May 23, 1933. J. H. PIERCE 1,910,561

MARINE PROPULSION DEVICE

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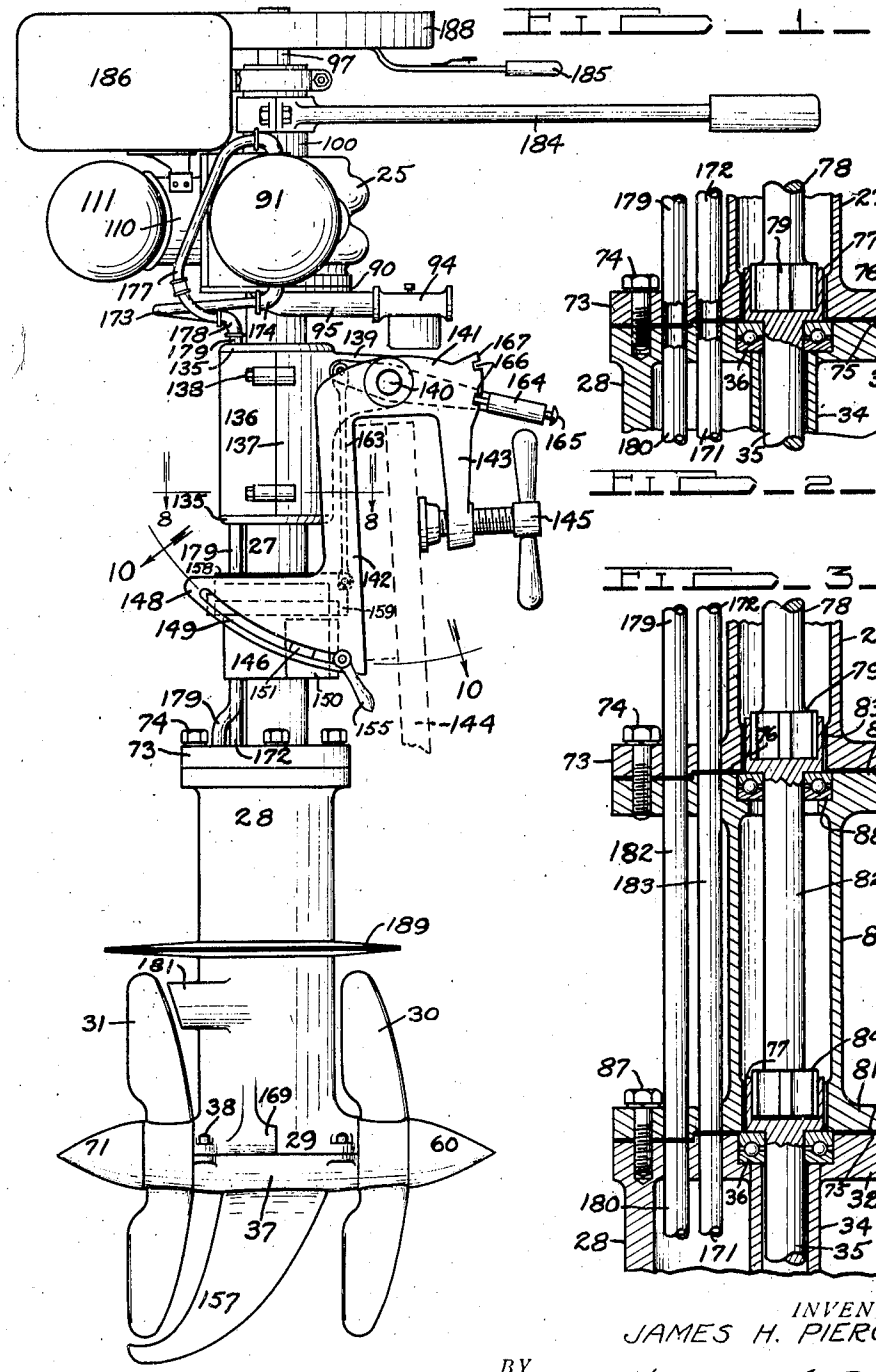


FIG. 2.

FIG. 3.

INVENTOR
JAMES H. PIERCE

BY Hodgson S. Pierce
ATTORNEY

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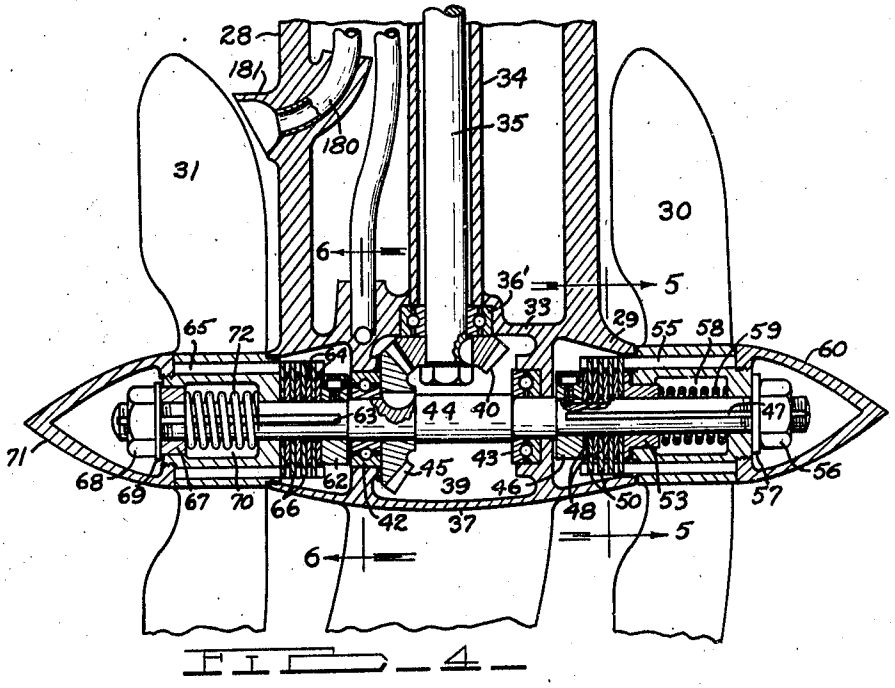


