

Jan. 3, 1967

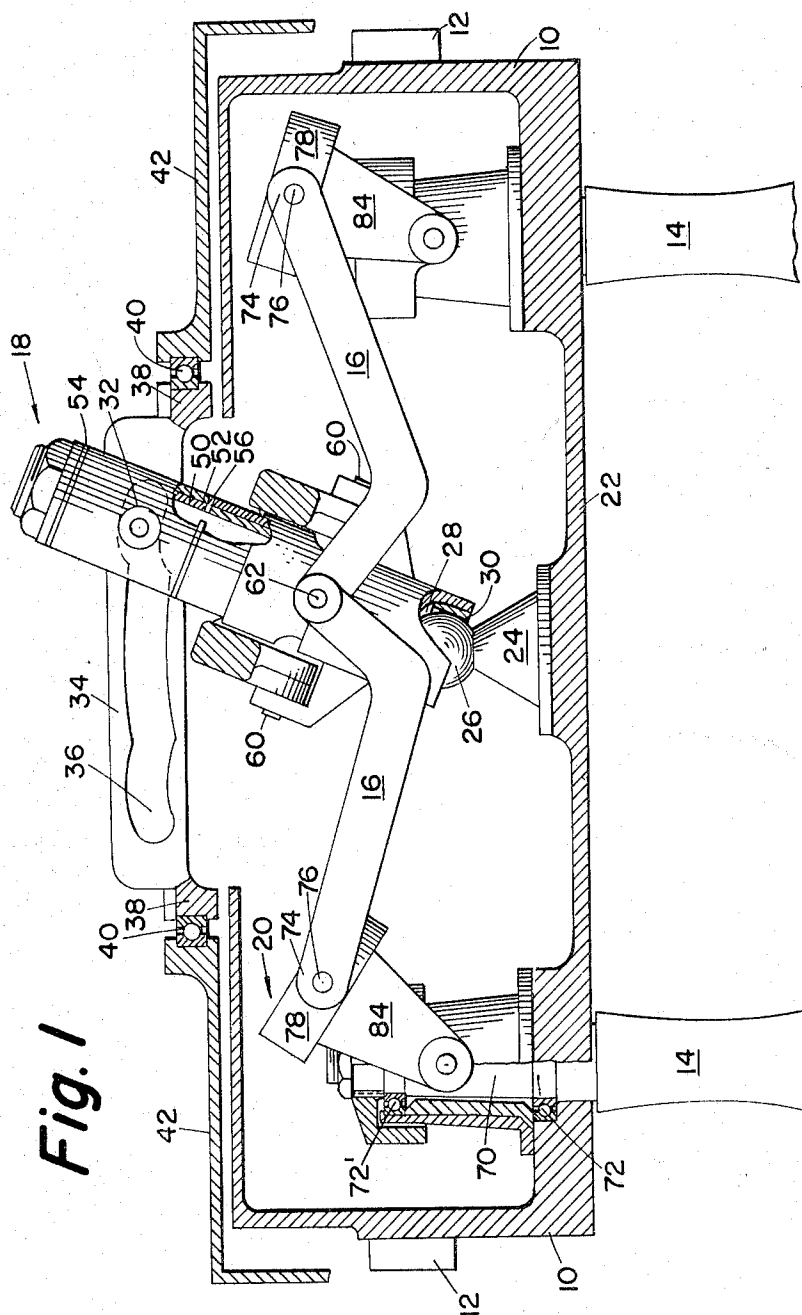
L. I. JAYNE

3,295,609

UNIVERSAL PITCH PROPELLER LINKAGE

Filed Dec. 30, 1965

2 Sheets-Sheet 1



INVENTOR:
LAURENCE I. JAYNE

BY

J. V. Sheehan
ATTORNEY

Jan. 3, 1967

L. I. JAYNE

3,295,609

UNIVERSAL PITCH PROPELLER LINKAGE

Filed Dec. 30, 1965

2 Sheets-Sheet 2

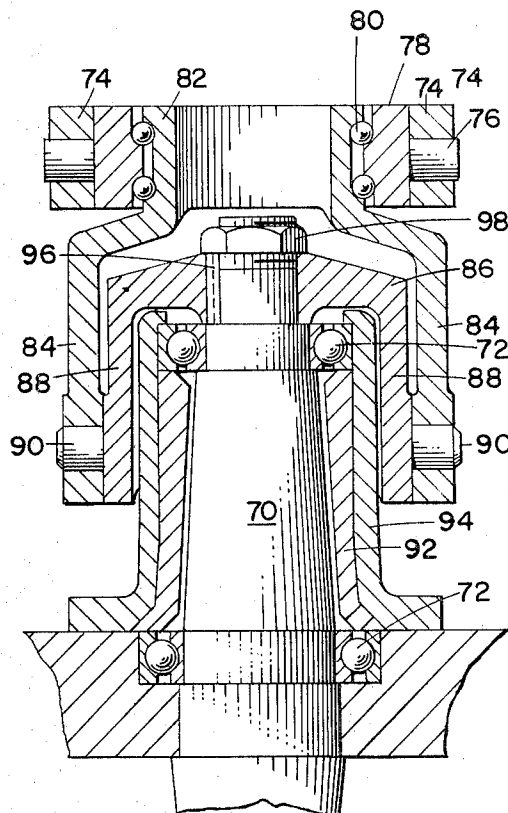


Fig. 3

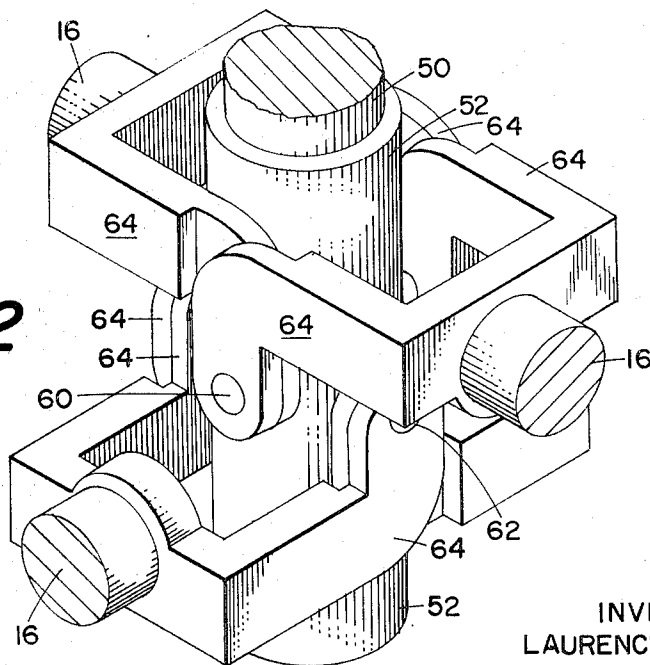


Fig. 2

INVENTOR:
LAURENCE I. JAYNE

BY

J. F. Sheehan
ATTORNEY

1

3,295,609

UNIVERSAL PITCH PROPELLER LINKAGE

Laurence I. Jayne, Renton, Wash., assignor, by mesne assignments, to the United States of America as represented by the Secretary of the Navy

Filed Dec. 30, 1965, Ser. No. 517,860

10 Claims. (Cl. 170-149)

This invention relates to marine propellers and more particularly to improvements in the cycloidal type of propeller having a group of blades each pivotally mounted on a vertical axis and which are arranged to revolve about a vertical axis.

Propellers of this general type employ a central control shaft for adjustment of the blades through linkage in order to alter the pitch of the propeller. The prior art has employed mechanical linkage, or a combination of mechanical linkage and fluid pressure structure between the control shaft and the blades for adjustment of the blades. Such linkage arrangements of the prior art have provided efficient operation in the low speed or the below "pi" pitch range but apparently do not have the capability of efficiently operating in the high speed or above "pi" pitch range.

