INBOARD-OUTBOARD MARINE DRIVE

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ABSTRACT

An inboard-outboard marine drive unit for boats wherein an outboard power leg is carried by an inverted yoke having a pair of downwardly extending, laterally spaced yoke arms receiving the power leg therebetween and a generally upwardly extending center post, the post being connected to the boat inboard of the stern transom. The inverted yoke is "steerable" in that steering of the power leg is accompanied by rotation of the yoke on its upwardly extending center post. Raising and lowering of the outboard power leg for trimming, tilting and kick-up is by rotation of the power leg about a generally horizontal axis extending between the spaced yoke arms.

11 Claims, 7 Drawing Figures
INBOARD-OUTBOARD MARINE DRIVE

BACKGROUND OF THE INVENTION

This invention relates to inboard-outboard marine drive units for watercraft, particularly boats, wherein an inboard engine has a rearwardly extending drive shaft coupled through universal joints to power transmission means in an outboard power leg to thereby drive a propeller carried at the lower end of the leg. The outboard power leg is aft of the stern and is mounted for pivoting on two mutually generally perpendicular axes. It is therefore free to swing laterally for steering the boat while also being free to swing vertically such that the lower end thereof may move rearwardly and upwardly in a tilting, trimming and/or kick-up motion relative to the steering of the boat in order to adjust the position of the power leg relative to the boat.

A main feature of the invention comprises the use of an inverted or downwardly disposed yoke member having an upwardly extending center post and downwardly extending laterally spaced yoke arms. The outboard power leg is carried on a generally horizontal axis by the yoke arms whereas the yoke and outboard power leg together are connected to the boat by the upwardly extending center post. The post provides a generally vertical axis for steering and is inside the boat where it is not exposed to water. Other features of the invention will become apparent below.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a partially broken away and partially sectioned port elevation of a boat with an inboard-outboard drive unit embodying the invention;

FIG. 2 is an enlarged view of part of the port elevation of FIG. 1 primarily in section shown, among other features, the steerable inverted yoke and the double universal joints interconnecting the drive means between the engine and the outboard power leg; the upper portion of the outboard power leg is shown in a raised position in phantom lines.

FIG. 3 is a fragmentary view of the exhaust outlet for the unit taken in the direction of arrow 3 in FIG. 1.

FIG. 4 is a fragmentary sectional view along lines 4-4 of FIG. 3.

FIG. 5 is an elevation showing the inverted yoke member by which the outboard power leg is supported and connected to the boat;

FIG. 6 is a perspective stern view showing the boat and outboard power leg of FIGS. 1 and 2, and

FIG. 7 is an enlarged view partially in cross section, taken generally along line 7-7 of FIG. 2, showing the pivoted connector attaching the forward ends of the hydraulic cylinders to the boat and showing in phantom the variable positions of the hydraulic cylinders when the outboard power leg is turned laterally to port and starboard for steering the boat.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing Figures, the inboard-outboard unit includes outboard power leg 10 carried aft of stern transom 12 on a partially shown boat or other watercraft 14. Outboard power leg 10 includes a propeller 16 carried by a horizontal propeller shaft 18 which is driven by power transmission means including vertical drive shaft 20 through a pair of bevel gears generally indicated at 22 to propel the boat forward.

Vertical drive shaft 20 is supported within outboard power leg housing 24 and is in turn driven by engine 26 mounted inboard of boat 14 through a horizontal drive shaft means 28 which extends rearwardly from the engine through a transom opening 30 and into a forwardly extending bell-shaped portion 32 of housing 24. Intermediate its length horizontal drive shaft means 28 is provided with a double universal joint generally indicated at 34 in FIG. 2. Double universal joint 34 has its center substantially at the intersection of a steering axis and a tilt axis of outboard power leg 10. These axes are described further hereinafter.

The drive connection between the horizontal drive shaft means 28 and vertical drive shaft 20 includes a pair of horizontal spaced beveled gears 36 and 38, one of which is a forward gear, the other being a reverse gear. Both are supported for rotation within suitable bearings on the upper end of shaft 20. A drive gear 40 carried on horizontal drive shaft means 28 drivingly engages gears 36 and 38 and causes the latter to rotate in opposed directions in the well-known manner. A clutch element, generally indicated at 42, is disposed between beveled gears 36 and 38 and is carried by shaft 20 and slideable axially thereon to selectively engage gears 36 and 38 to complete the drive connection between horizontal drive shaft means 28 and vertical drive shaft 20 to thereby drive propeller 16 in the desired direction.