FIG. 4

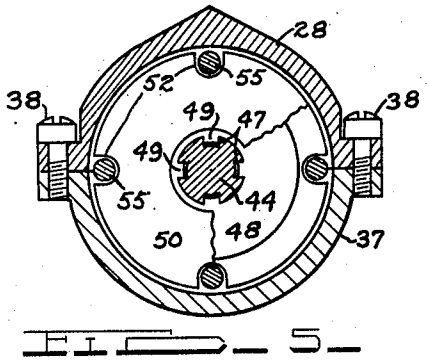


FIG. 5

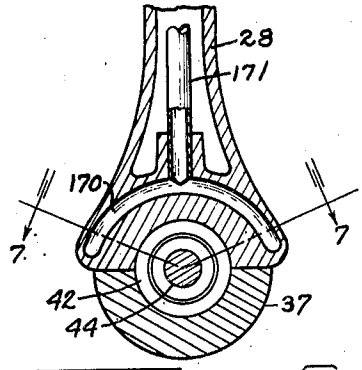


FIG. 6

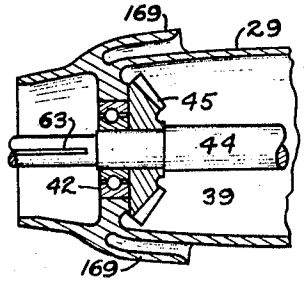


FIG. 7

INVENTOR
JAMES H. PIERCE

BY Hodgson & Pierce
ATTORNEY

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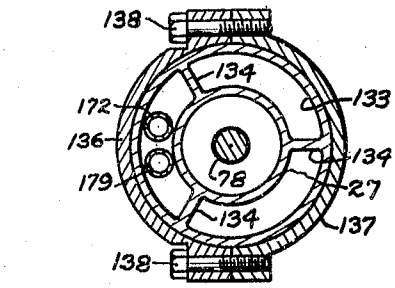


FIG. 8

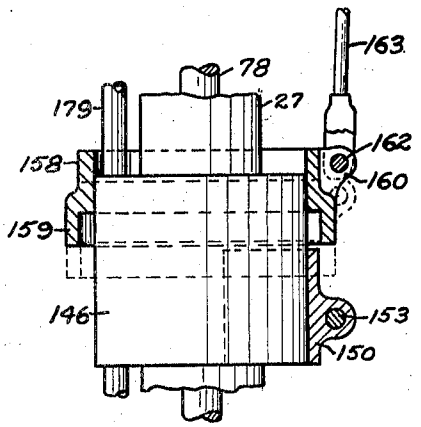


FIG. 9

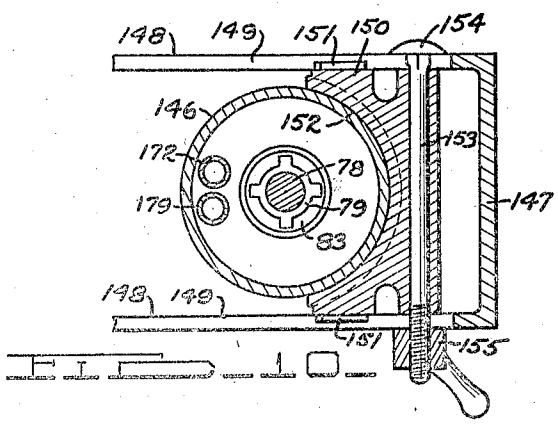


FIG. 10

INVENTOR
JAMES H. PIERCE
BY Hodgson S. Pierce
ATTORNEY

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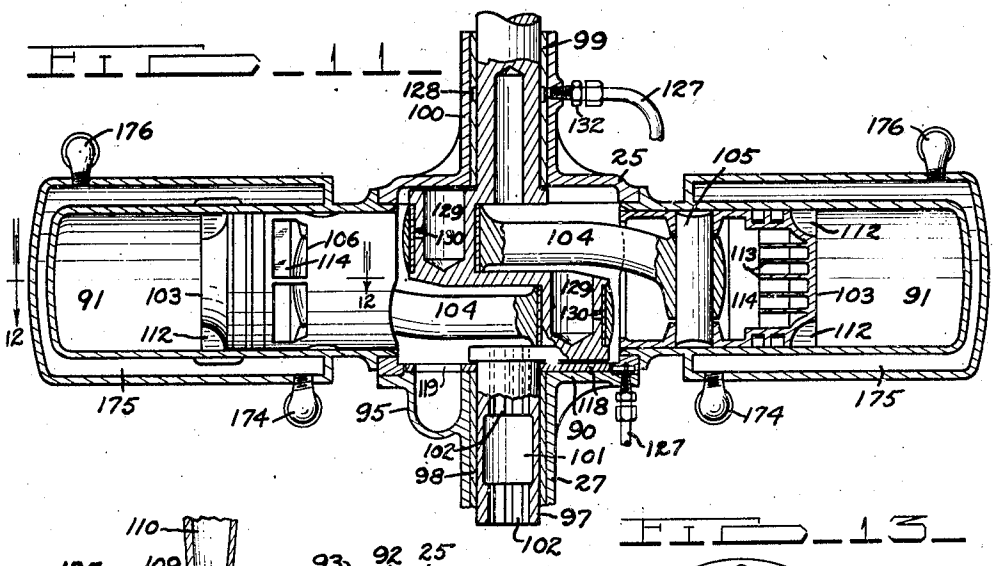


FIG. 11

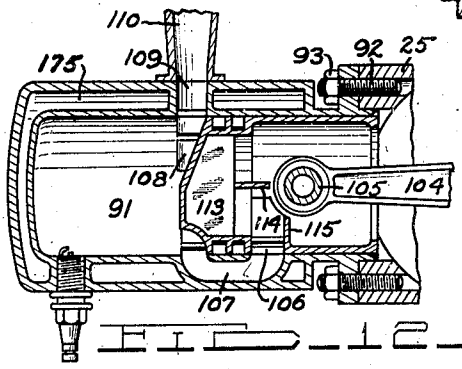


FIG. 12

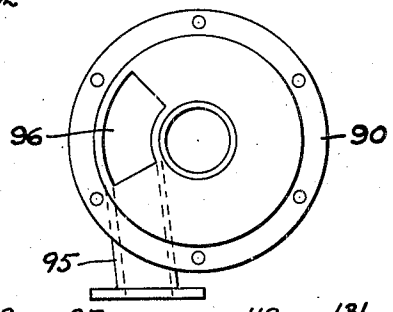


FIG. 13

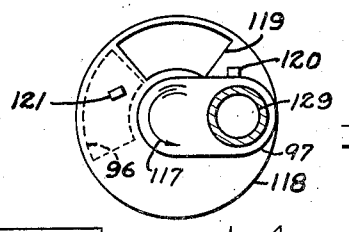


FIG. 14

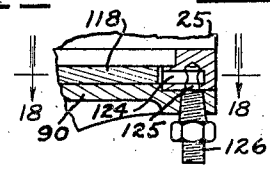


FIG. 16

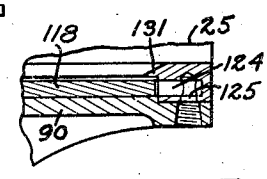


FIG. 17

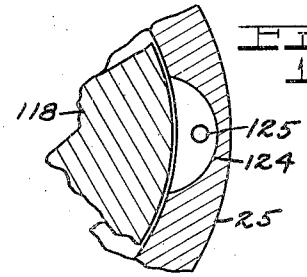


FIG. 18

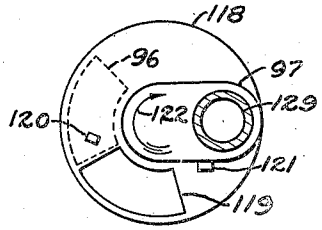


FIG. 15

INVENTOR.
JAMES H. PIERCE
BY Hodgson S. Pierce
ATTORNEY.

