Sept. 9, 1952 E. C. KIEKHAEFER 2,609,782

UNDERWATER EXHAUST AND DRIVE SHAFT HOUSING FOR OUTBOARD MOTORS

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FIG. 1.

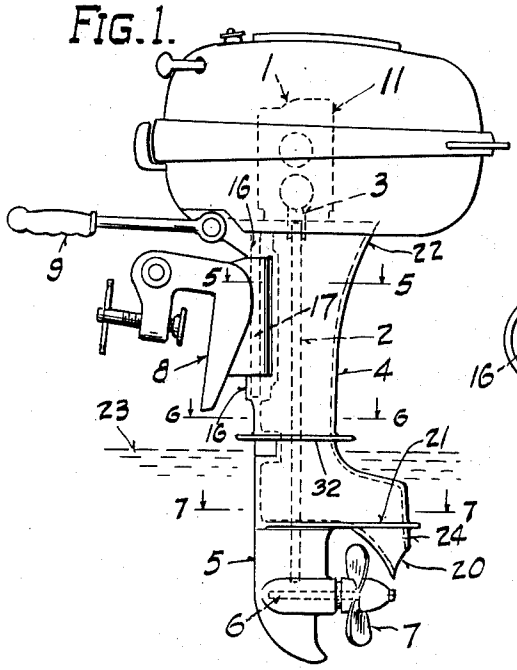


FIG. 4.

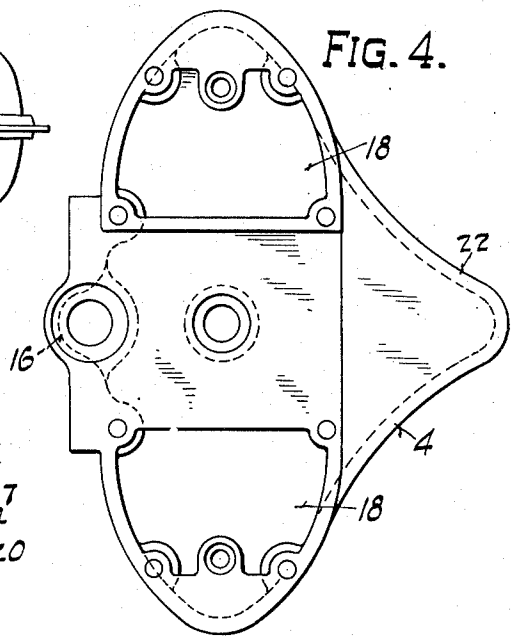


FIG. 5.

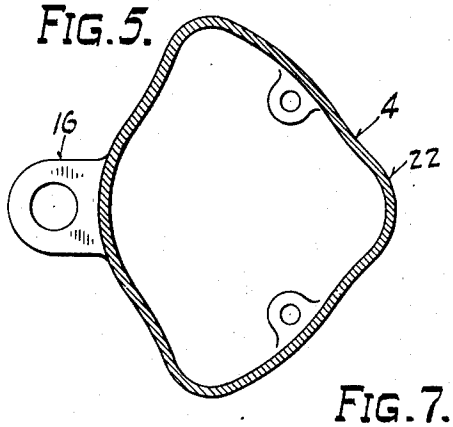


FIG. 6.

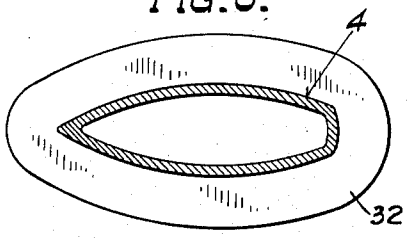
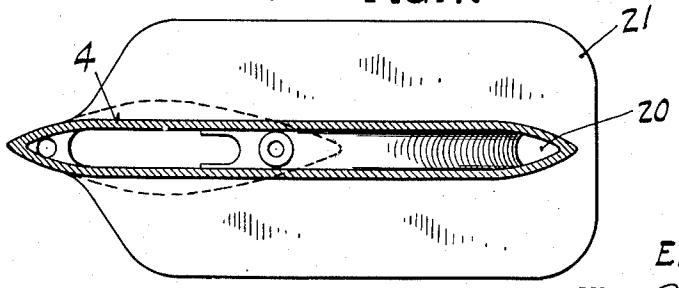


FIG. 7.



