

Aug. 9, 1960

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2,948,252

PROPELLER HUB EXHAUST SYSTEM

Filed Oct. 31, 1957

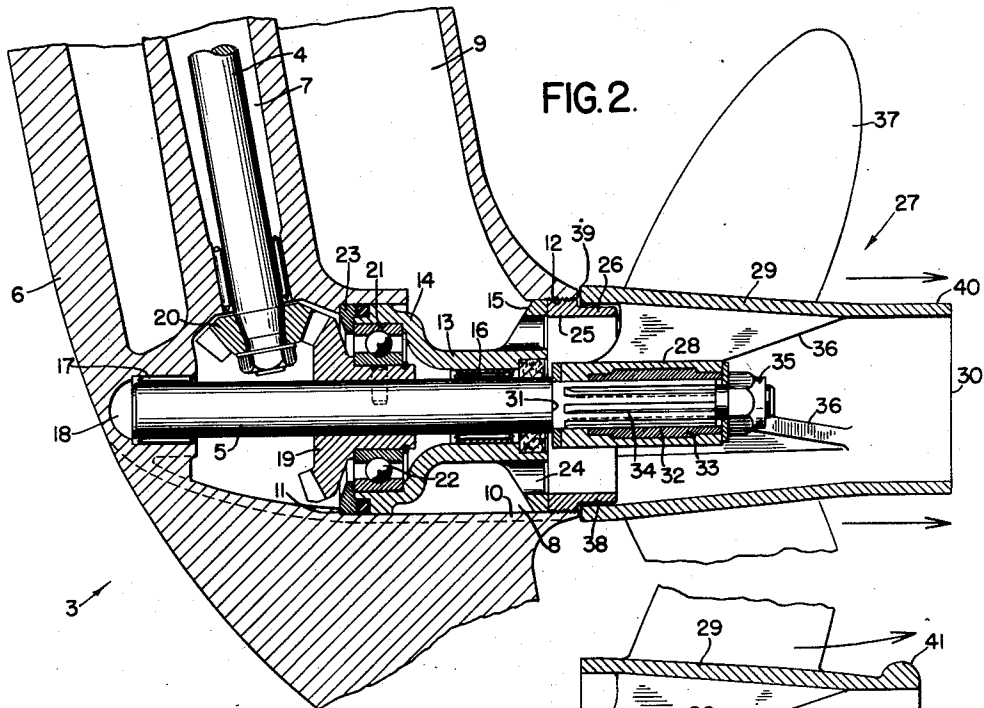


FIG. 3.

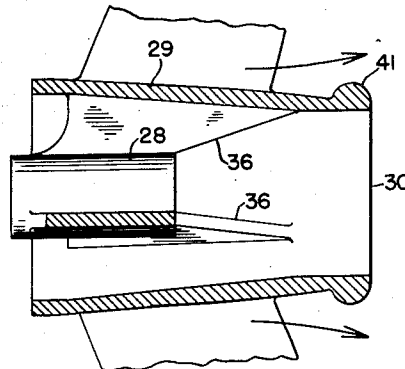


FIG. 4.

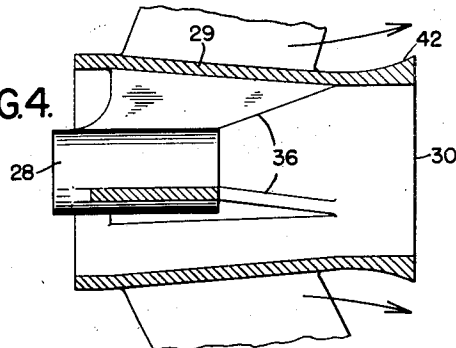


FIG. 1.

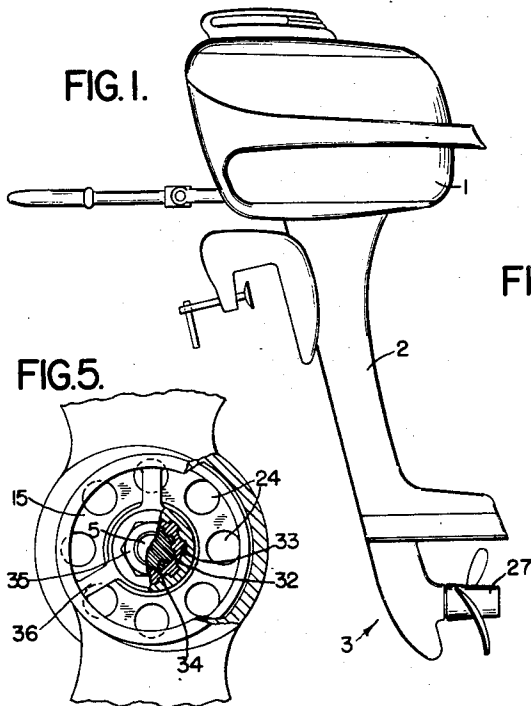
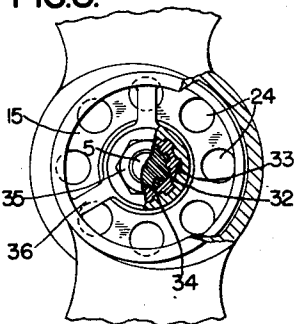


FIG. 5.



