This invention relates to an outboard type of marine drive for an inboard engine in a boat. This application is a continuation-in-part of my co-pending application, Serial No. 741,486, filed June 12, 1958, now abandoned.

There are various advantages and disadvantages to both outboard and inboard engines in small boats. Outboard engines overcome the major disadvantages of inboard engines, but, in turn, have numerous disadvantages themselves. The principal objections to an inboard engine are less maneuverability, the necessity for a central location in the boat, the inclination of the engine for alignment with the propeller shaft, the vulnerability of the propeller to underwater obstructions and in beaching the boat, and the difficulties of loading and hauling such a craft on an automobile trailer for highway transportation. For efficient propulsion an inboard engine ordinarily requires the propeller shaft, propeller and rudder to project permanently beneath the bottom of the boat. In such position the propeller shaft, as well as the propeller, is subject to frequent damage entailing costly repair work. Also, in fishing operations special guard devices, which impair the performance of the boat, must be employed to prevent entanglement with the fish lines and nets.

These disadvantages are all overcome by an outboard engine, but an outboard engine of appreciable horsepower constitutes an investment equal to that of an equivalent inboard engine and is less secure and trustworthy. While small outboard engines have the advantage of convenient portability and return for repair and service, they offer no motor boat as such and their theoretical portability is of even less advantage as a convenience under the present practice of installing them in tandem to develop even greater power output. Also, it is not economical from the standpoint of fuel consumption or service expense to operate and maintain two outboard engines in place of a single more efficient inboard engine.

It is, therefore, the general object of the present invention to provide a new and improved marine drive arrangement for an inboard engine which will overcome the objections and disadvantages of conventional drive arrangements.

More specific objects of the invention are to provide an outboard drive and transmission for an inboard engine, to provide an outboard drive having twin screws, to provide an outboard drive which steers and handles like an outboard engine and in which the propeller torque reaction on the steering mechanism is neutralized, to provide a propeller mounting which will kick up to the rear automatically without damage when an underwater obstruction is encountered and which may be lifted intentionally for beaching the boat, mounting the boat on a trailer, or for any other purpose and to provide a pair of propeller mountings which will kick up individually, either automatically upon encountering an obstruction or under the control of the operator.

In general, the present invention involves a transmission unit adapted to be mounted on the transom of a boat with the same position as the inboard motor but arranged for connection with a horizontal drive shaft projecting through the transom. The transmission incldes a pair of vertical housings for twin screws which rotate in opposite directions to neutralize the torque reaction in steering. In order to obtain the advantages of an outboard motor, the vertical housings are mounted to swing about a horizontal axis in order to kick up to the rear in passing over a submerged log and the like, and for convenience in beaching and trailering the boat. The rear kick-up is also of convenience in repairing or replacing a propeller while afloat and in disentangling fish lines or nets. The two housings also turn about their individual vertical axes for steering, whereby the steering effort is obtained, not only by rudder action, but also by changing the direction of thrust of the twin screws.

The invention will be better understood and the foregoing and other objects and advantages will become apparent as the description proceeds in connection with the particular embodiments shown in the accompanying drawings. It is to be understood, however, that the drawings are merely illustrative of the principles of the invention and are not to be considered as limiting the invention. Various changes may be made in the details of construction and arrangement of parts and certain features may be used without others, all such modifications within the scope of the appended claim being included in the invention.

In the drawings:

FIGURE 1 is a perspective view of a drive unit embodying the principles of the invention mounted on a boat;

FIGURE 2 is a side elevation view of the device of FIGURE 1 illustrating the kick-up feature;

FIGURE 3 is a top plan view of the transmission shown in FIGURE 1;

FIGURE 4 is an exploded view showing the pivotal housing removed from the stationary housing of the transmission;

FIGURE 5 is a perspective view of the drive shafting;

FIGURE 6 is a fragmentary sectional view taken on a transverse plane through the transmission;

FIGURE 7 is a vertical sectional view through one of the vertical housings;

FIGURE 8 is an enlarged fragmentary side elevation view showing an adjustable stop for positioning the vertical legs;

FIGURE 9 is a top plan view of a second embodiment of drive unit having provision for individual kick-up of the two vertical propeller drive housings;

