Feb. 1, 1966 E. L. LORENZ 3,232,350

CONTROLLABLE PITCH PROPELLER

Filed July 9, 1964 2 Sheets-Sheet 1

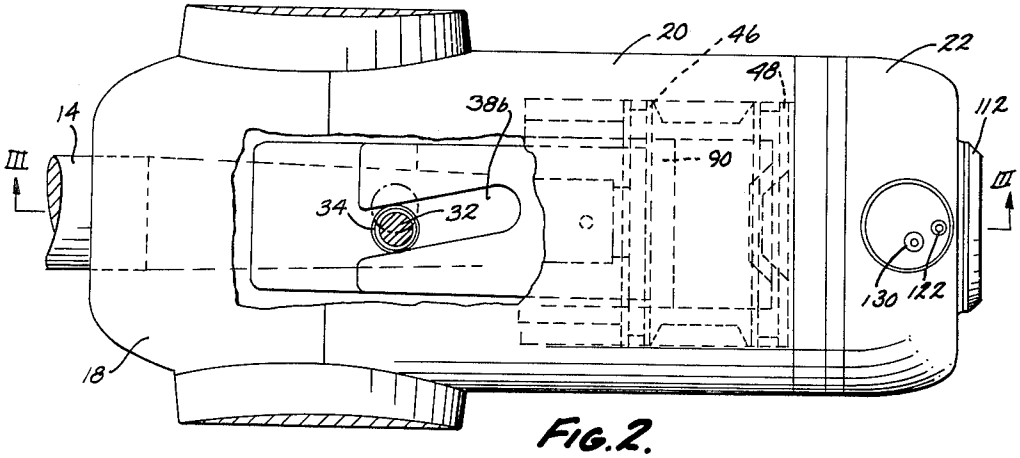

FIG. 2.

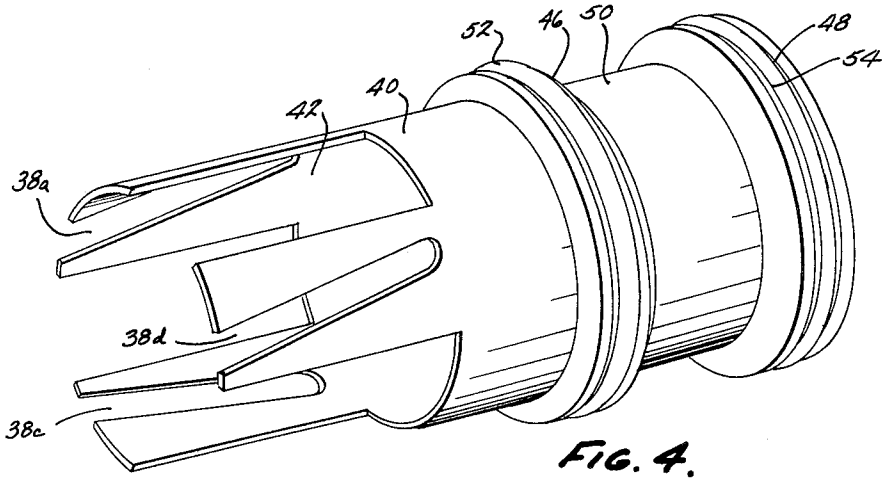

FIG. 4.

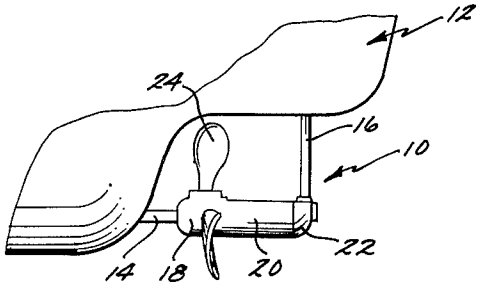

FIG. 1.