By way of explanation, zero propeller pitch will be understood to exist when the blade faces are tangent to the orbit circle formed by the revolution of the propeller about its vertical axis and "pi" pitch to exist when each revolution of the propeller produces an advance equal to the circumference of the orbit circle. In the below "pi" pitch operation or low speed range the blades pivot or move about their vertical axis in an oscillatory manner, while above "pi" pitch operation or in the high speed range, the motion of the blades is rotary and each blade moves about its vertical axis one complete rotation during a revolution of the propeller.

The broad object of this invention is to provide a cycloidal or vertical axis propeller which is operable selectively in the low speed or below "pi" pitch range or selectively in the high speed or above "pi" pitch range.

Another object of the invention resides in providing cycloidal or vertical axis propeller mechanism having control means which selectively permits the propeller blades to oscillate or to rotate through during one revolution of the propeller.

Another object is to provide a system of linkage between a central control shaft and each of the blades of a cycloidal or vertical axis propeller to permit selective operation of the propeller in either the low speed or high speed range.

Other and more specific objects of the invention will become apparent to those skilled in the art from the following detailed description of the invention as illustrated in the accompanying drawings, wherein:

FIGURE 1 of the drawing is a transverse sectional view of the cycloidal propeller device of this invention showing one type of linkage system for operator control of the adjustment of the propeller blades.