FIGURE 10 is a fragmentary side elevation view taken on the line 10—10 of FIGURE 9;

FIGURE 11 is a fragmentary vertical sectional view taken on the line 11—11 of FIGURE 9 showing the joint construction for kick-up of one of the vertical propeller drive housings;

FIGURE 12 is a fragmentary sectional view at a lower level in the plane of section line 11—11 in FIGURE 9 showing the swivel steering joint for one of the vertical propeller drive housings;

FIGURE 13 is a view showing the piston construction in one of the hydraulic lift units for raising a propeller out of the water; and

FIGURE 14 is a schematic hydraulic diagram for the hydraulic lift units.

Embodiment shown in Figures 1 to 8

FIGURES 1 and 3 illustrate the slight adaptation necessary in a conventional boat to receive the present transmission and drive arrangement. The boat 10 has a transom 11 which needs to be altered only to the extent of making an opening 12 for the drive shaft and a pair of openings 13 for the steering ropes 14 and 15. It is to be understood, however, that other conventional steer-
ing mechanisms, such as gearing, rods or push-pull cables, may also be used.

In general, the present transmission comprises three principal parts. These parts are stationary housing A which is mounted rigidly on the transom, a transverse C-shaped housing B which is pivotally mounted on the housing A to swing about a horizontal axis, and a pair of vertical housings C which pivot on their own axes relative to housing B. The housings C normally extend vertically downward and carry the counter-rotating twin screws 16 and 17.

Housing A is open on its forward side and equipped with an internal flange which is secured to the transom 11 about the margin of opening 12 by means of bolts 18, as shown in FIGURE 3. The opening 12 is aligned with a longitudinal drive shaft 20 from the engine. This drive shaft may be horizontal and well above the bottom of the boat, thereby allowing the engine to be mounted in level position and in the stern of the boat, if desired.

Extending through the stationary housing A is a transverse horizontal shaft 21 which carries at its central portion forward and reverse bevel gears 22 and 23. These gears are preferably mounted for rotation on shaft 21, and are engaged with a driving pinion 24 on a longitudinal horizontal stub shaft 25. The shafts 20 and 25 are connected together by a universal joint 26 or other suitable flexible coupling. The numeral 27 designates a conventional form of oil pump mounted concentrically on shaft 25 for a purpose to be presently described.

The gears 22 and 23 have internally splined end sockets 30 to receive externally splined sliding clutch collars 31. The collars 31 are also internally splined to prevent a rotation on shaft 21 whereby either one of the gears 22 and 23 may be connected with shaft 21 by sliding one of the collars 31 into the gear socket 30. The collars 31 are shifted on shaft 21 by a pair of shifting forks 32 rigidly mounted on a shifting rod 33. The shifting forks 32 are so spaced on rod 33 as to provide a neutral position in which both collars 31 are withdrawn from their gear sockets 30, allowing both gears 22 and 23 to turn idly on shaft 21 without driving the latter, as shown in FIGURE 6.

Shifting rod 33 is mounted for longitudinal sliding movement in a pair of aligned bores 34 and 35 in the housing A. When shifting rod 33 is moved to the right in FIGURE 6, the left collar 31 enters the gear 22 to key this gear to shaft 21 for forward drive, the reverse gear 23 then turning idly on shaft 21 in the reverse direction. When shift rod 35 is moved to the left, the right collar 31 is moved into its socket in reverse gear 23 to connect this gear with shaft 21 and allow the forward gear 23 to turn idly. Preferably, the collars and gears are also equipped with friction clutch devices as commonly used in gear transmissions to facilitate engagement of the splined members. Conventional hydraulic clutches may also be used to lock one or the other of the gears 22, 23 to shaft 21.

Movement of shift rod 33 to reverse position, as just described, extends the left end of this rod into a bore 36 in the housing B to lock the two housings A and B together for a purpose to be presently explained. The shift rod 33 may be moved idly by suitable means, such as an arm 37 connected with another slidable rod 38 having an exposed end which may be connected with a manual shift lever or the like.

