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(54) **DIFFERENTIAL MULTIPROPELLER SYSTEM**

MEHRPROPELLER SYSTEM MIT AUSGLEICHSGETRIEBE

SYSTEME DIFFERENTIEL A PLUSIEURS HELICES

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(56) References cited:  
**US-A- 4 529 387** **US-A- 4 963 108**  
**US-A- 5 009 621**

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## Description

**[0001]** The invention relates to a differential multipropeller system that is suited to be used especially in watercraft propulsion devices, but also in other applications. In particular, the invention relates to a multipropeller system in which the ratio of the rotational speeds of the propellers is not fixed.

**[0002]** Multipropeller systems, where at least two propellers are arranged concentrically in succession and relatively near to each other, have several verified advantages, such as the elimination of torques caused by the rotation of the propellers, which torques tend to deviate a craft from its direction of motion. The most common multipropeller systems designed for watercraft propulsion devices are provided with two propellers. From the Swedish patent publication No. SE 433,599 and from a respective US patent No. 4,529,387, there is known a double propeller system provided with a vertical drive shaft and two horizontal concentric propeller shafts, the first of which is tubular, so that the second propeller shaft rotates within the first propeller shaft. At the lower end of the vertical drive shaft, there is arranged a first bevel gear that transmits the rotary motion of the drive shaft to the second and third bevel gears located at the front end of the propeller shafts, said second and third bevel gears being of equal sizes and located on different sides of the first bevel gear. The equal size of the second and third bevel gears provided in the propeller shafts results in that the torques and angular velocities of the propeller shafts always have the same absolute values. The location of the second and third bevel gear on opposite sides of the first bevel gear results in that the angular velocities of the propeller shafts always have opposite signs.

**[0003]** The equal torque system of the above described type, where the torques and angular velocities of the propeller shafts are equal in their absolute values, is not the best possible solution with respect to the system efficiency. When a ship proceeds in water at various speeds, the flowing of the water near the propellers varies, so that even if the blade angles, diameters and other structural parameters of the propellers were optimal for the balanced torque with a given velocity, they can be highly disadvantageous with some other velocity. Moreover, both propeller shafts must rotate continuously. If one propeller shaft stops from rotating for instance due to a bearing damage, or when a foreign object prevents the rotation of one propeller, also the other propeller shaft stops, and the whole system becomes useless.

**[0004]** The above described drawbacks can be avoided by means a so-called differential torque system which is known from the US patent publication No. 5,009,621. There the leading idea is to provide in between the drive shaft and the propeller shafts a torque splitting device which in operation resembles a differential gear familiar from cars. The torque splitting device allows the angular velocities of the propeller shafts to

be adjusted automatically. Although the angular velocity of the drive shaft does not change, the angular velocity of the first propeller shaft may increase, in which case the angular velocity of the second propeller shaft is respectively reduced, and vice versa. One or the other of the propeller shafts may even stop completely, in which case the remaining propeller shaft rotates at the highest possible speed. A system composed of a differential torque system and two propellers connected thereto can be called a differential double-propeller system. In theory, this arrangement achieves many advantages in comparison with the equal torque system, but the structure of the differential double-propeller systems described in the US patent 5,009,621 is very complicated, wherefore their production costs rise high, and they contain several weak spots that are susceptible to damages.

**[0005]** The object of the present invention is to introduce a differential multipropeller system with a simple and solid structure.

**[0006]** The object of the invention is achieved by the features of claim 1.

**[0007]** The system according to the invention is characterized in that the drive shaft is concentric with the two propellers and extends through both of them.

**[0008]** In the invention, the first propeller or a part immediately connected thereto is in a way assumed as part of the torque splitting device, which divides the torque obtained from the drive shaft between the first and the second propeller. A first gear or friction wheel attached to the drive shaft moves one or several second gear or friction wheels, the motion of which rotates the first propeller in a direction perpendicular to the shaft(s) of the second gear or friction wheel(s). At the same time, the second gear or friction wheel(s) transmit part of the motion further to a third gear or friction wheel, which is advantageously located concentrically with the drive shaft, but is not attached thereto, but to the second propeller.

**[0009]** The splitting of the torques between the propellers according to the invention results in that on the average, the absolute value of the angular velocities of the propellers is only part of the angular velocity of the drive shaft, i.e. the system includes an integrated reduction gearing. In a double-propeller system, the absolute value of the angular velocities of the propellers is usually something like half of the angular velocity of the drive shaft. The integrated reduction gearing is particularly advantageous in systems where the drive shaft is rotated by an electric motor, because the rotational speed of the electric motor may be made higher than without the reduction gearing, and consequently the diameter of the electric motor can be smaller. The integrated gearing is also advantageous in applications where a propeller system according to the invention is used to rotate the drive shaft of a generator or a turbine, in which case it acts as a step-up gear: the rotational speed of the turbine axis is higher than the rotational speed of either

one of the propellers.

**[0010]** The invention is explained in more detail below, with reference to preferred embodiments by way of example, and to the accompanying drawings, where

figure 1 illustrates a preferred embodiment of the invention,

figure 2 illustrates a modification of the embodiment of figure 1,

figure 3 illustrates another modification of the embodiment of figure 1,

figure 4 illustrates a third modification of the embodiment of figure 1,

figure 5 illustrates a second preferred embodiment of the invention and

figure 6 illustrates how the invention is advantageously applied in a propulsion device.