Clutch element 42 also has an intermediate "neutral" position between gears 36 and 38 in which position propeller 16 is rendered inoperative. Axial movement of clutch element 42 relative to shaft 20 is effected by projecting member 44 which may be actuated by means not shown, but typically a remote control arrangement in boat 14 as is known in this art. The particular drive connection and clutch arrangement described may be varied as its specific design is not critical to the invention.

The mounting means for outboard power leg 10, associated with the boat between the engine and outboard power leg comprises a one-piece casting 46 although it may comprise inner and outer separate pieces positioned on each side of transom 12 and bolted or otherwise fastened together. Mounting means 46 includes an outer peripheral flange portion 48 which fits sealingly (seal 49) around transom opening 30 and may be fastened to transom 12 by a series of bolts as shown in FIG. 6. Mounting means 46 extends through transom opening 30 and terminates interiorly of boat 14 and transom 12 in an upper rigid mounting portion 50. The lower inner portion of mounting means 46 may include a lower mounting portion 52 for exhaust connection purposes. Mounting means 46 will preferably be shaped to include a hollow or indented area 54 (best shown in FIGS. 2 and 6) in the upper portion 56 of house 24 when the outboard power leg 10 is raised. Such an arrangement also provides clearance for steering in the raised position. Mounting means 46 may also carry a shaft support structure and seal arrangement generally indicated at 58 for supporting horizontal drive shaft means 28 in opening 30 of transom 12. An annular flexible bellows 60 is disposed about double universal joints 34 and has its ends secured forwardly to support structure 58 and rearwardly to housing portion 32 as shown in FIG. 2. Exhaust receiving means 62 is fitted to lower mounting portion 52 for receiving ex-
haust gases from engine 26, the interconnection there-
between not being shown for the sake of simplicity. Such
arrangements are well known. A flexible conduit
member 64 interconnects fittings 62 and housing 24 of
outboard power leg 10 for conducting engine exhaust
interiorly of housing 24 and out exhaust outlet 66, which is substantially at the water line when the out-
board power leg is in its normal operating position and
the boat is "on plane." The exhaust arrangement for the unit is shown in detail in FIGS. 3 and 4 of the draw-
ing. Exhaust outlet 66 is closed by a flexible flapper
member 67 which is normally closed to prevent the en-
trance of water into the unit. Due to its flexibility, it
opens with exhaust pulses to allow the escape of ex-
haust gases to the water. The unit may also include a
trim tab 69 for off setting torque reaction and reducing
steering effort.

The upper rigid mounting portion 50 of mounting
means 46 pivotally supports an inverted yoke member
68 on a generally vertical axis to provide for steering
movement of the outboard power leg in a lateral side
to side movement. Yoke member 68, best shown in
FIG. 5, is inverted or downward extending laterally
space yoke arms 72. Yoke member 68 is generally dis-
posed inboard of transom 12 being mounted for rota-
tion in upper rigid mounting position 50 by connection
with upwardly extending center leg 70 and suitable
bearing means and fastening means indicated at 74, 76
and 78 of FIG. 2. The inboard pivotal support of yoke
member 68 in upper mounting portion 50 provides the
reguiste steering axis and steering movement of out-
board power leg 10 which is carried by yoke arms 72
through its connection with housing portion 32 as best
shown in FIG. 6. This connection provides a generally
horizontal axis extending through yoke arms 72 at 80.
Any suitable pivotal connection means may be utilized
to establish the connection between housing portion 32
and yoke arms 72. Carried as described above, it can
be seen that there is provided a steerable yoke member
fitted inboard the boat in a compact manner.

Steering is provided for by means of tiller arm 90
which is connected to the upwardly extending center
post 70 of yoke member 68 such that lateral movement
tiller arm 90 causes yoke member 68 to pivot in
mounting portion 50 thus turning yoke 68 and moving
outboard power leg 10 in a rotary steering movement,
i.e., a lateral side to side movement. Remote control
mechanisms and/or power steering mechanism may be
attached to tiller arm 90 to allow steering to be accom-
plished from other locations in the boat remote from
the tiller arm. Such arrangements are well known in the
art and need not be described herein.