Patented May 23, 1933 1,910,561

UNITED STATES PATENT OFFICE

JAMES H. PIERCE, OF BAY CITY, MICHIGAN

MARINE PROPULSION DEVICE

Application filed July 5, 1928. Serial No. 290,563.

This invention relates to marine propulsion devices and particularly to that type thereof commonly known as outboard motors, the principal object being the provision of an outboard motor of a new and novel construction designed to provide a highly efficient device.

Another object is to provide an outboard motor including a vertically disposed drive shaft housing provided with a propeller at the lower end thereof positioned in front of the drive shaft housing.

Another object is to provide an outboard motor including a vertically disposed drive shaft housing at the lower end of which is suitably supported and driven a pair of propellers, one of which is disposed in front of the housing and the other of which is disposed rearwardly of the housing.

Another object is to provide a cooling system for an outboard motor including a water inlet disposed in the path of flow of water about the drive shaft housing and a water outlet disposed adjacent the path of travel of the forward edge of a propeller.

Another object is to provide an outboard motor having a separable drive shaft housing so formed as to permit an additional complete drive shaft housing section to be inserted therein.

Another object is to provide an outboard motor pivoted to swing about a horizontal line, together with manually operated means for locking the same against pivotal movement about such line.

Another object is to provide, in combination with an outboard motor having a submerged propeller shaft, a propeller rotatably mounted upon said shaft and a friction clutch connecting the propeller to the propeller shaft, whereby to normally constrain the propeller to equal rotation with the propeller shaft.

Another object is to provide a new and novel cooling system for an outboard motor.

Another object is to provide in combination with an outboard motor having a propeller shaft, a propeller rotatably mounted on the shaft and a friction clutch normally constraining the propeller to equal rotation with the propeller shaft, the clutch being so arranged that the thrust on the propeller during operation thereof tends to maintain the clutch against slipping.

Another object is to provide a new and novel oiling system for internal combustion engines of the outboard type.

Another object is to provide an internal combustion engine of the two-cycle type with a new and novel form of intake valve construction.

A further object is to provide a new and novel form of piston construction for two-cycle internal combustion engines.

The above being among the objects of the present invention, the same consists in certain features of construction and combinations of parts to be hereinafter described with reference to the accompanying drawings, and then claimed, having the above and other objects in view.

In the accompanying drawings which illustrate suitable embodiments of the present invention, and in which like numerals refer to like parts throughout the several different views,—

Fig. 1 is a side elevation of an outboard motor.

Fig. 2 is an enlarged fragmentary vertical sectional view taken through the center of the drive shaft housing at its line of separation thereof illustrating the construction of the same at and adjacent that line.

Fig. 3 is a view similar to Fig. 2 but illustrating the drive shaft extension inserted in place.

Fig. 4 is a vertical sectional view of the lower end of the drive shaft housing taken in the plane passing through the axes of the propeller shaft and the drive shaft.

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 4.

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 4.

Fig. 7 is a fragmentary sectional view taken on the line 7—7 of Fig. 6.

Fig. 8 is an enlarged sectional view taken on the line 8—8 of Fig. 1.

Fig. 9 is an enlarged fragmentary broken view showing the details of the collar for

locking the drive shaft housing against pivotal movement during reversing of the propeller.

Fig. 10 is an enlarged sectional view taken on the line 10—10 of Fig. 1.

Fig. 11 is a vertical sectional view of the engine for the outboard motor shown in Fig. 1 taken through the axes of the cylinders thereof.

Fig. 12 is a sectional view taken on the line 12—12 of Fig. 11.

Fig. 13 is a plan view of the cover member for the crank case of the engine shown in Figs. 11 and 12.

Fig. 14 is a plan view of the disc valve employed for controlling the flow of mixture into the crank case of the engine shown in previous views, a portion of the crank shaft being shown in connection therewith and its relation thereto during rotation of the crank in one direction.

Fig. 15 is a view similar to Fig. 14 but illustrating the position of the crank in respect to the disc valve when the crank is rotating in a direction opposite to that shown in Fig. 14.

Fig. 16 is an enlarged fragmentary vertical sectional view taken through the edge of the crank case cover at the point thereon where the lubricating oil is tapped out of the crank case to be led to the engine bearings.

Fig. 17 is a view similar to Fig. 16 but showing a slightly modified construction.

Fig. 18 is a fragmentary sectional view taken on the line 18—18 of Fig. 16.

I show in Fig. 1 an outboard motor comprising generally an engine having a crank case 25 and cylinders 91, a drive shaft housing comprising an upper section 27 and lower section 28, the latter of which terminates at its lower end in a housing portion 29 enclosing a propeller shaft the ends of which project both forwardly and rearwardly from the housing portion 29 and to the forwardly extending portion of which is suitably secured a propeller 30 and to the rearwardly extending portion of which is suitably secured a propeller 31.

The lower housing portion 28 is of cast construction with maximum dimension in the direction of movement and minimum dimension transversely thereto, the forward end rearward edges of which are sharp to reduce the resistance of the same passing through the water. As illustrated in Figs. 2, 3 and 4, the housing 28 is substantially closed at its upper end by a wall 32, and adjacent its lower end by a wall 33, and extending between the walls 32 and 33 is a tubular portion 34. A section 35 of the drive shaft is provided with a bearing 36 in the upper wall 32 and extends down through the tubular portion 34 through the lower wall 33 where it is provided with a bearing 36'. Referring to Fig. 5, the lower end of the housing portion 29 is provided with a removable cap 37 secured thereto by screws such as 38 which co-acts with the lower portion of the housing to provide a chamber 39 into which the lower end of the drive shaft section 35 projects and to which is secured a bevel gear 40. Rotatably supported in the bearings 42 and 43 clamped between the housing portion 29 and cap 37 is a propeller shaft 44 extending perpendicularly to the drive shaft 35. The propeller shaft 44 is provided with a bevel gear 45 in mesh with the gear 40 for driving movement therefrom. The propeller shaft 44 projects both forwardly and rearwardly past the front and rear faces respectively of the housing 29. A collar 46 is secured against rotation and axial movement on the shaft 44 ahead of the bearing 43, and the shaft 44 is grooved as at 47, as best shown in Figs. 4 and 5, from the collar 46 to the forward end of the shaft 44. A plurality of metal discs 48 are slidably received on the forward end of the shaft 44 and each is provided with a tongue 49 (see Fig. 5) which is received in the corresponding groove 47 so as to prevent such discs from rotation relative to the shaft 44. Loosely threaded on the shaft 44 between each pair of discs 48 is a disc 50 of slightly larger diameter than the discs 48 and each of which is provided at its outer edge with four equally spaced notches 52. Rotatably surrounding the shaft 44 ahead of the last disc 50 is an axially slidably shouldered collar 53. The propeller 30 is rotatably mounted on the shaft 44 at its forward end and rotatably mounted on the collar 53 at its rearward end and is provided with four equally spaced rearwardly extending pins 55 which lie in parallel relation to the axis of the shaft 44. The rear end of the pins 55 are received in the corresponding notches 52 of the discs 50 so as to constrain the discs 50 to equal rotation with the propeller 30. A nut 56 threaded on the forward end of the propeller shaft 44, with its co-operating washer 57, limits axial movement of the propeller 30 forwardly on the shaft 44. The hub of the propeller is formed to provide therein a chamber 58 surrounding the propeller shaft 44, and within the chamber 58 and surrounding the propeller shaft 44 is a coil spring 59 held under compression between the forward wall of the chamber 58 and the forward face of the collar 53. The result is that the coil spring 59 acting through the slidable collar 53 bears against the forward disc 50 and acts to clamp all of the discs together between the collar 53 and the collar 46, thereby frictionally locking the propeller to the shaft 44 for equal rotation therewith. It will be noted that in this construction the