INVENTOR.
Elmer C. Kiekhaefer

BY Andrus & Sceales

ATTORNEYS.

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FIG. 2.

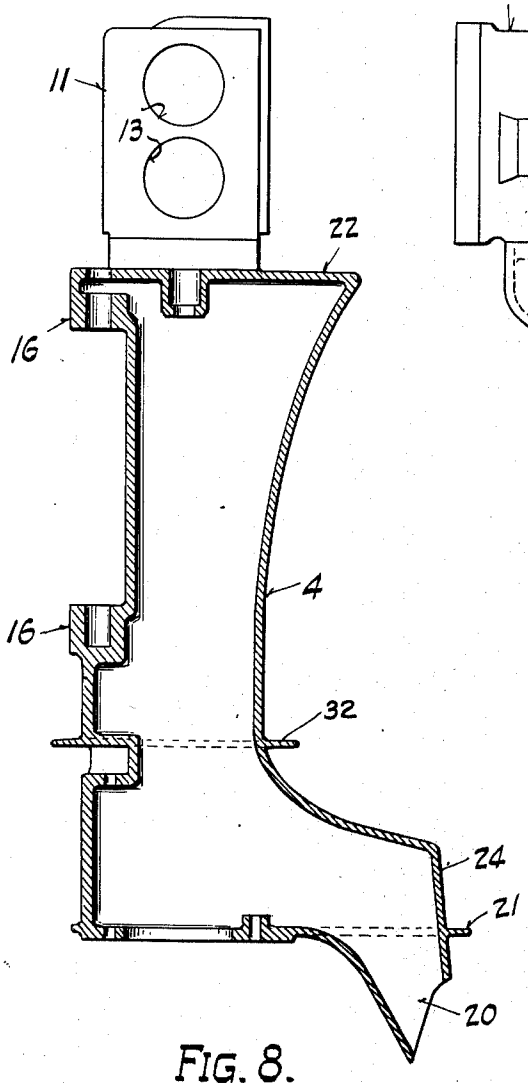


FIG. 3.

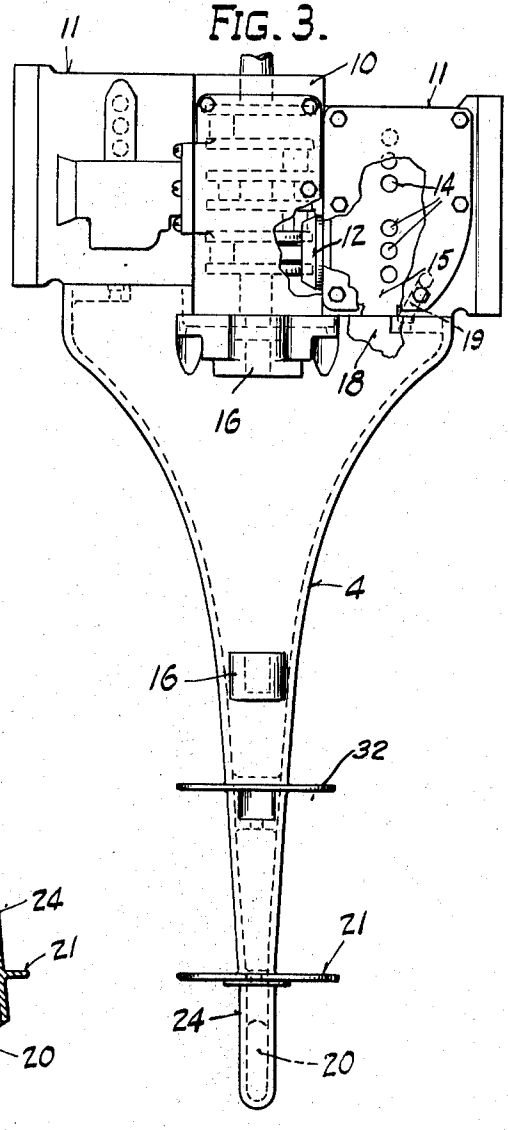
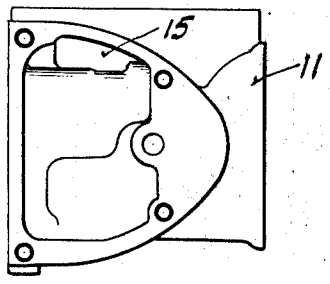