**[0011]** Like numbers for like parts are used in the drawings.

**[0012]** Figure 1 is a schematical cross-section of a differential double-propeller system 100 comprising a first propeller 101 and a second propeller 102. The drive shaft 103 extends throughout the whole system, and for rotating said shaft, there is provided a motor or a similar device which is not illustrated in the drawing. To the drive shaft, there is attached a first bevel gear 104, which in this embodiment of the invention is installed in a position where its conical cogged surface tapers towards the outermost end of the drive shaft 103, i.e. to the left with respect to the position illustrated in the drawing. The second bevel gears 105a and 105b are located at an angle of 90 degrees with respect to the first bevel gear 104, and so that while the first bevel gear turns around, it rotates the second bevel gears. The shafts 106a and 106b of the second bevel gears are attached with bearings to the recesses 107a and 107b provided in the first propeller 101. The third bevel gear 108 is like a mirror image of the first bevel gear 104 in relation to the plane where the shafts 106a and 106b of the second bevel gears are located. The third bevel gear 108 is not attached to the part of the drive shaft 103 passing there-through, but can freely rotate around it. On the other hand, the third bevel gear 108 is attached to the second propeller 102 by intermediation of a tubular shaft 109. The third bevel gear 108 could also be attached directly to the second propeller 102, without the tubular shaft, or it could even be part of the same piece. At the outermost end of the drive shaft 103, there are provided a support cone 110 and a locking nut 111, the purpose whereof is to keep the propellers 101 and 102 attached to the drive shaft 103. In order to detach the propellers 101 and 102, the locking nut 111 is opened, so that the

support cone 110 and the propellers 101 and 102 can be pulled apart from the drive shaft 102. All gear wheels illustrated in the structure, as well as the gear wheels illustrated below in connection with other preferred embodiments, could also be friction wheels. Gear wheels and friction wheels may be commonly designated as drive wheels.

**[0013]** When the first bevel gear 104 turns around along with the drive shaft, it tends to rotate the second bevel gears 105a and 105b, each around its respective shaft 106a and 106b. It also tends to revolve the whole assembly of second bevel gears 105a and 105b and shafts 106a and 106b around the drive shaft. If the shafts 106a and 106b should not, for one reason or another, be able to move around the drive shaft in a plane perpendicular to the drive shaft, the rotation of the second bevel gears 105a and 105b around their shafts would rotate the third bevel gear 108, and simultaneously the second propeller 102 at an angular velocity that is as high as the angular velocity of the first bevel gear 104, but of an opposite sign. On the other hand, if the shafts 106a and 106b are freely allowed to move around the drive shaft in a plane perpendicular to the drive shaft, but the third bevel gear 108 cannot rotate, for one reason or another, the movement of the shafts 106a and 106b rotates the first propeller 101 in the same direction in which the drive shaft 103 rotates. When the system according to figure 1 is placed in water or in some other medium and the drive shaft 103 rotates, the operation of the system is set in between said two extremes: owing to the flowing of the medium and to the motion-resisting forces created thereby, the propellers 101 and 102 rotate in opposite directions at such angular velocities, the mutual ratio whereof is defined by the propeller shapes and by the motion-resisting forces momentarily affecting said propellers.

**[0014]** Figure 1 illustrates two second bevel gears 105a and 105b. The invention does not, however, restrict the number of these gear wheels; consequently, there can be one or two or as many gear wheels as can be fitted around the first and third bevel gears. A natural alternative to attaching the shafts 106a and 106b of the second bevel gears with bearings to the recesses 107a and 107b provided in the first propeller 101 is to provide bearings between each second bevel gear and the respective shaft and to attach the shafts rigidly to the first propeller.

**[0015]** Figure 2 is a schematical cross-section of a preferred embodiment 200 of the invention, which embodiment in a way is a mirror image of the embodiment of figure 1. In figure 2, the drive shaft 203 is rotated, with respect to the position illustrated in the drawing, at the left-hand end of the drive shaft, and the support cone 210 and locking nut 211 that keep the propellers locked in place are located at the right-hand end of the drive shaft. The first bevel gear 204 is arranged so that its conical toothed surface tapers towards the inner end of the drive shaft 203. Functionally the embodiment of fig-

ure 2 corresponds to that of figure 1, and in the light of the description given above, the operation of the embodiment of figure 2 is easily understood.

**[0016]** Figure 3 is a schematical cross-section of an embodiment 400 of the invention, where the gear wheel assembly formed by the bevel gears 404, 405a, 405b and 408 is not located inside the propellers but in a transmission housing 420, which may also contain other parts connected to power transmission and even a whole engine that rotates the drive shaft 403. The shafts 406a and 406b of the second bevel gears 405a and 405b are attached with bearings to the recesses 407a and 407b provided in the propeller shaft 421, so that they transmit the rotary motion to the first propeller 401 by intermediation of the tubular propeller shaft 421. In other respects the system according to this embodiment functions in similar fashion as the embodiment illustrated in figure 1.

**[0017]** Figure 4 illustrates a modification 600 of the invention comprising a total number of four propellers 601, 602, 603 and 604. From the bevel gear 606 arranged at the end of the drive shaft 605, power is transmitted to the first and second propeller 601 and 602 in similar fashion as in the embodiment of figure 1. To the drive shaft, there also is attached a fourth bevel gear 607 which transmits power to the third and fourth propeller 603 and 604. In principle the invention does not restrict the number of propellers that can be installed successively in the described manner, but the motional resistances caused by the bevel gears become a restricting factor at some stage. This type of embodiment is suited for instance in an axial pump where the propellers 601 - 604 are located inside a cylindrical chamber, so that they push water or other medium contained in the cylinder towards the other end of said cylinder.

**[0018]** Figure 5 illustrates another preferred embodiment 700 of the invention in a partial cut-out diagram. In the embodiment of figure 5, the first gear wheel 701 attached to the drive shaft 702, and the second gear wheels 703a and 703b operationally engaging with the first gear wheel 701, are not conical but cylindrical in shape with their outer cylindrical surfaces toothed. The third gear wheel 704 is an inner-toothed cylindrical gear having an inner cylindrical toothed surface that operationally engages with the second gear wheels 703a and 703b; the general form of the third gear wheel 704 that of a "bowl" enclosing the second and first gear wheels, with a hole through the bottom of the "bowl" for the drive shaft 702 to pass through. The toothed surface of the third gear wheel 704 is the inner surface of the walls of the "bowl". With respect to simple manufacturing it may be more appropriate to provide a simple ring-formed inner-toothed gear as the third gear wheel. The shafts 705a and 705b of the second gear wheels 703a and 703b are parallel to the drive shaft 702 and have their other ends attached with bearings to the recesses 706a and 706b in the first propeller 707. Again the shafts 705a and 705b of the second gear wheels may be attached

essentially rigidly to the first propeller 707 if there are bearings between each second gear wheel and the respective shaft. The third gear wheel 704 is essentially rigidly connected to the second propeller 708.