thrust of the propeller 30 during operation has no effect whatsoever upon the pressure acting on the discs 48 and 50. The tension of the spring 59 is preferably such that the propeller 30 will not slip relative to the shaft 44 during maximum thrust of the propeller, but should the propeller strike some obstruction which would tend to prevent its rotation, the plates 48 and 50 will slip relative to each other sufficiently to prevent serious damage to the propeller or parts connecting the same to the engine. I preferably provide a pointed cap member 60 threaded on to the forward end of the propeller hub so as to reduce the resistance of the hub in passing through the water.

The rear end of the propeller shaft 44 is provided with a collar 62 and grooves 63 similar to the collar 46 and grooves 47 at the forward end of the same. Discs 64 similar to the discs 48 and co-operating with the grooves 63 are also provided. The propeller 31 is rotatably received on the rear end of the propeller shaft 44 and is provided with pins 65 which co-operate with discs 66 interposing between the discs 64 in the same manner as the pins 55 co-operate with the discs 50 at the forward end of the propeller shaft. The rear end of the propeller 31 is slidably and rotatably mounted on the collar 67 which is locked against rearward movement on the propeller shaft 44 by the nut 68 and washer 69. The interior of the hub of the propeller 31 is formed to provide a chamber 70 in which a coil spring 72 surrounding the propeller shaft is held under compression between the forward wall thereof and the forward face of the collar 67. The spring 72 acts to force the propeller 31 forwardly on the shaft 44 and thereby clamp the discs 64 and 66 between the hub of the propeller and the collar 62 to thereby clutch the propeller 31 to the propeller shaft 44. The result of this construction is exactly the same as that described in connection with the propeller 30 with the exception that in this case the thrust of the propeller 31 on the water tends to supplement the action of the spring 72 in holding the discs 64 and 66 against slippage. The hub of the propeller 31 is provided with a cap member 71 similar to the cap member 60 and designed to decrease the resistance of the passage of the hub through the water.

As indicated in Figs. 2 and 3, the upper housing section 27 is of generally circular hollow section and is provided with a flange 73 at its lower end through which the bolts 74 extend and which are threaded into the upper wall 32 of the lower housing member 28 in order to secure the same thereto. The upper face of the upper wall 32 of the lower housing 28 is provided with a pilot 75 and the lower face of the flange 73 is provided with a recess 76 in which the pilot 75 is received so as to locate the upper housing portion 27 in proper axial relationship with respect to the lower housing portion 28, suitable gaskets being interposed between the matching faces.

The drive shaft section 35 is provided above the upper face of the housing 28 with a cup-shaped interiorly grooved end 77 and the upper drive shaft section 78 is splined as at 79 and is non-rotatably but slidably received within the end 77. When the upper housing portion 27 and lower housing portion 28 are separated upon removal of the screws 74, the drive shaft sections 35 and 78 remain with their housing sections 28 and 27 respectively. This permits the employment of a section insertable between the housing sections 27 and 28 in order to increase the effective distance between the engine and the propellers in the following manner: A housing section 89 having an upper flange 80 duplicating the upper end of the housing 28 and the lower flange 81 duplicating the lower end of the housing portion 27 is provided with a shaft 82. The shaft 82 is provided at its upper end with a cup-shaped end 83 duplicating the end 77 of the shaft 35 and a lower splined end 84 duplicating the lower splined end 79 of the shaft 78. The shaft 82 is provided with a suitable bearing 88 within the section 89. In the particular construction shown, the lower end 84 of the shaft 82 is formed separately from the shaft 82 and secured thereto after assembly of the bearing 88, although this construction may be varied as is readily apparent. The section 82 is formed with a pilot 85 on its upper surface and a recess 86 on its lower face in exact accordance with the pilot 75 and recess 76 of the housing sections 28 and 27 respectively as previously described, so that when it is desired to increase the effective distance between the engine and the propellers in the construction as shown in Figs. 1 and 2, all that is necessary is to remove the screws 74, separate the sections 27 and 28, secure the lower end of the section 27 to the upper end of the section 89, and secure the lower end of the section 89 to the upper face of the section 28 by the use of additional screws 87. This provides a quick and easy method of obtaining the desired length of the drive shaft housing and as such insertable sections may be made in various lengths they are particularly suited in production to a uniform main construction which may be adjusted in length by the section 89 to suit the needs of the particular buyer.

As indicated in Figs. 1 and 11, the upper end of the upper housing section 27 is formed with an enlarged flange 90 which serves as a cap or cover for the lower face of the crank case 25 and which also serves to sup-

port the engine thereon. As shown in Figs. 11 and 12, the engine is of the two-cycle type having a pair of opposed cylinders 91 which are secured to the crank case 25 by bolts 92 and nuts 93. The combustible mixture is drawn into the crank case through a carbureter 94, which may be of any conventional construction, and through the duct 95 which opens into the crank case through the segmental opening 96 in the flange 90. The crank shaft 97 is of the two-throw type having bearing in the bushings 98 and 99 carried by the housing section 27 and crank case extension 100 respectively. The lower end of the crank shaft 97 is hollow as at 101 and is splined as at 102 for connection to the upper end of the upper drive shaft section 78 which is splined to co-operate therewith. Each of the cylinders 91 is provided with a piston 103 which is connected to its corresponding crank shaft throw by a connecting rod 104 and piston pin 105. Each piston is provided with a port 106 in its side wall through which the combustible mixture compressed in the crank case passes to the by-pass 107 (see Fig. 12) when the piston is at and near the bottom of its stroke in order to enter the cylinder 91 above the piston. The burned gases in the cylinders escape through the ports 108 into the passages 109 where they are led into the exhaust pipes 110 and thence to the muffler 111 in the conventional manner.