FIGURE 2 shows one arrangement for connecting the linkage system to the central control shaft of a cycloidal propeller.

FIGURE 3 is a vertical sectional view to show details of an arrangement for blade mounting.

The propeller rotor housing is indicated generally at 10 and is mounted, for example, in a naval vessel in a manner permitting it to revolve about a central vertical axis and be driven through gearing represented at 12 by the vessel's engine. The propeller blades are indicated at 14 and are mounted in suitable bearings near the periphery of the rotor and desired thrust is produced by adjustment of the blades as they move in the orbit circle of the propeller. The linkage system for adjusting the blades

2

comprises a link arm indicated at 16 for each blade which interconnects a central control shaft 18 and a blade actuator assembly 20. The blade actuator assembly 20 functions generally similar to a gimbal mounting and is operative to adjust the blades for oscillatory movement to effect below "pi" pitch operation or for rotary movement to effect above "pi" pitch operation. The blades may be arranged in groups of, for example, two, four or six and will extend outwardly from the control shaft 18 as shown in FIGURE 1. For the purpose of explaining the invention, the description will be limited to the details of the linkage between the control shaft and only one blade, since the linkage for the other blade will be the same.

In FIGURE 1, the bottom closure plate for the propeller housing 10 is indicated at 22 and has an upright central standard 24 fixed thereto and which terminates in a spherical end 26. The control shaft 18 has a socket 28 at its lower end which receives the end 26 and the socket may be formed by a liner 30, as shown, to permit a push-pull or reciprocating movement of the shaft 18 and also to provide a sliding connection to permit the shaft 18 to be moved axially.

The shaft 18 is provided with opposed cam rollers 32 which are received in a cammed traverse formed by similar bracket arms 34 having a cammed space 36 to provide an arrangement for operating the blade actuators or controllers 20. Thus, pitch adjustment of the propeller blades 14 is effected by movement of the control shaft 18 through its connection with the end 26 on standard 24. The bracket arms 34 are formed as part of a ring 38 which is mounted in bearings 40 and supported by the fixed structure 42 of the vessel to permit rotary movement of the bracket arms and connected structure for effecting steering adjustment.

The control shaft 18 extends through a central opening in the top wall of housing 10 and is formed of an inner cylindrical element 50 and outer sleeve 52. Upper and lower thrust washers 54 and 56 are fixed to the inner cylindrical element to provide for independent rotary movement of the upper portion of the outer sleeve 52 and the cam rollers 32. This provides an arrangement to permit independent steering adjustment without affecting the blade adjustment. In order to effect pitch adjustment of the blades, the connections between the link arms 16 and the control shaft 18 are made with the lower portion of the outer sleeve 52 below the lower thrust washer 56 and such connections are shown in detail in FIGURE 2. The lower portion of the outer sleeve 52 is provided with two pairs of generally similar opposed pins or trunnions, the trunnions of one pair being identified by 60 and the trunnions of the other pair being identified by 62. Preferably, as shown, the trunnions of each pair have a common axis and the common axes of each pair intersect at a point on the longitudinal axis of the control shaft 18. The inner ends of the link arms 16 are bent at an angle to the main body of the arms and are bifurcated to provide a pair of similar apertured prongs 64-64 in order to be received by the pins or trunnions 60 and 62. It will be understood from the above description that the control shaft 18 can be pushed or pulled by an operator to move the cam rollers 32 between the limits of the cammed space 36 of the bracket arms 34 for pitch adjustment and that the bracket arms 34 can be rotated through an arc by rotation of the support ring 38.

The particular mounting arrangement for each blade 14 is shown in FIGURE 3. Each blade has an integrally formed shank 70 which, as shown, is mounted between bearings 72-72' for rotative movement and depends from the blade actuator assembly 20 which is joined to a link arm 16. Each link arm 16 has a bifurcated outer end providing similar apertured prongs 74-

74 which are received by a pair of pins or trunnions 76—76 extending outwardly from a ring 78. The ring 78 provides an outer race for bearings 80 while an inner ring 82 provides an inner race for the bearings 80 and has depending similar apertured yoke arms 84—84. An inner yoke formed of an upper web 86 and depending yoke arms 88—88 which are provided with similar pins or trunnions 90—90 and received in the apertured yoke arms 84—84 and supported thereby. A spacer 92 embraces the shank 70 and is located between bearings 72—72' while a bearing housing 94 is provided, as shown, between the web 86 and bottom 22 of the housing. The upper end of shank 70 is secured to the web 86 by a key 96 and a nut 98 removably connects the controller assembly to the shank 70.