To control and limit the tilt, trim and/or kick-up
movements of the outboard power leg 10, a pair of
extendable/collapsible hydraulic cylinders 82 and 84
are attached to each side respectively of power leg 10
and to boat 14. In its preferred form, cylinders 82 and
84 are pivotally connected to support 86 which is itself
pivoted for turning at 88 on substantially the same axis
as post 70 of yoke member 68. Such an arrangement
provides for the maintenance of the same relative posi-
tion of the hydraulic cylinders 82 and 84 as outboard
power leg 10 is turned through its various steering
movements. As shown in FIG. 7, the hydraulic cylin-
ders can assume varied positions shown in phantom de-
pending on the extent of the steering movement. Thus
there is provided an additional connection between the
outboard power leg and the boat. Such cylinders can be
readily designed to provide for trimming, tilting and/or
kick-up and such design details do not provide any part
of this invention and need not be described herein since
such matters are well known in the art.

Additionally, support 86 may include a pair of spaced
lateral side members 92 and 94 (best seen in FIGS. 1
and 7) for slidably receiving outboard power leg hous-
ing 24 therebetween to provide lateral support therefor
due to side loading of the unit. The extent of the en-
gagement provided by the side members may be varied
by changing their size both overall and length.

What is claimed is:
1. In an inboard-outboard marine drive unit for boats
having an inboard engine connected to an outboard
power leg through drive shaft means and universal joint
means, the improvement comprising a yoke member
having a generally upwardly extending center post di-
drected oppositely from generally downwardly extend-
ing laterally spaced yoke arms, means pivotally mount-
ing the power leg to the yoke arms about an axis to
allow the power leg to be rotated upwardly and rear-
wardly for trimming, tilting and kick-up, and means
pivotally connecting the upwardly extending center
post of the yoke to the boat about an axis to allow the
yoke and power leg to rotate laterally for steering the
boat.
2. The inboard-outboard drive unit according to
claim 1 wherein the yoke member is carried by the boat
so as to position the axis of the post at the horizontal
drive center line inboard of the aft side of the boat stern
transom.
3. The unit according to claim 2 wherein the yoke
member is carried such that the axis through the yoke
arms is also inboard of aft side of the stern transom.
4. The inboard-outboard drive unit according to
claim 1 including means in addition to the yoke mem-
ber for connecting the power leg to the boat below the
universal joint means.
5. The unit according to claim 4 wherein the means
connecting the power leg to the boat includes a lower
support means pivotally attached to the boat for turn-
ning on a steering axis corresponding to that for the out-
board power leg and hydraulic cylinder means extend-
ing between the lower support means and the power leg
for raising and lowering the power leg about the axis
provided at the yoke arm.
6. The unit according to claim 5 wherein the lower
support means further includes a pair of spaced lateral
side members for receiving at least a portion of the
power leg therebetween and providing lateral support
thereeto.
7. In an article of manufacture for use with an in-
board engine and rearwardly extending flexible drive
means in a boat, an outboard power leg including pro-
peller means adapted for connection to the flexible
drive means, a downwardly disposed yoke member po-
tioned forward of the power leg and comprising an
upwardly extending center post and a pair of laterally
spaced yoke arms extending downwardly from the cen-
ter leg for carrying the drive means thereon, first pivot
means mounting the power leg to the yoke arms for
movement of the power leg about a generally horizon-
tal axis, and second pivot means adapted for mounting
the post of the yoke to the boat for lateral steering
movement of the yoke and power leg.
In an inboard-outboard drive in combination with a boat having a transom and an inboard engine with a drive means extending rearwardly from the engine through the transom, an outboard power leg including power transmission means connected to the drive means including a double universal joint interconnecting the engine drive shaft and the power transmission means of the power leg, a propeller at the lower end of the power leg driven by the power transmission means, a mounting member fixedly associated with the boat between the engine and the power leg, an inverted yoke comprising an upwardly extending center post and a pair of downwardly extending laterally spaced arms, means pivotally connecting the center post of the yoke to the mounting member above the working center of the double universal joint, and means pivotally connecting the power leg to the yoke arms for fore and aft swinging of the leg.

9. The combination according to claim 8 including means in addition to the yoke member, for connecting the power leg to the boat.

10. The combination according to claim 8 wherein the center post of the yoke member is received by the mounting member inboard the aft side of the boat transom.

11. The combination according to claim 10 wherein the entire yoke member is positioned inboard of the aft side of the boat transom.