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Feb. 1, 1966 E. L. LORENZ 3,232,350

CONTROLLABLE PITCH PROPELLER

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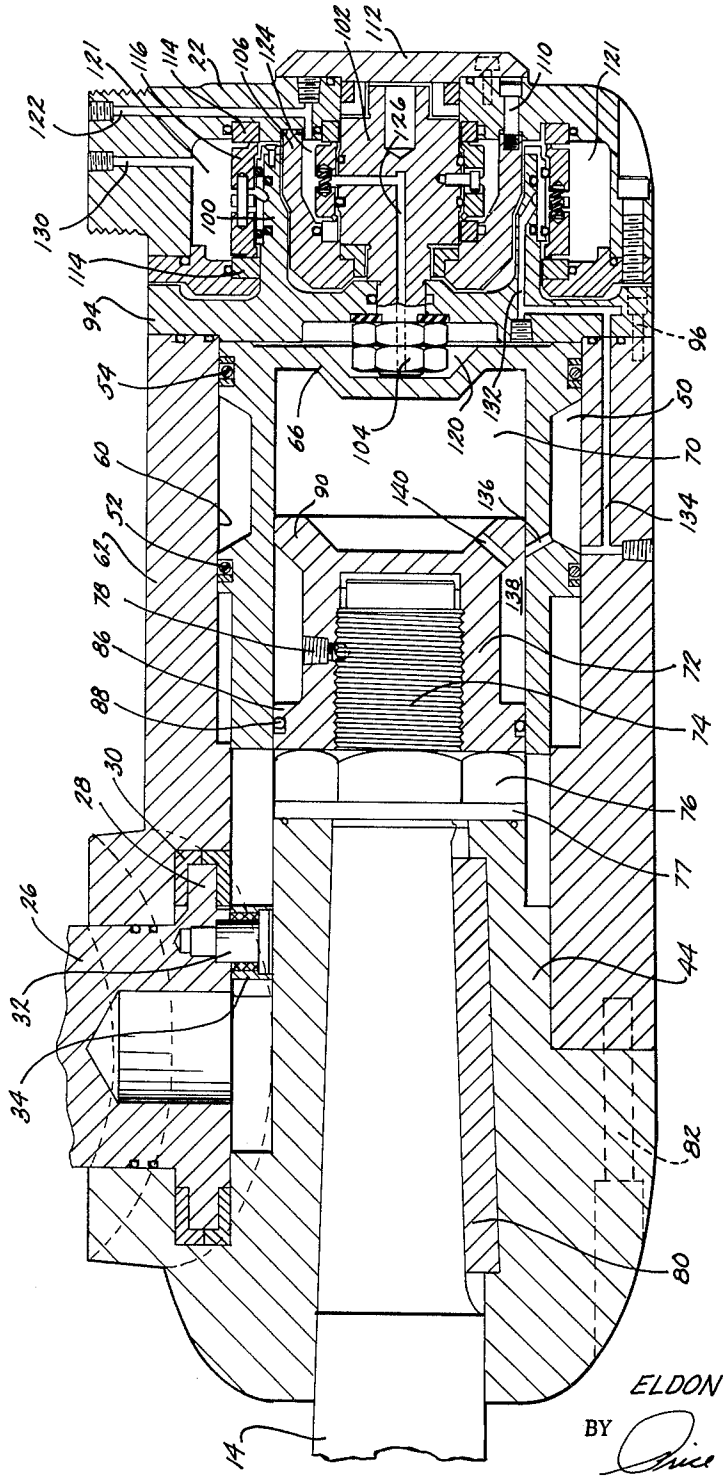

FIG. 3.

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United States Patent Office

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CONTROLLABLE PITCH PROPELLER

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3 Claims. (Cl. 170—160.32)

This invention relates to a marine propeller assembly, and more particularly to a controllable, adjustable pitch marine propeller assembly for commercial boats. The loads required to be propelled on commercial boats vary greatly. With each variance in load, it is extremely advantageous to be able to change the propeller pitch exacting amounts for optimum engine loading. Using fishing trawlers as an example, when the empty trawler goes out to sea, the optimum propeller pitch is completely different from that required for slow trolling, or for the return trip under load.

