June 4, 1963 J. K. MacLEAN 3,092,186

VARIABLE PITCH PROPELLER MECHANISM

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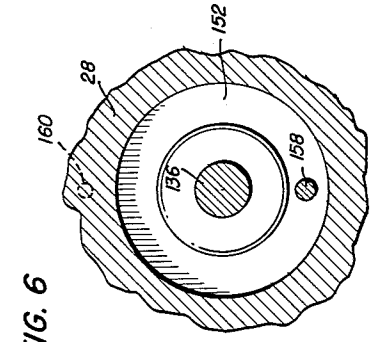


FIG. 6

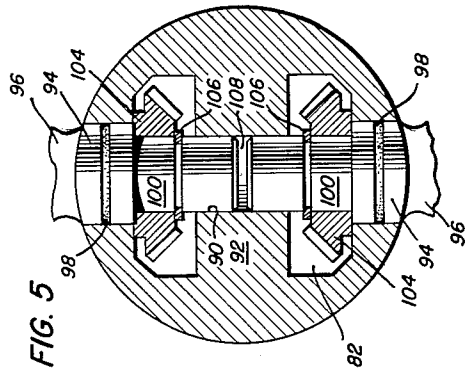


FIG. 5

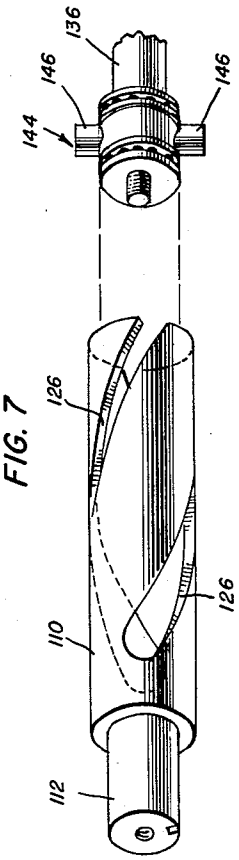


FIG. 7

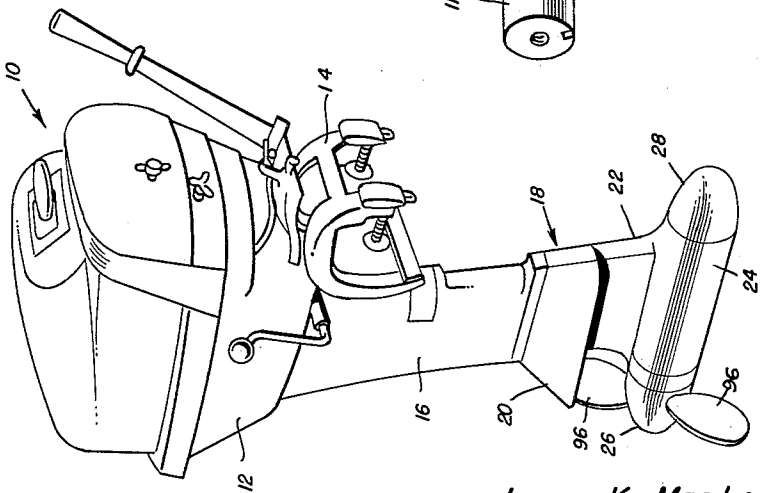


FIG. 1

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VARIABLE PITCH PROPELLER MECHANISM