FIG. 8.



INVENTOR.
Elmer C. Kiekhaefer
BY Andrus & Sceales
ATTORNEYS.

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FIG. 9.

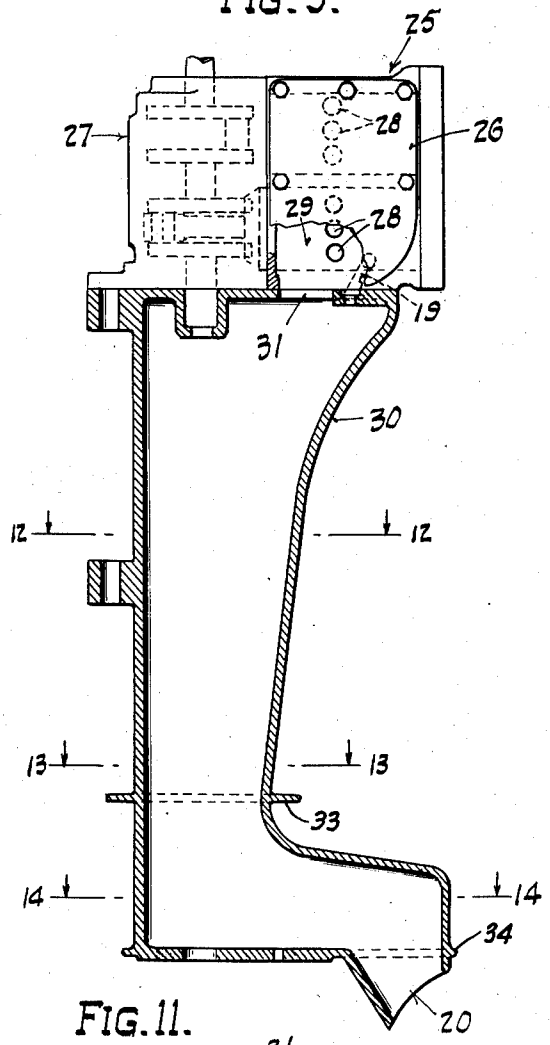


FIG. 10.

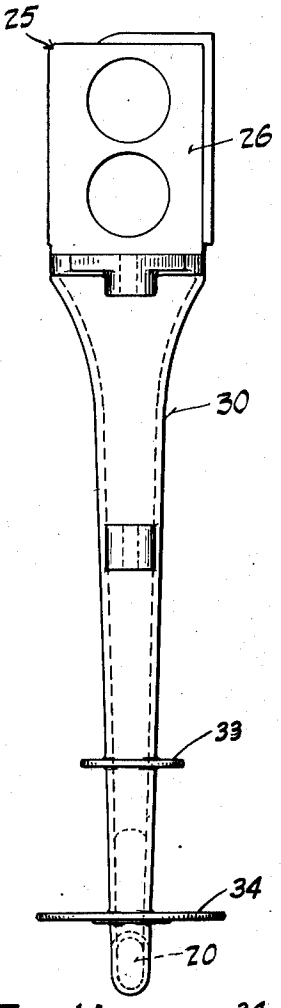


FIG. 11.