**[0019]** The operation of the embodiment of figure 5 is analogous to that of the embodiments described above. The first gear wheel 701 rotates along with the drive shaft 702, tending to rotate the second gear wheels 703a and 703b each around its corresponding shaft. If, for some reason, the third gear wheel 704 could not rotate, the second gear wheels 703a and 703b would roll between the rotating first gear wheel 701 on their inside and the stationary third gear wheel 704 on their outside, resulting in the shafts 705a and 705b being revolved around the drive shaft 701 like the cartridges in the cylinder of a revolver. Because the shafts 705a and 705b are attached to the first propeller 707, the revolving movement of the shafts 705a and 705b is synonymous to the rotation of the first propeller. Should, on the other hand, the rotation of the first propeller 707 be prevented while the third gear wheel 704 is allowed to rotate freely, the rotating movement of the drive shaft 701 would only rotate each second gear wheel 703a and 703b around its corresponding shaft 705a and 705b. This, in turn, would cause the third gear wheel 704 (and the second propeller 708 along with it) to rotate into the direction opposite to that of the drive shaft rotation. In a realistic situation where the assembly according to figure 5 is immersed in water or some other flowing medium and a motor or other motion-providing means rotates the drive shaft 701, the flow of the medium and the associated motion-resisting forces will cause the propellers 707 and 708 to rotate at some rotational speed between zero and the maximum rotational speed according to the above-explained extreme value.

**[0020]** For a man skilled in the art it is obvious that some kind of bearings and/or lubrication must be provided in between all parts that slide against each other, and that the seepage of water or other surrounding medium to the gear wheels and bearings must be prevented by means of a suitable sealing. However, bearings, lubrication and sealing represent known technology, and they are not significant as for the characteristic novel features of the invention, wherefore they are, for the benefit of both graphic and textual clarity, left out of the figures 1 - 5 and of the associated descriptions. Likewise, in the above specification we have not set any particular requirements for the mutual relations of the radii of the gear or friction wheels. Such sizes of the gear or friction wheels that are advantageous both functionally and for the production technique can be found out by way of experimentation. The invention does not require any particular propeller diameter or shape or number of blades, but also these structural parameters can be adjusted to be suitable by way of trial and by taking into account the power of the motor used at any given time, the size and desired velocity of the craft in question, as well as other affecting factors.

[0021] A particularly advantageous embodiment of the invention is such where at least one of the propellers is made adjustable. There are numerous known ways of producing an adjustable propeller; they are most commonly found in connection with airplane engines where the adjustable parameter is the blade angle. Adjustment of the propeller may be based on mechanics, pneumatics, hydraulics, electronics or any combination of these. A popular and simple construction includes a toroidal, nonrotating part placed around the drive shaft movably in the longitudinal direction thereof. A roller bearing communicates the linear movement of the toroidal part to a corresponding part in the propeller hub, where an arrangement of levers transforms the linear movement into a synchronised rotational movement of the propeller blades around their corresponding longitudinal axes. An adjustable propeller known as such is easily fitted into a construction according to the invention, where it gives the user a large freedom to dynamically choose the operational parameters of the propeller system.

[0022] Figure 6 illustrates how the invention is applied in an azimuth propulsion device 500, which is a propulsion device that is attached to the bottom of a craft and turns around a pivoted-axis 501. The housing 502 of the azimuth propulsion device may contain an electric motor that rotates the drive shaft, from which the motion is transmitted to the differential multipropeller system according to the invention, said system comprising in this embodiment the propellers 503 and 504. Because the system according to the invention comprises an integrated reduction gear, the propellers 503 and 504 each rotate approximately at a speed the absolute value of which is half of the rotational speed of the rotor of the electric motor. In general, the electric motor can be constructed so that the higher its rotational speed in normal use, the smaller its diameter; consequently, owing to the present invention, the housing 502 of the azimuth propulsion device can be made smaller in cross-sectional surface than in the known arrangements of the prior art, where the rotary motion is transmitted from the electric motor to the propeller without a reduction gear. A small cross-sectional area means a low flow resistance, and it also means that the housing of the propulsion device is a lesser obstruction to the water flowing to the propellers, wherefore the efficiency of the propellers is improved.

[0023] Advantageously the invention can also be applied in water jet propulsion devices, where the water is sucked in through a suction hole or holes, provided at the bottom of the craft, to a flow channel containing a propeller assembly that pushes the water out at a strong force through a blow aperture or apertures provided at the rear of the craft. Now the advantage brought about by the invention is that the share of the motor and/or gear system in the transversal surface area of the flow channel is smaller than in prior art arrangements applying the multipropeller system, as well as the fact that the structure according to the invention is extremely solid.

Another application of the invention where the integrated gearing and propeller assembly would most advantageously be fitted in a tube would be a turbine of a hydro-electric power installation, operating either under the unidirectionally flowing conditions of a river power plant or the alternately flowing conditions of a tidal power station. In the turbine applications it is naturally the flow of the surrounding medium that puts the propellers into motion and not vice versa as in the propulsion applications, and the integrated gearing inherent to the invention will act as a step-up gearing, giving the turbine shaft a higher angular velocity than in known multipropeller solutions. The argument of smaller transversal surface area of the flow channel being taken by the gear system also applies.

[0024] The invention does not restrict the ways by which the drive shaft rotating the multipropeller system is set to rotate in the propulsion applications, wherefore the invention can be applied in propulsion devices driven both by combustion engines and electric motors as well as in hydraulic propulsion devices. The simplicity of the invention ensures that the drive shaft extends through the propellers, which makes the structure very solid. In principle, the invention can also be applied in assemblies where the rotation of the propellers by for example water or air flow rotates the drive shaft and not vice versa. For instance an electric generator can then be connected to the drive shaft. Shafts in general should be understood in their widest meaning in the present patent application. For example, the shaft of a gear wheel is the part that gives mechanical support to the gear wheel and is essentially stationary with respect to the rotational motion of the gear wheel, irrespective of the design and mechanical details of the parts. The invention does not require that the first and second propellers should be placed in immediate succession.

