

Oct. 27, 1953

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2,656,812

GEAR CASE UNIT FOR OUTBOARD MOTORS

Filed May 11, 1951

3 Sheets-Sheet 1

Fig. 1

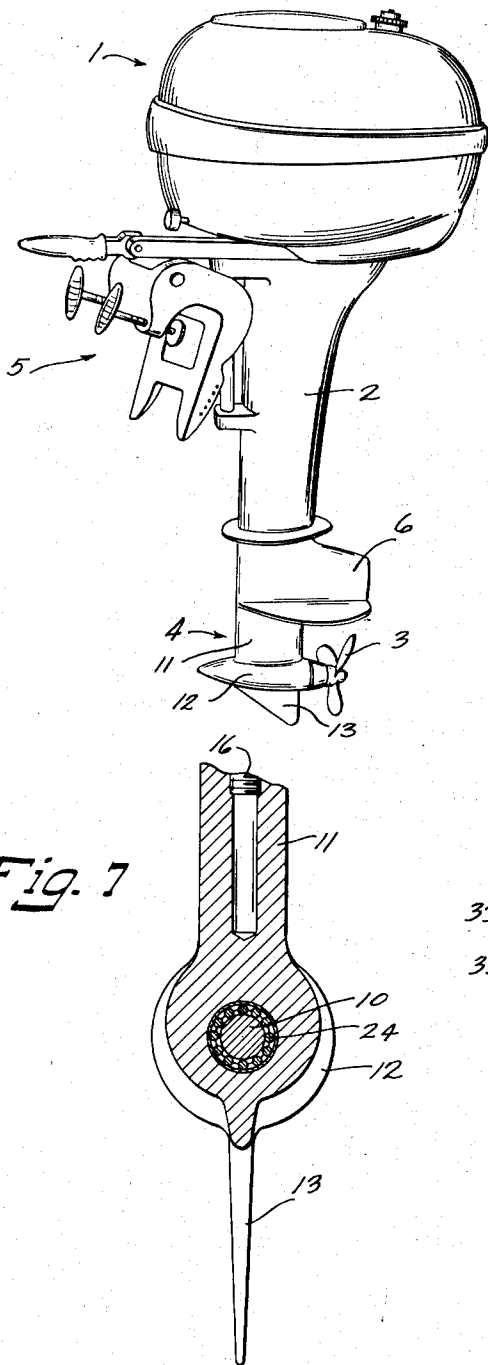


Fig. 6

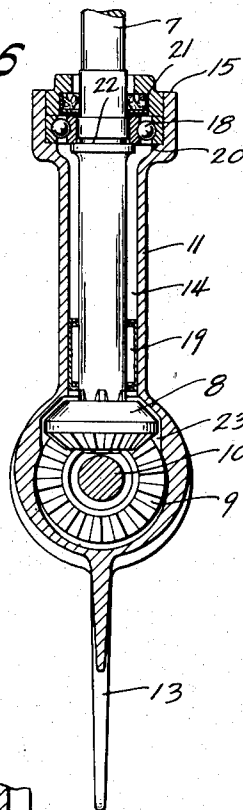


Fig. 7

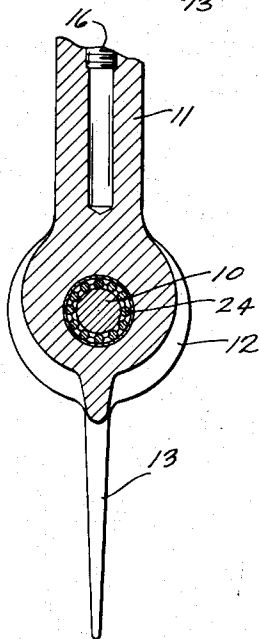
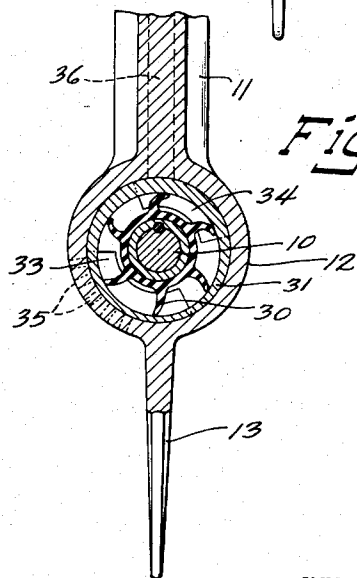