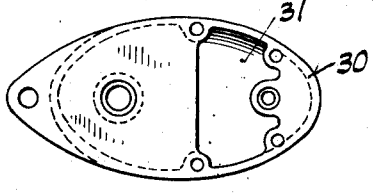


FIG. 12.



FIG. 13.

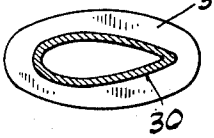
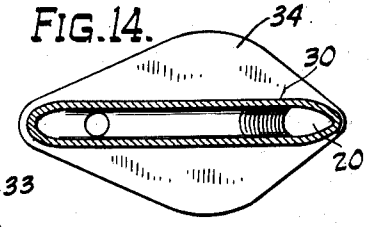


FIG. 14.



INVENTOR.
Elmer C. Kiekhaefer
BY Rudnick & Scealer
ATTORNEYS.

Patented Sept. 9, 1952 2,609,782

UNITED STATES PATENT OFFICE

2,609,782

UNDERWATER EXHAUST AND DRIVE SHAFT HOUSING FOR OUTBOARD MOTORS

Elmer C. Kiekhaefer, Cedarburg, Wis.

Application January 19, 1949, Serial No. 71,592

1 Claim. (Cl. 115—17)

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This invention, relating to two-cycle outboard engines for propelling boats and the like and particularly to the exhaust expansion chambers therefor, constitutes a continuation in part of the invention disclosed and claimed in the application of the present inventor, filed September 5, 1947, Serial Number 772,344 for Outboard Motors, now U. S. Patent No. 2,549,479 of April 17, 1951.

A principal object of the invention is to provide greater efficiency and smoother and more quiet operation of outboard motors throughout their full operating range by means of certain improvements obtaining a greater vacuum in the exhaust systems thereof and affording a more efficient scavenging of the engine.

A more particular object of the invention is to provide for the more uniform cooling and greater contraction of the exhaust gases passing from the engine for discharge under water to obtain greater negative pressures at the exhaust ports of the engine.

Another object is to obtain a greater and more uniformly increasing vacuum progressively from the engine exhaust ports to the exhaust outlet whereby optimum negative pressures at the exhaust ports is substantially maintained at all speeds of the engine and under all operating conditions of the motor.

Another object is to reduce the possibility of pre-ignition and detonation of the fuel mixture within the cylinders of the engine by providing for the improved scavenging of the engine and reduced operating temperatures.

Another object is to provide an efficient underwater exhaust for outboard motors whereby exhaust noises will be reduced to a minimum.

These and other objects and advantages of the invention will be more fully disclosed in the following description of a preferred embodiment of the invention illustrated in the accompanying drawings.

In the drawings:

Figure 1 shows an outboard motor in side elevation with parts broken away to show various details of construction thereof;

Fig. 2 is an enlarged vertical longitudinal section through the drive shaft housing;

Fig. 3 is a front elevational view of the drive shaft housing and parts of the engine broken away and sectioned;

Fig. 4 is a top plan view of the upper end of the housing;

Fig. 5 is a transverse section of the housing taken on line 5—5 of Fig. 1;

Fig. 6 is a transverse section of the housing taken on line 6—6 of Fig. 1;

Fig. 7 is a transverse sectional view taken on line 7—7 of Fig. 1;

Fig. 8 is a bottom plan view of a cylinder block;

Fig. 9 is a view similar to Fig. 2 of an outboard

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motor showing an alternate embodiment of the invention as employed therewith;

Fig. 10 is a front elevational view of the housing shown in Fig. 9;

Fig. 11 is a top plan view of the upper end of the housing of Fig. 9;

Fig. 12 is a transverse section taken on line 12—12 of Fig. 9;

Fig. 13 is a transverse section taken on line 13—13 of Fig. 9; and

Fig. 14 is a transverse sectional view taken on line 14—14 of Fig. 9.