## Claims

1. A differential multipropeller system (100, 200, 400, 600, 700) comprising a drive shaft (103, 203, 403, 605, 702) for transmitting rotational force to and/or from the differential multipropeller system as well as a first propeller (101, 601, 707) and a second propeller (102, 602, 708), said first and second propeller being arranged concentrically in succession, **characterized in that**
  - it comprises a first drive wheel (104, 204, 404, 701), a second drive wheel (105a, 105b, 405a, 405b, 703a, 703b), a second drive wheel shaft (106a, 106b, 406a, 406b, 705a, 705b) and a third drive wheel (108, 408), of which the first drive wheel is connected to the drive shaft (103, 203, 403, 605, 702) and the second drive wheel operationally engages with the first drive wheel and the third drive wheel,

- the first propeller (101, 601) is connected to the second drive wheel shaft (106a, 106b, 406a, 406b, 705a, 705b) and the second propeller (102, 602) is connected to the third drive wheel (108, 408), and
  - the drive shaft (103, 203, 403, 605, 702) is concentric with the two propellers (101, 601, 707, 102, 602, 708) and extends through both of them.
2. A differential multipropeller system (100, 200, 400, 600) according to claim 1, **characterized in that** the first, second and third drive wheel are bevel gears and that the shaft of the second drive wheel is at right angles to the rotational axes of the first and third drive wheels.
3. A differential multipropeller system (700) according to claim 1, **characterized in that** the first and second drive wheels are outer-toothed cylindrical drive wheels and the third drive wheel is an inner-toothed cylindrical drive wheel and that the shaft of the second drive wheel is parallel to the rotational axes of the first and third drive wheels.
4. A differential multipropeller system (100, 200, 700) according to claim 1, **characterized in that** the first, second and third drive wheel are located inside one of the propellers.
5. A differential multipropeller system (400) according to claim 1, **characterized in that** the first, second and third drive wheel are located inside a transmission housing which is not located inside either of the propellers.
6. An azimuth propulsion device (500), **characterized in that** it comprises a differential multipropeller system according to claim 1, wherein the drive shaft is arranged to transmit rotational force from a motor to the differential multipropeller system.
7. A water jet propulsion device, **characterized in that** it comprises a differential multipropeller system according to claim 1, wherein the drive shaft is arranged to transmit rotational force from a motor to the differential multipropeller system.
8. A turbine device, **characterized in that** it comprises a differential multipropeller system according to claim 1, wherein the drive shaft is arranged to transmit rotational force from the differential multipropeller system to a generator.
- (100, 200, 400, 600, 700) bestehend aus einer Antriebswelle (103, 203, 403, 605, 702) zur Übertragung von Rotationskraft zu und/von dem Differentialmultipropellersystem, und einem ersten Propeller (101, 601, 707) und einem zweiten Propeller (102, 602, 708); die besagten Propeller (der erste und der zweite) sind konzentrisch in einer Nacheinanderfolge arrangiert, wobei die kennzeichnende Eigenart ist, dass
- es aus einem ersten Antriebsrad (104, 204, 404, 701), aus einem zweiten Antriebsrad (105a, 105b, 405a, 405b, 703a, 703b), aus einer zweiten Antriebsradwelle (106a, 106b, 406a, 406b, 705a, 705b) und einem dritten Antriebsrad (108, 408) besteht, wobei das erste Antriebsrad mit der dritten Antriebswelle (103, 203, 403, 605, 702) verbunden und das zweite Antriebsrad bei Betrieb mit dem ersten Antriebsrad und mit dem dritten Antriebsrad gekuppelt ist,
  - der erste Propeller (101, 601) ist mit der zweiten Antriebsradwelle (106a, 106b, 406a, 705a, 705b) verbunden und der zweite Propeller (102, 602) ist mit dem dritten Antriebsrad (108, 408) verbunden, und
  - die Antriebswelle (103, 203, 403, 605, 702) ist konzentrisch mit den zwei Propellern (101, 601, 707, 102, 602, 708) und läuft durch die beiden hindurch.
2. Ein Mehrpropeller System mit Ausgleichsgetriebe (100, 200, 400, 600) entsprechend dem Anspruch 1, wobei die kennzeichnende Eigenart ist, dass das erste, zweite und dritte Antriebsrad Kegelradgetriebe sind, und dass die Welle des zweiten Antriebsrades im rechten Winkel zu den rotierenden Achsen des ersten und dritten Antriebsrades ist.
3. Ein Mehrpropeller System mit Ausgleichsgetriebe (700) entsprechend dem Anspruch 1, wobei die kennzeichnende Eigenart ist, dass das erste und zweite Antriebsrad zylindrische mit Aussenzähnen versehene Antriebsräder sind und das dritte Antriebsrad ein mit Innenzähnen versehenes zylindrisches Antriebsrad ist und dass die Welle des zweiten Antriebsrades parallel mit den rotierenden Achsen des ersten und dritten Antriebsrades läuft.
4. Ein Mehrpropeller System mit Ausgleichsgetriebe (100, 200, 700) entsprechend dem Anspruch 1, wobei die kennzeichnende Eigenart ist, dass sich das erste, zweite und dritte Antriebsrad innerhalb eines der Propeller befinden.
5. Ein Mehrpropeller System mit Ausgleichsgetriebe (400) entsprechend dem Anspruch 1, wobei die kennzeichnende Eigenart ist, dass sich das erste,

#### Patentansprüche

1. Ein Mehrpropeller System mit Ausgleichsgetriebe

deuxième et troisième Antriebsrad innerhalb eines Kraftübertragungsgehäuses befinden, welches sich nicht innerhalb eines der beiden Propeller befindet.

