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(54) **TWO-PIECE AXLE BUSHING AND MARINE PROPELLER USING SAME**

(57) A two-piece axle bushing (40) for marine propeller (10) includes a first transmission member (50) including an accommodation chamber (52) and longitudinal inner ribs (54) spaced around an inner perimeter of the accommodation chamber (52), and a second transmission member (60), which includes a tube shaft (70) that includes a first transmission segment (71) inserted into the accommodation chamber (52) of the first transmission member (50) and including longitudinal outer ribs (74) spaced around the outer perimeter thereof and respectively movably inserted into one respective buffer space (56) of the first transmission member (50) and selectively engageable with one respective longitudinal inner rib (54) and a second transmission segment (72) connected to the first transmission segment (71), and a shock absorber (80) fixedly surrounding the outer perimeter of the second transmission segment (72). Thus, the two-piece axle bushing (40) of the present invention can generate power hysteresis effects when the engine starts up, reducing vibration due to a sudden high torque and further enhancing marine propeller (10) start-up stability and smoothness.

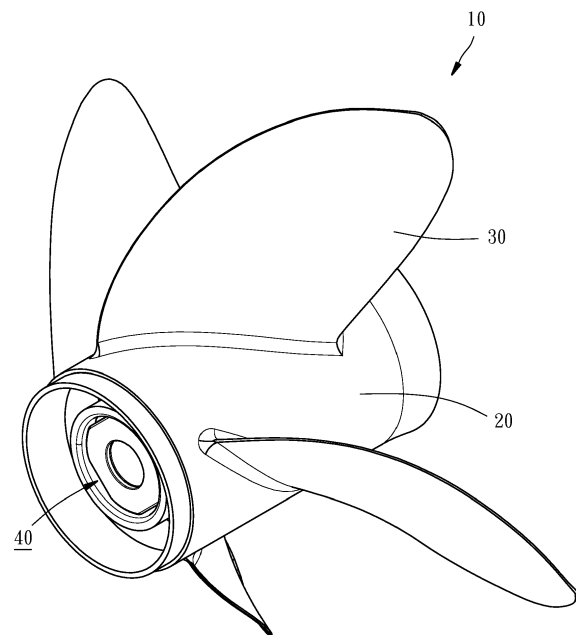


FIG. 1

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to marine propeller technology, and more particularly to a two-piece axle bushing and a marine propeller using this design of two-piece axle bushing.

2. Description of the Related Art

[0002] Structurally, a conventional marine propeller generally comprises a propeller hub, a plurality of propeller blades radially connected to the periphery of the propeller hub, and an axle bushing mounted in the propeller hub. During operation, the engine transmits power to the axle bushing through a drive shaft, causing the axle bushing to rotate the propeller hub. During rotation of the propeller hub, the propeller blades are rotated to create thrust in water.

[0003] Conventional axle bushings for marine propeller are generally made from a hard material (such as metal). If a marine propeller hits an external object during its operation, the axle bushing can become brittle, and may even cause damage to the drive shaft. If the axle bushing has become brittle, it can no longer drive the propeller hub to rotate smoothly, affecting power transmission effects. Further, if the drive shaft outputs a high torque, the axle bushing can become brittle. Therefore, conventional axle bushings are not suitable for use with a high horsepower engine.

[0004] In order to settle the aforesaid problem, Taiwan Patent M310175, invented by the present inventor, discloses an axle bushing, which comprises a metal layer and a shock-absorbing layer fixedly surrounding the metal layer. The axle bushing, on the one hand, is connected to the drive shaft of the engine by the metal layer, and, on the other hand, fastened to the axle hole of the propeller hub by the shock-absorbing layer. Thus, if the propeller hub hits an external object during its operation, the shock-absorbing layer of the axle bushing absorbs shocks, avoiding embrittlement of the metal layer and protecting the drive shaft against damage. However, according to the aforesaid prior art patent design, in the moment the engine starts up, the output torque of the drive shaft of the engine will be directly transmitted to the propeller hub without leaving any buffering time in the power transmission process, causing sudden vibration of the marine propeller due to a high impact.

SUMMARY OF THE INVENTION

[0005] The present invention has been accomplished under the circumstances in view. It is the main object of the present invention to provide a two-piece axle bushing for marine propeller, which utilizes soft start-up to effec-

tively reduce vibration in the moment the engine starts up, thereby enhancing marine propeller start-up stability and smoothness.

[0006] To achieve this and other objects of the present invention, a two-piece axle bushing for marine propeller comprises a first transmission member and a second transmission member. The first transmission member comprises an accommodation chamber, at least two longitudinal inner ribs equiangularly spaced around an inner perimeter of the accommodation chamber and radially projecting toward the inside of the accommodation chamber at a predetermined distance, and a buffer space defined inside the accommodation chamber between each two adjacent longitudinal inner ribs. The second transmission member comprises a tube shaft and a shock absorber. The tube shaft comprises a first transmission segment, and a second transmission segment connected to the first transmission segment. The first transmission segment is inserted into the accommodation chamber of the first transmission member, comprising at least one longitudinal outer rib located at an outer perimeter thereof and respectively movably inserted into one respective buffer space of the first transmission member and selectively engageable with one longitudinal inner rib. The shock absorber fixedly surrounds the outer perimeter of the second transmission segment.