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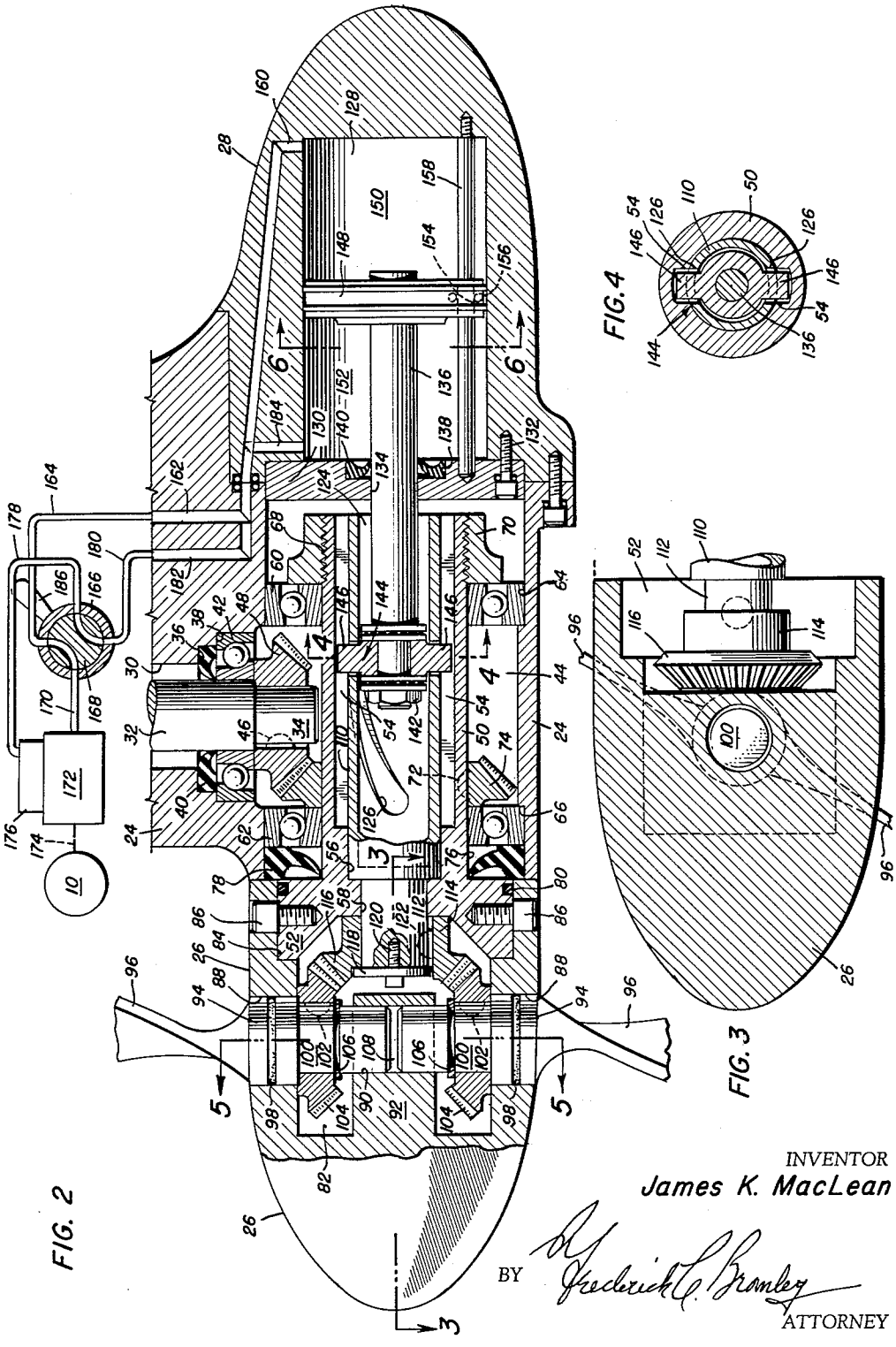


FIG. 2

FIG. 4

FIG. 3

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VARIABLE PITCH PROPELLER MECHANISM

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This invention relates to an improved variable pitch propeller control mechanism, and more particularly to a variable pitch propeller control mechanism especially adapted for use in connection with drive shafts of motor boats.

The use of outboard motors has become quite popular especially in view of the relative expense of this type motor or engine as compared with a "inboard" engine installation. The speeds at which a boat is propelled over the water may vary a considerable degree, for example, when a fisherman is trying to reach a remote fishing area or perhaps when the fisherman is trolling. Most outboard motors are not provided with variable speed transmissions or transmissions which permit the reversing of the motor. It is well known that by varying the pitch or angle of attack of a propeller blade, optimum efficiency can be obtained thereby.

Accordingly, a primary object of the present invention is to provide a variable pitch propeller control mechanism which may be readily incorporated in a propeller drive shaft for the purpose of obtaining satisfactory operation of a boat at low and high speeds with normal operation of the motor, as well as providing means whereby the propeller pitch may be reversed without reversing the direction of rotation of the propeller shaft.