6. Eine Azimutantriebsvorrichtung (500), deren kennzeichnende Eigenart ist, dass sie aus einem Differentialmultipropellersystem entsprechend dem Anspruch 1 besteht, worin die Antriebswelle so arrangiert ist, dass sie die Rotationskraft von einem Motor zu dem Differentialmultipropellersystem überträgt. 5 10
7. Eine Wasserstrahlantriebsvorrichtung, deren kennzeichnende Eigenart ist, dass sie entsprechend dem Anspruch 1 aus dem Differentialmultipropellersystem besteht, wobei die Antriebswelle so arrangiert ist, dass sie die Rotationskraft von einem Motor zu dem Differentialmultipropellersystem überträgt. 15 20
8. Eine Turbinenvorrichtung, deren kennzeichnende Eigenart ist, dass sie entsprechend dem Anspruch 1 aus einem Differentialmultipropellersystem besteht, wobei die Antriebswelle so arrangiert ist, dass sie die Rotationskraft von dem Differentialmultipropellersystem zu einem Generator überträgt. 25

#### Revendications

1. Un système différentiel à plusieurs hélices (100, 200, 400, 600, 700) comprenant un arbre de transmission (103, 203, 403, 605, 702) pour transmettre la force de rotation au et/ou du système de propulsion différentiel, ainsi qu'une première hélice (101, 601, 707) et une deuxième hélice (102, 602, 708), ces dernières étant aménagées concentriquement en série, **caractérisé en ce que** 30 35 40
  - il comprend une première roue motrice (104, 204, 404, 701), une deuxième roue motrice (105a, 105b, 405a, 405b, 703a, 703b), une deuxième arbre de roue motrice (106a, 106b, 406a, 406b, 705a, 705b) et une troisième roue motrice (108, 408), dont la première roue motrice est reliée à l'arbre de transmission (103, 203, 403, 605, 702) et la deuxième roue motrice s'engage pratiquement avec la première et la troisième roue motrice. 45 50
  - la première hélice (101, 601) est reliée au deuxième arbre de roue motrice (106a, 106b, 406a, 406b, 705a, 705b) et la deuxième hélice (102, 602) est reliée à la troisième roue motrice (108, 408), et 55
  - l'arbre de transmission (103, 203, 403, 605, 702) est concentrique avec les deux hélices (101, 601, 707, 102, 602, 708) et s'étend à tra-

vers les deux.

2. Un système différentiel à plusieurs hélices (100, 200, 400, 600, 700) selon la revendication 1, **caractérisé en ce que** la première, la deuxième et la troisième roue motrice sont des renvois d'angle et **en ce que** l'arbre de la deuxième roue motrice est en angle droit par rapport aux axes de rotation de la première et de la deuxième roue motrice.
3. Un système différentiel à plusieurs hélices (700) selon la revendication 1, **caractérisé en ce que** la première et la deuxième roue motrice sont des roues motrices cylindriques à denture extérieure et **en ce que** la troisième roue motrice est une roue motrice cylindrique à denture intérieure, et que l'arbre de la deuxième roue motrice est parallèle aux axes de rotation de la première et de la troisième roue motrice.
4. Un système différentiel à plusieurs hélices (100, 200, 700) selon la revendication 1, **caractérisé en ce que** la première, la deuxième et la troisième roue motrice sont situées à l'intérieur de l'une des hélices.
5. Un système différentiel à plusieurs hélices (400) selon la revendication 1, **caractérisé en ce que** la première, la deuxième et la troisième roue motrice sont situées à l'intérieur du boîtier de transmission qui ne se trouve pas à l'intérieur de l'une ou de l'autre hélice.
6. Un moyen de propulsion azimutal (500), **caractérisé en ce qu'il** comprend un système différentiel à plusieurs hélices selon la revendication 1, dans lequel l'arbre de transmission a été réalisé de façon à transmettre la force de rotation du moteur au système différentiel à plusieurs hélices.
7. Un système de propulsion par jet d'eau, **caractérisé en ce qu'il** comprend un système différentiel à plusieurs hélices selon la revendication 1, dans lequel l'arbre de transmission a été réalisé de façon à transmettre la force de rotation du moteur au système différentiel à plusieurs hélices.
8. Un moyen à turbine, **caractérisé en ce qu'il** comprend un système différentiel à plusieurs hélices selon la revendication 1, dans lequel l'arbre de transmission a été réalisé de façon à transmettre la force de rotation du système différentiel à plusieurs hélices à une génératrice.

