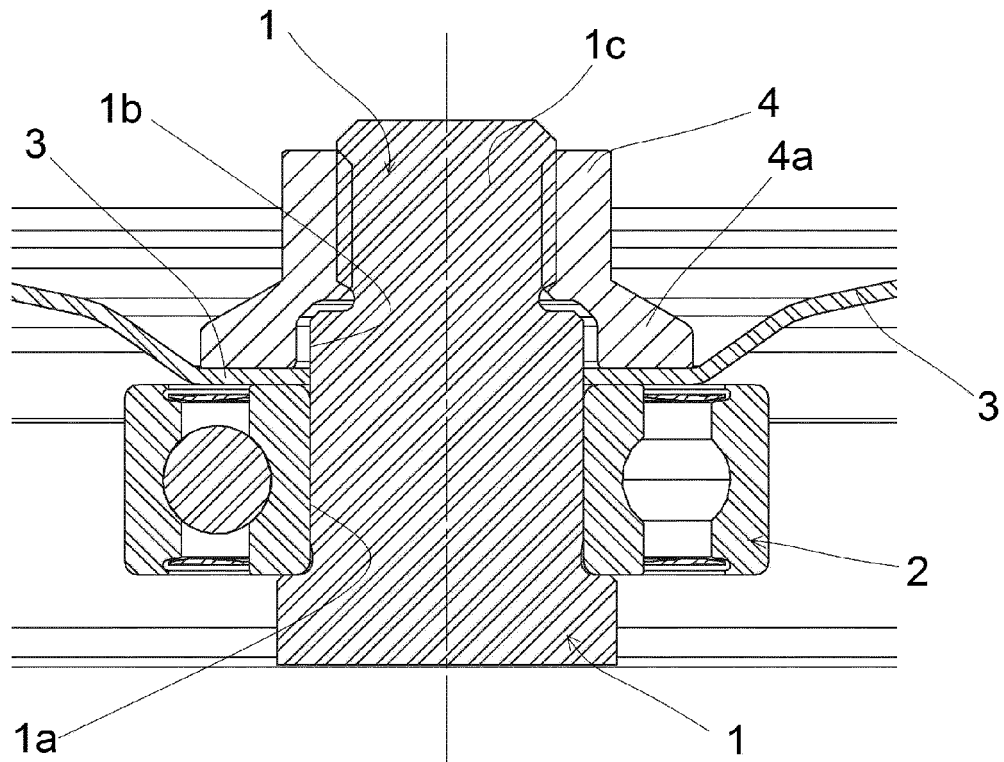


FIG. 1

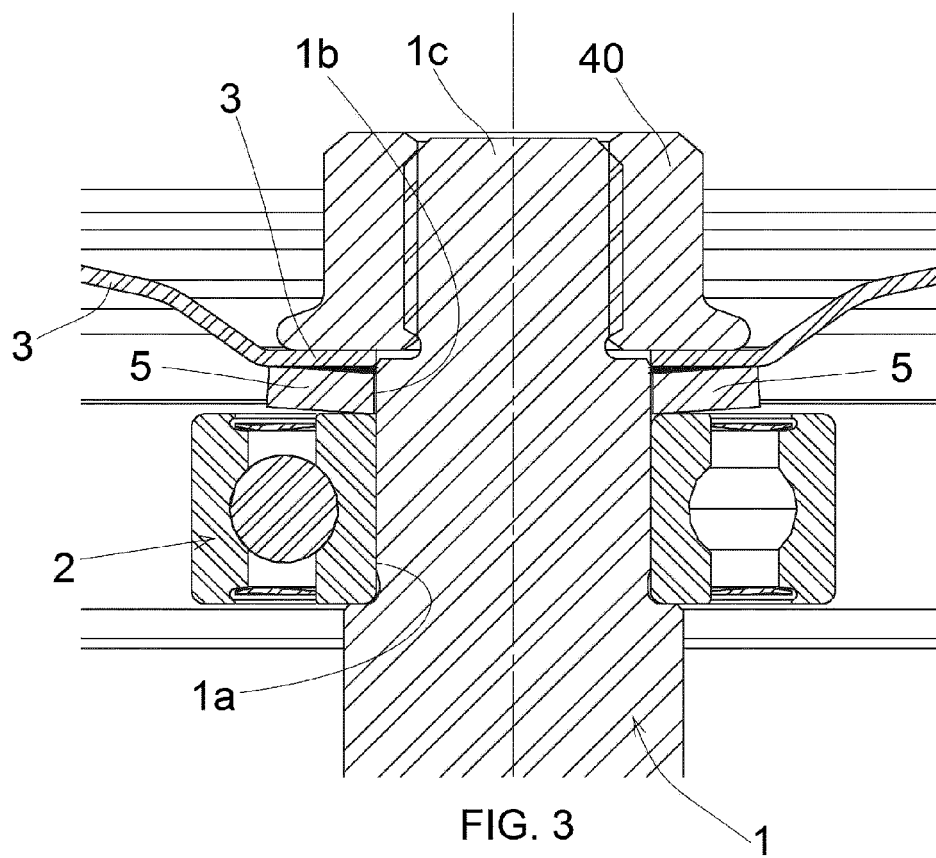
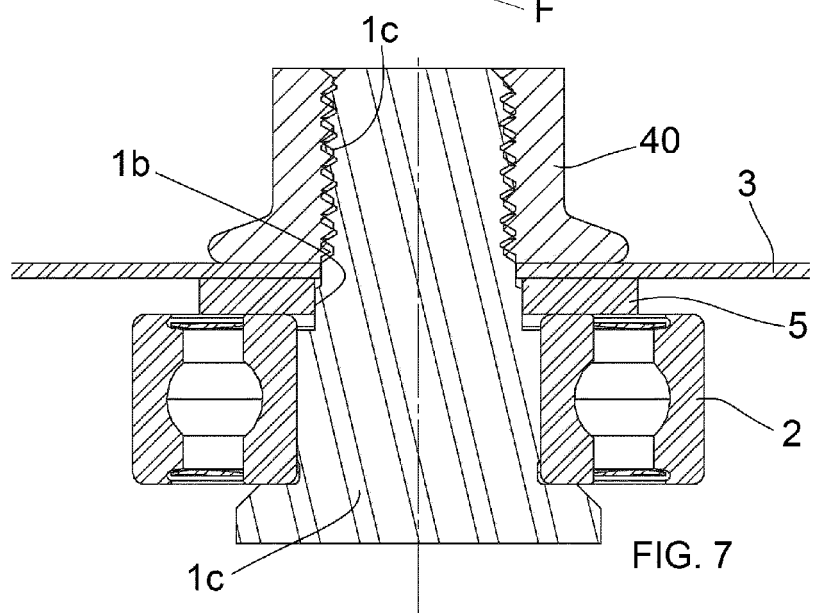
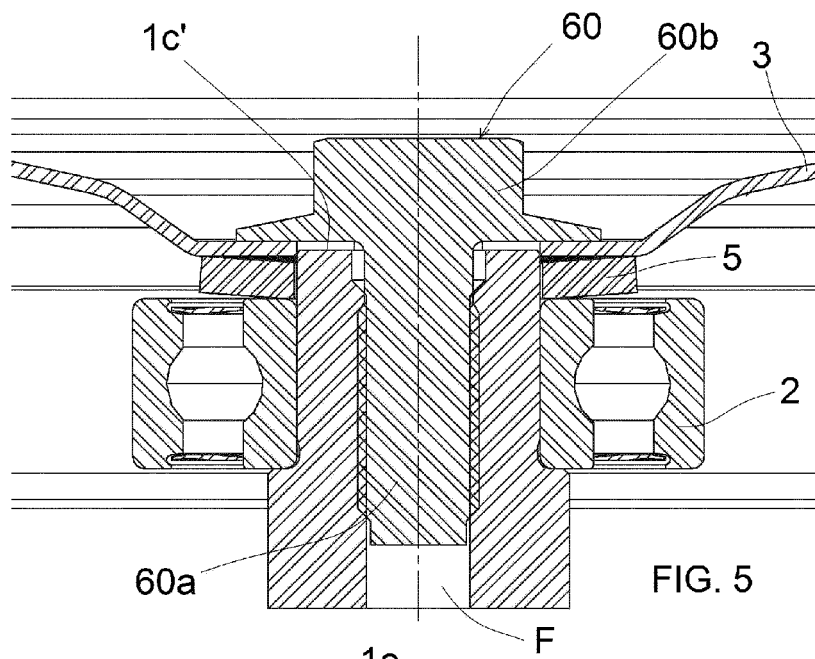
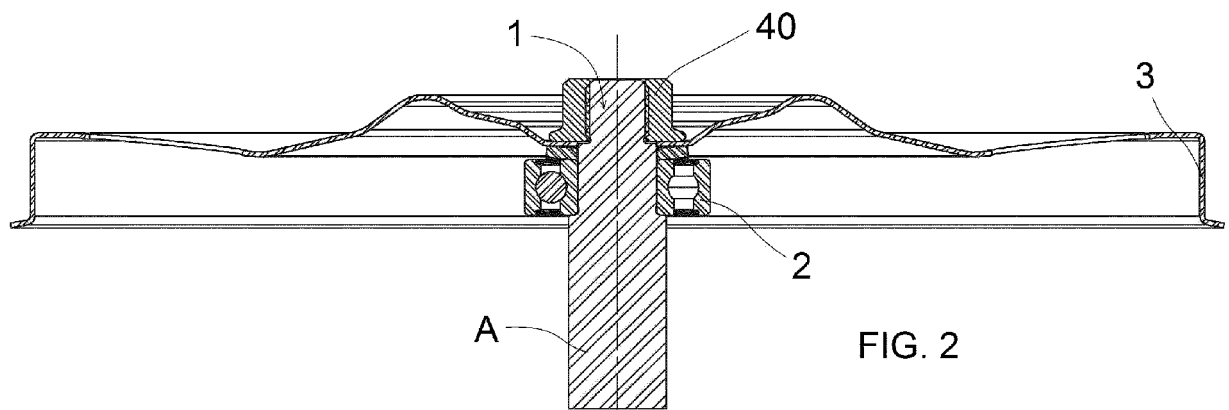
