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PROPULSION UNIT

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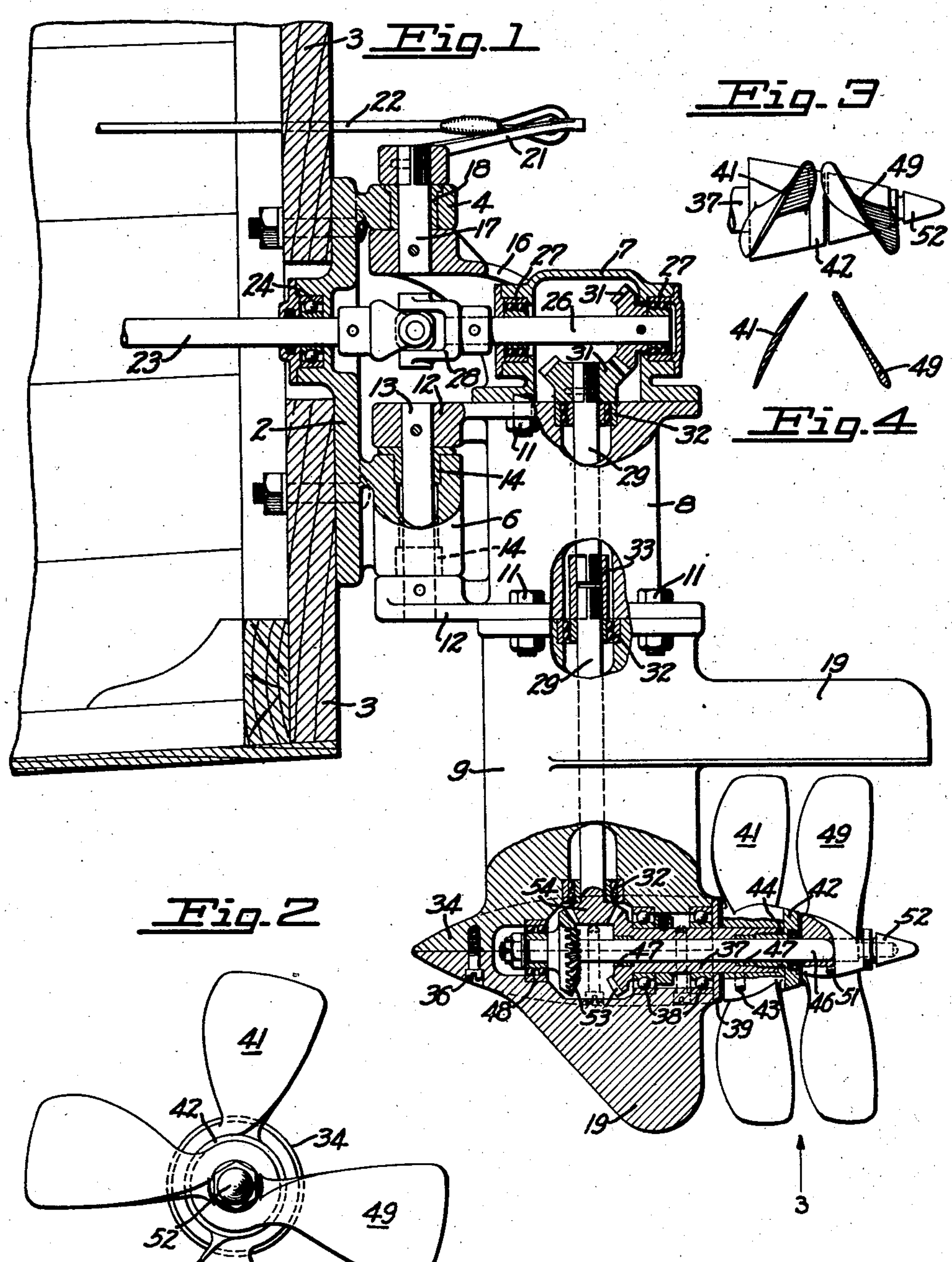

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PROPULSION UNIT

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6 Claims. (Cl. 170—165)

My invention relates to a propulsion unit, and more particularly to improvements in screw propellers.