[0007] Thus, in the moment the engine starts up, the second transmission member will be driven to rotate by the drive shaft of the engine, and the first transmission member will be rotated with the second transmission member only after the longitudinal outer ribs of the tube shaft of the second transmission member have been put into engagement with the longitudinal inner ribs of the first transmission member. As soon as the first transmission member is rotated with the second transmission member, the output torque of the engine can be transmitted to the marine propeller, causing the marine propeller to create thrust in water. Thus, the two-piece axle bushing of the present invention can generate power hysteresis effects when the engine starts up, reducing vibration due to a sudden high torque and further enhancing start-up stability and smoothness of the marine propeller. Further, subject to the shock absorbing effect of the shock absorber of the second transmission member, the two-piece axle bushing can absorb shocks if the marine propeller hits an external object accidentally, protecting the tube shaft of the second transmission member and the drive shaft of the engine against damage.

[0008] It is another object of the present invention to provide a marine propeller, which comprises a propeller hub defining therein an axle hole, a plurality of propeller blades equiangularly and radially extended from an outer perimeter of the propeller hub, and a two-piece axle bushing as described above. The two-piece axle bushing is mounted in the axle hole of the propeller hub for connection to a drive shaft of an engine.

[0009] Other advantages and features of the present invention will be fully understood by reference to the fol-

lowing specification in conjunction with the accompanying drawings, in which like reference signs denote like components of structure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1 is an oblique top elevational view of a marine propeller in accordance with a first embodiment of the present invention.

FIG. 2 is an exploded view of the marine propeller in accordance with the first embodiment of the present invention.

FIG. 3 is an exploded view of the two-piece axle bushing used in the marine propeller in accordance with the first embodiment of the present invention.

FIG. 4 is a sectional assembly view of the marine propeller in accordance with the present invention.

FIG. 5 is a rear end view of the two-piece axle bushing used in the marine propeller in accordance with the present invention.

FIG. 6 is a transverse sectional view of the two-piece axle bushing used in the marine propeller in accordance with the present invention, illustrating the longitudinal outer ribs of the second transmission member spaced from the longitudinal inner ribs of the first transmission member.

FIG. 7 is similar to FIG. 6, illustrating the longitudinal outer ribs of the second transmission member respectively engaged with the longitudinal inner ribs of the first transmission member.

FIG. 8 is similar to FIG. 7, illustrating the first and second transmission members rotated in the reversed direction.

DETAILED DESCRIPTION OF THE INVENTION

[0011] Referring to FIGS. 1 and 2, a marine propeller 10 in accordance with the present invention is shown. The marine propeller 10 comprises a propeller hub 22, four propeller blades 30, and a two-piece axle bushing 40.

[0012] The propeller hub 20 comprises an axle hole 22 extended through opposing front and rear ends thereof.

[0013] The propeller blades 30 are equiangularly and radially extended from the outer perimeter of the propeller hub 20.

[0014] The two-piece axle bushing 40 is mounted in the axle hole 22 of the propeller hub 20, comprising a first transmission member 50 and a second transmission member 60, as shown in FIG. 3.

[0015] The first transmission member 50 is made from metal. For use with a high horsepower engine, the first transmission member 50 can be made from stainless steel; for use with a low horsepower engine, the first transmission member 50 can be made from aluminum alloy.

[0016] Structurally, the first transmission member 50

comprises an accommodation chamber 52 and four longitudinal inner ribs 54. These four longitudinal inner ribs 54 are equiangularly spaced around an inner perimeter of the accommodation chamber 52 and radially projecting toward the inside of the accommodation chamber 52 at a predetermined distance such that a buffer space 56 is defined inside the accommodation chamber 52 between each two adjacent longitudinal inner ribs 54. Further, as shown in FIG. 6, each longitudinal inner rib 54 comprises two first sloping surfaces 541 respectively located at two opposite sides thereof. Preferably, the first sloping surfaces 541 of each two adjacent longitudinal inner ribs 54 define therebetween a contained angle in the range of 21~25°. Further, the outer perimeter of the first transmission member 50 consists of multiple first planes 58 connected to one another so that the first transmission member 50 can be engaged with the peripheral wall of the axle hole 22 of the propeller hub 20 by the first planes 58.

