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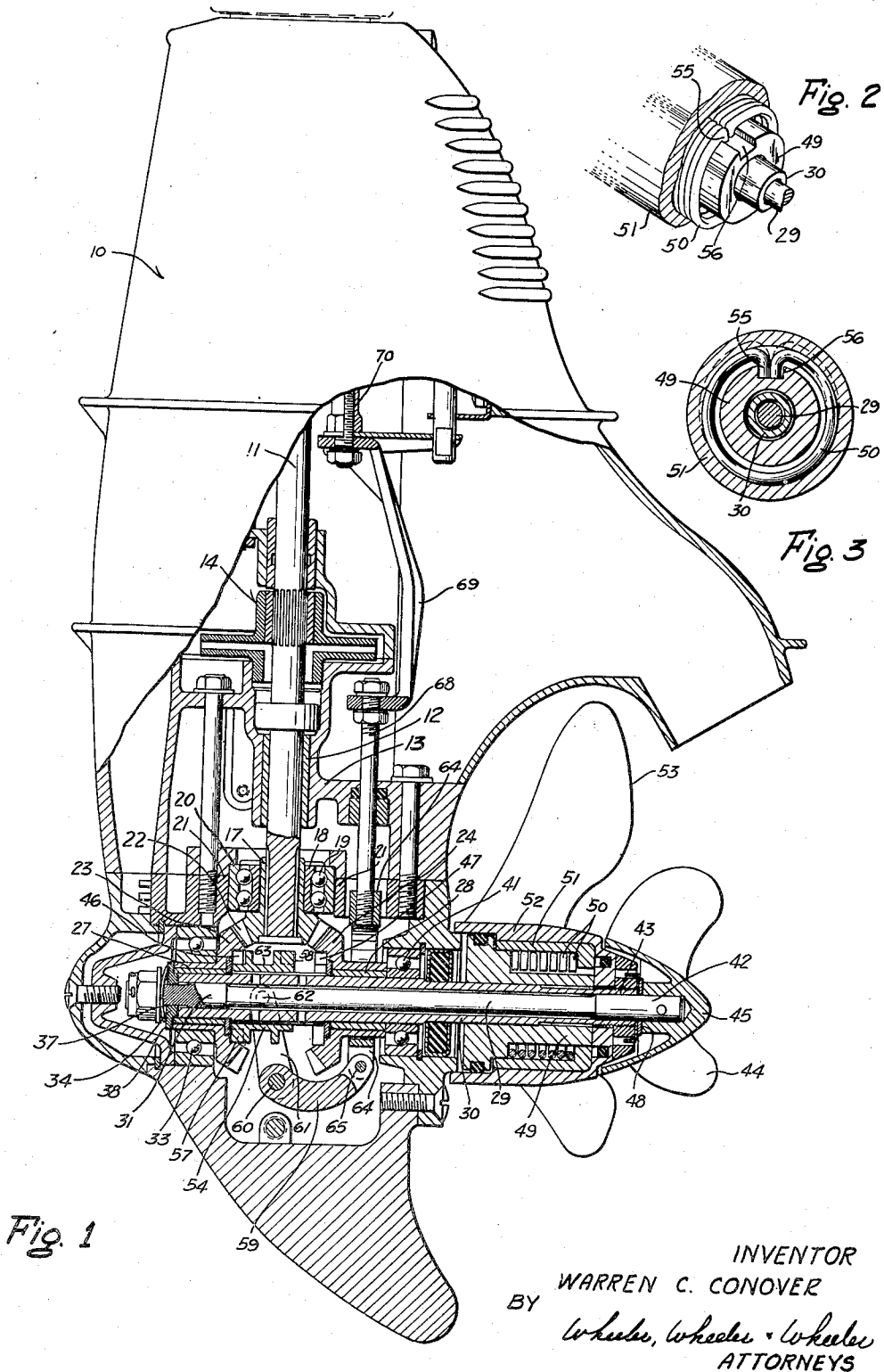
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DUAL PROPELLER PROPULSION DEVICE