The outboard motor shown in the Figs. 1 to 8 includes the engine 1, the drive shaft 2 connected to the vertical crankshaft 3 of the engine and the drive shaft housing 4.

The underwater gear case 5 secured to the lower end of housing 4 carries the propeller shaft 6 and propeller 7 and the gears, not shown, drivingly connecting shafts 2 and 6.

The bracket assembly 8 is provided for securing the motor to the transom of a boat, not shown, and allows the motor to be raised out of the water by tilting forwardly and to be turned by means of the handle 9 on a vertical axis for steering of the boat.

The engine 1 comprises a crankcase 10 and two cylinder blocks 11 bolted to opposite sides of the crankcase and carrying the pistons 12 in the cylinders 13 in opposed relation extending transversely of the outboard motor.

The exhaust ports 14 for each of cylinders 13 open into the passages 15 formed in one side of each block 11 and opening downwardly thereof.

Housing 4 comprises a hollow aluminum casting having generally uniform wall thicknesses so that the interior section of the housing, as will be described, corresponds generally to the outer body of the housing. The lugs 16 extending forwardly of the housing and formed integrally therewith receive the upper and lower ends of the swivel pin 17 carried by bracket assembly 8 for the pivotal support of the motor as described for steering of the boat.

The upper end of the housing 4 is of general dimensions substantially equal to the corresponding dimensions of crankcase 10 and cylinder blocks 11 of engine 1 to fully support the same, and is provided with openings 18 registering with the discharge passages 15 of the engine to receive the exhaust gases therefrom. Bolts or other suitable means secure the engine 1 in place on the housing.

The discharge conduits or ports 19 in the engine blocks for the water circulating system of the engine register with the openings 18 in the housing to discharge the water into the upper end of the housing.

The discharge opening or orifice 20 of the housing is located at the lower end thereof be-

neath and rearwardly of the propeller anti-cavitation plate 21 to discharge the exhaust gases with the cooling water into the vortex of the propeller.

The upper end of he housing provides a chamber of substantial size immediate to exhaust passages 15 and in the embodiment of the invention shown in the drawings is further enlarged to extend rearwardly of the engine as at 22. The forward vertical edge of the housing is preferably straight for the entire length thereof. The cross-section of the housing moving downwardly from the upper end thereof becomes immediately substantially more narrow and streamlined relative to the direction of movement of the housing through the water and diminishes proportionately to a short distance above the waterline 23 of the housing.

The underwater part of the housing below waterline 23 extends a substantial distance rearwardly to the rear edge of plate 21 and is of particularly narrow dimensions for maximum streamlining and reduced frontal area. The lower end piece 24 which is provided with the discharge opening 20 is formed integrally with the body of the housing and should be as narrow as possible within the limitations of the inner dimensional requirements, as will be described, so that there is no increased drag of that part of the housing. The lower end piece 24 is spaced rearwardly of gear case 5 so that the water parted by the gear case at the front thereof flows at an increased velocity with movement of the housing through the water and past the rearward opening 20 to add to the normal Venturi effect obtaining at the opening.

The outboard motor shown in Figs. 9 to 14, inclusive, is substantially the same as that shown in Figs. 1 to 8, with the exception of the engine and the general shape of the upper end of the drive shaft housing. The embodiment of Figs. 9 to 14 is included herein to illustrate the adaptability of the invention to various types and sizes of engines in outboard motors.

The engine 25, illustrated in Figs. 9 to 14 comprises a single cylinder block 26 secured to and disposed rearwardly of the crankcase 27.

The exhaust ports 28 for each cylinder of block 26 open into the passage 29 formed in one side of the block and which opens downwardly into the upper end of the drive shaft housing 30.

The drive shaft housing 30 is similar to that disclosed in the copending application of the present inventor referred to above.

The housing 30 is generally similar to housing 4, previously described, except that the upper end of the housing 30 is constructed of a shape to fit beneath the engine block 26 and crankcase 27 and has an opening 31 therein registering with the downward opening of passage 29 for receiving the exhaust gases and cooling water of the engine.