[0017] The second transmission member 60 comprises a tube shaft 70. The tube shaft 70 is made from metal. For use with a high horsepower engine, the tube shaft 70 can be made from stainless steel; for use with a low horsepower engine, the tube shaft 70 can be made from aluminum alloy. Structurally, the tube shaft 70 comprises a first transmission segment 71, and a second transmission segment 72 connected to the first transmission segment 71. The first transmission segment 71 of the tube shaft 70 is inserted into the accommodation chamber 52 of the first transmission member 50. The second transmission member 60 further comprises a shock absorber 80 fixedly surrounding the second transmission segment 72 of the tube shaft 70, and an internal gear 73 formed integral with the inner perimeter of the second transmission segment 72 of the tube shaft 70 (see FIG. 4 and FIG. 5). The internal gear 73 is meshed with a drive shaft (not shown) of an engine (not shown) so that the tube shaft 70 is rotatable by the drive shaft of the engine. As shown in FIGS. 5 and 6, the tube shaft 70 further comprises four longitudinal outer ribs 74 and four bearing portions 75. These four longitudinal outer ribs 74 are equiangularly spaced around an inner perimeter of the first transmission segment 71 and radially projecting toward the outside of the first transmission segment 71 at a predetermined distance. Further, each longitudinal outer rib 74 comprises two second sloping surfaces 742 respectively located at two opposite sides thereof. The longitudinal outer ribs 74 of the tube shaft 70 are respectively engaged in the buffer spaces 56 inside the first transmission member 50. When the longitudinal outer ribs 74 of the tube shaft 70 are respectively engaged with one respective longitudinal inner rib 54 of the first transmission member 50, as shown in FIG. 7, the second sloping surface 742 of each longitudinal outer rib 74 is abutted against one first sloping surface 541 of one respective longitudinal inner rib 54. At this time, the tube shaft 70 can drive the first transmission member 50 to rotate. As the bearing portions 75 extend radially from the outer perimeter of the second transmission segment 72 a pre-

determined distance, they assist the tube shaft **70** to bear an output torque from the drive shaft of the engine.

[0018] As shown in FIG. 3 and FIG. 5, the shock absorber **80** of the second transmission member **60** is made from, but not limited to, rubber. The shock absorber **80** fixedly surrounds the outer perimeter of the second transmission segment **72** of the tube shaft **70** over the bearing portions **75**, and, the outer perimeter of the shock absorber **80** consists of multiple second planes **82** that are connected to one another and respectively disposed in line with the first planes **58** of the first transmission member **50** in a flush manner so that the shock absorber **80** can be engaged peripheral wall of the axle hole **22** of the propeller hub **20** by the second planes **82**.

[0019] Thus, when the engine is started up, subject to the engagement relationship between the drive shaft of the engine and the tube shaft **70**, the drive shaft of the engine drives the second transmission member **60** to rotate. At the beginning the second transmission member **60** starts to rotate, the longitudinal outer ribs **74** of the second transmission member **60** are disposed in the respective buffer spaces **56** and not engaged with the longitudinal inner ribs **54** of the first transmission member **50**, as shown in FIG. 6, before engagement between the longitudinal outer ribs **74** of the second transmission member **60** and the longitudinal inner ribs **54** of the first transmission member **50**, the first transmission member **50** and the propeller hub **20** are immovable. Once the second transmission member **60** is rotated to the angular position where the longitudinal outer ribs **74** of the second transmission member **60** are respectively engaged with the longitudinal inner ribs **54** of the first transmission member **50**, as shown in FIGS. 7 and 8, the first transmission member **50** begins to rotate with the second transmission member **60**. When the first transmission member **50** begins to rotate with the second transmission member **60**, the first transmission member **50** and the second transmission member **60** can then transfer the output torque of the engine to the propeller hub **20**, causing the propeller blades **30** to rotate with the propeller hub **20** and to further generate a propelling force.

[0020] On the other hand, if the marine propeller **10** hits an external object, the shock absorber **80** that fixedly surrounds the outer perimeter of the second transmission segment **72** of the tube shaft **70** over the bearing portions **75** can absorb the shocks thus produced, preventing breaking of the metal tube shaft **70** due to excessively high vibration level and simultaneously giving good protection to the drive shaft. Further, by means of the bearing portions **75**, the tube shaft **70** of the second transmission member **60** can bear the output torque of the drive shaft of the engine, and thus, the marine propeller **10** is practical for use with a high horsepower engine.

[0021] In conclusion, subject to the design of the buffer spaces **56**, the two-piece axle bushing **40** can achieve a soft start-up effect to effectively reduce vibration of the marine propeller **10** in the moment the engine starts up, thereby enhancing start-up stability and smoothness of

the marine propeller **10**. Further, the two-piece axle bushing **40** not only can absorb shocks to protect the engine but also can bear a high torque for high horsepower application.

[0022] Although a particular embodiment of the invention has been described in detail for purposes of illustration, various modifications and enhancements may be made without departing from the spirit and scope of the invention. Accordingly, the invention is not to be limited except as by the appended claims.

Claims

1. A two-piece axle bushing (40) for marine propeller (10), comprising:

a first transmission member (50) comprising an accommodation chamber (52), at least two longitudinal inner ribs (54) equiangularly spaced around an inner perimeter of said accommodation chamber (52) and radially projecting toward the inside of said accommodation chamber (52) at a predetermined distance, and a buffer space (56) defined inside said accommodation chamber (52) between each two adjacent said longitudinal inner ribs (54); and

a second transmission member (60) comprising a tube shaft (70) and a shock absorber (80), said tube shaft (70) comprising a first transmission segment (71) and a second transmission segment (72) connected to said first transmission segment (71), said first transmission segment (71) being inserted into said accommodation chamber (52) of said first transmission member (50), said first transmission segment (71) comprising at least one longitudinal outer rib (74) located at an outer perimeter thereof and respectively movably inserted into one respective said buffer space (56) of said first transmission member (50) and selectively engageable with one said longitudinal inner rib (54), said shock absorber (80) fixedly surrounding the outer perimeter of said second transmission segment (72).