Fig. 8



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3 Sheets-Sheet 2

Fig. 3

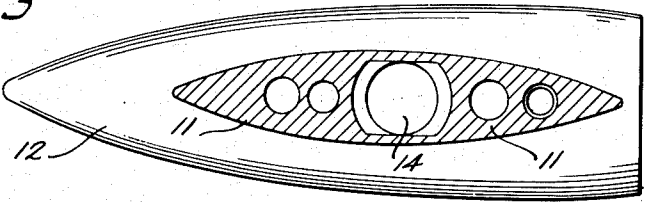


Fig. 2

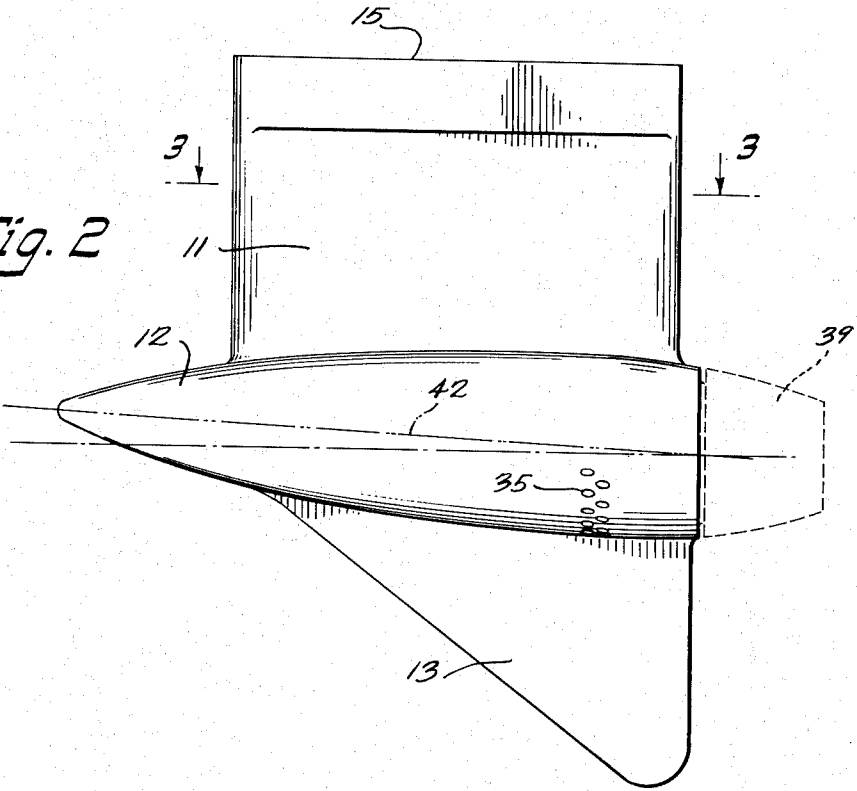
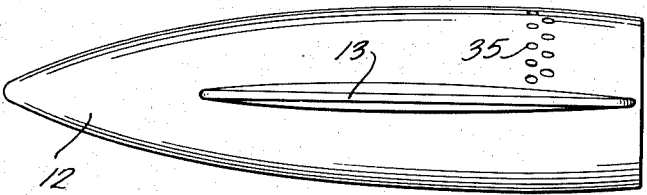