Mechanisms are currently provided for reversing the pitch of a propeller assembly. These ordinarily employ a hollow drive shaft to the propeller hub. A controlling pressure fluid actuates the propeller in reverse direction against the bias of a spring which normally holds the propeller in the forward direction. The hollow shaft principle is expensive, however, and does not enable a control unit to be attached to a conventional propeller mechanism without major rebuilding of the drive train. These known assemblies are difficult and expensive to repair. Further they do not provide accurate controllable pitch movement of the blades, but rather a two position forward-reverse action. Other controllable pitch propeller adjustment devices have also been devised. However, these involve complex mechanism with hollow shafting, and the like.

It is an object of this invention to provide a controllable pitch propeller which has a practically unlimited selection of propeller pitch angles in the forward direction to enable the propeller pitch to match the particular load conditions exactly, yet has a relatively simple structure. Another object of this invention is to provide such an assembly which can be attached to a conventional propeller drive shaft, enables controlled accurate blade pitch adjustment to suit light loads, heavy loads, high speeds, low speeds, or intermediate speeds, has double acting control, and yet has a relatively small number of interfitting parts. The mechanism does not utilize or require a hollow drive shaft, and enables initial installation and subsequent repairs to be relatively simple.

Another object of this invention is to provide a controlled pitch marine propeller assembly that will maintain its position at a set pitch angle even if the hydraulic unit should fail.

These and several other objects of this invention will become apparent upon studying the following specification in conjunction with the drawings, in which:

FIG. 1 is a side, elevational, fragmentary view of the stern of a boat showing the novel propeller assembly mounted to the drive shaft;

FIG. 2 is an enlarged, fragmentary, plan view of the novel propeller assembly;

FIG. 3 is a sectional, side elevational view of the apparatus taken on plane III—III of FIG. 2; and

FIG. 4 is a perspective view of the reciprocable, fluid actuated, two way, piston sleeve and integrally connected camming sleeve.

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Referring now specifically to the drawings, the novel propeller assembly **10** is shown mounted to the stern of a boat **12**, such as a commercial fishing boat. The front end of the assembly is connected to a solid boat drive shaft **14**. Its back end is mounted by a hollow support **16** attached to the boat. Hydraulic conduits lead through this hollow support **16** in a manner to be described.

The propeller assembly **10** includes the front propeller hub **18**, a central housing section **20**, and a fixed rear end cap **22**. A plurality of propeller blades **24**, usually three, project radially in an equally spaced manner from propeller hub **18**. Each of the blades of the propeller has a propeller shaft, e.g., shaft **26**, received in and retained by the housing assembly. The inner end of propeller shaft includes a peripheral outwardly, radially extending flange **28** received in a pair of annular L-shaped bearings fitted together to form a bearing **30** U-shaped in cross-sectional configuration.

A cam follower pin **32** and its peripheral bearing sleeve **34** extend axially from the inner end of the propeller shaft, offset from the center line of the propeller shaft. The three cam follower pins of the three blades interfit in three respective diagonal slots **38***a*, **38***b*, and **38***c*, formed at specific, like, acute angles, in the extended annular camming sleeve **40**. This cylindrical sleeve is fitted axially within the housing of the propeller shaft assembly. The sleeve also includes three cutout portions **42** which interfit with three rearwardly extending guide portions **44** of the propeller hub to maintain a constant rotational relationship between the propeller hub and camming sleeve.

The integral opposite end of this camming sleeve comprises a fluid actuated axially shifting, two-way piston sleeve. It has a pair of radially extending annular flanges **46** and **48** spaced from each other by an intermediate peripheral recess **50**. Annular seals such as O-rings **52** and **54** are inserted in receiving slots in these flanges **46** and **48** respectively. These seal the piston sleeve to the inner cylindrical wall **60** of central housing section **62**. The axial rear end of the hollow piston sleeve is closed by the partition head **66** (FIG. 3).

The hollow piston sleeve has an interior fluid containing chamber **70**. It receives the specially configurated sleeve guide and shaft cover nut **72**. This nut is threadedly attached to the threaded rear end **74** of drive shaft **14**. The end of the shaft is received by the propeller hub through a front opening, and is retained by a washer **77**, a first nut **76**, and the special locking nut **72**. A set screw **78** secures nut **72** to the threaded end of the shaft.