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## PROPELLER HUB EXHAUST SYSTEM

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Filed Oct. 31, 1957, Ser. No. 693,661

10 Claims. (Cl. 115-17)

This invention relates to outboard motors of the type wherein the exhaust gases are discharged through the propeller hub.

Heretofore, outboard motors exhausting through the propeller hub have not been overly successful for the reason that back pressures are developed in the exhaust system which adversely affect the efficiency of the engine. Generally, efforts to improve such exhaust systems have been directed to the interior of the hub such as by utilizing an internal venturi contour, which has not resulted in the improvement desired.

The present invention is based upon the discovery that the flow pattern of the water flowing over the hub limits the volume of exhaust which can flow from the mouth of the hub. It is an object of this invention, therefore, to provide a hub structure which influences the flow pattern of the water at the mouth of the hub so as to prevent exhaust flow restriction at the mouth of the hub and thereby provide for more efficient engine operation.

According to this invention, the underwater housing of an outboard motor is adapted to receive a horizontally disposed spool-like member having a cylindrical bore. The propeller shaft is rotatably supported within the bore and extends rearwardly of the spool-like member into the propeller hub. The spool-like member is provided rearwardly with an annular flange having a plurality of angularly spaced openings for conducting the exhaust gases from the underwater housing communicating with the engine to the propeller hub. The propeller hub comprises a central portion adapted to be secured to the propeller shaft and an outer casing carrying the propeller blades and spaced from the central portion by a plurality of angularly spaced radially extending fins. The outer surface of the hub casing adjacent to the exhaust discharge opening is provided with a water converging retarding surface to substantially delay the radially inward component of water flow at the discharge opening and thereby prevent exhaust flow restriction at the mouth of the hub.

The drawings furnished herewith illustrate the best mode of carrying out the invention as presently contemplated and described hereinafter.

In the drawings:

Figure 1 is a side elevation of an outboard motor employing the propeller hub exhaust system of this invention;

Fig. 2 is an enlarged sectional view of a portion of the underwater unit of an outboard motor showing details of the propeller hub exhaust system;

Fig. 3 is a sectional view showing the propeller hub of another embodiment of the invention;

Fig. 4 is a sectional view showing the propeller hub of still a third embodiment of the invention; and

Fig. 5 is an end elevation of the propeller hub of Fig. 2 with parts broken away and sectioned.

The outboard motor shown in the drawings includes

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an engine, not shown, enclosed within a cowl 1 supported at the upper end of the drive shaft housing 2, and a lower underwater unit 3 carried at the lower end of the drive shaft housing. The drive shaft 4 extends downwardly within the housing 2 and drivingly connects the engine with the propeller shaft 5 of the lower unit 3.

The lower underwater propeller unit 3 comprises a housing 6 having a downwardly extending passage 7 within which the drive shaft 4 is rotatably disposed and a lower horizontal chamber 8 into which the lower end of the drive shaft extends. An exhaust passage 9 communicating with the engine surrounds passage 7 and connects with chamber 8 rearwardly of the drive shaft.

Rearwardly of drive shaft 4, the chamber 8 constitutes a cylindrical bore 10 terminating at shoulder 11 and is provided with a threaded opening 12 rearwardly of housing 6. An annular spool-like member 13 having a stepped forward portion 14 is provided with an external flange 15 rearwardly thereof and is adapted to be received within the bore 10 between shoulder 11 and opening 12 and is disposed coaxial with the bore and opening.

The propeller shaft 5 is rotatably supported within spaced needle bearings 16 and 17 disposed respectively within the spool-like member 13 and recess 18 formed in housing 6 forwardly of chamber 8 and extends rearwardly through opening 12. The driven gear 19 is secured on shaft 5 forwardly of the spool-like member 13 and meshes with the bevel gear 20 secured on the end of drive shaft 4 within chamber 8. The hub of gear 19 on propeller shaft 5 extends rearwardly into the cylindrical recess 21 provided in the forward portion 14 of member 13 and is further rotatably supported within bearing 22 disposed between the hub and the wall of the recess. An annular spacing ring 23 disposed between shoulder 11 and the spool-like member 13 serves to maintain the gear 19 in proper relation with respect to gear 20 and secure bearing 22 within the recess 21.