Fig. 4



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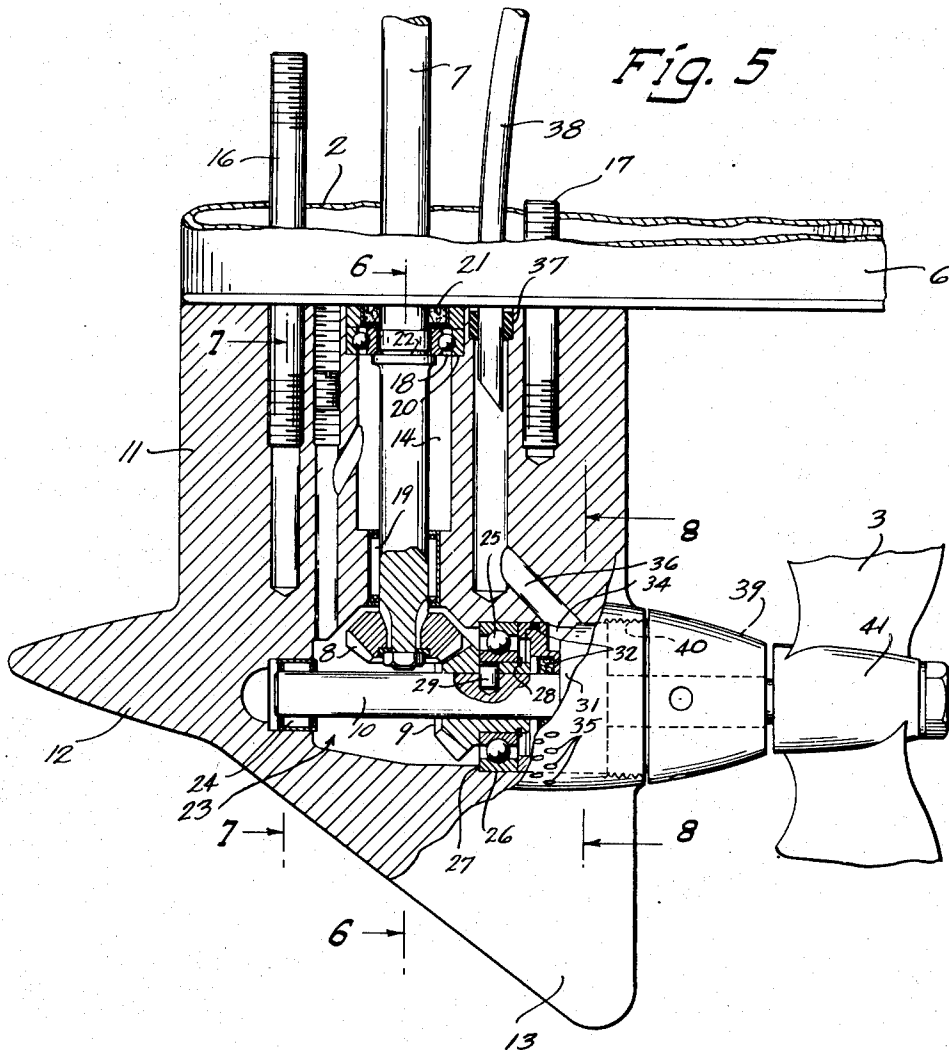
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GEAR CASE UNIT FOR OUTBOARD MOTORS

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3 Sheets-Sheet 3



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GEAR CASE UNIT FOR OUTBOARD MOTORS

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8 Claims. (Cl. 115—17)

1

This invention relates to outboard motors and particularly to the underwater gear case unit which includes the water intake and pump for the delivery of coolant to the motor.

The invention provides a gear case having outer dimensions having improved hydrodynamic characteristics adapted for operation near the surface of the water and providing a water intake especially for such operation.

A more particular object is to provide an improved streamline of the gear case which creates a minimum of turbulence and assures greater propeller efficiencies.

The principal object of the invention is to reduce the frontal area of the gear case and the drag to provide for higher operating speeds of the motor.

Another object of the invention is to locate the water intake openings for dependable water supply for cooling of the motor.

Another object is to place the openings shear with the laminar flow of the water past the openings.

These and other objects and advantages will be more fully set forth in the following description of the invention as illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a perspective view of an outboard motor with the gear case unit embodying the invention;

Fig. 2 is an enlarged side elevation of the gear case shown in Fig. 1;

Fig. 3 is a horizontal section taken on line 3—3 of Fig. 2;

Fig. 4 is a lower plan view of the gear case shown in Fig. 2;

Fig. 5 is an enlarged vertical longitudinal cross-section of the gear case unit shown in Fig. 1;

Fig. 6 is a vertical cross-section taken on line 6—6 of Fig. 5;

Fig. 7 is a sectional view taken on line 7—7 of Fig. 5; and

Fig. 8 is a sectional view taken on line 8—8 of Fig. 5.