Filed April 28, 1951

2 Sheets-Sheet 1



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Fig. 5

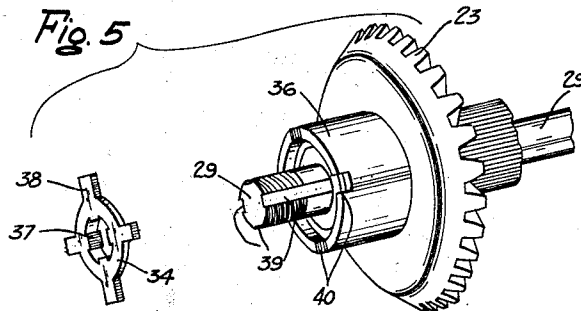
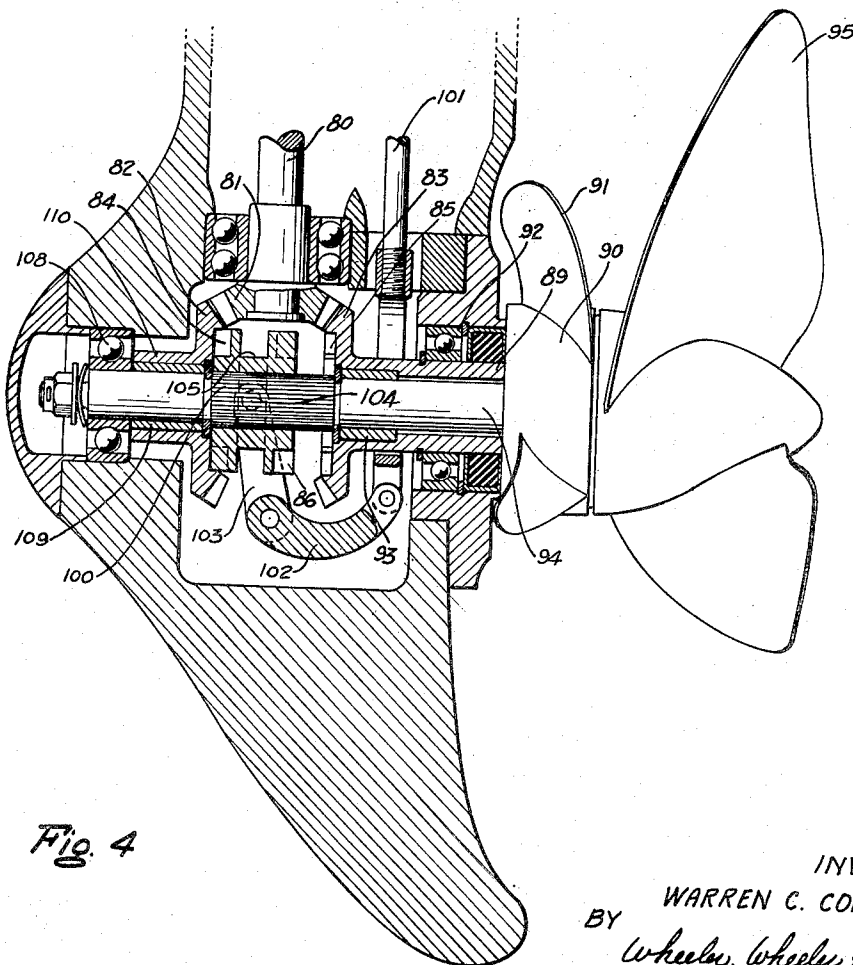


Fig. 4

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DUAL PROPELLER PROPULSION DEVICE

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This invention relates to a dual propeller propulsion device. The improvement is usually, but not necessarily, incorporated in an outboard motor. In addition to the provision of two propellers on separate concentric shafts, the invention contemplates means whereby one of the two propellers may be stopped with respect to the other or may be rotated in the same or in an opposite direction. It is further contemplated that the two propellers will be of different sizes. The pitch of their blades may be the same or opposite.

When the two propellers are so rotated that their thrust is in the same direction, the boat upon which the propulsion device is mounted will be driven at maximum speed in the direction of such thrust. When the larger of the two propellers is not driven and the smaller of the two propellers is operated in a direction to propel the boat forwardly, the low pitch and small diameter of the small propeller will permit the driving engine to operate at speeds sufficient to preclude the fouling of its plugs, while driving the boat at very low trolling speeds. When one of the two propellers is reversed with respect to the other, the boat will be driven at reduced speed either forwardly or in reverse, according to whether the larger or the smaller propeller is reverse. Assuming that the larger propeller is reversed, in accordance with preferred practice, the smaller propeller continuing to operate in a forward direction, the boat will be reversed but will operate at reduced speed in relation to engine speed. This is a desirable condition to prevent the boat from being swamped due to the fact that its stern is seldom adapted to take the waves at full engine speed.