From the above description of the invention, it will be understood that the rotor 10, blades 14, linkage 16 and the portion of the control shaft 18 below the lower thrust washer 56, will rotate as a unit while the portion of the control shaft 18, above this thrust washer, and the bracket arms 34, will remain stationary. When the control shaft 18 is in a vertical position with respect to the rotor 10, the propeller blades will be at zero pitch and the pitch of the blades may be adjusted by movement of the control shaft 18 as permitted by the cammed bracket arms 34. In FIGURE 1, the control shaft 18 is shown in the above "pi" pitch range and will be moved toward the vertical position for changing from this range to the below "pi" pitch range. The shape of the cammed area 36 in the bracket arms 34 shows a central zone which may be considered to generally define the limits of the below "pi" pitch range while the relatively shorter end zones of the cammed space may be considered the extent of the above "pi" pitch zones. Thus, the blade adjustment may be made by either pushing or pulling the control shaft toward or away from its vertical position.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

I claim:

1. A cycloidal propeller formed of a cylindrical housing having a top wall with a central opening and mounted in ship structure for revolvment in a horizontal plane and comprising,

- (a) a group of blades depending from the bottom wall of the housing adjacent its periphery and movable in a circle orbit during revolvment of the housing,
- (b) each of said blades having upper shanks within the housing mounted in bearing structure for movement about a vertical axis,
- (c) a fixed central standard extending upwardly from said bottom wall and having an upper spherical end disposed within the housing,
- (d) a control shaft having a socket at its lower end receiving said upper spherical end of the standard to permit reciprocation and a rotatable upper end,
- (e) an actuator assembly for each blade disposed within the housing and secured to each blade shank,
- (f) each actuator assembly being operable to selectively adjust the blade for oscillatory or rotary movement,
- (g) a group of link arms each having its inner end pivotally connected to said control shaft and its outer end pivotally connected to one of the actuator assemblies,
- (h) a rotatable ring mounted by the ship structure and

having cammed traverse means extending above the central opening in the housing top wall,

- (i) cam roller means extending from the rotatable upper end portion of the control shaft and received by said cammed traverse whereby

- (j) said upper end of the control shaft may be reciprocated in the cammed traverse to effect pitch adjustment of the blades or rotated to effect steering adjustment of the propeller.

2. A cycloidal propeller as set forth in claim 1, further characterized by said control shaft having the outer sleeve formed of upper and lower sections with the lower section extending below the inner cylindrical element to provide a socket and the inner cylindrical element having a thrust washer in its upper end portion separating the sections and providing the rotatable upper end.

3. A cycloidal propeller as set forth in claim 1, further characterized by each blade actuator assembly comprising an outer ring for receiving the outer end of a link arm and an inner ring rotatably supported by the outer ring and having a pair of outer depending yoke arms which are pivotally connected to a pair of depending arms of an inner yoke member carried by the blade structure.

4. A cycloidal propeller as set forth in claim 3, further characterized by the outer and inner rings providing outer and inner raceways having coacting bearing seats receiving ball bearings whereby the inner ring is supported by the outer ring.

5. A cycloidal propeller as set forth in claim 3, further characterized by the inner yoke member having an apertured central web mounted on the upper end of the blade shank.

6. A cycloidal propeller as set forth in claim 1, further characterized by each link arm having bifurcated inner ends which are connected to the control shaft on a common axis and each link arm having bifurcated outer ends and connected to the blade actuators on a common axis.

7. A cycloidal propeller as set forth in claim 6, further characterized by the group of link arms being relatively disposed to position their bifurcated inner ends on common axes which intersect at a point on the vertical axis of the control shaft.

8. A cycloidal propeller as set forth in claim 1, further characterized by the cammed traverse means comprising a pair of bracket arms each having similar slots extending transversely of the central opening of the housing.

9. A cycloidal propeller as set forth in claim 8, further characterized by each slot having a central portion defining below "pi" pitch operation and opposed end portions each defining above "pi" pitch operation.

10. A cycloidal propeller as set forth in claim 8, further characterized by the bracket arms being positioned to receive the rotatable upper end of the control shaft therebetween and further characterized by the cam roller means comprising opposed rollers having a common axis and received in the similar slots.

References Cited by the Applicant

UNITED STATES PATENTS

1,681,500	8/1928	Schneider.
2,037,069	4/1936	Ehrhart.
2,291,062	7/1942	Schneider.
2,850,104	9/1958	Hub.
2,859,829	11/1958	Mueller.
2,978,036	4/1961	Schneider.

MARTIN P. SCHWADRON, *Primary Examiner.*

E. A. POWELL, JR., *Assistant Examiner.*