2. The two-piece axle bushing (40) as claimed in claim 1, wherein each said longitudinal inner rib (54) of said first transmission member (50) comprises at least one first sloping surface (541); each said longitudinal outer rib (74) of said second transmission member (60) comprises at least one second sloping surface (742); when each said longitudinal outer rib (74) of said second transmission member (60) is engaged with one respective said longitudinal inner rib (54) of said first transmission member (50), one said second sloping surface (742) of each said longitudinal outer rib (74) is abutted against one respective

- said first sloping surface (541) of one respective said longitudinal inner rib (54).
3. The two-piece axle bushing (40) as claimed in claim 1, wherein said second transmission segment (72) of said tube shaft (70) comprises a plurality of bearing portions (75) equiangularly spaced around the outer perimeter thereof and embedded in said shock absorber (80). 5
 4. The two-piece axle bushing (40) as claimed in claim 1, wherein said first transmission member (50) and said shock absorber (80) of said second transmission member (60) are peripherally kept in flush. 10
 5. The two-piece axle bushing (40) as claimed in claim 1, wherein each two adjacent said longitudinal inner ribs (54) define therebetween a contained angle in the range of 21~25 degrees. 15
 6. The two-piece axle bushing (40) as claimed in claim 1, wherein the outer perimeter of said first transmission member (50) consists of a plurality of first planes (58) connected to one another; said shock absorber (80) comprises an outer perimeter consisting of a plurality of second planes (82) that are connected to one another and respectively disposed in line with said first planes (58) of said first transmission member (50) in a flush manner. 20
 7. The two-piece axle bushing (40) as claimed in claim 1, wherein said first transmission member (50) is made from metal. 25
 8. The two-piece axle bushing (40) as claimed in claim 1, wherein said tube shaft (70) of said second transmission member (60) is made from metal. 30
 9. The two-piece axle bushing (40) as claimed in claim 1, wherein said shock absorber (80) of said second transmission member (60) is made from rubber. 35
 10. A marine propeller (10), comprising:
 - a propeller hub (20) comprising an axle hole (22); 40
 - a plurality of propeller blades (30) equiangularly and radially extended from an outer perimeter of said propeller hub (20); and
 - a two-piece axle bushing (40) as claimed in claim 1, said two-piece axle bushing (40) being mounted in said axle hole (22) of said propeller hub (20). 45
 11. The marine propeller (10) as claimed in claim 10, wherein each said longitudinal inner rib (54) of said first transmission member (50) comprises at least one first sloping surface (541); each said longitudinal 50
 - outer rib (74) of said second transmission member (60) comprises at least one second sloping surface (742); when each said longitudinal outer rib (74) of said second transmission member (60) is engaged with one respective said longitudinal inner rib (54) of said first transmission member (50), one said second sloping surface (742) of each said longitudinal outer rib (74) is abutted against one respective said first sloping surface (541) of one respective said longitudinal inner rib (54). 55
 12. The marine propeller (10) as claimed in claim 10, wherein said second transmission segment (72) of said tube shaft (70) comprises a plurality of bearing portions (75) equiangularly spaced around the outer perimeter thereof and embedded in said shock absorber (80).
 13. The marine propeller (10) as claimed in claim 10, wherein said first transmission member (50) and said shock absorber (80) of said second transmission member (60) are peripherally kept in flush.
 14. The marine propeller (10) as claimed in claim 10, wherein the outer perimeter of said first transmission member (50) consists of a plurality of first planes (58) connected to one another; said shock absorber (80) comprises an outer perimeter consisting of a plurality of second planes (82) that are connected to one another and respectively disposed in line with said first planes (58) of said first transmission member (50) in a flush manner.
 15. The marine propeller (10) as claimed in claim 10, wherein each two adjacent said longitudinal inner ribs (54) define therebetween a contained angle in the range of 21~25 degrees.