A further object of the invention is to provide a novel friction clutch between the propeller hub of the main propeller and its selectively driven shaft whereby to relieve shock resulting either from clutch shifting or the striking of a submerged obstacle. In this connection, it is an object to provide a plurality of independent yieldable resilient but discontinuous ring members disposed between the coaxial rotating parts of the propeller hub and drive shaft, a large number of rings being employed in a pattern wherein each ring carries substantially equal load. In the preferred arrangement all rings will release simultaneously and in proportions to the excessiveness of the load.

Other objects and advantages of the invention will be more apparent to one skilled in the art upon examination of the following disclosure in which:

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Fig. 1 is a vertical cross sectional view through the lower unit of an outboard motor embodying the invention.

Fig. 2 is a fragmentary perspective view, partly in cross section, showing the details of construction of the special friction clutch between the hub of the main propeller and its drive shaft.

Fig. 3 is a cross section through the clutch shown in Fig. 2 and upon a plane transverse to the shaft axis, the spring rings being shown in elevation.

Fig. 4 is a vertical cross section through the lower unit of an outboard motor embodying a modification of the invention showing a somewhat different internal connection of the propeller hubs and propeller shafts, the respective propellers being of opposite pitch.

Fig. 5 is a perspective view in spaced relation of the means for directly connecting one of the gears of the drive gear mechanism with the propeller shaft of the auxiliary or smaller propeller of the embodiment of the invention shown in Fig. 1.

In the outboard motor exemplification shown in Fig. 1 the lower unit of an outboard motor, indicated generally as 10, houses a vertical drive shaft 11 which receives power from the engine (not shown) and which rotates in the bearing 12 which is in turn supported in the internal frame members 13. In the exemplification illustrated, drive shaft 11 also carries in splined connection an engine-cooling water pump indicated generally as 14.

Below the frame members 13 is disposed a transmission or drive gear mechanism for transmitting power from the drive shaft 11 to a propeller shaft and thence to the propellers which drive the motor and the boat to which the motor is attached.

The drive shaft 11 is splined at its lower end to a bevel gear 17 which is rotatably supported upon the inner race 18 of a ball bearing 19, the outer race 20 of the bearing being securely supported upon the housing seat portion 21.

The driving bevel gear 17 is provided with teeth 22 meshing at opposite sides of its axis with the axially spaced beveled driven gears 23 and 24. The driven gears 23 and 24 are respectively mounted on axially aligned bushings 27 and 28. Bushing 27 supports the outermost of two independently rotatable coaxial propeller shafts 29 and 30. At its forward end innermost shaft 29 is enlarged somewhat at 31 to provide a bearing within outermost propeller shaft 30. Driven gear 28 is in turn rotatable in ball bearing 33 which has an outer race seated in the lower unit.

As best shown in Fig. 5 the inner propeller drive shaft 29 is driven directly from the bevel drive gear 23 through a special form of key comprising a washer 34 which has inwardly and outwardly extending radial coplaner arms 37 and 38 which respectively engage shallow grooves 39 cut into the propeller shaft 29 and notches 40 cut into the sleeve portion 36 of the driven gear 23.

The trailing end of the lower unit is provided with a ballbearing 41 which rotatably supports the propeller shaft or tube 30. The driven bevel gear 24 is mounted on bushing 28 from shaft 33.

The rear end of the propeller shaft 29 is enlarged at 42 to bear against and receive support from the inner periphery of the trailing end extremity 43 of tube 30. Hub 45 of the small auxiliary or trolling propeller 44 is directly connected to the enlarged portion 42 of innermost propeller shaft 29. A water seal or washer 43 is provided to prevent water from entering the bearing surfaces between the shaft portion 42 and tube portion 43.