In view of the high speeds at which it is desirable to operate an engine of the type shown, and to reduce vibration, it is desirable that the pistons 103 be of as light construction as possible, and it is therefore desirable that such pistons be constructed of a light metal such as aluminum or one of the alloys thereof. In the preferred construction of pistons for two-cycle engines, deflecting baffles such as 112 are provided. These baffles are relatively difficult to cool, and heretofore when pistons equipped with such baffles have been constructed of light metal having a relatively low melting point, the baffles have often been burned off at high engine speeds and full load. In accordance with the present invention I provide a construction for such pistons which insures cooling of the piston head to such a degree as to obviate any possibility of damage to the baffles 112 due to the excessive heat, and at the same time I am enabled to heat the combustible mixture entering the cylinder an amount commensurate with optimum engine operating conditions. This is accomplished in the following manner as illustrated in Figs. 11 and 12: Extending downwardly from the top of the piston 103 in parallel and spaced relationship and in a direction perpendicular to the side of the piston on which the port 106 opens, is a plurality of we's 113 which extend to a point spaced from the outer ends of the connecting rods 104. Extending diametrically across the piston between the lower ends of the webs 113 and the outer end of the co-operating connecting rod and perpendicular to the planes of the webs 113 is a baffle 114 which extends into relatively close relationship with respect to the corresponding end of the connecting rod. A third baffle 115, best illustrated in Fig. 12, extends from the inner edge of the port 106 into relatively close relationship with the corresponding end of the connecting rod 104. The result of this construction is that as the engine is operating and combustible mixture is drawn into the crank case 25 on the outstroke of the pistons and compressed therein on the instroke thereof, when the pistons reach the inner end of their stroke, the compressed combustible mixture in the crank case is forced through the piston and out of the port 106 into the by-pass 107 and thence into the cylinder. In passing through each piston, the baffle 115 causes the combustible mixture to pass through the piston on the opposite side of the piston pin 105 from the baffle 115, and in passing over the piston pin and outer end of the connecting rod, the baffle 114 directs the combustible mixture up over the same and between the webs 113 which, being cast integrally with the head of the piston, rapidly conduct the heat therefrom. After passing through the webs 116 the combustible mixture may escape through the port 106 into the by-pass 107, as described. In this manner substantially all the combustible mixture entering the cylinders is forced to pass up into closely adjacent relationship with respect to the head of the corresponding piston and takes up heat therefrom as well as from the ribs 113 connected thereto. This insures such a rapid transfer of heat from the baffles 112 that the same are prevented from reaching a temperature which may be detrimental to them. Furthermore, I have found that this construction maintains the head of the piston at a temperature below that at which the hydro-carbons in the crank case, and which may find their way into contact with the head of the piston, are sufficiently heated to cause cracking thereof and subsequent depositing of free carbon on the under side of the piston head.

Another feature of the present invention is the valvular means provided for regulating the admittance of combustible mixture through the duct 95 into the crank case. As is well-known in the art, the usual method of introducing combustible mixture into the crank case of a two-cycle engine is either through a check valve placed in the passage between the crank case and the carbureter, or by a port through the cylinder controlled by the movement of the piston during its

travel, or by a combination of both. The employment of a check valve is undesirable because of the relatively delicate construction of the same necessary for high engine speeds and the spring means which must be employed in connection with it, the tension of which spring must be overcome in drawing combustible mixture into the crank case past the valve. In overcoming the tension of such spring, a corresponding drop in the effective suction tending to draw the combustible mixture in the crank case results and a corresponding loss of volume of combustible mixture per stroke of the pistons and consequent loss of power results. In the construction in which the combustible mixture is taken through the cylinder and controlled by the movement of the piston, the length of time during which such port is open to the admittance of combustible mixture is necessarily limited and consequently it is impossible to obtain desirable volumetric efficiency with such construction.

In the present invention a disc valve 118 is provided for controlling the admittance of the combustible mixture into the crank case. The valve 118 rotatably encircles the lower end of the crank shaft 97 and overlies the upper surface of the flange 90. The disc 118 is provided with a segmental opening 119, as best illustrated in Figs. 14 and 15, of substantially the same area as the opening 96 in the flange 90. The disc 118 is further provided on its upper surface with a pair of upstanding lugs 120 and 121 which are adapted to engage the adjacent throw of the crank shaft in order to impart driving movement to the disc 118 from the crank shaft 97. The lug 120, as illustrated in Fig. 14, is so positioned relatively to the opening 119 that when the crank shaft is turning in the direction indicated by the arrow 117 in Fig. 14 and the pistons are at the bottom of their stroke, the leading edge of the opening 119 is in or about to become in overlapping relationship with respect to the near edge of the opening 96. In other words, the moment that the pistons start on their outer travel, the openings 119 and 96 overlap each other and thus provide a clear path for the combustible mixture from the carbureter to enter the crankcase. The openings 96 and 119 are so designed in length that they remain in overlapping relationship until the pistons reach the top or the outer limit of their travel. Furthermore, it will be apparent that when the piston is in its midstroke position during its outer travel, at which time the greatest suction is present within the crank case 25, the openings 119 and 96 are fully aligned, thereby providing a maximum of a port opening into the crank case for the admittance of the combustible mixture. This construction permits a maximum size of port opening to be employed with absolutely no restriction of the opening, and which is maintained in open position during the entire time that a suction is apparent in the crank case. It will also be apparent that it may be desirable in some cases to maintain the intake port open into the crank case for a short period after the piston has reached the outer limit of travel, and in such cases the openings 119 and 96 may obviously be varied to accomplish such result.

When the crank shaft is turning in the opposite direction to that shown in Fig. 14, or as indicated by the arrow 122 in Fig. 15, it will be obvious that if the lug 120 only were employed, the relation of the openings 119 and 96 would not be correct for proper timing of the entrance of the combustible mixture into the crank case. For this reason, the lug 121 is provided which co-operates with the adjacent throw of the crank shaft 97, when the engine is turning as indicated by the arrow 122, in the same manner that the lug 120 co-operates therewith, as previously described when the engine is turning in the opposite direction. This gives a construction in which it is possible to instantly reverse the direction of rotation of the engine without affecting the relative timing of the same in any manner whatsoever. The disc 118 being in contact with the upper face of the flange 90 and being separated therefrom by the usual film of lubricating oil, has sufficient drag to maintain the lug 120 or 121, as the case may be, against the crank shaft during operation of the engine, and still turns free of the crank shaft when the direction of rotation of the engine is reversed, although separate means may be provided for insuring such action, if desired.