Referring now to FIGURE 5, the transverse shaft 21 is equipped at its ends with bevel gears 41 which mesh with bevel gears 42 on vertical shafts 43 and 44. The lower ends of vertical shafts 43 and 44 carry bevel gears 45 which mesh with bevel gears 46 on the two propeller shafts 47.

Referring again to FIGURE 6, each upstanding end or lobe 48 of the housing B is equipped with a tubular sleeve 50 containing a bearing for the shaft 21. The external surface of sleeve 50 serves as a bearing for the housing B in an opening 51 in an end wall 52 of the housing A, whereby the housing B may rotate relative to the housing A on the axis of shaft 21, as shown in FIGURE 5. The housing B has inner end walls 53 equipped with O-ring seals, or the like, 54 which are engageable with the confronting walls 52 to prevent water from entering the rotating joints between the housings A and B. Housing B is equipped with gasketed removable end caps 55 to provide necessary access for assembling and disassembling. The housing B comprises a bottom horizontal portion 49, or bridge, beneath the housing A and two upstanding end lobes 48 integral with bridge 49 confronting opposite sides of housing A, only one end of housing B being shown in FIGURE 6.

Each vertical housing C is rotatorily mounted on one end of the housing B, as shown in FIGURE 7. Each lobe 48 of housing B contains a vertical flanged sleeve 60 which extends across the joint at 61 between the two housings and provides a bearing for rotation of one of the housings C about the axis of shaft 44, the sleeve 60 being concentric with this shaft. The two housings may be held in assembled position by the housings C secured in the end of sleeve 60 which projects from housing B. A sealing ring 63 prevents water from entering the joint 61 between the two housings. The foregoing details of the bearings and rotatable housing connections and seals may take various forms as will be appreciated by persons skilled in the art, the present embodiment being merely illustrative in regard to these details. In FIGURE 7 certain bearings and other details are omitted in order to show more clearly the novel features described.

The vertical housings C are equipped with hollow rudder fins 64 and rearwardly extending lugs 65 which are pivotally interconnected by a transverse tie rod 66 so that they will turn in unison for steering. Each housing C is also equipped with a steering arm 70 having an upper end 71 connected by a clevis with one of the steering ropes 14, 15. If a push-pull steering link is used, only one of the housings C need be equipped with an arm 70. The ends 71 of the steering arms 70 are located on the axis of shaft 21, or, at least, in such position relative to this axis that they will not obstruct the steering ropes when the housings are shifted to the rear as shown in FIGURE 2. The steering ropes may be equipped with suitable shock take-up and tensioning pulleys, if necessary.

Either manual or power operated means may be employed for intentionally raising the propellers, as shown in FIGURE 2. In the present embodiment, this lifting means comprises an hydraulic cylinder and piston unit 75 connected by flexible conduits 76 with the oil pump 27 and a suitable control valve, not shown. The piston rod of unit 75 is pivotally connected with an ear 77 on housing B, and the cylinder is pivotally connected with a bracket 78 on housing A.

Suitable means is provided to permit kick-up when an underwater obstruction is encountered while under way. For this purpose the piston of unit 75 may be equipped with a simple cup leather, or else a port and check valve, not shown, permitting relatively free upward movement of the piston rod when the cylinder is full of oil. After such an upward movement, either by power operation or by encountering an underwater obstruction, the piston will remain at the upper end of the cylinder by the check valve action of the cup leather on the piston, or a check valve in the piston, until the control valve is manipulated in its lower port and the oil is forced from the cylinder and relieve hydraulic fluid from the lower end of the cylinder. The cup leather or check valve will hold sufficient pressure for the down stroke because the weight of housings C will assist in returning these housings back to vertical position.

Suitable stop means is provided on the lower portion
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of housing A to limit the clockwise rotation of housing B in FIGURE 2 during forward drive. This stop is preferably made adjustable to compensate for different vertical angles of the transom, and also to make it possible to directly the propeller thrust either slightly above or slightly below a horizontal plane, depending upon the trim of the boat. In FIGURE 2, a lug 30 on the under side of housing A is equipped with a stop screw 31 to position the housing B. A rubber pad 32 on one of these parts provides a cushion between the metal surfaces.