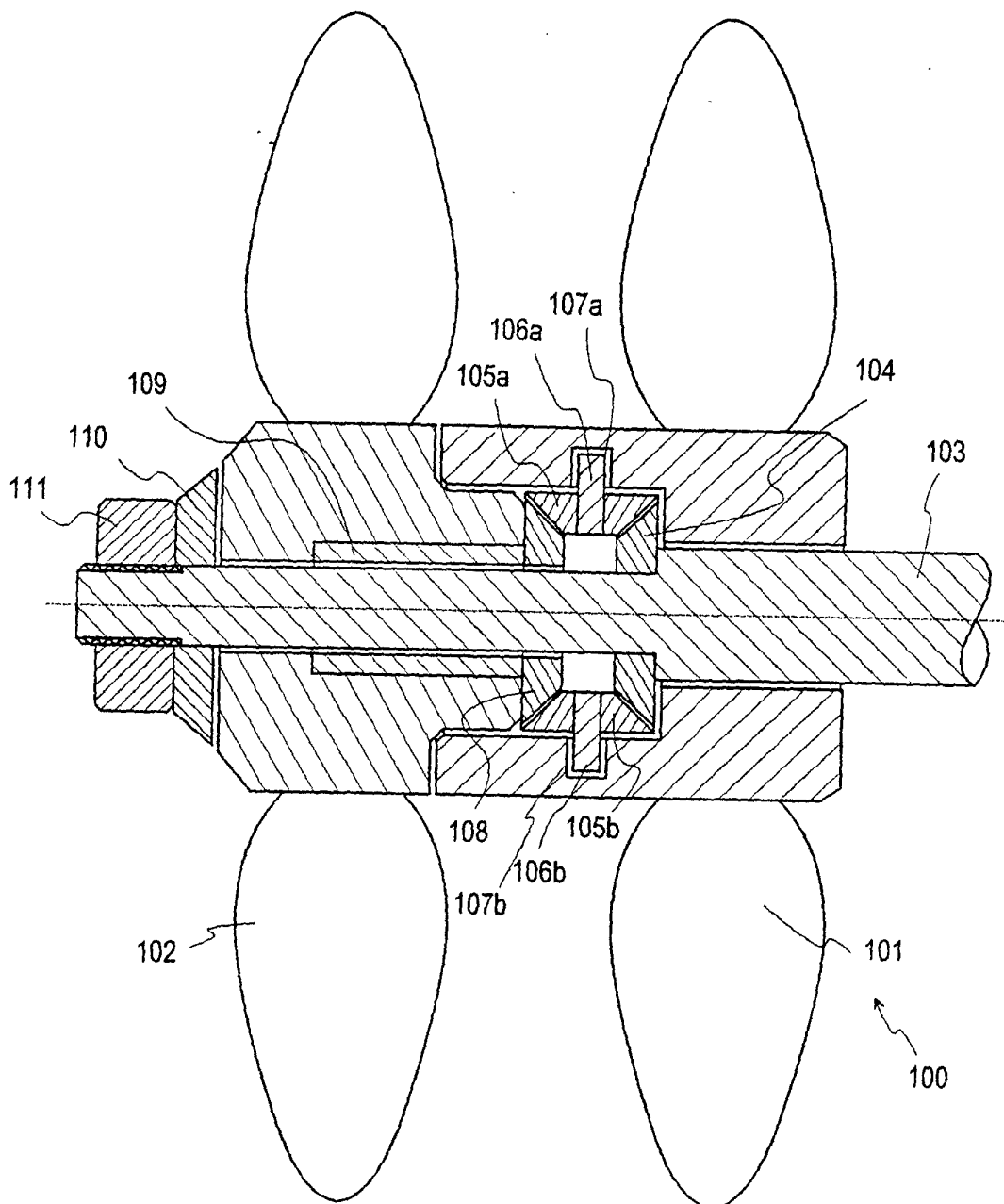


Fig. 1

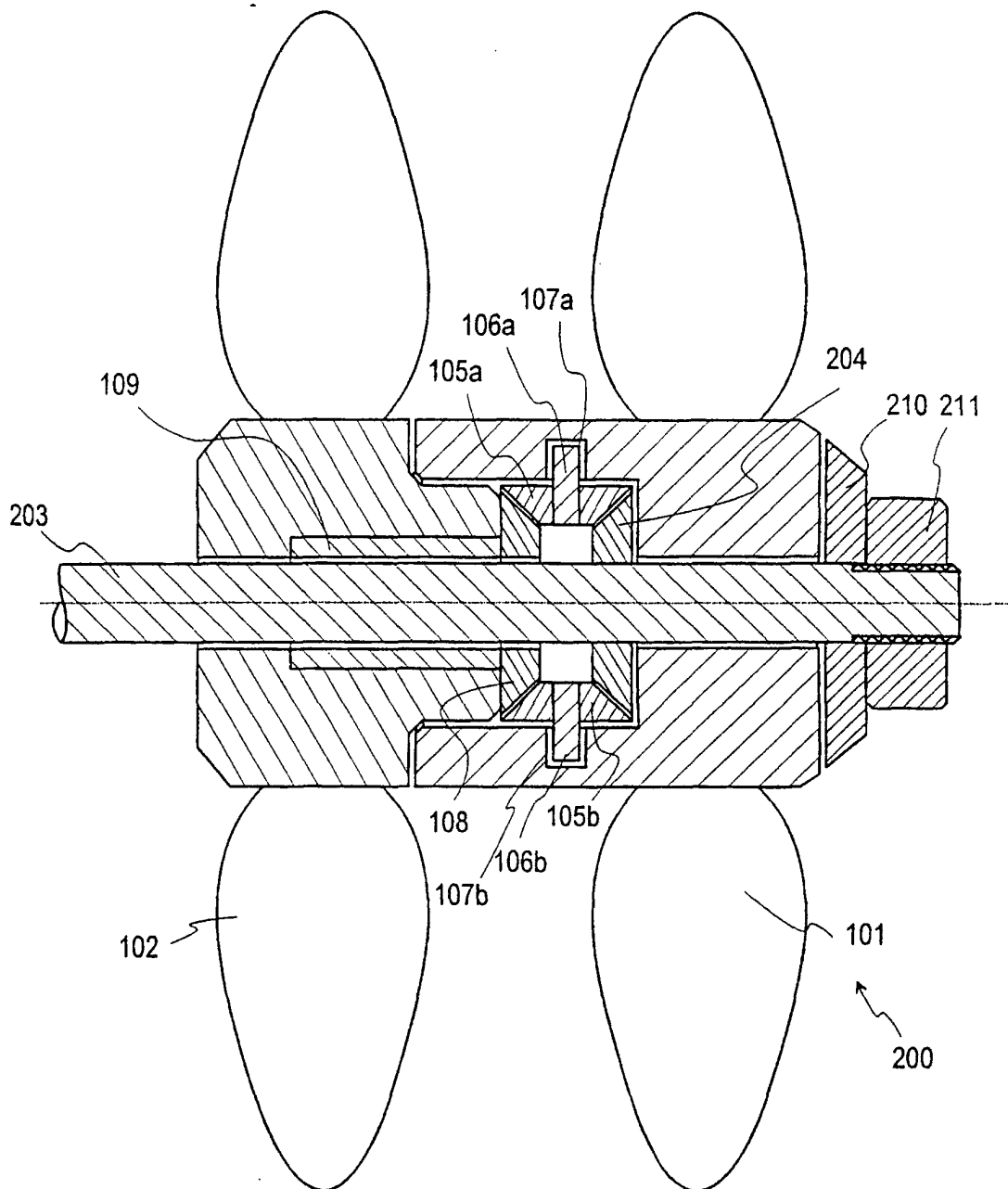