Another object of the invention is to provide a variable pitch propeller control mechanism which may be readily and easily installed to replace a conventional propeller drive shaft without materially increasing the size of the engine.

A still further object of the present invention is to provide a novel variable pitch propeller control mechanism which is sturdy and satisfactory in construction and which requires relatively little maintenance and repair.

Other objects and the nature and advantages of the subject invention will become apparent from the reading of the following description of the preferred embodiment of the invention, the appended claims and accompanying drawings, in which:

In the drawings:

FIGURE 1 is a perspective view of a typical engine in which the variable pitch propeller control mechanism may be incorporated;

FIGURE 2 is an enlarged longitudinal section showing details of the variable pitch propeller control mechanism of the invention in conjunction with a fluid pressure control system shown diagrammatically;

FIGURE 3 is a section taken substantially on the plane of line 3—3 of FIGURE 2;

FIGURE 4 is a section taken substantially on the plane of line 4—4 of FIGURE 2;

FIGURE 5 is a section taken substantially on the plane of line 5—5 of FIGURE 2;

FIGURE 6 is a section taken substantially on the plane of line 6—6 of FIGURE 2; and

FIGURE 7 is an exploded perspective view of the torque shaft and cam portion of the variable pitch propeller control mechanism.

Referring to FIGURE 1, an outboard motor embodying the present invention is indicated generally at 10 and includes a motor casing 12, mounting bracket 14, depending drive shaft casing 16 connected to an underwater unit indicated generally at 18 which includes a spacer 20 and a gear case or housing 22.

The gear housing or casing 22 comprises a central section 24, hub or spinner section 26, and tail section 28.

The central section 24 includes a vertical bore 30 through which the lower end of a power output or drive shaft 32 extends, the shaft 32 terminating in a lower step-down portion 34. Communicating with the bore 30 are stepped shoulder portions 36 and 38 which respectively receive therein a lip seal 40 and bearing assembly 42 which are circumposed about the shaft 32. The bore 30 communicates with a longitudinally extending chamber 44. The lower portion 34 of the drive shaft 32 has keyed thereon, as indicated at 46, a beveled drive pinion gear 48.

Extending axially of the chamber 44 below the terminal end of the drive shaft portion 34 is a hollow drive shaft 50 which terminates in an enlarged annular mounting portion 52 at one end and includes an elongated cylindrical chamber 56 opening at the other end. The chamber 56 communicates with a reduced bore portion 58 extending centrally through the annular mounting portion 52. The shaft 50 has circumposed thereabout bearing assemblies 60 and 62 which are disposed on opposite sides of a bevel drive pinion 48 and respectively engage longitudinally spaced shoulder portions 64 and 66 formed in the chamber 44. The shaft 50 is externally threaded at 68 and receives thereon a thrust nut 70 engaged with the inner race of the bearing assembly 60. The drive shaft 50 has keyed thereon at 72 a driven beveled pinion gear 74 meshingly and drivingly engaged with the beveled driving pinion 48. The driven pinion gear 74 includes a hub portion engaged with the inner race of the bearing assembly 62, the other side of the inner bearing race engaging an annular abutment shoulder formed on the drive shaft 50. A suitable lip seal 78 is circumposed about the shoulder 76 and abuttingly engages one side of the mounting hub 52. The mounting hub 52 has circumposed thereabout in a suitable annular groove an O-ring seal 80 for combining with the lip seal 78 to retain lubricant within the chamber 44.