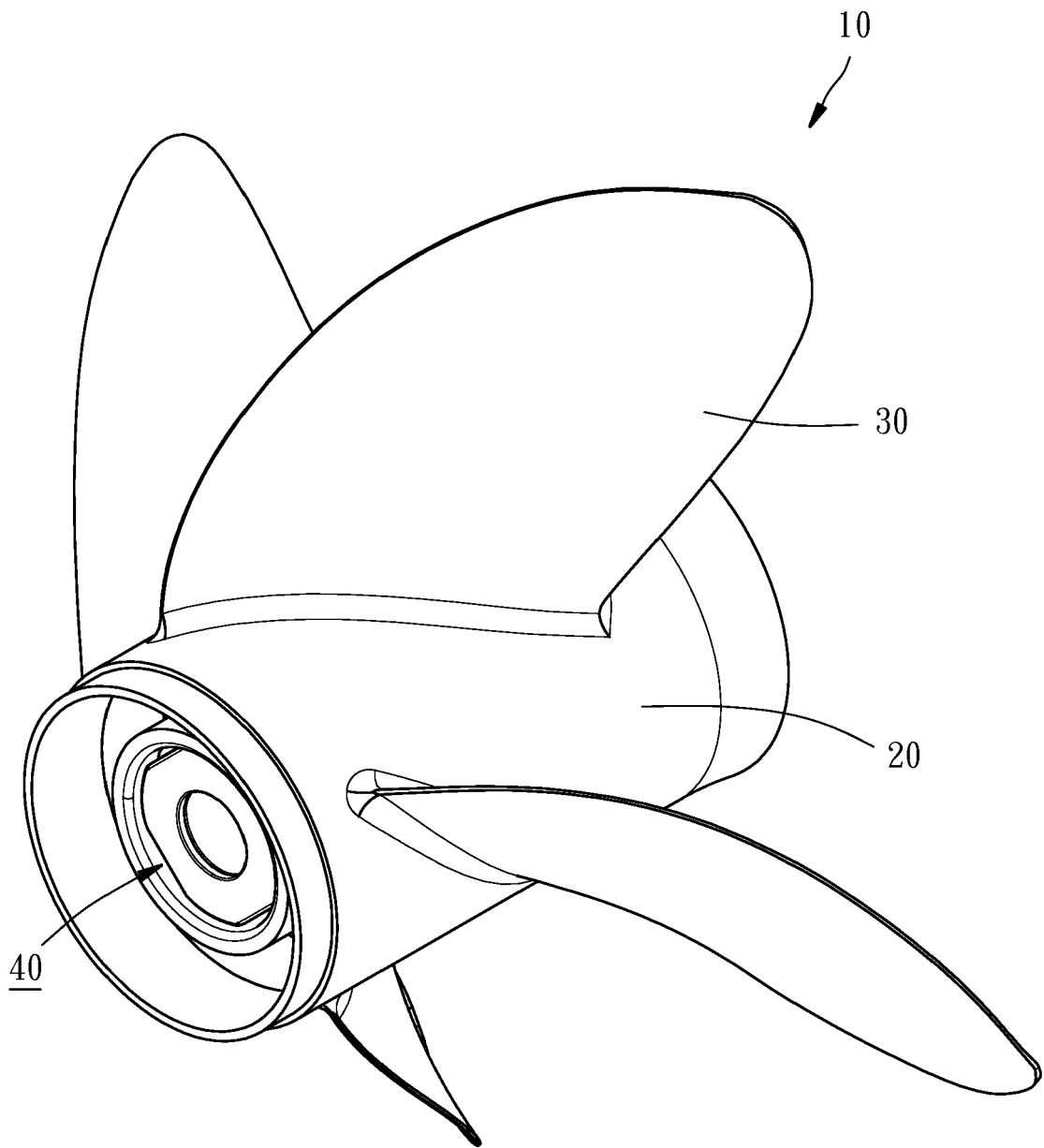


FIG. 1

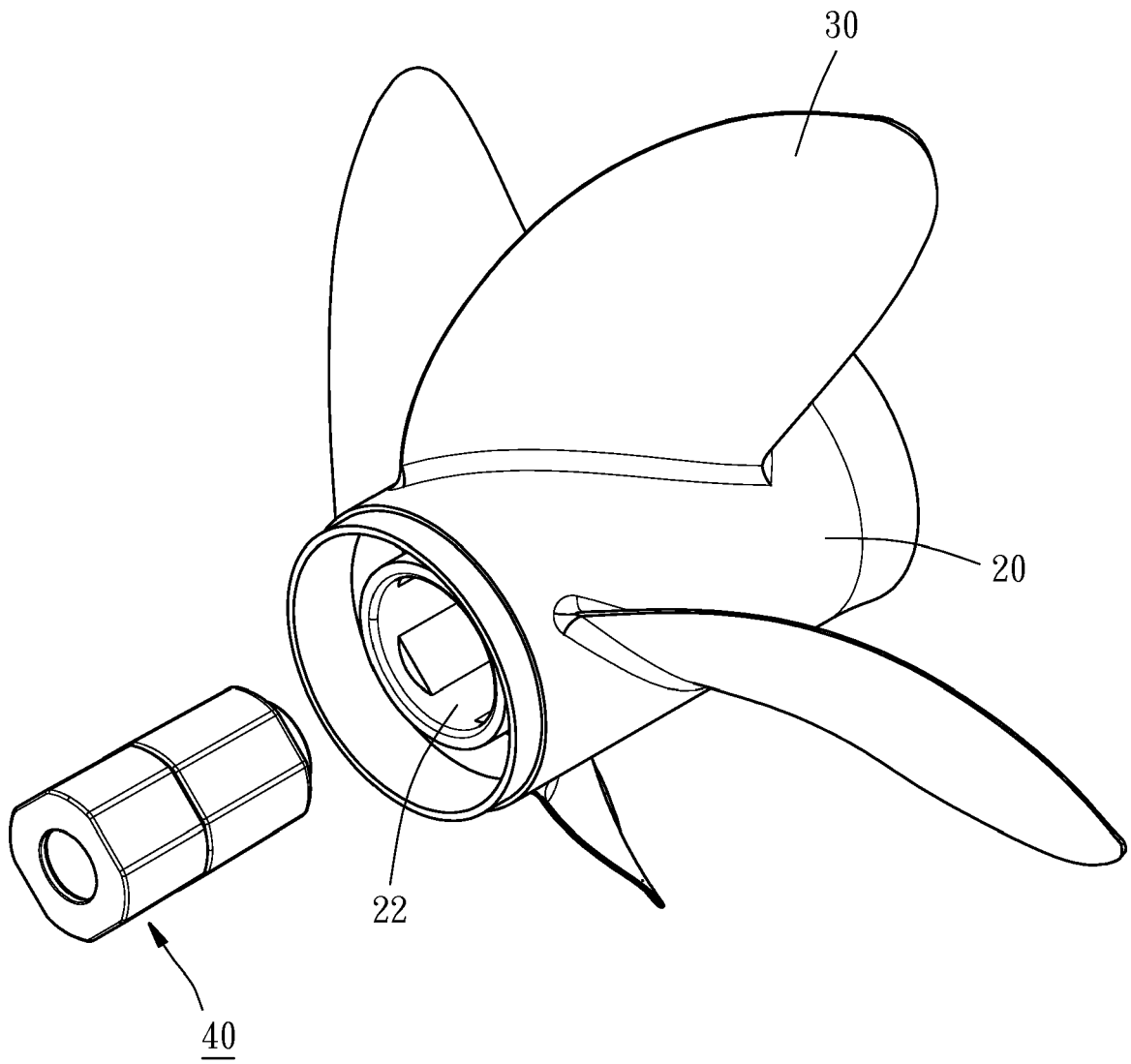


FIG. 2

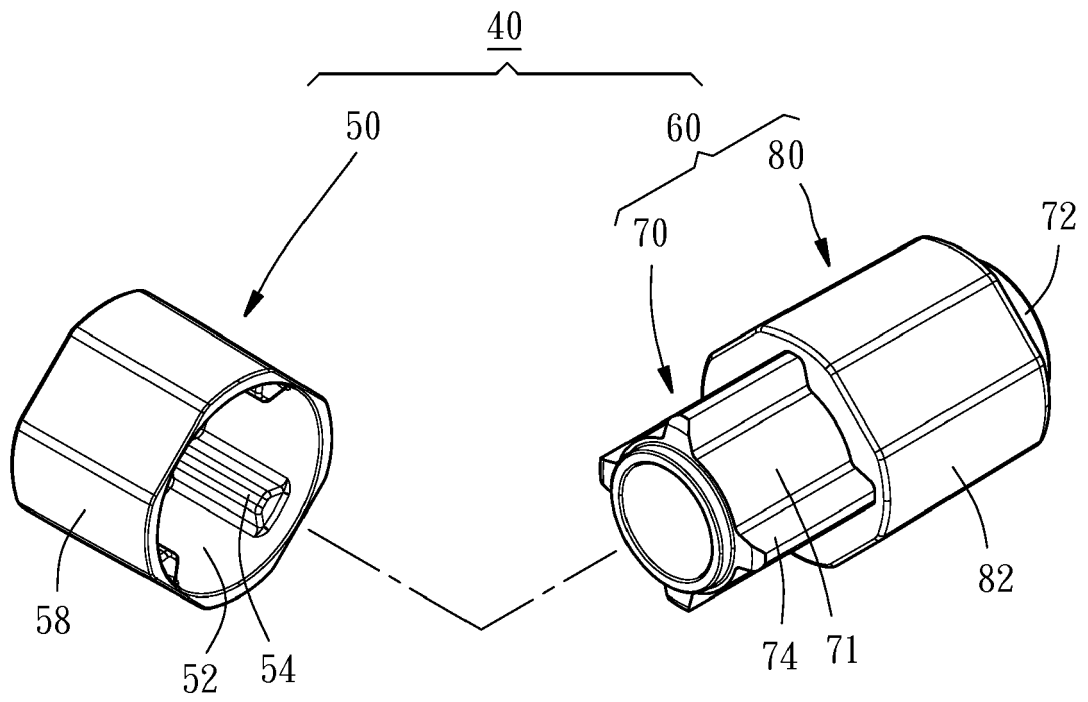


FIG. 3

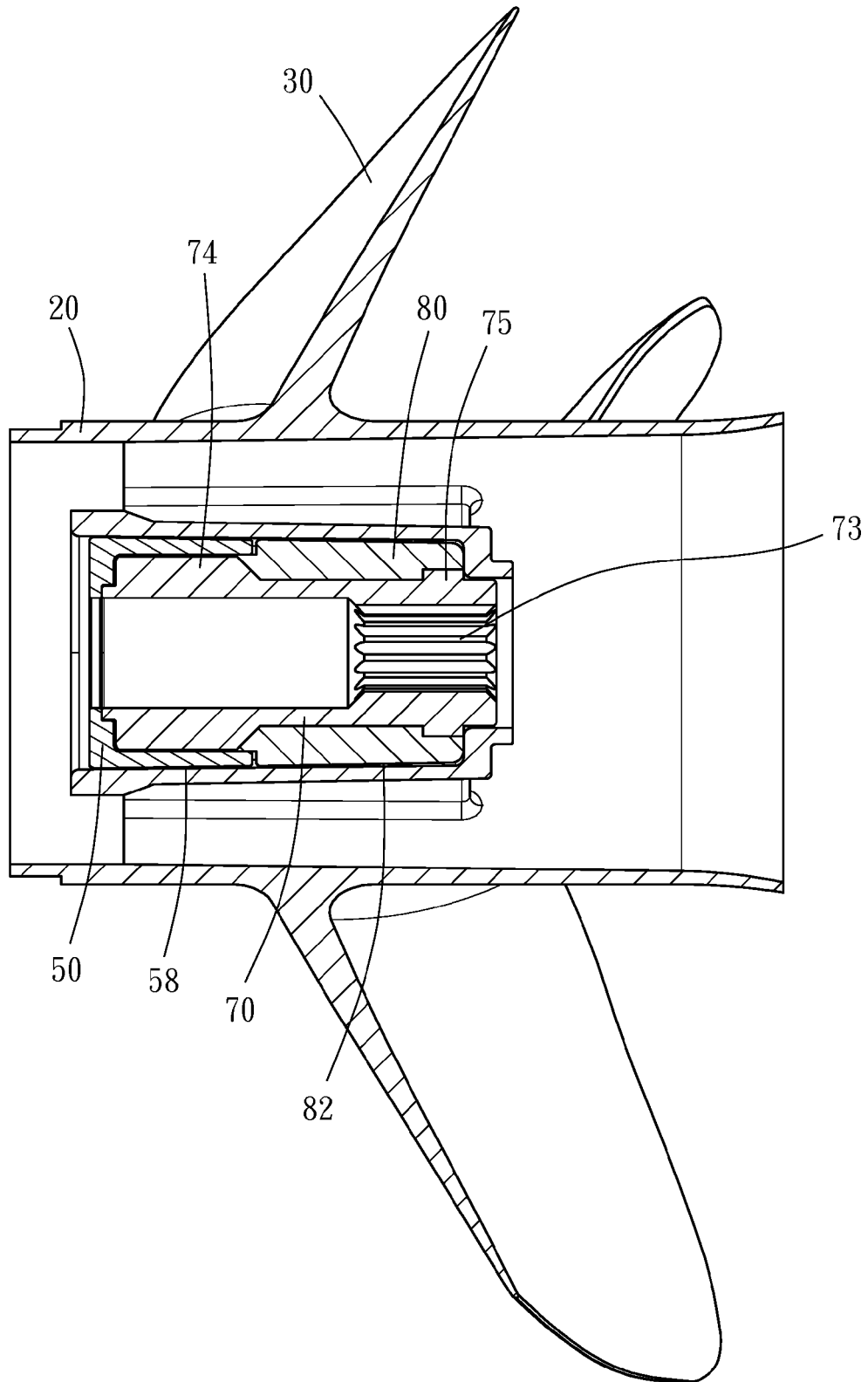


FIG. 4