As is commonly the case with engines of this type, lubrication for the same is provided by mixing the lubricant with the fuel in the fuel tank so that it is fed into the engine with the combustible mixture. The bulk of such lubricant is separated out in the crank case and collects there in appreciable amounts. In accordance with the present invention I am enabled to utilize this fact in connection with the disc 118 to provide a novel and efficient additional lubricating means for the crank shaft and the connecting rods. Due to the fact that the disc 118 is positioned in the bottom of the crank case and due to the fact that the lubricating oil tends to collect in the bottom of the crank case, the lubricating oil comes in contact with the disc 118 and the rotation of the latter tends to throw the lubricating oil to the outer edge of the same with considerable force. Taking advantage of this fact I extend the disc 118 into relatively closely adjacent relationship with respect to the co-operating edge of the crank case

25, as best illustrated in Figs. 16, 17 and 18, and I extend such edges of the crank case 25 so as to be in alignment with the disc 118 throughout the width of the same. This causes the oil carried to the outer edge of the disc 118 during rotation thereof to build up between its outer edge and the adjacent edge of the crank case. I then provide a recess as at 124 in the adjacent edge of the crank case and opening on to the outer edge of the disc 118. I then connect this recess 124 by an opening 125, connection 126, and tube 127 to the point where I desire the lubricant to be deposited. Such a point may be in connection with the upper main bearing of the crank shaft 97, as is illustrated in Fig. 11, and in which an annular groove 128 is provided in the bushing 99 about the crank shaft 97 and which is connected by means of the connection 132 to the tube 127. The lubricant is thus forced by the disc 118 into the recess 124 from which it is conducted through the opening 125 and the tube 127 to the groove 128 where it serves to lubricate the inner surface of the bushing 99. I find that where the pressure of the lubricant thus obtained is not as high as I desire, the crank case 25 may be formed with a flange or lip 131, as indicated in Fig. 17, overlying the upper face of the disc 118 adjacent its outer edge so that the outer edge of the disc 118 is enclosed on three sides. This has the effect of restricting the escape of the oil upwardly from the outer edge of the disc 118 and serves to provide a construction which may be likened to the conventional type of centrifugal pumps.

The lubricant thus deposited in the groove 128 may work downwardly and again be drawn into the crank case and I provide means whereby such lubricant may be caught and employed for lubricating the large ends of the connecting rod in the following manner: Each throw of the crank shaft 97 is provided with a relatively large central blind opening 129 opening on the upper face thereof which not only serves to lighten the crank shaft itself but also serves as a cup in which the lubricant thrown about in the crank case and dripping down from the bushing 99 is trapped. Each of the openings 129 is connected by a small opening 130 to the bearing face for the large end of the corresponding connecting rod 104, the openings 130 being positioned at the outer sides of the openings 129 from the axis of the crank shaft so that the lubricating oil therein will be thrown by the centrifugal force acting on it because of the rotation of the crank shaft to the bearing surface. This provides an extremely efficient lubricating system amply adapted to take care of the needs of high speeds and full engine loads.

In the construction shown in the drawings the disc 118 is in the bottom of the crank case. In those cases in which the disc 118 is placed at the top of the crank case, as may be desirable under certain circumstances, a dummy disc (not shown) may be placed in the bottom and secured to the crank shaft for rotation therewith in order to accomplish the same method of lubrication shown, and in some cases it may be found desirable to form the throws of the crank shaft as discs to accomplish the same result, and thereby dispense with an additional disc for such purpose.

The engine and housing assembly together with the various parts are supported to swing about the axis of the drive shaft housing and about a horizontal line in the following manner: The upper housing portion 27 is provided with a concentric shell 133 outwardly spaced from the tubular portion 27 and connected thereto by the webs 134. The shell 133 is formed to provide a cylindrical outer surface of material length bounded at its upper and lower edges by the radial flanges 135. Rotatably embracing the shell 133 between the flanges 135 is a collar member formed in two parts 136 and 137 which are secured together by screws such as 138. The part 137 is provided with an extending portion 139 in which is received the shaft 140 which connects it to the supporting backet 141. The supporting bracket 141 is provided with spaced downwardly extending leg portions 142 and 143 which are adapted to receive the stern section 144 of a boat between the same and which stern portion is adapted to be clamped therein by means of one or more clamping screw members 145 threaded into the arms 143. Thus, the drive shaft housings 27 and 28 and all parts connected thereto are supported for rotation about the axis of the drive shaft, and are also supported for pivotal movement about the axis of the shaft 140. Formed on the drive shaft housing section 27 between the sleeve 133 and flange 73 is a cylindrical enlargement 146. The legs 142 of the supporting bracket are extended down to substantially the lower end of the enlarged portion 146 where they are suitably connected together at their front ends by a cross member 147, and each of which extends rearwardly therefrom as at 148 on either side of the enlarged portion 146. Each of the portions 148 is provided with an arcuate slot 149 whose center is coincident with the axis of the shaft 140. As best illustrated in Fig. 10 a member 150 is received between the portions 148 and is provided with short end lugs 151 which are received in the slots 149 so as to maintain the member 150 in a pre-determined angular position with respect to the axis of the shaft 140. The rear face of the member 150 is formed to provide a semi-circular bearing face 152 against which is rotatably received

the enlarged housing portion 146. A bolt 153 slidably extending through the member 150 and both slots 149 is provided with a head 154 on the outer face of one of the portions 148, and a hand nut 155 on the outer face of the opposite portion 148. By drawing up the nut 155 the side members 148 are drawn together so as to clamp the member 150 therebetween against sliding movement relative to the portions 148. Upon loosening the nut 155 the member 150 may be moved relative to the slots 149 so as to vary the pivotal position of the apparatus relative to a vertical plane passing through the axis of the shaft 140. This is in order that the axes of the drive shafts may be maintained in substantially vertical position during operation within a relatively wide range of angles between the stern piece 144 and the vertical. The enlarged portion 146 will, of course, bear against the bearing face 152 when the engine is operating during normal forward movement due to the fact that the thrust of the propellers will maintain it in such position. It is formed with only a semi-cylindrical bearing face in order that when the lower end of the housing or skeg 157 contacts with the bottom in shallow water, or with logs or other obstructions, during normal forward movement of the boat, the housing may swing about the axis of the shaft 140 and thereby obviate possibility of damage from such cause.

However, it will be apparent that should the engine and housing be rotated about the axis of the housing until the thrust of the propellers are in the opposite direction to that shown, or rearwardly, unless some additional means were provided, such thrust would cause the assembly to pivot about the axis of the shaft 140 and the lower end of the housing with the propellers would be drawn to the surface of the water and thereby defeat their efforts towards propulsion. This is taken care of in the present invention in a simple and economical manner. The surface of the member 150 is formed at its upper edge as part of a cylinder and terminates a material distance below the upper edge of the portion 146 which, as before explained, is cylindrical in section. Rotatably and vertically slidably received on the upper end of the portion 146 is a collar 158 which is provided at its lower end with a sleeve portion 158, the interior surface of which is spaced outwardly from the surface of the portion 146 an amount slightly greater than the thickness of the upper end of the member 150. The collar 158 is provided with a pair of ears 160 which are pivotally connected by the pin 162 to the rod 163, as indicated in Fig. 9. Referring to Fig. 1, rotatably supported between its ends on the shaft 140 is a lever 164, the rear end of which is pivotally connected to the upper end of the rod 163. The forward end of the lever 164 is provided with a radially extending spring pressed plunger 164, the inner end of which is adapted to engage notches 166 formed in the segment 167 provided on the bracket 141. It will be obvious that if the plunger 165 is withdrawn from the notches 166 the lever 164 may be pivoted about the shaft 140, and in so pivoting, it acts through the rod 163 to cause the collar 158 to move either up or down on the enlarged housing portion 146. When the plunger 165 engages the lower notch 166, as indicated in Fig. 1, the lower edge of the sleeve 159 is positioned above the upper edge of the thrust block 150, as is indicated in Fig. 9 and the housings 27 and 28 are free to pivot about the shaft 140. If the plunger 165 is withdrawn from the lower notch 166 and moved up into the upper notch 166, the rear end of the lever 164 in moving downward will force the collar 158 downwardly, as indicated in dotted lines in Fig. 9, until the sleeve portion 159 envelops the upper end of the member 150. When this happens the engine and housing assembly may be rotated about the axis of the drive shaft so that the propellers are pulling to the rear instead of to the front as shown, and the thrust of the propellers will be taken up by the sleeve 159 and collar 158 acting through the member 150 so as to prevent pivotal movement of the assembly about the axis of the shaft 140.