The broad object of my invention is to provide a propulsion unit which yields a greater driving thrust at the available horse power.

A more specific object of my invention is to increase the efficiency of screw propellers.

A further object of my invention is to provide an improved combination rudder and propeller unit for small marine craft, such as speed boats.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of my invention. It is to be understood that I do not limit myself to this disclosure of species of my invention, as I may adopt variant embodiments thereof within the scope of the claims.

Referring to the drawing:

Figure 1 is a side view, partly in section and partly in elevation, of the propulsion unit embodying my invention; and

Figure 2 is a rear elevational view of the twin propellers employed in my propulsion unit.

Figure 3 is a side view of the propellers, taken in a direction indicated by the arrow 3 of Figure 1.

Figure 4 is a vertical sectional view of the propeller blades, taken in a plane transversely through the mid-portion of the blades when the latter are in alignment as illustrated in Fig. 3.

In terms of broad inclusion, the propulsion unit embodying my invention comprises a plurality of axially aligned right and left-hand screw propellers in which the blades of a trailing propeller are pitched on both sides, and means for rotating the propellers in opposite directions. The oppositely rotating right and left-hand propellers mutually cooperate to increase the driving thrust by resolving rotational flow in the projected stream of fluid into useful sternward or axial flow; this being effected by the tendency on the part of the trailing propeller to set up a spiral flow opposing that set up by the leading propeller. This beneficial effect of a second propeller is secured in the propulsion unit of my invention without materially increasing the power required to drive the unit over that required to drive a single propeller. In my improved construction the trailing propeller is assisted in its rotation by the flow from the leading propeller. As the fluid is projected rearwardly by the leading propeller it impinges on the back sides of the blades on the trailing propeller, which sides are pitched so that a portion of the force of the impinging fluid is utilized to drive the propeller.

For purposes of detailed description, the propulsion unit of my invention is shown as embodied in a marine propeller construction; it being understood that this showing is merely for purposes of illustration, and that the principles embodied in my invention apply equally well to propellers working in a medium of air, such as air craft propellers. The propulsion unit for small marine craft which has been chosen for purposes of illustration comprises a bracket 2 adapted for mounting on the rear end of a boat 3 and having a pair of vertically spaced and rearwardly extending journals 4 and 6. The bracket 2 provides a pivotal mounting for a sectional housing preferably comprising an upper portion 7, an intermediate portion 8 and a lower portion 9 connected together by suitable bolts 11.

The intermediate section 8 of the housing is provided with a pair of forwardly extending arms 12 carrying a pivot pin 13 journaled in the bracket portion 6 in suitable bearings 14. The upper portion 7 of the housing is provided with an upwardly and forwardly extending bifurcated arm 16 carrying a pivot pin 17 journaled in the upper bracket journal 4 in a suitable bearing 18. But one branch of the arm 16 is shown, the other being cut out of the view by the plane of section.

The lower section or portion 9 of the housing is provided with suitable fins 19, so that the housing in effect provides a rudder with which the boat 3 may be steered. Steering control for the rudder is provided by a laterally extending arm 21 secured to the upper pivot pin 17 and to which the steering cable 22 is fastened. Of course it is understood that another arm similar to the arm 21 but extending in the opposite direction is provided, to which another steering cable is connected; the latter arm and cable not being shown because of the sectional view. By this arrangement the rudder may be turned from side to side about its pivot axis by a steering wheel conveniently arranged adjacent the forward end of the boat, as will be readily understood.

A drive shaft 23, connecting with a suitable motor mounted in the boat, is journaled adjacent its rear end in the bracket 2 in a suitable bearing 24. This shaft connects with a driven shaft 26 extending transversely of the housing and journaled in the upper housing section 7 in suitable bearings 27. The shafts 23 and 26 are coupled by a universal joint 28 positioned intermediate and co-axial with the pivot pins 13 and 17 of the rudder mounting. By this arrangement the shaft 26 may be continuously driven by the shaft 23 and without interfering with the free pivotal movement of the rudder.

