CONTROLLABLE PITCH PROPELLERS

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ABSTRACT OF THE DISCLOSURE

In a controllable pitch propeller, a double-crank blade-turning mechanism having a self-aligning connection between an axially movable control member and one set of crankpins, to provide equal loadings on all the crankpins.

This invention relates to controllable pitch propellers of the class having two crankpins on each blade flange (and to double-crank mechanisms in general).

In controllable pitch propellers of the class having two crankpins on each blade flange for turning the blades, the difficulty has been to load the two crankpins equally (because of the impossibility of achieving absolute manufacturing accuracy in the various parts); lack of accuracy results in throwing most or all of the loading onto one crankpin of a double-crank mechanism, and the slight inaccuracy may not only cause uneven loading, but may bind or lock the parts of such mechanisms, rendering them unworkable. The principal object of the invention is to provide, in a controllable pitch propeller, a double-crank blade-turning mechanism having self-aligning connections between an axially movable control member and one set of crankpins, to provide equal loadings on all the crankpins.

A blade-turning double-crank mechanism having a plurality of hydraulic cylinders, one attached to each crank, is known, but is very costly and complex. Also since the individual piston areas are limited in size (all cylinders being located within the propeller hub) the oil pressure required to actuate the mechanism must be excessive. An object of the invention is to provide a blade-turning double-crank mechanism for controllable pitch propellers with a plurality of blades, having only one hydraulic cylinder and piston combined with self-aligning connections providing equal loadings on the several crankpins.

Other objects are to provide a self-aligning linkage which will prevent binding or locking between any parts of a double-crank mechanism; to provide a mechanism that is applicable to a controllable pitch propeller having any number of blades; and to provide a blade-turning mechanism for a controllable pitch propeller that is simple and easy to manufacture, and to assemble and maintain in operation.

These and other objects of the invention will be apparent from the following description in connection with the drawings in which:

FIG. 1 is a longitudinal section of the propeller hub;
FIG. 2 is a plan view partially in section on line 2–2 of FIG. 1;
FIG. 3 is a transverse section on line 3–3 of FIG. 1;
FIG. 4 is a transverse section on line 4–4 of FIG. 1;
FIGS. 5, 6, and 7 are diagrammatic transverse sectional views showing the self-aligning flexible connections for two-bladed, four-bladed, and five-bladed controllable pitch propellers respectively.

Referring to the drawings, propeller hub 10 is bolted to shaft 11 by capscrews 12. Propeller hub 10 is provided with sockets 15 each of which receives flange 14 attached to propeller blade 15. Flange 14 is provided with two crankpins 16. Carrier blocks 17 and 18 are slidable on the inner surface of flange 14 and have slots 19 and 20 respectively. Sliding block 21 is pivoted on one of crankpins 16 of flange 14 and is slidable in slot 19 of carrier block 17. Sliding block 22 is pivoted on the other crankpin 16 of flange 14 and is slidable in slot 20 of carrier block 18. Slots 23 of carrier blocks 17 and 18 match interlocks 24 with notched flange 25 of cylindrical nut 26. Cylinder 25 is provided with pistons 27 having cylindrical portion 28 extending out from one end of cylinder 25 and through center block 29. Cylindrical portion 27 of piston 26 is provided with convex spherical seat 30 matching concave spherical seat 31 of self-aligning member 32. Also, convex spherical seat 32 of self-aligning member 31 mates with and slides in concave spherical seat 33 of nut 34, these spherical mating surfaces 29, 30, 32 and 33 being concentric. Slots 35 of carrier blocks 17 may interlock with notched flange 36 of self-aligning member 31. Pin 41 prevents self-aligning member 31 from rotating relative to hub 10, to prevent slots 35 of carrier blocks 17 from unlocking from notched self-aligning member 31. Key 42 prevents cylinder 25 from rotating relative to hub 10, to prevent slots 23 of carrier blocks 18 from unlocking from notched flange 24 of cylinder 25.

Propeller hub end cap 37 is fastened to hub 10 and is provided with inner cylindrical surface 38 which serves as a sliding guide for cylinder 25. In a controllable pitch propeller construction, it is desirable to make the hub in one unit, not split on the plane of the propeller blades. This, however, often poses problems in assembly; special tools may be required. In this invention, assembly is easy; all parts may be inserted easily as follows:

Referring to FIGS. 1–4, flanges 14 are inserted through one end of hub 10 and blades 15 are fastened to flanges 14. Carrier blocks 17 are inserted from one end of hub 10 and carrier blocks 18 are inserted from the other end of hub 10, using the space provided for but not yet occupied by spacers 40. Sliding blocks 21 and 22 are inserted in slots 19 and 20 and are pivoted on crankpins 16. Insertion of spacers 40 and center block 28 hold the previously assembled parts in place.