Fig. 2

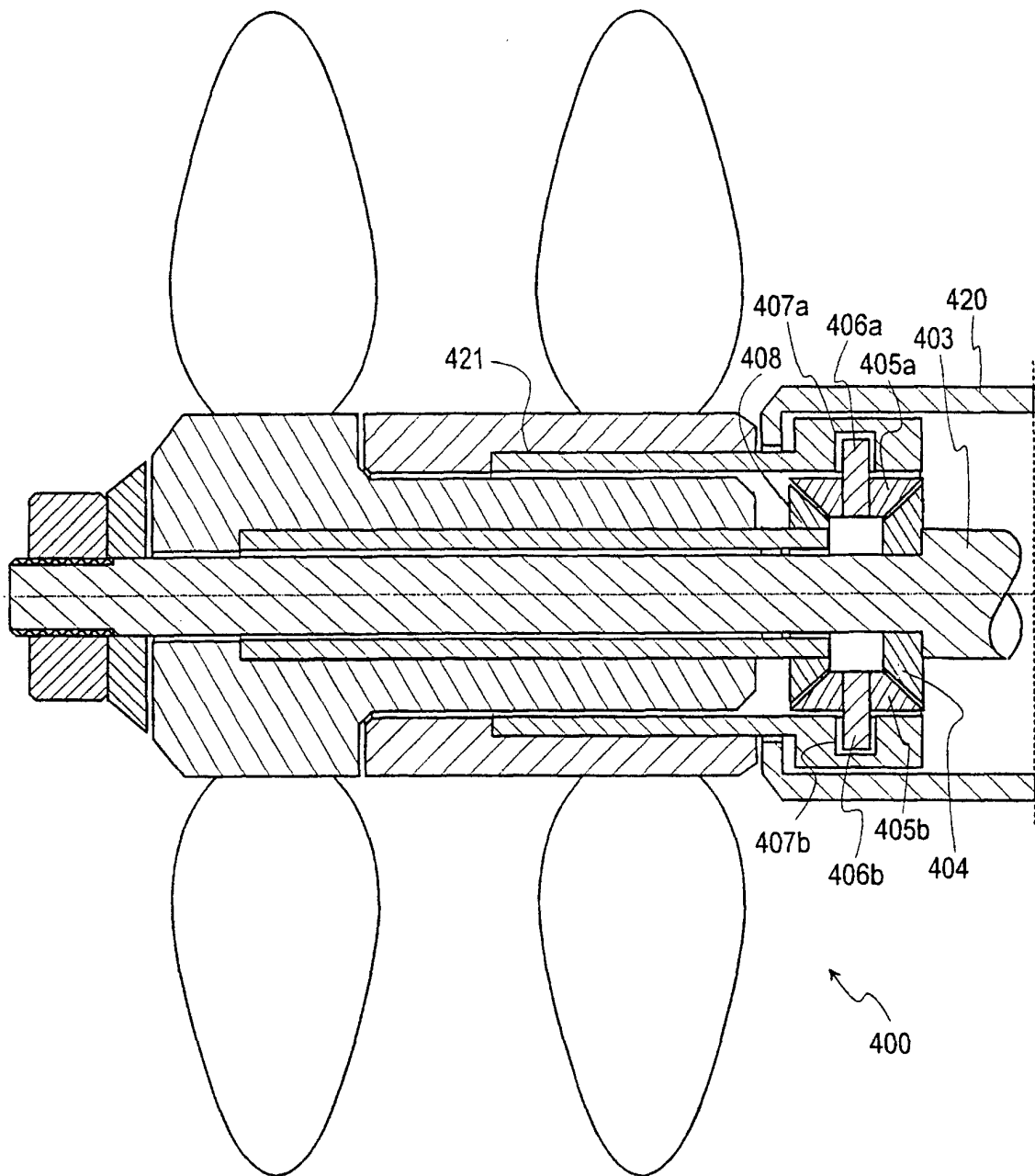
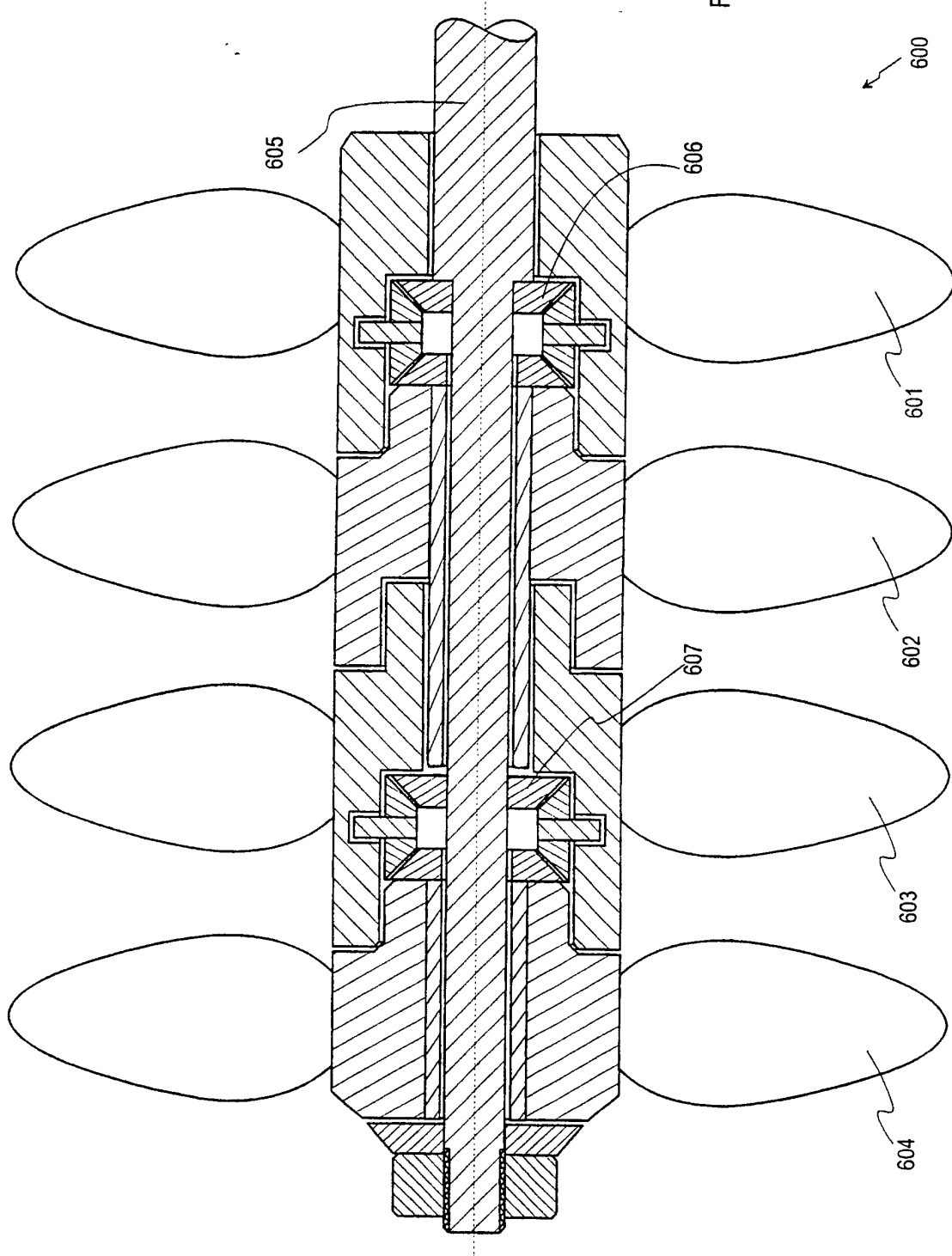