The splash guards 32 and 33 are formed integrally with housings 4 and 30, respectively, so as to be disposed immediately above the water line, and extend fully around the housing in each instance. Each splash guard forms a horizontal plate substantially as described and claimed in the present inventor's Patent No. 2,442,728, issued June 1, 1948, for Drive Shaft Housing for Outboard Motors, and has a flat undersurface which deflects downwardly the water which is ordinarily otherwise thrown upwardly and carried into the boat. The anti-cavitation plate 21 of housing 4 and the similar plate 34 of housing 30, and splash guards 32 and 33 serve as cooling fins which help to maintain the lower submerged ends of the housings at lower temperatures.

The heat transfer from the upper end of the housings to the lower end is effected by reason of their integral construction. In this regard, the use of aluminum alloys for reasons of weight savings provides the additional advantage of a favorable heat transfer rate in the heat conductivity properties of aluminum.

Each of the housings 4 and 30 provides an exhaust passage for the gases from the engine to the underwater discharge opening of substantially uniformly decreasing cross-section. The cooling of the exhaust gases is effectively provided for by the large water-cooled surface areas of the housings particularly at the upper ends thereof so that the exhaust gases immediately upon entering the housings begin a contraction which is substantially uniformly continued during passage through the housing and until discharge into the stream of the propeller. The uniform contraction of the gases provides a substantially uniformly increasing velocity of flow through the housing whereby the normal vacuum conditions obtained at the lower end thereof is extended with maximum effect up into the housing.

The exhaust gases are substantially uniformly and continuously accelerated in flow from the upper end of the drive shaft housing until they are discharged through opening 20 at the bottom. By reason of this fact the gases are drawn from the engine block rapidly so that the scavenging of the engine is more perfect and there is an increase in engine efficiency. In this respect the present invention differs greatly from former exhaust systems wherein the gases were often interrupted in flow and were accelerated in a non-uniform and, in fact, non-continuous manner so that the engine received very little, if any, of the advantage obtainable with the underwater discharge.

The substantial and gradual reduction in cross-sectional area of the drive shaft housing from top to bottom provides for an increase in velocity of the gases, and utilizes the contraction of the gases on cooling to effect the final acceleration in the flow of the gases.

Various embodiments of the invention may be employed in outboard motors having two-cycle engines other than shown in the drawings and within the scope of the accompanying claim.

I claim:

In an outboard motor, an internal-combustion engine having a planiform lower face and a chamber opening through said lower face for discharge of the exhaust gases, an underwater propeller unit, a drive shaft connecting said engine and propeller unit, and a housing for said drive shaft comprising a unitary cast metal hollow member enclosing said shaft and rigidly supporting said engine and propeller unit, said housing having an upper end opening registering with the opening of said engine chamber to receive the exhaust gases therefrom and a discharge orifice opening under water and rearwardly into the propeller slip stream, said housing providing a passage conducting the exhaust gases for underwater discharge through said orifice under the conditions of negative pressure effected by said propeller unit, said housing member having a flared upper end portion to provide a broad supporting platform for said engine and an en-

larged chamber immediate thereto, and said housing member including a lower tapered portion having a cross-sectional open area which gradually diminishes from the enlarged chamber of said flared upper end portion downwardly to said orifice, the opening from the engine chamber into the upper flared end of said housing being smaller than the upper end of said flared portion and at least as large as the cross-sectional opening intermediate the chamber of said flared portion and the remainder of the housing to provide for substantial expansion of the exhaust gases as they pass from said engine exhaust chamber into said housing chamber and for a gradual cooling and reduction in volume of the gases as they pass downwardly through the housing to the orifice whereby the negative pressure thereon at the orifice is gradually effective upwardly of the housing and is generally free of pulsations initiated by the discharge of the exhaust gases from said engine.

ELMER C. KIEKHAEFER.

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