The outboard motor unit shown in the drawings includes the engine power head 1, the housing 2 supporting the power head, the propeller 3 at the lower end of the motor and the underwater gear case 4 secured to the lower end of housing 2 and supporting the propeller.

The clamp bracket assembly 5 is adapted to be secured to the transom of a boat, not shown, and pivotally supports housing 2 for turning of the motor unit on a vertical axis to effect the directional control of the boat, not shown.

2

Housing 2 comprises a hollow, cast member which is adapted to receive the exhaust of the engine for discharge through an opening in the lower rear extending member 6 and encloses the drive shaft 7. Drive shaft 7 is connected at its upper end to the engine 1 and carries the drive beveled gear 8 at its lower end and in mesh with the driven beveled gear 9 mounted on the propeller shaft 10 to drive propeller 3.

The gear case 4 comprises a single, cast member generally including the strut 11, the enlarged torpedo section 12 and the skeg 13 which extends as a thin, downwardly projecting fin from the underside of the torpedo section.

The strut 11 is formed with a chamber 14 which opens upwardly from the upper planiform face 15 thereof and is secured by the forward and rear tie bolts 16 and 17, respectively, to the lower end of housing 2 which latter closes the upper end of chamber 14. The upper and lower bearings 18 and 19, respectively, journal support drive shaft 7 in chamber 14. The upper bearing 18 is seated in a suitable bore against the shoulder 20 formed in the strut 11 near the upper end thereof and with the seal 21 mounted thereover on shaft 7. The shoulder 22 engages the inner race of bearing 18 to transmit the axial thrust of gear 8 thereto. The lower bearing 19 is preferably a needle or roller bearing unit with a minimum outer diameter and is disposed within the lower end of strut 11 to support the lower end of shaft 7 immediately above torpedo section and gear 8.

The torpedo section 12 of gear case 4 is formed with a chamber 23 which opens rearwardly thereof and communicates forwardly with the lower end of chamber 14. The lower end of drive shaft 7 projects into chamber 23 and carries gear 8 therein in an enlarged pocket forming a part of chamber 23 in the gear case to accommodate the gears.

The forward bearing 24 is seated in the bored forward end of chamber 23 and supports the forward end of shaft 10.

The larger bearing 25 is secured and fits a corresponding bore 26 at the rear of chamber 23 and is disposed against the shoulder 27 formed therein and facing rearwardly thereof. The inner race of bearing 25 supports directly the hub of gear 9 and the ring 28 axially secures the inner race of bearing 25 and the gear. The pin 29 secures the hub of gear 9 and shaft 10 on which the gear is mounted and the shaft is supported intermediate the ends thereof.

The pump unit which supplies the engine of power head 1 with coolant under pressure is

mounted on shaft 10 rearwardly of bearing 25 and includes the impeller 30 rotationally secured on shaft 10 within the pump body 31 which houses the impeller. Pump body 31 is cylindrical to fit within bore 26 and is provided with suitable seals 32 engaging shaft 10 and the walls of the torpedo to close chamber 23.

The inlet and outlet parts 33 and 34 of pump body 31 register respectively with the intake ports 35 and discharge passage 36 formed in the gear case. Passage 36 extends from chamber 23 rearwardly of seals 32 upwardly within strut 11 and is fitted with the seal 37 in the upper face 15 of the strut to receive the lower end of delivery conduit 38 connected to the coolant system of the engine.

The conical member 39 is fitted within the threaded rear opening of chamber 23 and engages the pump body 31 to secure the latter therein and secures also bearing 25 against shoulder 22 to prevent axial displacement of shaft 10.

According to the invention the torpedo section 12 is a rotationally symmetrical streamlined body supported by strut 11 to provide a minimum of drag and is angularly disposed respecting the axis of shaft 10 to accommodate the dimensional requirements of chamber 23 and gears 8 and 9 and the location of intake ports 35 to assure the supply of water to the pump.