Fig. 3

**Fig. 4**



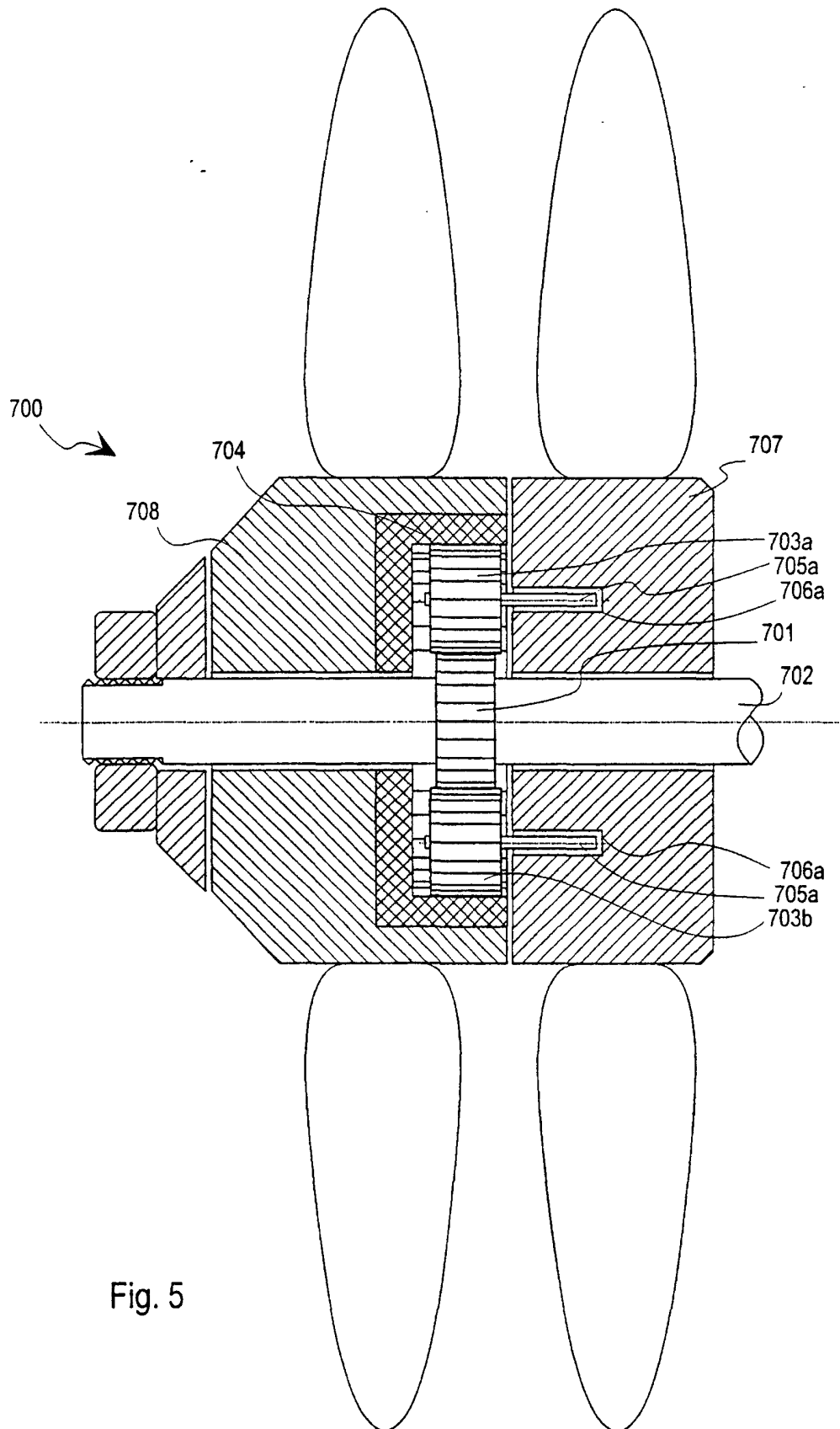


Fig. 5

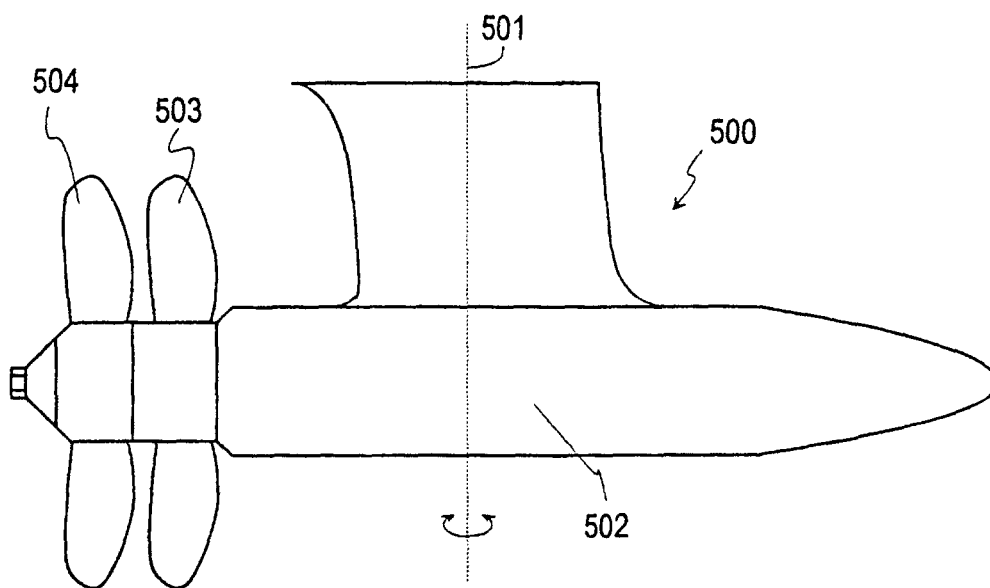


Fig. 6