While the stepped forward portion 14 of member 13 is fully closed to exclude exhaust gases and moisture from the portion of chamber 8 housing the gears 19 and 20, the rearwardly disposed flange 15 is provided with a plurality of angularly spaced holes 24 which conduct the exhaust gases rearwardly from chamber 8. An annular retaining ring 25 is threaded outwardly and is adapted to be received in opening 12 and engages the flange 15 of member 13 to secure the member within the bore 10. The retaining ring 25 has a stepped outer periphery to provide an annular portion 26 having a lesser outer diameter than the threaded portion thereof and which extends rearwardly from opening 12 when the retaining ring is seated against flange 15.

The exhaust gases passing through holes 24 of member 13 from chamber 8 enter the propeller hub 27 and move rearwardly between an inner sleeve 28 and the annular outer casing 29 and are discharged from the hub through the mouth 30. The hub 27 is mounted on the rearwardly projecting portion of shaft 5 with the inner sleeve 28 engaging shoulder 31 on the shaft. A split insert 32 of relatively soft metal is interposed between sleeve 28 and shaft 5 and is rotationally interlocked with the sleeve by means of grooves 33 and with the shaft by means of splines 34. A lock nut 35 threaded on the end of shaft 5 secures the hub upon the shaft.

Outer casing 29 is spaced from the inner sleeve 28 by means of angularly spaced fins 36 and carries a plurality of blades 37 outwardly thereof. At the forward end thereof, casing 29 overlaps annular portion 26 of retaining ring 25 and a right angle clearance 38 is provided between the casing and the retaining ring together

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with the adjacent projecting wall of opening 12 provided on underwater unit 3. The provision of clearance 38 at the forward end of casing 29 eliminates the need for exacting tolerances between the casing, retaining ring 25, and the projecting wall of opening 12.

To prevent leakage of exhaust gases from within the hub through clearance 38, the forward end of casing 29 extends radially outward a small distance beyond the radial extremity of the rearwardly projecting wall of opening 12 as shown at 39. As the underwater unit 3 moves through the water, water engages the radial extension at 39 and the resultant dynamic pressure forces some water through the clearance. The amount of the radial extension at 39 should be adequate to develop a dynamic pressure which will exceed the exhaust pressure in the hub. The water entering the hub 27 through clearance 38 moves rearwardly along the inner surface of casing 29 due to the centrifugal action of the hub and is expelled through the mouth 30.

The diameter of mouth 30 rearwardly of casing 29 is adequate to accommodate the volume of exhaust gases at maximum speed. If, however, water flowing over the outer surface of casing 29 has an immediate radial inward component at the mouth, the effective mouth diameter is reduced to the extent of such radial component giving rise to a back pressure build-up in the exhaust system to materially reduce engine efficiency.

To prevent formation of a radial inward component in the water immediately at the mouth of the hub, the outer surface of casing 29 adjacent to the mouth is provided with a water converging retarding surface 40 which according to the structure of Fig. 2 constitutes a cylindrical surface that directs the water axially of the hub at the mouth 30 as shown by the arrows. In the hub structure of Fig. 3, the rounded flange 41 on the outer surface of casing 29 adjacent to the mouth provides the water flowing over the hub with an outward radial component at the mouth 30 as shown by arrows. According to Fig. 4, the outer surface of casing 29 adjacent to the mouth is provided with an end portion 42 which diverges or flares outwardly. Water flowing over end portion 42 also has an outward radial component at the mouth of the hub as shown by arrows.

The construction of the invention retards or delays the inward closing of the water behind the hub until the exhaust gases have fully escaped from casing 29 with the result that the exhaust gases mix with the water as the latter more gradually closes in thereon.

The invention thus provides a propeller exhaust system for an outboard motor which is fully able to accommodate the volume of exhaust gases from the engine and thereby prevent back pressure build-ups in the exhaust system that adversely affect engine efficiency.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. In an outboard motor including an underwater unit having a passage for conducting exhaust gases through said unit to an opening rearwardly of the unit communicating with said passage, a propeller hub mounted rotatably in alignment with said opening rearwardly thereof and comprising an annular hub member defining a second passage having a diameter at the forward end thereof corresponding generally to that of the first named opening for receiving the exhaust gases from said first named passage and terminating in a discharge opening at the rear of said member for discharging the exhaust gases, said annular hub member carrying the propeller blades radially outwardly thereof and providing a smooth outer surface tapering rearwardly gradually to a smaller diameter in the region of said blades and extending for a substantial distance beyond said region with an outer surface shaped to provide a peripheral water converging

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retarding surface ahead of said discharge opening to substantially eliminate any immediate radial inward component in the water flowing over the hub in service at the discharge opening.