Slots 35 of carrier blocks 17 are positioned to the left of carrier blocks 18, and slots 23 of carrier blocks 18 are located to the right of carrier blocks 17 (FIGS. 1 and 2). Inserting cylinder 25 and piston 26 assembly from the right end of hub 10, notched flange 24 of cylinder 25 may pass between carrier blocks 18; then rotating cylinder 25 causes notched flange 24 to interlock with slots 23 of carrier blocks 18, joining carrier blocks 18 and cylinder 25 in one assembly. Key 42 keeps cylinder 25 from turning out of interlocking position with carrier blocks 18. Self-aligning member 31 is inserted against spherical seat 29 of piston cylindrical stem 27, clearing carrier blocks 18 and spacers 40. Rotating self-aligning member 31 interlocks its notched periphery with slots 35 of carrier blocks 17. Insertion of lock pin 41 and nut 34 completes the assembly of the hub structure.

Piston 26 is provided with two ports, one leading to each end of cylinder 25. Servo valve 38 is attached to end of control rod 39 which also serves as an oil supply line carrying oil under pressure to move cylinder 25 and piston 26 in opposite directions to control the pitch of the propeller from forward position to neutral and reverse, and return.

FIGS. 1–4 illustrate a three-bladed controllable pitch propeller with three carrier blocks 17 each being connected to self-aligning member 31. Three is the maximum number of controllable pitch propeller self-aligning member may have and provide equal loading on all crankpins 16. FIG. 6 shows diagrammatically a four-bladed controllable pitch propeller arrangement in which equal loading is obtained on all crankpins.
carrier blocks 17 are interconnected to a common linkage 43 by means of the spherical self-aligning connection hereinafter described. Triangular connector plate 44 connects linkage 43 with the remaining two carrier blocks 17. By loading the center of connector plate 44 in a self-aligning manner, plate 44 and linkage 43 will pivot slightly to provide equal loading on all carrier blocks 17 and crankpins 16.

FIG. 7 shows diagrammatically a similar arrangement for a five-bladed propeller, and FIG. 5 shows the arrangement for a two-bladed propeller; these views are self-explanatory.

In operation, axial movement of control rod 39 will divert fluid to one side of piston 26 causing cylinder 25 to move in one axial direction and piston 26 to move in the opposite direction. Cylinder 25 (being connected by carrier block 18 and sliding blocks 22 to one set of crankpins 16) and piston 26 (being connected by self-aligning member 31 and carrier blocks 17 and sliding blocks 21 to the other set of crankpins 16) coact to rotate flanges 14 and propeller blades 15 to control the pitch of the propeller from full-speed forward to full-speed reverse and vice versa. Since spherical surfaces 29, 30, 32 and 33 are concentric with center on the axis of hub 10, the loading on the six crankpins 16 will be equal.

Having described the invention and its operation, it is obvious that the objects stated have been attained in a practical manner. While certain specific embodiments of the invention as applied to controllable pitch propellers have been shown and described, it is understood that the invention may be applied to double-crank mechanisms in general, and that changes may be made in the construction and arrangement of the various parts without departing from the spirit or scope of the invention as expressed in the following claims:

I claim:

1. In a controllable pitch propeller having a propeller hub and a plurality of blades radiating therefrom, a blade-turning mechanism comprising a flange on each blade and operably seated in said hub, a pair of crankpins on each flange, an axially movable hydraulic cylinder in said hub, operable connections between said cylinder and one set of said crankpins; an axially movable piston in said cylinder; and operable connections between said piston and the other set of said crankpins, one of said operable connections including a self-aligning member constructed and arranged to equalize the loading on the several crankpins, and means for moving said cylinder and piston in opposite directions to control the pitch of said blades from forward position to neutral and reverse, and return.

2. Structure as claimed in claim 1, the said means for moving said cylinder and piston in opposite directions comprising means for feeding oil under pressure to said cylinder on either side of said piston.

3. Structure as claimed in claim 1, the propeller hub being an integral unit (not split on the plane of the propeller blades), and said operable connections including members notched to permit interlocking assembly of the various parts in said integral propeller hub.

4. Structure as claimed in claim 1, said operable connections each including a block operably pivoted on one of said crankpins, a carrier block slideable on the inner face of each of said blade flanges, a slot in said carrier block and slideable on said crankpin-pivoted block, a transverse slot at one end of each of said carrier blocks, and a notched member rotatable during assembly into interlocking connection with said transverse slots.

5. In a controllable pitch propeller having a propeller hub and a plurality of blades radiating therefrom, a blade-turning mechanism comprising a flange on each blade and operably seated in said hub, a pair of crankpins on each flange, axially movable control means in said hub, operable connections between said control means and one set of said crankpins, operable connections between said control means and the other set of said crankpins and including self-aligning members constructed and arranged to equalize the loading on the several crankpins, and means for moving said control means to control the pitch of said blades from forward position to neutral and reverse, and return.

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