The main propeller 53 is driven from propeller shaft 30 through a clutch carrier or sleeve 49 which is splined to the shaft 30 and which carries a plurality of axially adjacent individual discontinuous or split rings 50. As best shown in Figs. 2 and 3 the individual rings 50 are initially fabricated in oval form (as suggested by the dotted lines in Fig. 3) so that when compressed radially to fit within the annular space between the clutch carrier 49 and a sleeve 51, which is keyed to the main propeller hub 52, they will occupy true circles. The outward self bias of each ring will normally frictionally bind it against the sleeve 51. The respective rings are terminated at each end in inwardly directed prongs 55. The respective prongs on each ring are initially arcuately spaced from each other, and, when forced into the position shown, both engage the axial slot 56 in the clutch carrier 49. By reason of this mechanical interlock of the prongs 55 with the clutch carrier 49, the rings must turn with the drive shaft 30, to which the carrier is splined (this being clockwise in Fig. 3). Under normal running loads the several rings 50 will frictionally transmit power from drive shaft 30 to the main propeller 53 to drive the boat. Under temporary excessive propeller load, however, torque exerted frictionally on the rings will exceed the resilient bias with which the rings are expanded. The trailing end of each ring being anchored, the friction will advance the leading end slightly, as shown in Fig. 3, to retract them partially from peripheral contact with the inner bore of sleeve 51 and allow slippage to occur. Accordingly the rings will slip on the sleeve to permit relative rotation of the sleeve 30 and propeller 53, thereby preventing injury or shock to the engine, gear mechanism, or propeller elements. Normal load conditions will restore the friction clutch to full power transmission.

There are several important advantages in using separate rings 50, which operate in parallel, as distinguished, for example, from a coil spring wound into a helix, which is sometimes used for friction clutch purposes. Only if individual rings are used will the driving force comprise the sum of the effect of the individual coils. When a coil spring is used only the terminal coils are effective. Consequently the separate coils achieve in limited space much greater power transmission than is otherwise obtainable. Moreover, the separate rings disclosed distribute the load uniformly and accordingly may be made of relatively

smaller gauge metal to permit reduction in the size and weight of the clutch and parts housing the clutch.

An additional important feature of the clutch disclosed resides in the comparatively loose fitting of both end prongs 55 of the rings in the slot 56 of the clutch carrier. This arrangement permits operation of the clutch in either direction of relative rotation of the parts, one or the other of prongs 55 being driven by the carrier, and the other prong trailing, depending on the direction.

From the foregoing it is evident that propeller 44 is directly connected for rotation with the axial drive shaft 29, and that the main propeller 53 is impositively driven through the friction clutch mechanism by the tubular propeller shaft 30.

Propeller shaft 30, may be idle, or it may be driven in either direction through a clutch member or collar 54 which is splined to shaft 30 for limited axial movement. The collar 54 is provided with dogs or teeth 57, at one end of the collar, which may mesh with complementary teeth 46 on bevel gear 23. The collar is provided at its opposite end with teeth 58 which may mesh with teeth 47 on bevel gear 24.

The shifting collar 54 is controllable by means including a bell crank 59 having a fixed pivot 60 intermediate its ends. One arm of the bell crank 59 is forked at 61 and carries spaced axially aligned prongs 62 which ride diametrically oppositely in a peripheral groove 63 in the shifting collar 54. The bell crank is actuated by means of a linkage system which includes a link 64 which is offset to clear the drive shafts and is pivotally connected at 65 to the bell crank 59. Link 64 is connected through rod 66 to link 69 and thence to operating rod 70 which is connected to an operating lever (not shown) within reach of the operator. The position of the shifting collar 54 respecting gears 23 and 24 is controlled by depressing or lifting the linkage system to shift the collar axially on the sleeve 30 and move the respective teeth 57 or 58 of the sliding member respectively into engagement with the complementary teeth 46 or 47 on the drive gears 23 and 24 to rotate shaft 30 and propeller 53 in either direction dependent on which gear 23 or 24 is furnishing the power.

By positioning the shifting collar 54 intermediate the spaced gears 23 and 24 with its teeth 57, 58 out of mesh with the gears, the main propeller 53 will be completely disconnected from drive shaft 30 and will remain substantially stationary except for the effect of the moving water on its blades.

In the embodiment of Fig. 1, as the auxiliary or trolling propeller 44 is constantly driven from the forward gear 23, it is evident that when the shifting collar 54 is engaged with gear 23 both the main and the auxiliary propellers will receive power from gear 23 and will operate in the same direction. Their thrust will then be exerted in the same direction if their blades are correspondingly pitched. In this position of the gear mechanism the propellers will aid one another in propelling the boat. When the shifting collar 54 is in intermediate or neutral position, the main propeller 53 exerts no thrust, and even is responsible for some drag. The auxiliary or trolling propeller 44 will then propel the boat at trolling speeds. When the shifting collar 54 is engaged with the reverse gear 24, the propeller 53 will be driven oppositely to the auxiliary propeller 44 and the relatively greater blade area of

the main propeller 53 will exert the greater thrust and cause the boat to move rearwardly.