Hydraulic lift unit 75 may advantageously incorporate a shock absorber action at both limits of its piston rod movement making stop 81 unnecessary. In such arrangement unit 75 in its full extended position would determine the driving position of housing B and assume the forward driving thrust force of the propellers.

When the transmission is put in reverse, shift rod 33 enters the bore 36 in housing B to lock this housing in drive position, with housings C extending vertically downward, and prevent kick-up, as shown in FIGURE 2, from reverse propeller thrust.

The gears are equipped with a lubrication system, not shown, operated by oil pump 27 which circulates the oil through the hollow lower ends of the housings C for cooling. The hydraulic lift unit 75 is operated by the lubricating oil.

By employing counter-rotating twin screws, the propeller torque in the two vertical shafts 43 and 44 is neutralized so that the same effort is required to steer in either direction and no effort is required to hold a straight-ahead course. Other advantages of the twin screw drive and steerable propellers are reduced draft and maneuverability superior to mere rudder action. Transmission noise and vibration are placed outside the boat and may be insulated from the boat by providing a cushion mounting pad between housing A and the transom.

The present transmission, being separate and apart from the engine, is suited to various makes and models of engines, particularly non-marine types which are ordinarily difficult to install in a boat. The drive arrangement permits great latitude in the positioning of the engine in the boat and is particularly adapted for the mounting of a set of over the stern. It also permits the use of an engine having an attached transmission unit containing clutch and reverse gear. In such case the reverse gear 23 and its clutch may be omitted and the forward gear 22 may be keyed permanently to shaft 21.

Modification in FIGURES 9 to 14

FIGURES 9-14 illustrate a modification in which the two vertical housings may kick up individually in case only one of these housings should encounter an underwater obstruction and in which the housings and their propellers may be raised individually in case of damage or entanglement. In case of damage to one propeller, that propeller may be raised out of the water to avoid drag and the boat may proceed by the propulsion effort of the other propeller.

In this modification a stationary housing D is mounted on the rear of the transom 11 as described in connection with the housing A in FIGURE 3. The transmission, gearing and shafting are arranged the same as described in connection with FIGURE 5. However, instead of the single C-shaped housing B of the first embodiment, there are in the modification in FIGURES 9-14 a pair of end housings 101 rotatable on opposite sides of stationary housing D at the joints 100 in FIGURES 9 and 11. The housings E are connected with housing D for rotation about the horizontal axis of shaft 21. The vertical housings F are rotatable with respect to housings E at joints 101, as shown in FIGURES 10 and 12 for steering the housings F being rotatable about the axes of the vertical shafts 43, 44.

Each vertical housing F is equipped with a steering arm 70 which has a pivot connection 71 on or adjacent the axis of shaft 21 with a link 102 extending forwardly through transom opening 13. This opening is preferably closed with a flexible boot 104 to keep out water. The forward ends of links 102 are pivotally connected at 103 with the opposite ends of a rudder bar 105. The pivot connections at 71 and 103 are preferably ball joint connections to permit universal movement.

A steering lever 105 is pivotally mounted at 106 on a bracket 107 on the inside of the transom 11 just below shaft 21. The opening 12 in the transom for shaft 25 does not appear in the plane of the offset section in FIGURE 9. Steering lever 105 has a bell crank arm 106 attached thereto, and is equipped with a ball stud for pivota connection with a push-pull steering rod 109. The steering lever is also equipped with either holes or studs 110 for alternative rope steering means.

Referring now to FIGURE 11, the kick-up joints 100 are defined by the annular end walls 115 on opposite ends of housing D and corresponding annular end walls 116 on each housing E. End walls 115 have re-entrant cylindrical bearing portions 117 concentric with shaft 21 receiving tubular journal portions 118 on the end walls 116. The end of each journal portion 118 is externally threaded at 119 to receive a nut 120 which is locked to the journal portion by a suitable retainer or locking device 121. An annular seal 54 is connected with shaft 21 prevents water from entering the joint 100.

The ends of shaft 21 are supported by the gear 41 in bearings 122. These gears and bearings are supported and adjusted axially of shaft 21 by bearing rings 123 in the joint 115 having threaded ends receiving adjusting nuts 124. The threaded portions of bearings rings 123 also engage threaded portions 125 in journals 118 whereby the axial adjustment of each bearing ring 123 is maintained by a nut lock or retainer 126 when the nut 124 is tightened against end wall 116.