A vertical shaft 29 is provided, extending longitudinally of the housing, and is connected at its upper end with the driven shaft 26 by a pair of beveled gears 31; these gears being enclosed by the upper portion 7 of the housing. The vertical shaft 29 is journaled in the housing in suitable bearings 32, and preferably comprises two sections coupled by a sleeve 33 so that the lower portion 9 of the rudder construction may be assembled as a unit.

The lower section 9 of the housing has an enlarged torpedo-shaped portion 34 which is split along a horizontal plane and held together by suitable screws 36 to give access to the interior of this portion of the housing. A transversely extending sleeve 37 is journaled in this portion of the housing section 9 in suitable bearings 38; an end plate 39 being provided to hold the outer bearing in position. The sleeve 37 projects rearwardly from the housing, and carries on its projected end a screw propeller 41 held in place on the sleeve by a threaded collar 42. The propeller 41 is further held against axial movement by a set screw 43 and also by a flange 44 provided on the hub of the propeller and locked between the end of the sleeve 37 and the retaining collar 42.

A propeller shaft 46 is journaled in the sleeve 37 in suitable bearings 47, and is also journaled adjacent its forward end in the housing in a suitable bearing 48. This shaft projects rearwardly beyond the sleeve 37, and carries on its projecting end a second propeller 49. The latter propeller is held fixed on the shaft by a set screw 51 and also by a nut 52 threaded on the end of the shaft.

The sleeve 37 and propeller shaft 46 each carry adjacent their forward ends a beveled gear 53 meshed with a beveled pinion 54 fixed on the lower end of the vertical or longitudinally extending shaft 29. By this arrangement rotation of the drive shaft 23 will effect rotation of the propellers 41 and 49, but in opposite directions. The beveled gears 53 are preferably of the same size, so that the propellers are rotated at substantially the same speed.

As best shown in Figure 3, one of the axially aligned propellers is a right-hand screw propeller and the other is a left-hand screw propeller. The blades of these propellers are preferably of substantially equal size, and preferably have driving faces of substantially equal pitch. This pitch may be either straight or expanding. I have used a 17 inch straight pitch with good results.

An important feature of my invention is the pitching of the back sides of the trailing propeller blades. The leading propeller 41 is of ordinary propeller design with blades having pitched driving faces providing a concave surface as shown in Fig. 4, but the trailing propeller 49 has blades which are pitched on both the front and back sides. The back sides of the trailing propeller (the sides facing the leading propeller) are concave as shown in Figure 4, and have a pitch which is preferably less than the pitch of the front or driving sides of the blades. I have used a 15 inch straight pitch with good results. Of course the pitching of the back side of the blade forms a surface which is reversely curved relative to the front surface of the blade. In order to take care of this the trailing edge of the blade is made somewhat heavier or thicker than the leading edge. Figure 4 brings out these features of construction.

As shown in Figure 1, the hubs of the adjacently positioned propellers are shaped and proportioned so that together they form a bullet-shaped body; this body maintaining the lines and providing the trailing portions of the torpedo-shaped body 34 of the housing. This construction and design is important in the interest of minimizing resistance to passage through the water.

A feature of construction to be noted is that the lower portion 9 of the mechanism, which comprises the driving head of my propulsion unit, is demountable and designed for attachment to the power unit of an ordinary outboard motor. This adaptability increases the utility of my construction, as will be readily appreciated.

While numerous refinements are numbered among the improvements of my invention, it will be seen that the broad combination of elements comprises a plurality of axially aligned right and left-hand screw propellers in which the blades of a trailing propeller are pitched on both sides, and means for rotating the propellers in opposite directions. I have found that screw propellers operated in this manner mutually cooperate in their action in the water, which coaction yields a performance of new functions with the production of new and improved results as evidenced by an increased driving thrust at the available horse power.