It is well known in the art that the cooling of outboard motors has caused considerable difficulty in the past. Heretofore, a pump of some description has been employed in connection with the cooling system, and in view of the fact that outboard motors are commonly employed in shallow water, sand is often drawn into the cooling system. This sand in being drawn into the pump acts as an abrasive and causes premature wearing out of the pump. In my Patent No. 1,579,834 I show a construction designed to minimize the effects of sand being drawn into the cooling system, but in the present invention I provide a construction which does away with the pump entirely and yet provides ample cooling. This is accomplished in the following manner. Referring to Figs. 4, 6 and 7, the lower end 29 of the housing 28 adjacent the cap 37 is provided on opposite sides with a pair of forwardly opening scoop members 169 which are positioned substantially at or adjacent to the point of maximum width of the lower housing 28. The interior of each of the scoops 169 are connected together by a cross passage 170 cored in the housing 28, and connected to the passage 170 is a tube 171 which extends upwardly therefrom and is anchored at its upper end in the upper wall 32 of the housing 28 and opens on the upper face thereof. The upper housing 27, as indicated in Figs. 2 and 3, is provided

with a similar tube 172 positioned exteriorly thereof which extends down through the flange 73 in alignment with the tube 171 and opens on the lower face thereof. The tube 172 passes through the upper and lower walls of the enlarged housing portion 146 and then through the flanges 135 between the housing 27 and the shell portion 133, as indicated in Fig. 8. Immediately above the upper flange 135 the tube 172 is connected by tubes 173 (see Fig. 1) with the L's 174 which lead into the lower portion of the water jackets 175 for the cylinders 91, as indicated in Fig. 11. The upper portions of the water jackets 175 are provided with L's 176 which are connected by tubes 177 and the L 178 to a tube 179 which extends down to a point below the lower wall of the enlarged housing portion 146 in parallel relationship to the tube 172, as illustrated in Figs. 8 and 10. Below the lower wall of the enlarged portion 146, the tube 179 is bent to the rear and passes down through the flange 73, as indicated in Figs. 2 and 3, and opens on to the lower face of the same. Another tube 180 is secured at its upper end in the upper wall 32 of the lower housing 28 in alignment with the tube 179 and opens on to the upper face of the wall 32. The tube 180 extends downwardly from the wall 32, as illustrated in Fig. 4, and opens on the outer rear face of the housing 28 below the upper edge of the propeller 31. The housing 28 at the point where the tube 180 opens on to the same is provided with a bell-mouthed enlargement 181, the rear edges of which terminate in spaced but adjacent relationship to the line of travel of the forward edge of the blades of the propeller 31.

The result of this construction is that as the housing 28 moves through the water, the scoops 169 catch the water and force it up through the passage 170, tubes 171, 172 and 173 into the water jacket 175 from which it passes down through the tubes 177, 179 and 180 and escapes through the bell mouth 181. The propeller 31 in rotating past the mouth of the bell-mouthed portion 181 exerts a suction upon the interior of the bell mouth 181 which aids in drawing the water through the water circulating system. Furthermore, in view of the fact that the bell mouth 181 is used, the movement of the same through the water because of such movement causes a suction to build up back of the bell mouth 181 which further aids to accelerate the water circulation through the water jackets 175. By the use of this system a very efficient and reliable cooling system is provided in which no moving parts whatsoever are necessary and therefore no parts of it require servicing in operation.

The insertable sections 89, which are adapted to be placed between the housing sections 27 and 28 when a longer housing is desired, is provided with a pair of tubes 182 and 183 which extend between the flanges 80 and 81 and open on the upper and lower face thereof respectively in alignment with the tubes 172 and 179 and 171 and 180 respectively, so that when such section is interposed between the sections 27 and 28, the circulation of water is not affected in any respect whatever.

The assembly is, of course, provided with the usual steering handle 184 for the purpose of turning the same about the axes of the drive shafts so as to utilize the thrust of the propeller as a rudder as in conventional constructions. The crank shaft 97 is provided with the usual fly wheel 188 in which a magneto (not shown) may be built and which may be provided with a control handle 185, or other ignition means for the engine may be employed if desired. A fuel tank 186 suitably supported on the engine is, of course, provided for furnishing fuel to the carbureter 94, and other necessary parts are provided as in conventional constructions.

The tubular portion 34 is preferably formed by casting a copper or other metal tube into the housing 28. By this means the portion or tube 28 acts as a support for the core during the casting operation and permits me to provide the solid end walls 32 and 33 with consequent greater relative structural strength, and blocks off the interior of the housing from possible filling with water. Another advantage of forming the portion 34 as a tube cast in place is that during machining of the housing 28 centers may be inserted in the ends of the tube to properly and quickly locate the work for machining. Furthermore, the only machining of the bore of the housing 28 is that necessary to receive the bearings 36 and 36'.

While I show a propeller 30 forwardly of the housing 28 and another 31 rearwardly of the housing 28, it will be apparent that either one or the other may be dispensed with and but a single propeller used. In such a case I prefer to employ the front propeller 30 only as such propeller works in smooth and unbroken water and is therefore enabled to work more efficiently. Where only the rear propeller is employed it works in the water that has been disturbed by the lower end of the housing 28 and in such case it is preferable to provide the decavitating plate 189 to prevent air from being drawn down into the propeller. Where either of the propellers 30 and 31 are not employed, the cap 60 or 71, as the case may be, may be replaced by another cap (not shown) which is lengthened an amount equal to the thickness of the hub of the corresponding propeller and which may be secured in any suitable manner such as screwing it on to the corresponding end of the propeller shaft 44. Where

both propellers are employed as shown, the rear propeller 31 preferably has a greater pitch than the forward propeller 30 so that both propellers will exert substantially the same thrust on the water. The increase in pitch of the rear propeller 31 over the front propeller 30 is preferably an amount equal to the slip of the forward propeller 30 so that, in effect, both propellers have the same effective pitch relative to the water upon which they act.

Although I show but one form of the various phases of the present invention, it will be apparent that they are capable of various modifications and changes apparent to the ordinary workman in order to suit various uses of the same and adapt them to particular constructions, and formal changes may be made in the specific embodiment of the invention described without departing from the spirit or substance of the broad invention, the scope of which is commensurate with the appended claims.