2. The invention as set forth in claim 1 wherein the peripheral water converging retarding surface on said annular member is disposed between the blades and said discharge opening and comprises a substantially cylindrical surface directing the water flowing over the hub in service axially of the hub at the discharge opening.

3. In an outboard motor including an underwater unit having a passage for conducting exhaust gases through said unit to an opening rearwardly of the unit communicating with said passage, a propeller shaft rotatably supported within said unit axially of said opening and extending rearwardly through said opening, a propeller including a plurality of blades carried by an annular outer casing having a diameter at the forward end thereof corresponding generally to that of the first named opening and terminating in a discharge opening, said propeller having an inner sleeve secured on said propeller shaft with circumferentially spaced means securing said sleeve to said outer casing and providing a plurality of circumferentially spaced longitudinal passages between said sleeve and casing for receiving the exhaust gases from said first named passage for discharge through said discharge opening, the outer periphery of said casing being tapered rearwardly in the region of said blades and continuously merging into a water converging resisting region just ahead of said discharge opening to substantially eliminate any immediate radial inward component in the water flowing over the outer casing in service at the discharge opening.

4. In an outboard motor underwater assembly, a housing having a generally cylindrical horizontal projection rearwardly thereof provided with an opening, said housing further having a chamber including a cylindrical bore aligned with said opening and communicating therewith and a passage communicating with said chamber for conducting exhaust gases to said chamber, a spool-like member having an annular flange rearwardly thereof provided with a plurality of angularly spaced openings, said spool-like member being adapted to be disposed within said bore with the flange adjacent said first named opening and with the spaced openings within said flange communicating with the first named opening for conducting the exhaust gases from said chamber through said first named opening, means to secure the spool-like member within the bore, a propeller shaft rotatably supported within the axial bore of the spool-like member and extending rearwardly through said first named opening, and a propeller including a hub comprising an annular outer casing carrying the propeller blades and having a diameter at the forward end thereof corresponding generally to that of the first named opening and terminating in an exhaust discharge opening and an inner sleeve adapted to be secured on said shaft with angularly spaced means secured to said sleeve and casing to space the sleeve from said outer casing and define a plurality of annular passages between the sleeve and casing for receiving the exhaust gases from said chamber and conducting same to the discharge opening.

5. In an outboard motor underwater assembly, a housing having a generally cylindrical horizontal projection rearwardly thereof provided with a threaded opening, said housing further having a chamber including a cylindrical bore aligned with said opening and communicating therewith and a passage communicating with said chamber for conducting exhaust gases to said chamber and an annular shoulder formed by said bore and facing said opening, a spool-like member having an annular flange rearwardly thereof provided with a plurality of angularly spaced openings, said spool-like member being adapted to be disposed within said bore and extending between said shoulder and said threaded opening with

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the spaced openings in the spool-like member communicating with the threaded opening in the housing for conducting the exhaust gases from said chamber through said threaded opening, an annular threaded retaining member adapted to be received within the threaded opening to secure the spool-like member within the bore, a propeller shaft rotatably supported within the axial bore of the spool-like member and extending rearwardly through the threaded opening, and a propeller including a hub comprising an annular outer casing carrying the propeller blades and having a diameter at the forward end thereof corresponding generally to that of the threaded opening and terminating in an exhaust discharge opening and an inner sleeve adapted to be secured on said shaft with angularly spaced fins secured to said sleeve and casing to space the sleeve from said outer casing and define a plurality of annular passages between the sleeve and casing for receiving the exhaust gases from said chamber conducting same to the discharge opening.