The tapered end of the drive shaft is affixed in its rotational relationship to the propeller hub by a slot and key combination **80**. A plurality of bolts **82** secure the propeller hub to the housing section **62** after the propeller shaft assembly and the drive shaft assembly are secured in the housing. Special nut **72** includes a front peripheral, outwardly extending flange **86** receiving an annular seal **88** to prevent fluid passage to the forward assembly. It also includes a rearwardly positioned radially extending diagonal peripheral flange **90** which maintains alignment of the piston sleeve as it is reciprocated. Reciprocation of the sleeve causes caming slots **38***a*, **38***b*, and **38***c* to be axially shifted also. This rotationally shifts the position of the camming pins to rotate the propeller shafts and blades due to the offset position of the cam follower pins.

The action of the camming sleeve and the piston sleeve is two-way, and can be controlled to give any particular intermediate position between the two extreme positions of the piston, one of which is shown in FIG. 3, and the other of which would be with end **66** adjacent flange **90** of nut **72**.

The slots **38***a*, **38***b*, and **38***c* are purposely formed at a small acute angle of about 22° or less with respect to a line along the surface of sleeve **40** and parallel to the axis of the sleeve. This causes the sleeve and blades to remain in fixed positions in case of fluid pressure failure, since water force on the propeller blades cannot rotate the blades.

The piston sleeve assembly is controlled by the entrance and exit of hydraulic fluid. This hydraulic fluid is introduced through the fixed or stationary rear end cap **22**. This cap remains stationary due to its connection with support **16**, while the other portions of the assembly rotate. The cap may actually vary widely in detail provided it includes mounting means, fluid passage means, and connection means to the rest of the assembly. A transition ring **94** is positioned between the particular cap shown and central housing **62**. This ring is secured to housing **62** by bolts **96**. The ring has a rearwardly extending, generally cylindrical, peripheral flange **100** which extends into the cap assembly. It also has a rearwardly extending axial plug **102** attached by nuts **104** to the center of ring **94**. These two elements rotate with the ring and housing assembly.

The cap includes a generally cylindrical annular collar **106** between ring **100** and plug **102** secured by bolts **110**. A cover plate **112** is positioned at the rear end of the assembly to seal off plug **102** from the water. A pair of annular seals **114** is in constant rubbing contact with the cooperative, spring biased, rotating seal elements **116** to prevent water entry into the hydraulic fluid chamber **121**.

The piston sleeve is reciprocated forwardly toward the propeller shaft from the position illustrated in FIG. 3 by hydraulic fluid flowing under pressure into rear chamber **120**. Entry is made through passageway **122**, annular chamber **124**, passageway **126**, through the center of nuts **104** into chamber **120**.

Reciprocation of the sleeve in the opposite direction is achieved by entry of pressurized fluid into chamber **70**, between nut **72** and inner face of head **66**. This is achieved by transfer of fluid through passageway **130**, annular chamber **121**, passageway **132**, passageway **134** in housing section **62**, annular chamber **50**, passageway **136** in the piston sleeve, annular chamber **138** around the periphery of nut **72**, and passageway **140** through the nut into chamber **70**.

In operation, it has been found that the mechanism is completely dependable, and actually enables accurate angular pitch adjustment of propeller shaft blades while remaining in the forward driving condition. It comprises an adjustable pitch propeller with hydraulic actuation in both directions. It has been found that with the small angle of the cam follower and slot combination, even if the hydraulic fluid system fails, the torque imparted to the blades by the water does not cause the blade pitch to shift. Rather, they remain constant and fixed at the previously set position. The unit can be attached to a conventional drive shaft without any machining or replacement of the drive shaft train. The propeller blades are actuated from the rear rather than from the front. Various other advantages will readily occur to those in the art upon studying the foregoing form of the invention. Also it is conceivable that certain details of the structure may be modified somewhat without departing from the concept presented. Therefore, the invention is to be limited only by the scope of the appended claims and the reasonable equivalents to those defined therein.