The spinner or hub 26 projects axially from the mounting portion 52 of the propeller shaft 50 and has formed therein a chamber 82 which communicates with an enlarged diameter portion 84 circumposed about the annular mounting portion 52 of the drive shaft 50, and retained thereon by means of Allen screws 86 or the like. The hub 26 has formed therein diametrically oposed bore portions 88 which are in alignment with a bore portion 90 formed in an axially porjecting portion 92 extending into the chamber 82 on the forward end of the spinner or mounting hub. The bore portions 88 receive therein the lower mounting hub 94 of similarly formed, radially extending propeller blades 96. The mounting hubs 94 of the blades 96 have circumposed thereabout suitable O-ring seals 98 and terminate in reduced diameter stub shaft portions 100. The stub shaft portions 100 have keyed thereon, as indicated at 102, beveled pinion gears 104 and split retaining rings 106 which are received in suitable grooves around the reduced diameter shaft portions 100. The shaft portions 100 terminate in spaced relation, as indicated at 108, within the bore portion 90 of the portion 92 of the hub or spinner 26. The propeller blades 96 may rotate within the bores 88 about their longitudinal axes and may be rotated a sufficient degree to substantially and simultaneously change the pitch of the propeller blades which combine to form the propeller of the motor, and may also be rotated to the extent wherein the pitch of the blades would be reversed.

Extending longitudinally within the cylindrical chamber 56 is a tubular torque shaft 110, conforming to and being rotatably supported in the bore portion 56 of the drive shaft 50. The torque shaft 110 includes a reduced

diametered portion 112 extending through the aperture or bore portion 58 of the annular mounting hub 52 and being rotatable therein. The shaft portion 112 of the torque shaft has circumposed thereabout the hub portion 114 of a beveled pinion gear 116 drivingly engaged with the beveled pinion gears 104 keyed on the shaft portions 100 of the propeller blades 96. The gear 116 is retained on the torque shaft portion 112 by means of a suitable clamp washer 118 and machine screw 120. Thus, rotation of the torque shaft 110 about its longitudinal axis will result in rotation of the beveled pinion gear 116 and rotation of the propeller blades 96 about their longitudinal axes. The hub 114 of the gear 116 is suitably keyed on the torque shaft portion 112, as indicated at 122.

The torque shaft 110, as previously mentioned, is hollow, and includes an open end 124 and has formed diametrically opposed helical cam grooves 126, see FIGURES 4 and 7.

The tail section 28 includes an internal fluid chamber 128 in coaxial relation with the chambers 44 and 56. The chamber 128 is closed by means of a suitable plate 130 retained on the section 28 by means of suitable screws 132. The plate 130 is centrally apertured, as indicated at 134, for receiving therethrough a piston shaft 136 and disposed in a recess 138 in the plate 130 is a lip seal 140 for maintaining fluid in the chamber 128. The piston rod 136 has secured thereon by means of a retaining nut 142 a rotatably disposed cam element 144 having diametrically opposed cylindrical cam pins 146 which are guidingly received in the opposed helical cam grooves 126 of the torque shaft 110. Said cam pins 146 radially project beyond the periphery of said torque shaft 110 and slidably engage in longitudinal slots 54, respectively provided in the annular surface of the chamber 56. Slots 54 (FIGS. 2 and 4) are diametrically opposed and are disposed in a plane containing the axis of the drive shaft 50. Slots 54 constrain said cam pins 146 against turning relative to the drive shaft 50 but allow said cam pins 146 to move conjointly with endwise movement of piston shaft 136. Thus reciprocal movement of the piston shaft 136 will accordingly cause movement of the pins 146 within the helical cam grooves 126 and cause rotation of the torque shaft 110 within the drive shaft 50 to afford changing of the pitch of the propeller blades 96 through the medium of the drivingly engaged beveled pinion gears 116 and 104. The pins 146 extend through the grooves 126 and may guidingly engage the inner surface of the cylindrical chamber 56 of the drive shaft 50.

The piston shaft 136 has secured on the other end thereof in any suitable manner a transversely disposed and suitably sealed piston 148 which formed opposed variable volume chambers 150 and 152 on opposite sides thereof. If desired, the piston may have a transverse bore 154 suitably sealed by an O-ring, as indicated at 156, and having extending therethrough a longitudinally disposed guide rod 158 extending along the length of the chamber 128.