In the embodiment of Fig. 4, the propellers, friction clutch, and propeller shafts are arranged in a somewhat different manner. In this embodiment of the invention the drive gear mechanism is substantially the same, a vertical drive shaft 80 driving a bevel gear 81 which simultaneously meshes with the spaced bevel driven gears 82 and 83, which are respectively provided with teeth 84 and 85, selectively engageable by the complementary teeth upon the shifting collar 86. In this embodiment of the invention driven gear 83 is made integral with or is directly connected to propeller drive tube 89 which is keyed to hub 90 of the trolling propeller 91. Propeller drive tube 89 has ball bearing support at 92 and carries a bearing bushing 93 for the support of coaxial propeller drive shaft 94. Drive shaft 94 is in driving connection with the main propeller 95 in any desired manner, as through the friction clutch disclosed in connection with the embodiment of Fig. 1. The forward end of the drive shaft 94 is rotatably supported by ball bearing 103, the shaft also carrying bearing bushing 109 which supports the sleeve portion 110 of the front drive gear 82, whereby to rotatably support the fore part of the entire drive mechanism.

The embodiment of Fig. 4 illustrates a modification of the invention wherein the auxiliary propeller is disposed forwardly of the main propeller. This view also shows another modification wherein the auxiliary propeller and the main propeller derive opposite rotation from different gears during forward propulsion to drive the boat at full speed. The blades are therefore oppositely pitched and the torsion of the slip stream of the forward propeller is rectified by the blades of the rearward propeller. Since the propellers derive power from separate gears during normal forward operation, the load upon the drive gears will be somewhat balanced, thereby resulting in a smoother operation of the drive mechanism than where both propellers are normally driven from the same drive gear, as is the case in the embodiment of Fig. 1.

Shifting collar 86 is splined at 109 to the center axial propeller shaft 94 much in the same manner as the shifting collar 54 was splined to the shaft 30 in the embodiment shown in Fig. 1. The clutch collar is actuated by manipulation of control rod 101 which acts through bell crank 102 and forked arms 103 and the pegs 104 thereof which ride within a peripheral groove 105 on the shifting collar.

From the foregoing description taken in connection with the accompanying drawings it is seen that an improved propeller arrangement and drive mechanism is provided whereby large outboard motors may be adapted for trolling purposes. By reason of the novel structure disclosed the engine may continuously be operated at speeds sufficiently high to permit smooth operation and which would otherwise propel the device too rapidly for trolling.

The novel friction clutch between the main propeller hub and main propeller drive shaft, which absorbs the shock load when the main propeller is selectively placed in the service, greatly simplifies the problem of engaging the main propeller when the engine is operating at normally high speed. The novel structure of the friction clutch is, however, such as to adapt it for a variety of purposes other than that specifically disclosed.

I claim:

1. In a marine drive, the combination with first and second propellers of different thrust capacity and means mounting the propellers substantially co-axially, of a common drive shaft, and separate driving connections from said shaft to the respective propellers, the driving connections to said first propeller comprising a direct connection whereby said first propeller is constantly driven, the driving connections to said second propeller comprising a reverser having forward, reverse and neutral positions whereby the driving thrust of said propellers from said shaft may represent the thrust of said first propeller only or the sum of the thrusts of both propellers, or the difference in the thrusts of said propellers.

2. The device of claim 1 wherein said second propeller has a hub in yieldable resilient connection to its propeller shaft.

3. The device of claim 1 wherein the driving connections rotate the propellers in opposite direction and the said propeller blades are oppositely pitched, whereby counterrotation of said propellers will cause the respective thrusts of the propellers to be additive.

4. In a marine drive, the combination with a drive shaft, of propeller shafts substantially co-axial with each other and angularly related to the drive shaft, propellers of different thrust capacity mounted on the respective propeller shafts, a driving gear on the drive shaft, a pair of oppositely rotating driven gears meshing with the driving gear and mounted co-axially with the propeller shafts, a first driving connection from one of the driven gears to one of the propeller shafts, clutch members connected with the gears and spaced axially of said shafts, and a reversing clutch sleeve splined to the other propeller shaft and having clutch members selectively engageable with the clutch members of the respective driven gears and having an idle position therebetween whereby the propeller on the propeller shaft to which said sleeve is splined may be brought to rest or actuated in either direction, the net propulsive effort of the two propellers representing either the thrust of one propeller only or the thrust of both propellers together or the differential of the opposed thrusts of the respective propellers, according to the position of said clutch sleeve.