6. In an outboard motor underwater assembly, a housing having a generally cylindrical horizontal projection rearwardly thereof provided with a threaded opening, said housing further having a gear chamber therein and a cylindrical bore aligned with said opening and communicating with said chamber and a passage communicating with said bore for conducting exhaust gases to the bore, an annular shoulder formed by said bore at the end thereof opposite from said opening, a spool-like member having an annular flange rearwardly thereof provided with a plurality of angularly spaced openings, said spool-like member being adapted to be disposed within said bore and extending between said shoulder and said threaded opening, with the forward portion of the spool-like member serving to close off said gear chamber to prevent ingress of exhaust gases to the chamber and with the spaced openings in the spool-like member communicating with the threaded opening in the housing for conducting the exhaust gases from the bore through said threaded opening, an annular threaded retaining member adapted to be received within the threaded opening and engaging the flange of the spool-like member to secure said member within the bore, a propeller shaft rotatably supported within the axial bore of the spool-like member and extending forwardly into the gear chamber and rearwardly through the threaded opening, and a propeller including a hub comprising an annular outer casing carrying the propeller blades and having a diameter at the forward end thereof corresponding generally to that of the threaded opening and terminating in an exhaust discharge opening and an inner sleeve adapted to be secured on said shaft with angularly spaced fins secured to the sleeve and casing to space the sleeve from said outer casing and define a plurality of annular passages between the sleeve and casing for receiving the exhaust gases from said first named bore and conducting same to the discharge opening.

7. In an outboard motor underwater assembly, a housing having a generally cylindrical horizontal projection rearwardly thereof provided with a threaded opening and forming a rearwardly projecting annular face, said housing further having a passage communicating with said opening for conducting exhaust gases from the housing through said opening, and a propeller hub mounted rotatably in alignment with said opening and comprising an annular member defining a second passage having an inner diameter at the forward end thereof corresponding generally to that of the opening for receiving the exhaust gases from said first named passage and terminating in a discharge opening at the rear of said member for discharging the exhaust gases, the forward end of the annular member being spaced from said annular face to provide a clearance therebetween communicating with said second passage, said annular member having a greater outside diameter at the forward end thereof than

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the annular face adjacent thereto to provide an annular surface on said member for engaging water in service to develop a dynamic pressure inwardly through said clearance and thereby prevent leakage of exhaust gases outwardly through said clearance.

8. In an outboard motor underwater assembly, a housing having a generally cylindrical horizontal projection rearwardly thereof provided with a threaded opening, said housing further having a chamber including a cylindrical bore aligned with said opening and communicating therewith and a passage communicating with said chamber for conducting exhaust gases to said chamber, a propeller shaft extending axially of said bore and rearwardly through said threaded opening, an annular support member having an annular flange rearwardly thereof provided with a plurality of openings, said support member being adapted to be disposed within said bore with the flange adjacent said threaded opening and with the flange openings communicating with the threaded opening for conducting the exhaust gases from said chamber through said threaded opening, an annular threaded retaining member adapted to be received within the threaded opening and engaging the flange of the support member to secure said member within the bore, said retaining member together with the projection forming a rearwardly disposed annular face, an annular rearwardly extending flange provided at the inner periphery of said retaining member, and a propeller including a hub comprising an annular outer casing carrying the propeller blades and terminating in an exhaust discharge opening and an inner sleeve adapted to be secured on said shaft with angularly spaced means secured to said sleeve and casing to space the sleeve from said outer casing and define a plurality of annular passages between the sleeve and casing receiving the exhaust gases from said chamber and conducting same to the discharge opening, the forward end of the outer casing overlapping said flange on the retaining member and being spaced respectively axially from said annular face formed by the retaining member and projection and radially from said flange to define an L-shaped clearance communicating with the passage through said hub, said outer casing extending radially outward beyond the radial extremity of the annular face formed by the retaining member and projection to provide an annular surface on said casing for engaging water in service to develop a dynamic pressure inwardly through said L-shaped clearance and thereby prevent leakage of exhaust gases through said clearance.

9. In an outboard motor including an underwater unit having a passage for conducting exhaust gases through said unit and an opening rearwardly of the unit communicating with said passage, and a propeller hub mounted rotatably in alignment with said opening and comprising an annular member defining a second passage having a diameter at the forward end thereof corresponding generally to that of the first named opening for receiving the exhaust gases from said first named passage and terminating in a discharge opening at the rear of said member for discharging the exhaust gases, a plurality of radially spaced blades secured to the hub and extending outwardly therefrom, said annular member having a rounded annular flange on the outer surface thereof adjacent the discharge opening providing the water flowing over the hub in service with an outwardly directed radial component at the discharge opening.

10. In an outboard motor including an underwater unit having a passage for conducting exhaust gases through said unit and an opening rearwardly of the unit communicating with said passage, and a propeller hub mounted rotatably in alignment with said opening and comprising an annular member defining a second passage having a diameter at the forward end thereof corresponding generally to that of the first named opening for receiving the exhaust gases from said first named passage and terminating in a discharge opening at the rear of

said member for discharging the exhaust gases, a plurality of radially spaced blades secured to the hub and extending outwardly therefrom, said annular member having a rearwardly diverging surface adjacent the discharge opening providing the water flowing over the hub in service with an outwardly directed radial component at the discharge opening.

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