The forward end or nose of the torpedo section 12 is raised so that the frontal exposure of the underside of the section extends up to ports 35 located rearwardly of the section. The ports are located in the underside of the torpedo to assure the access of the pump to a supply of water particularly where the unit is disposed near the surface of the water in operation. The ports 35 open approximately at right angles to dead water passing the ports so that occasional eddy currents at the ports will not temporarily reduce the water delivery of the pump. The ports 35 are further located near the rear of skeg 13 where they are least apt to be clogged by mud or covered by leaves or the like which might be picked up and draped over the forward edge of the gear case.

The axis of the torpedo 12 and cone 39 intersects the axis of shaft 10 at the open end of bore 26 and the rear of gear case 4. Cone 39 is threaded within the open end of bore 26 as at 40 to secure pump body 31 therein and has a rear opening for shaft 10 approximately adjacent the hub 41 of propeller 3. The mid-section of torpedo 12 is of the largest cross-section to accommodate gears 8 and 9 and particularly gear 8 which is disposed horizontally above shaft 10.

The raised mid-section of the torpedo 12 accommodates the dimensions of gear 8 and a given wall thickness and eliminates the "bulge" customarily resorted to in the usual gear case and allows the development of a rotationally symmetrical torpedo supported by a strut with a minimum of drag.

An angularity of 3° has been found to provide for the above features in the embodiment of the invention shown and which includes the torpedo 12 and cone 39 developed about the chord 42 which forms the axis thereof as referred to above.

The chord length should provide a torpedo of adequate cross-section to enclose chamber 23 with a given maintained wall thickness. The rear end of cone 39 is truncated to provide an end face which corresponds with the forward end of hub 41 of propeller 3.

By reason of the angularity of the torpedo 12,

the boundary layer of water passing over the torpedo is reduced at the top where strut 11 joins torpedo 12 and the disturbance of the boundary layer by strut 11 is thereby reduced substantially, avoiding eddy currents and vortices ordinarily having a tendency to develop rearwardly of the torpedo.

Strut 11 is of streamlined dimensions generally corresponding to the developed shape of torpedo section 12 and is of uniform cross-section throughout from the upper end thereof just below bearing 18 down to the torpedo 12.

The development of the streamlines of the outer surfaces of strut 11 and torpedo 12 is based generally on the rotation of an arc of a circle to provide a uniform flow of the fluid past or around the members with a minimum of turbulence and without breaking away of the fluid from the surfaces thereof.

The gear case is especially adapted for operation near the surface of the water where breaking away of the water into waves occurs readily and results in almost total cavitation of the propeller. The development of torpedo 12 shown in the drawings is carried out approximately by the rotation of an arc of between 135 and 145° of the length of chord 42 which locates the largest section well forwardly of hub 40 of propeller 3 with the forward approach thereto providing a substantially uniform angularity. The trailing portion of the torpedo is shaped to allow the water to follow without breaking away and to close in on the hub 41 of the propeller with a minimum of turbulence.

The cone 39 forming the portion of the torpedo section rearwardly of the trailing edge of strut 11 should be sufficient to allow the water to close ahead of the propeller and should be approximately one-third the length of the cross-section of strut 11. At the rear end of cone 39 the water enters into the propeller at the base of the blades so that the entire length of the blades is effectively utilized and a propeller of less diameter turning at higher speeds can be efficiently employed.

Various embodiments of the invention may be employed within the scope of the following claims.

I claim:

1. In an outboard motor, a gear case including a narrow streamlined vertical strut and an enlarged torpedo at the lower end of the strut having opposite ends extending forwardly and rearwardly thereof, a gear chamber formed within said torpedo, said torpedo having outer dimensions approximately developed by rotation of an arc on a chord and having a radius of between 135 and 145% of the length of the chord, said chord forming an angle with the horizontal of approximately 3° and with the forward end of the torpedo raised whereby a reduced boundary layer of water passes over the upper side of the torpedo and is subject to less disturbance by said strut.