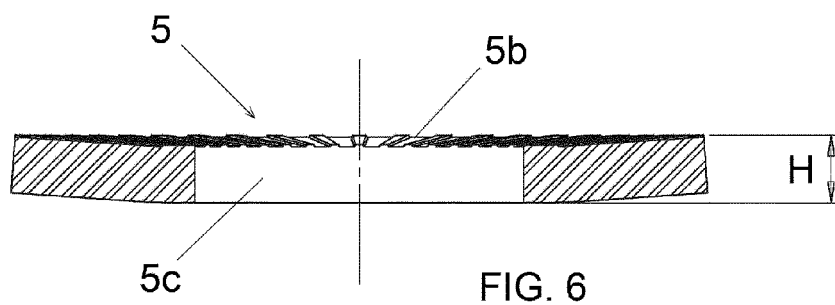
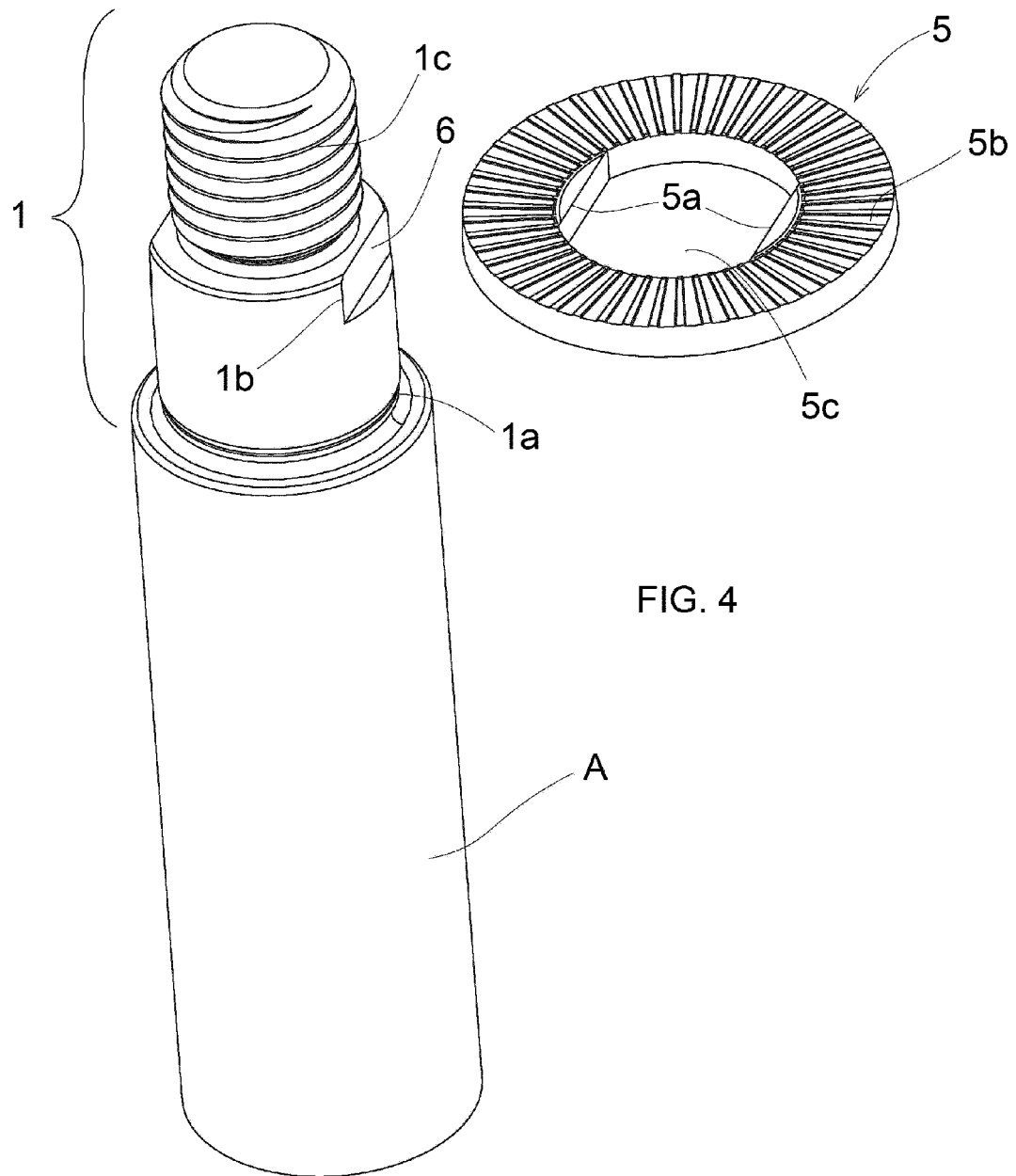


FIG. 3







EUROPEAN SEARCH REPORT

Application Number
EP 13 17 5058

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 8 October 2013	Examiner Clivio, Eugenio
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
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EP 13 17 5058

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