A somewhat similar assembly arrangement is employed in the steering joints 101, as shown in FIGURE 12. The upper end of shaft 44 is supported in gear 42 which is carried by a bearing assembly 130. Bearing assembly 130 is supported and adjusted vertically by a sleeve 131 having a threaded upper end 132 screwed into a threaded portion of a journal sleeve 133 depending from an end wall 134 on the housing E. The threaded adjustment of sleeve 131 in sleeve 133 is secured by a setscrew 135.

Sleeve 131 carries a lower bearing assembly 136 for the vertical housing F, the lower end of the sleeve being threaded to receive a bearing retainer nut 137. Thus, sleeve 131 becomes an integral part of housing E with shaft 44 rotating within this sleeve and vertical housing F rotating around this sleeve and also around journal sleeve 133 for steering purposes. Water is kept out of joints 101 by annular seals 63.

A detail of the hydraulic lift unit 75 is shown in FIGURE 13. The cylinder of the lift unit contains a piston formed by a flexible cup washer 140 clamped between a pair of rigid washers 141 on the end of piston rod 142. The cylinders are always full of oil on both sides of the piston. When one of the vertical housings F strikes an underwater obstruction and is pushed rearwardly and upwardly as shown in FIGURE 2, the housing E rotates in joint 100, pushing piston rod 142 forwardly in the cylinder. Flexible cup washer 140 acts as a check valve permitting the piston to move forwardly in the cylinder without displacing oil but preventing its reverse movement. The two cylinders 75 are pivotally connected to brackets 78 on a portion of stationary housing D and the two piston rods 142 are connected to ears 77 on the two end housings E, E.

A simple hydraulic system for operating the lift units 75 is shown in FIGURE 14 although it is to be understood that other circuit and valve arrangements may be employed. The opposite ends of each cylinder 75 have flexible hose connections 150 and 151 with a valve unit.
Also connected with each valve unit 152 is a pressure line 153 from pump 27 and a relief line 154 to an oil reservoir 155. The circuit is completed by a suction line 156 from the reservoir back to the pump. A slideable, balanced spool valve member 160 in each of the valve units 152 directs fluid pressure from pump 27 either through pipe 151 to raise the propeller or through pipe 150 to lower the propeller, the other pipe in each case being connected by the spool valve member with relief line 154. Obviously, the two valve units 152 may be combined into one unit having a single manual operator movable to different positions for raising and lowering the propellers individually or in unison.

In practice, the reservoir 155 need not be a separate tank as indicated in the diagram but may comprise the hollow legs of vertical housings F, which is desirable for cooling the oil since the same oil is used for lubricating the transmission gears and bearings by a lubrication system, not shown.

The modification in FIGURES 9-14 also includes a suitable double lock device, not specifically illustrated, operating on the same principle as the single lock device shown, for example, at 35 in FIGURE 6 for locking both housings E against rearward kick-up rotation during reverse drive. Forward rotation of the housings E and F in forward drive may be prevented by stop screws 81 in lugs 89 on opposite sides of housing D, which screws are engageable with pads 82 on housing E as shown in FIGURE 10, or this function may be accomplished by the lift units 75, the piston rods 142 at the limit of their extension from their cylinders determining the positions of vertical housings F when the housings are subject to propeller thrust.

Having now described my invention and in what manner the same may be used, what I claim as new and desire to protect by Letters Patent is:

An outboard drive on the transom of a boat comprising a stationary housing mounted on the outside of said transom, a pair of end housings mounted on opposite sides of said stationary housing for individual pivotal movement about a transverse horizontal axis, a pair of vertical propeller drive shaft housings mounted for rotation about their respective axes on said end housings, steering arms on said vertical housings, steering connections on said steering arms located on said transverse axis, a pair of hydraulic lift units connected between said stationary housing and said end housings, respectively, a steering lever pivotally mounted inside of said transom, links connecting said steering lever with said steering connections on said steering arms, and steering means connected with said steering lever.

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