2. In an outboard motor, a gear case including a narrow streamlined vertical strut and a larger torpedo at the lower end of the strut having a forward end extending forwardly of the strut and a skeg projecting downwardly of the torpedo, a gear chamber formed within said torpedo and opening rearwardly thereof to receive the gears and having an enlarged pocket for said gears in the largest section of the torpedo, a water delivery passage within said strut having intake openings in the underside of the torpedo

5

adjacent said skeg and rearwardly of said pocket, said torpedo having outer dimensions approximately developed by rotation of an arc on a chord and having a radius of between 135 and 145% of the length of the chord, said chord forming an angle with the horizontal of approximately 3° with the forward end of the torpedo raised whereby a reduced boundary layer of water passes over the upper side of the torpedo and is subject to less disturbance by said strut and said intake openings are exposed directly to the water normally passing the underside of the torpedo.

3. In an outboard motor, a gear case including a narrow streamlined vertical strut and a larger torpedo at the lower end of the strut having a forward end extending forwardly of the strut and a skeg projecting downwardly of the torpedo, a chamber formed in the torpedo of said gear case and including a bore within the forward end thereof and a larger rear bore axially aligned with said first bore and spaced therefrom and opening rearwardly of the torpedo, a drive shaft and a drive gear carried by said drive shaft within said chamber between said bores, a propeller shaft extending from said chamber through said larger bore and projecting rearwardly of the torpedo, a driven gear fixed on said propeller shaft in said chamber and in mesh with said drive gear, a first bearing carried by said housing in said forward bore journally supporting the forward end of said propeller shaft, a second bearing mounted within said larger bore rearwardly of said drive gear and supporting said shaft intermediate the ends thereof and said driven gear thereon, said housing having a shoulder formed at the inner end of said larger bore and facing the open end thereof to locate and support said second bearing against axial and angular displacement, a pump having a cylindrical pump body member disposed within said bore rearwardly of and against said second bearing, a cone member extending from within the open end of said bore and disposed against said pump body to secure the latter therein and said second bearing against said shoulder and to secure said driven gear and propeller shaft against axial displacement, said chamber being formed within said torpedo to receive the gears and having an enlarged pocket for said gears in the largest section of the torpedo, a water delivery passage within said strut communicating with said pump, intake openings in the underside of the torpedo adjacent said skeg and rearwardly of said pocket and communicating with said pump, said torpedo and cone member having outer dimensions approximately developed by rotation of an arc on a chord and having a radius of between 135 and 145% of the length of the chord, said chord forming an angle with the horizontal of approximately 3° with the forward end of the torpedo raised whereby a reduced boundary layer of water passes over the upper side of the torpedo and is subjected to less disturbance by said strut and said intake openings are exposed directly to the water normally passing the underside of the torpedo.

4. In an outboard motor lower unit, a gear case housing having an enlarged torpedo section with a chamber formed therein and including a bore within the forward end thereof and a larger rear bore axially aligned with said first bore and spaced therefrom and opening rearwardly of the section, a drive shaft and a drive gear carried

6

by said drive shaft within said chamber between said bores, a propeller and a shaft therefor extending from said chamber through said larger bore and projecting rearwardly to carry said propeller rearwardly of the torpedo section of said housing, a driven gear fixed on said shaft in said chamber and in mesh with said drive gear, a first bearing carried by said housing in said forward bore journally supporting the forward end of said propeller shaft, a second bearing mounted within said larger bore rearwardly of said drive gear and supporting said shaft intermediate the ends thereof and said driven gear thereon, said housing having a shoulder formed at the inner end of said larger bore and facing the open end thereof to locate and support said second bearing against axial and angular displacement, a pump having cylindrical pump body member disposed within said bore rearwardly of and against said second bearing, a closure member within the open end of said bore against said pump body member, and a cone member securing said pump body member in said bore and said second bearing against said shoulder and to secure said driven gear and propeller shaft against axial displacement, said cone member having a portion threadedly secured near the rear opening of said bore and having outer dimensions continuing the streamlines of the torpedo section rearwardly to the hub of said propeller.