The variable volume chamber 150 communicates by means of a passage 160 in the tail section 28 with a passage 162 communicating with a fluid line 164 connected to a port of a fluid control valve 166. The valve 166 includes a manually controllable valve element 168 for permitting fluid to communicate with a line 170 connected to a pump 172. The pump 172 is operatively connected to a power take-off shaft 174 of the motor 10. The pump 172 includes a reservoir 176 which communicates with a line 178 operatively connected to the reversible control valve 166. The valve includes another line 180 connected to a passage 182 formed in the housing section 24 which accordingly communicates with a passage 184 communicating with the other variable volume chamber 152.

Through the control handle 186 of the reversible fluid control valve 166, fluid pressure can be directed to one

or the other of the variable volume chambers 150 or 152 formed by the piston 148. Accordingly, reciprocation of the piston 143 and the rod thereof may be moved toward the right or the left as indicated by the direction arrow in chamber 150.

Although a fluid pressure system is shown as being a desirable one in the exemplary embodiment, it will be readily apparent to those skilled in the art that other means may be utilized for moving the cam element 144 longitudinally within the chamber 54 of the drive shaft 50. The chambers 54 and 82 may be readily packed with grease, and although specific types of seals have been mentioned, any suitable seals may be utilized in the variable pitch propeller control mechanism. Additionally, although a two-bladed propeller has been described, a three-bladed propeller installation may be utilized, if desired.

It is believed readily apparent that there has been disclosed a variable pitch propeller control mechanism which will permit the propeller blades 96 to be readily adjusted for the purpose of driving a boat both at high and low speeds.

It will be obvious to those skilled in the art that various changes may be made without departing from the spirit of the invention, and therefore, the invention is not limited to what is shown in the drawings and described in the specification, but only as indicated in the appended claims.

What is claimed is:

1. An outboard motor assembly comprising in combination an upper motor housing for containing a power source, mounting bracket means for mounting said assembly on the stern of a boat, a drive shaft housing depending from said motor housing and including a depending drive shaft terminating therebeneath, an underwater unit including a housing at the lower end of said drive shaft housing and disposed normal thereto and including a central section into which said drive shaft extends, a tubular drive shaft disposed normal to and operatively connected to said first mentioned drive shaft and journaled for rotation about its longitudinal axis in said central portion, a spinner at one end of said central section and secured to one end of said tubular drive shaft for rotation therewith, radial blade means journaled for rotation on said spinner normal to the axis of rotation thereof, a tubular torque shaft open at one end and disposed axially within said tubular drive shaft for rotation about its longitudinal axis, said torque shaft including one end projecting into said spinner and operatively connected to said blade means for changing the pitch thereof, said torque shaft including a longitudinally extending, helical cam groove extending through the open end thereof, a tail section secured to the other end of said central section, force transmitting means housed in said tail section and including a shaft projecting into the open end of said torque shaft for axial reciprocation therein, and a cam follower journaled on the shaft projecting radially into said tubular shaft and engaged in said helical cam groove whereby axial movement of said shaft operated by said force transmitting means in said tail section will cause a change of pitch of said blade means.

2. The structure of claim 1 in which said tail section comprises a hollow chamber, said force transmitting means comprising a piston disposed transversely of said hollow chamber and defining variable volume chambers therein, and a fluid pressure system operatively connected to said variable volume chambers for axially displacing said piston and shaft in said tail section.

3. The structure of claim 2 including means in said hollow chamber in said tail section and engaged with and maintaining said piston against rotation during axial displacement thereof.

4. The structure of claim 1 including bearings circumposed about said tubular drive shaft within said central section at opposite sides of the operative connection with

said first mentioned drive shaft, and a thrust nut secured on said tubular drive shaft in opposition to said spinner for retaining the spinner thereon.

5. The structure of claim 4 in which said tail section is removably mounted on said central section for permitting ready access to said thrust nut to permit removal of said spinner and tubular shaft as a unit.

6. The structure of claim 5 in which said tail section comprises a hollow chamber, said force transmitting means comprising a piston disposed transversely of said hollow chamber and defining variable volume chambers therein, and a fluid pressure system operatively connected to said variable volume chambers for axially displacing said piston and shaft in said tail section.

7. The structure of claim 1 in which a second helical cam groove in diametrically opposed relation to said first mentioned helical cam groove, said cam follower including opposite ends thereof respectively engaged in said diametrically opposed helical cam grooves.

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