I claim:

1. An adjustable pitch marine propeller and drive shaft assembly enabling internal fluid actuated rotation of the propeller blades, but preventing external rotation thereof by water pressure on the blades, comprising: a rotatable propeller hub housing having an opening in its forward end to receive the drive shaft; a plurality of propeller blades radially around said housing, each having an end shaft received in said housing to revolve with said housing, each of said end shafts having a peripheral rotational bearing connection in said housing to allow rotation of the shafts on their axes; each of said end shafts having cam follower pin means on the inner end thereof, offset from the axis of said end shaft; a fluid cylinder, formed in the rear of said housing behind said end shafts and mounted to rotate with said housing; a hollow fluid actuator sleeve slidably mounted in said cylinder for fore and aft motion, having a cross partition, an inner chamber, and an annular outer peripheral recess, and including axially interfitting guide means interfitted with said housing to prevent rotation of said sleeve with respect to said housing while allowing axial movement thereof; a sealing and guide element mounted to the end of the drive shaft to rotate therewith, having seal means sealing the forward open end in engagement with the inner wall of said sleeve, and having an annular outer peripheral recess; the integral forward end of said sleeve having like diagonal camming slots each at a small acute angle no greater than about 22° with respect to a line parallel to the axis of said sleeve, and receiving the respective offset pins on said propeller blade shafts; the interfit of said slots and offset pins having a binding action with reverse rotational force applied to said blades to prevent rotation thereof; a fixed non-rotatable rear end closure cap having a pair of fluid passage means to opposite sides of said sleeve to actuate it axially fore and aft and thereby controllably adjust the pitch of said propellers, one of said passage means extending through said housing to said sleeve peripheral recess, including a passage from said sleeve peripheral recess through said sleeve to said guide element annular recess, and including a second passage from said guide element peripheral recess through said guide element to said sleeve inner chamber; and sliding seal means between said housing and said closure cap.

2. An adjustable pitch marine propeller and solid drive shaft assembly enabling internal fluid actuated rotation of the propeller blades, but preventing external rotation thereof by water pressure on the blades, comprising: a rotatable propeller hub housing having an opening in its forward end receiving the rear end of a solid drive shaft; a plurality of propeller blades radially around said housing, each having an inner end shaft received in said housing; each of said end shafts having a peripheral rotational bearing connection in said housing around the end shaft axis; each of said end shafts having a cam follower pin on the inner end thereof, offset from the axis of said end shaft; a fluid cylinder, formed in the rear of said housing behind said end shafts; a fluid actuator sleeve slidably mounted in said cylinder for fore and aft motion; said actuator sleeve having a hollow center forming an inner chamber, an open front end to said chamber, receiving the revolving end of the drive shaft, and an annular outer peripheral recess; said actuator sleeve also having a closed rear end portion, and including axial guide means axially interfitted with said housing to prevent rotation of said sleeve with respect to said housing but allow axial movement thereof; a sealing and guide nut mounted to the end of the drive shaft to rotate therewith; said nut having seal means sealing the forward open end of said sleeve, having portions in alignment engagement with the inner wall of said sleeve, and having an annular outer peripheral recess; the forward end of said sleeve having like diagonal camming slots each at a small acute angle and receiving the respective offset pins on said propeller blade shafts; the interfit of said slots and

offset pins having a binding action with reverse rotational force applied to said blades to prevent rotation thereof; and a fixed rear end closure cap having a pair of fluid passage means to opposite sides of said rear end sleeve portion to actuate it fore and aft and thereby controllably rotate said propeller, one of said passage means extending through said housing to said sleeve peripheral recess, including a passage from said sleeve peripheral recess through said sleeve to said nut annular recess, and including a second passage from said nut peripheral recess through said nut to said sleeve inner chamber to form a constantly connecting fluid system.

3. The assembly in claim 2 wherein said housing and closure cap are separated by a transition ring attached to said housing and retaining seal means in sliding contact with said closure cap.

References Cited by the Examiner

UNITED STATES PATENTS

2,355,039	8/1944	Eves	170—160.32
2,513,156	6/1950	Eaves	170—160.21
2,931,443	4/1960	Pehrsson	170—160.32
3,095,044	6/1963	Medlock	170—160.47 X
3,153,454	10/1964	Gaubis	170—160.1 X

FOREIGN PATENTS

168,030	12/1954	Australia.
954,911	6/1949	France.

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