The increased driving thrust afforded by the propulsion unit is attributable largely to the tendency on the part of the trailing propeller to reduce or eliminate rotation in the rearwardly moving column or stream, and to divert this rotational flow into useful sternward flow. It is well known that the driving thrust of a screw propeller is derived from its projecting a mass of fluid through the surrounding fluid medium. The reactionary force of the propeller in projecting this mass of fluid constitutes the driving thrust, and is directly proportional to the weight of the mass of projected fluid, and to the sternward velocity of the projected fluid relative to the surrounding fluid medium (the latter factor being known as the real slip). Obviously therefore any increase in the sternward velocity of the projected fluid is accompanied by an increase in driving thrust.

The column or stream of fluid projected by a single screw is not a straight line flow, but moves in a spiral. In other words, there is a rotational effect in the projected stream as well as an axial flow. The rotational effect serves no useful purpose and may be called wasteful slip. In the propulsion unit of my invention the trailing propeller tends to set up a spiral rotating in a direction opposite to that of the leading propeller. Since the propellers are of substantially equal size and pitch and rotate at substantially the same speed, the two superimposed spirals tend to neutralize each other and the rotational flow is resolved into axial flow. This increases the sternward velocity of the projected column of fluid, with a consequent increase in the driving thrust of the propellers.

Not only is the loss due to rotational slip largely eliminated, but it is thought that the coacting propellers function to reduce losses due to cavitation. The latter effect is due to the inability of the fluid to fill in about the screw to maintain the flow set up by the latter's operation. In my propulsion unit the leading propeller creates a forced flow to the trailing propeller, and losses due to cavitation at the latter propeller are decreased.

This desirable twin propeller action is secured by the propulsion unit of my invention without materially increasing the power required to drive the unit over that required to drive a single propeller. As the fluid is projected rearwardly by the leading propeller it impinges on the back sides of the blades on the trailing propeller, which sides are pitched so that a portion of the force of the impinging fluid is utilized to drive the propeller. In the two blade propeller unit shown for purposes of illustration there will be times during the revolution when the trailing propeller receives more turning thrust than others; viz., those times when the blades of the two propellers are opposed. In other words, the driving will be by impulses. By increasing the number of blades on one or both propellers the impulses will be brought closer together and approach a constantly applied turning force. I have used a three blade trailing propeller in combination with a two blade leading propeller with good results.

I claim:

1. A propulsion unit comprising a plurality of axially aligned right and left-hand screw propellers, the back sides of the blades on a trailing propeller being concave and pitched so that fluid projected from a leading propeller and impinging thereon aids said trailing propeller in its rotation, and means for rotating the propellers in opposite direction.

2. A propulsion unit comprising a plurality of axially aligned right and left-hand screw propellers, the driving faces of said propellers being curved and the back faces of a trailing propeller being reversely curved relative to said driving faces, and means for rotating the propellers in opposite directions.

3. A propulsion unit comprising a plurality of axially aligned right and left-hand screw propellers, the driving faces of a leading propeller and both the driving and back faces of a trailing propeller being concave, and means for rotating the propellers in opposite directions.

4. A propulsion unit comprising a plurality of axially aligned right and left-hand screw propellers, the driving faces of a leading propeller and both the driving and back faces of a trailing propeller being concave, the trailing edges of blades of the trailing propeller being thicker than the leading edges, and means for rotating the propellers in opposite directions.

5. A propulsion unit comprising a split housing, a shaft arranged in and projecting from the housing, a sleeve encircling the shaft and also projecting from the housing, propellers on the outer projecting ends of said shaft and sleeve, driving gears on the inner ends of the shaft and sleeve, bearings for journalling the sleeve and held between the sections of said housing, and a bearing for journalling the inner end of the shaft and also held between the sections of the housing.

6. A propulsion unit comprising a split housing, a shaft arranged in and projecting from the housing, propellers on the outer projecting ends of said shaft and sleeve, driving gears on the inner ends of the shaft and sleeve, bearings for journalling the sleeve and held between the sections of said housing, a bearing for journalling the inner end of the shaft and also held between the sections of the housing, and bearing rings in the sleeve for journalling the shaft.

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