What I claim is:

1. In an outboard motor, in combination, a housing enclosing a vertically disposed power shaft, said housing being rotatable about a vertically disposed line, a horizontally disposed propeller shaft disposed at the lower end of said propeller shaft and operatively connected thereto for driving movement therefrom, said propeller shaft projecting both forwardly and rearwardly from said housing, a propeller secured to said propeller shaft forwardly of said housing, and a propeller secured to said propeller shaft rearwardly of said housing, the last mentioned propeller having a greater pitch than the first mentioned propeller.

2. In an outboard motor, in combination, a housing enclosing a vertically disposed power shaft, a horizontally disposed propeller shaft disposed at the lower end of said propeller shaft and operatively connected thereto for driving movement therefrom, said propeller shaft projecting both forwardly and rearwardly from said housing, a propeller secured to said propeller shaft forwardly of said housing, and a propeller secured to said propeller shaft rearwardly of said housing, the pitch of the last mentioned propeller exceeding the pitch of the first mentioned propeller an amount corresponding to the normal loss of effective pitch which said last mentioned propeller is subjected to due to travelling in the slip stream of said first mentioned propeller.

3. In combination with an outboard motor, a drive shaft housing including a pair of separable housing sections normally directly connected together, each of said housing sections being provided with a separate drive shaft section, said drive shaft sections being formed to relatively non-rotatably engage each other when said housing sections are secured together, water passages in said housing sections co-operatively positioned with respect to each other when said housing sections are secured together, and an extension section for said drive shaft section comprising a housing section provided with a drive shaft section and water passages and adapted to be inserted between said housing sections upon separation of the latter with its said drive shaft section connecting the first mentioned drive shaft sections and its water passages connecting the first mentioned water passages.

4. In an outboard motor, in combination a vertically disposed drive shaft housing terminating at its lower end in a propeller shaft housing, an engine provided with a water jacket at the upper end of said housing, said propeller shaft housing being provided with an opening on the side thereof at the point of maximum width thereof, a water passage connecting said opening with said water jacket, and an outlet for said jacket.

5. In combination with an outboard motor, a vertically disposed housing provided with an opening in the side thereof below the normal water line thereon and proximate to the point of maximum width thereof, an engine at the upper end of said housing provided with a water jacket, a forwardly opening scoop over said opening, a passage connecting said scoop and said water jacket, and an outlet for said water jacket.

6. In an outboard motor, in combination, a vertically disposed housing provided with an engine at the upper end thereof and a propeller at the lower end thereof, a water jacket for said engine, means for introducing water into said jacket, a bell mouth on said housing below the normal water lever thereon and of greater width than that portion of the housing nearest said bell mouth, said bell mouth opening rearwardly adjacent the path of travel of the forward edges of the blades of said propeller, and a water passage connecting said bell mouth and said water jacket.

7. In an outboard motor, in combination, a vertically disposed drive shaft housing, a propeller shaft housing secured to the lower end thereof, a drive shaft in said drive shaft housing, a propeller shaft in said propeller shaft housing, means connecting said drive shaft and said propeller shaft for simultaneous movement, said propeller shaft projecting out of said propeller shaft housing, a propeller rotatably mounted on said shaft, a plurality of pins secured to the hub of said propeller and projecting therefrom in spaced but parallel relation with respect to said propeller shaft, a plurality of discs slidably encircling said propeller shaft, said discs being provided with notches in the periphery thereof in which said pins are

received, a plurality of other discs slidably encircling said propeller shaft, one of the last mentioned discs being positioned between each pair of the first mentioned discs, and spring means acting in the direction of propeller thrust constantly urging all of said discs into contact with each other.

8. In an outboard motor, in combination, a hollow drive shaft housing comprising an upper and a lower portion rigidly secured together, said lower portion being provided at its lower end with a propeller shaft housing rigidly secured thereto, a wall separating the interiors of said lower portion and said propeller shaft housing, and a wall separating the interiors of said upper and lower portions.

9. In an outboard motor, in combination, a hollow drive shaft housing comprising an upper and a lower portion rigidly secured together, said lower portion being provided at its lower end with a propeller shaft housing rigidly secured thereto, a wall sealing the interior of said propeller shaft housing from the interior of said lower portion, and a wall sealing the interior of said lower portion from the interior of said upper portion.

10. In an outboard motor, in combination, a hollow drive shaft housing comprising an upper and a lower portion rigidly secured together, said lower portion being provided at its lower end with a propeller shaft housing rigidly secured thereto, a wall sealing the interior of said propeller shaft housing from the interior of said lower portion, a wall sealing the interior of said lower portion from the interior of said upper portion, a drive shaft extending between said walls, and an auxiliary housing extending between said walls about said drive shaft.

11. A spacer device for insertion between the separable drive housing and gear housing of an outboard motor comprising an exterior portion to conform to the complementary surfaces of said housings and means within said exterior portion to engage the complementary ends of the drive shaft within said housings.

12. In combination with an outboard motor, including a drive shaft housing and a gearing housing and a drive shaft interposed between the prime mover and the gearing, said drive shaft housing, gearing housing, and drive shaft and gearing, including separable connector means, of spacer members, between said housings, the drive shaft and gearing having complemental engaging connections, whereby the relative position of the propeller of the outboard motor may be deepened.

13. In combination with an outboard motor, including a prime mover, a drive shaft housing, and gearing housing, for driving a propeller, the entire assembly being arranged to resist the thrust of the propeller, separable sliding drive shaft connection between said prime mover and gearing of a spacer for said housings, intermediate connector means between the drive shaft and gearing, having complemental sliding engagement, a thrust bearing carried by said spacer for said intermediate connector, whereby the propeller may be deepened and the entire assembly combined into an independent unitary structure.

14. In combination with an outboard motor, comprising a prime mover, propeller gearing, a drive shaft between said prime mover and propeller gearing, a housing for said drive shaft, a housing for said propeller gearing, including separable connecting means, but serving to provide a unitary structure, of means for deepening the depth of the propeller, comprising an intermediate spacer for said housings, having complemental engaging portions with said drive shaft housing and gearing housing, and an intermediate connector between said drive shaft and gearing having bearing in said spacer member.

15. In combination with an outboard motor, comprising a prime mover and propeller gearing, a drive shaft between said prime mover and propeller gearing, a housing for said drive shaft, a housing for said propeller gearing, including separable connecting means, but serving to provide a unitary structure, of means for deepening the depth of the propeller, comprising an intermediate spacer for said housings, having complemental engaging portions with said drive shaft housing, and gearing housing, and an intermediate connector between said drive shaft and gearing, having bearing in said spacer member and a thrust bearing carried by said spacer for said intermediate connector.

16. A spacer device for an outboard motor, adapted to be attached to complemental connecting portions of the drive shaft and gearing housing, including an end thrust bearing for a connector between the drive shaft and gearing of said motor.

JAMES H. PIERCE.