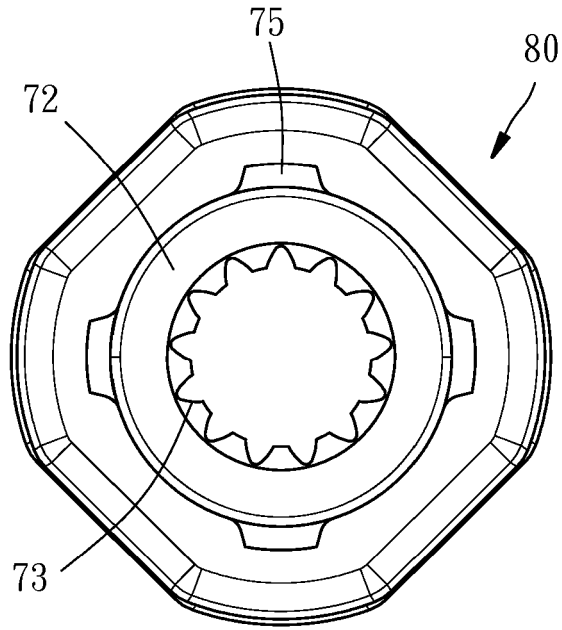


FIG. 5

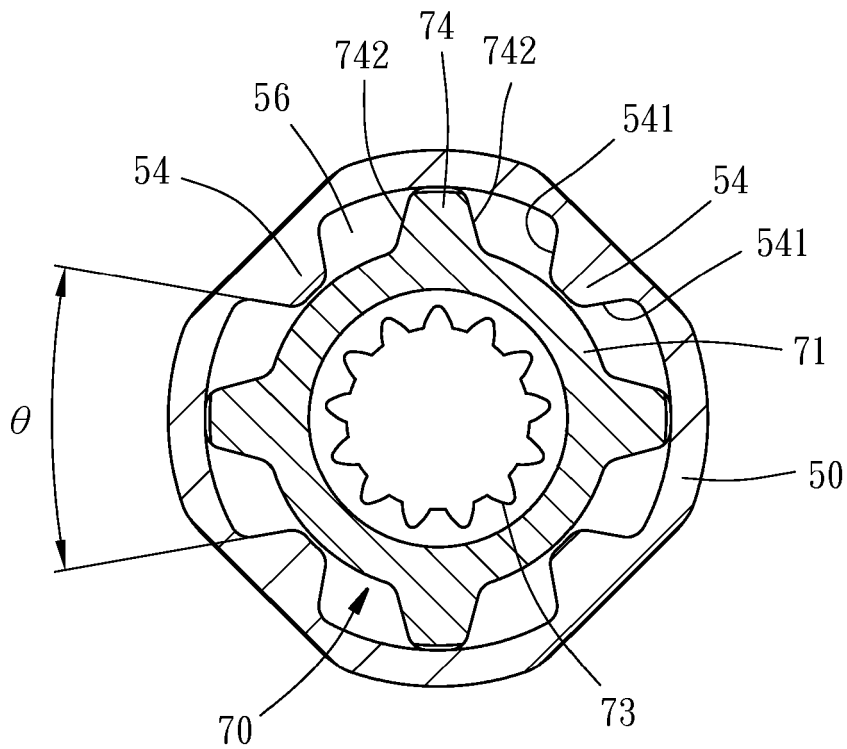


FIG. 6

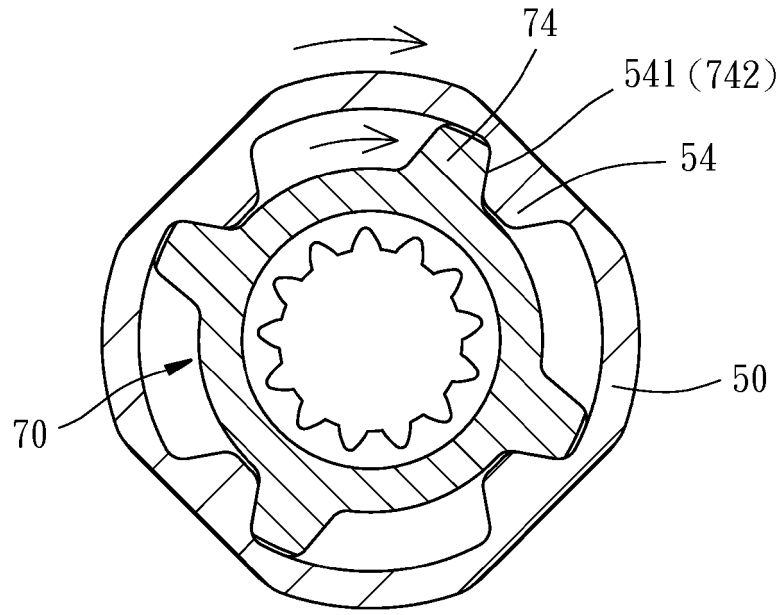


FIG. 7

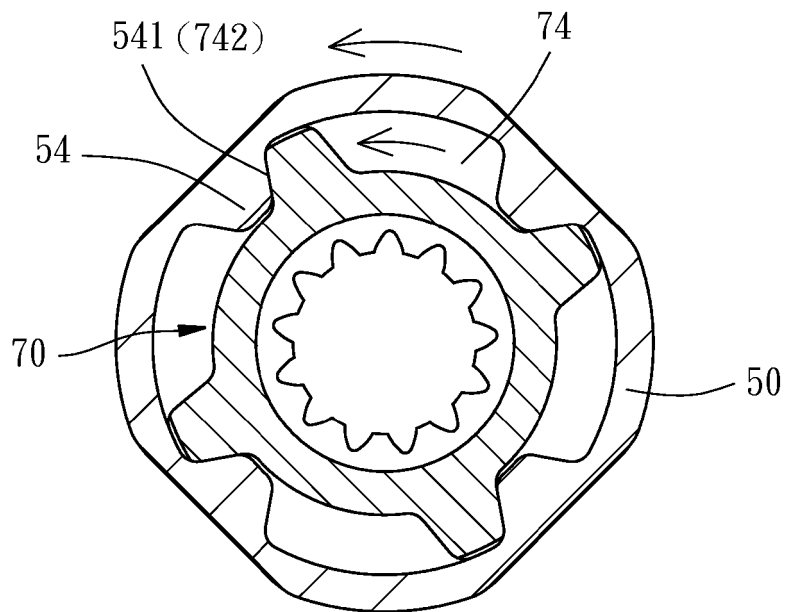


FIG. 8



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Application Number
EP 16 16 9853

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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		22 June 2017	Balzer, Ralf
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ANNEX TO THE EUROPEAN SEARCH REPORT
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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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