5. In an outboard motor lower unit, a gear case housing having an enlarged torpedo section with a chamber formed therein and including a bore opening rearwardly of the section, a propeller and a shaft therefor extending from said chamber through said bore and projecting rearwardly to carry said propeller rearwardly of the torpedo section of said housing, a bearing mounted within said bore and supporting said shaft intermediate the ends thereof, said housing having a shoulder formed at the inner end of said bore and facing the open end thereof to locate and support said bearing against axial and angular displacement, and a cone member securing said bearing against said shoulder and said propeller shaft against axial displacement, said cone member having a portion threadedly secured near the rear opening of said bore and having outer dimension continuing the streamlines of the torpedo section rearwardly to the hub of said propeller.

6. In an outboard motor, a gear case including a narrow streamlined vertical strut and a larger torpedo at the lower end of the strut having a forward end extending forwardly of the strut and a skeg projecting downwardly of the torpedo, a chamber formed in the torpedo of said gear case and including a bore opening rearwardly of the torpedo, a drive shaft and a drive gear carried by said drive shaft within said chamber forwardly of said bore, a propeller shaft extending from said chamber through said bore and projecting rearwardly of the torpedo, a driven gear fixed on said shaft in said chamber and in mesh with said drive gear, a bearing carried by said housing forwardly in said chamber and journally supporting the forward end of said propeller shaft, a second bearing mounted within said bore rearwardly of said drive gear and supporting said shaft intermediate the ends thereof and said driven gear thereon, said housing having a shoulder formed at the inner end of said bore and facing the open end thereof to locate and support said second bearing against axial and angular displacement, a pump having

a cylindrical pump body member disposed within said bore rearwardly of and against said second bearing, a cone member extending from within the open end of said bore and disposed against said pump body to close the latter and to secure the same therein and said second bearing against said shoulder and to secure said driven gear and propeller shaft against axial displacement, said chamber being formed within said torpedo to receive the gears and having an enlarged pocket for said gears in the largest section of the torpedo, a water delivery passage within said strut communicating with said pump, intake openings in the underside of the torpedo adjacent said skeg and rearwardly of said pocket and communicating with said pump, said torpedo and cone member having outer dimensions approximately developed by rotation of an arc on a chord intersecting the axis of said propeller shaft at the rear of the housing and at an angle with the forward end of the torpedo raised whereby the pocket of said chamber for said gears is wholly disposed within the torpedo and said intake openings are exposed directly to the water normally passing the underside of the torpedo.

7. In an outboard motor, a gear case including a narrow streamlined vertical strut and an enlarged torpedo at the lower end of the strut having opposite ends extending forwardly and rearwardly thereof, a gear chamber formed within said torpedo, said torpedo having outer dimensions approximately developed by rotation of an arc on a chord forming an acute angle with the horizontal and with the forward end of the torpedo raised whereby a reduced boundary layer of water passes over the upper side of the torpedo and is subject to less disturbance by said strut.

8. In an outboard motor, a gear case including a narrow streamlined vertical strut and a larger torpedo at the lower end of the strut having a forward end extending forwardly of the strut and a skeg projecting downwardly of the torpedo, a chamber formed in the torpedo of said gear case

and including a bore opening rearwardly of the torpedo, a drive shaft and a drive gear carried by said drive shaft within said chamber forwardly of said bore, a propeller shaft extending from said chamber through said bore and projecting rearwardly of the torpedo, a driven gear fixed on said shaft in said chamber and in mesh with said drive gear, a bearing carried by said housing forwardly in said chamber and journally supporting the forward end of said propeller shaft, a second bearing mounted within said bore rearwardly of said drive gear and supporting said shaft intermediate the ends thereof and said driven gear thereon, said housing having a shoulder formed at the inner end of said bore and facing the open end thereof to locate and support said second bearing against axial and angular displacement, and a cone member disposed within the open end of said bore to secure said second bearing against said shoulder and to secure said driven gear and propeller shaft against axial displacement, said chamber being formed within said torpedo to receive the gears and having an enlarged pocket for said gears in the largest section of the torpedo, said torpedo and cone member having outer dimensions approximately developed by rotation of an arc on a chord intersecting the axis of said propeller shaft at the rear of the housing and at an acute angle with the forward end of the torpedo raised whereby the pocket of said chamber for said gears is wholly disposed within the torpedo.

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