5. In a marine drive having a drive shaft, the combination with a first propeller shaft and propeller thereon, and a driving connection from said drive shaft to said first shaft, of a second shaft and a propeller thereon having a hub, and a driving connection including a clutch between said second shaft and said drive shaft whereby said second propeller may be selectively driven from the drive shaft or allowed to idle, said second shaft and propeller hub comprising radially spaced members and a yieldable resilient connection therebetween, said connection comprising a plurality of separate discontinuous rings disposed in said space, said rings having a relatively fixed connection to one of said members and being normally tensioned for peripheral frictional contact with the other of said members.

6. In a dual propeller propulsion device, the combination with a drive shaft, first and second propellers, a first propeller shaft and a second propeller shaft co-axial with said first propeller shaft, a drive gear mechanism between said drive shaft and said first and second propeller shafts, said drive gear mechanism including spaced driven gears simultaneously oppositely driven by said drive shaft, one of said first and second

propeller shafts being connected continuously to one of said driven gears, the other of said propeller shafts having a toothed member adjustably connected thereto and disposed between said spaced driven gears, and motion transmitting connections to said toothed member whereby said gear member may be selectively engaged with one or the other or neither of said spaced drive gears whereby said other propeller shaft may be selectively driven in the same or opposite direction with respect to said one propeller shaft.

7. The device of claim 6 wherein said propeller blades are oppositely pitched whereby their thrusts will be additive when driven from different driven gears.

8. The device of claim 6 wherein said propeller blades are pitched in like direction whereby their thrusts will be additive when driven from the same driven gear.

9. The device of claim 6 wherein said driven gears are driven from a single drive gear connected to the drive shaft, said drive shaft being disposed upon an axis transverse to the axis of rotation of the spaced driven gears whereby the driven gears rotate in opposite directions, said first propeller shaft having a continuous connection with one of said driven gears and the second propeller shaft comprising a tube co-axial with said first shaft and freely rotatable about said first shaft.

10. In a dual propeller propulsion device, the combination with a common drive shaft, first and second propellers of different thrust capacity, a first propeller shaft and a second propeller shaft co-axial with said first propeller shaft, a drive gear mechanism between said drive shaft and said first and second propeller shafts, said drive gear mechanism including spaced driven gears co-axial with said propeller shafts and simultaneously oppositely driven by said drive shaft and having clutch faces, one of said shafts being peripherally grooved and one of said drive gears having a grooved hub portion proximate the propeller shaft grooves, and a key mutually engaged with the shaft grooves and hub grooves whereby to continuously connect said shaft and driven gear, the other of said propeller shafts having a clutch member connected thereto and disposed between said spaced driven gears, and motion transmitting clutch shifting connections to said clutch member whereby said clutch member may be selectively engaged with one or the other or neither of said faces of said spaced driven gears whereby said other propeller shaft may selectively idle or rotate in the same or opposite direction with respect to said one propeller shaft.

11. The device of claim 10 in which said key comprises an annular ring having co-planar thrust transmitting arms extending radially inwardly and outwardly of the ring.

12. In a dual propeller propulsion device, the combination with a common drive shaft, first and second propellers, a first propeller shaft and a second propeller shaft co-axial with said first propeller shaft, a drive gear mechanism between said drive shaft and said first and second propeller shafts, said drive gear mechanism including spaced driven gears co-axial with said propeller shafts and simultaneously oppositely driven by said drive shaft, one of said driven gears having a hub integral with one of said propeller shafts whereby to continuously connect said shaft and driven gear, the other of said propeller shafts having a clutch member connected thereto and disposed between said spaced driven gears, and motion transmitting connections to said clutch member whereby said clutch member may be selectively engaged with one or the other or neither of said spaced driven gears for driving said propellers in the same direction, opposite directions, or allowing one propeller to idle while the other is driven.

13. The device of claim 12 wherein said propeller blades are oppositely pitched whereby their thrusts will be additive when driven from different driven gears.

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