PRESSURE EQUALIZER FOR CONTROLLABLE PITCH PROPELLER

Fig. 1

Fig. 2

Fig. 3
PRESSURE EQUALIZER FOR CONTROLLABLE PITCH PROPELLER

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The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This application is a continuation-in-part of my copending application Serial No. 79,471, filed December 29, 1960, which in turn was a continuation-in-part of application Serial No. 853,426, filed November 16, 1959, now abandoned, both applications being for Pressure Equalizer for Controllable Pitch Propeller.

The invention relates to ship propulsion and is concerned with propulsion equipment consisting of a propeller hub structure including propeller devices which are adjustable in pitch by an inner reciprocable conduit which extends through the propeller hub and are rotated by an outer conduit which is connected to the propeller hub. The propeller hub is additionally provided with casing structure which forms a chamber through which the inner conduit passes and includes a cylindrical closed end housing which receives the inner conduit and provides an end chamber in communication therewith. The inner and outer conduit and end chamber provide one section of the lubricant system while the chamber and hub structure form another section of the lubricant system and both sections are supplied with lubricating oil.

By the present invention, the above generally described equipment is arranged to be operated without causing undue agitation or turbulence of oil in the lubricating system and, consequently, prevents seals provided in the equipment from being ruptured with the resultant loss of lubricant or the admission of sea water into the equipment.

The broad object of the invention is to provide a lubricating system for ship propulsion equipment wherein loss of the lubricating oil from the system by pressure surges is prevented or minimized.

Another object of the invention is to provide a lubricating system for ship propulsion equipment wherein the equipment may be operated without causing excessive agitation or turbulence of the oil within the system.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings, wherein:

FIG. 1 is a diagrammatic view showing the relationship of the essential elements of a controllable pitch propeller arrangement;

FIG. 2 is a sectional view taken on the line 2—2 of FIG. 1 and enlarged to show some details.

In FIG. 1, the propeller hub assembly is indicated at A, a servo-motor section at B, a propulsion motor section at C and the oil injector and control valve unit at D. The hub assembly supports a group of propeller blades P, usually four, and is mechanically connected by a propeller shaft S with the propulsion equipment C and is rotated thereby. Pitch adjustment of the propeller blades P is accomplished by the servo-motor B through a control shaft, which is not shown in FIG. 1 but is concentrically mounted within the propeller shaft S. Oil supply which is controlled by D operates both the servo-motor B and the propulsion equipment C. No detailed explanation of the operation of these elements is considered necessary for the purpose of understanding this invention but reference may be had to Patent 2,798,564 to Strandell for a detailed explanation of this general type of controllable pitch propeller operation.

In FIG. 2, the hub assembly A is formed of a hub housing 10 and a streamlined end casing 11 which are interconnected by a spacer ring 12. The hub housing 10 is provided with four equidistantly spaced cylindrical cavities or recesses G for propeller equipment. The cavities have outer large diameter portions 13 and inner small diameter portions 14 which communicate with an axial passageway or bore 15 formed in the hub structure.

In the top cavity of FIG. 2 is shown one detailed arrangement for securing a propeller blade P. A bushing 20 is mounted in the small diameter portion 14 of the cavity and receives the root end 21 of a cup-shaped receptacle 22 termed a crank pin ring. The receptacle 22 has its inner wall threaded at 23 to removably secure the shank H of the propeller blade P. The outer wall of the receptacle 22 is rabatted for reception of a bearing ring 24 and a locking ring 25 which is removably secured to the inner face of cavity G by a threaded area 26. The shank H of the propeller blade merges into an outer flange or cap 27 which bears on the upper rim of the bearing ring 24 and a seal ring or washer 28 which is disposed between the bearing ring and the inner wall of the cavity, as shown. The above described propeller mounting arrangement provides bearing surfaces for rotative adjustment of the propeller P and additionally seals the cavity.

The propeller shaft S is in the form of a conduit which is screw-threaded to mounted to the hub housing 10 at 30 for rotating the propeller hub structure. An inner conduit 31 has an end portion 31a concentrically mounted within the conduit S and extends through the axial passageway 15 of the hub positioning its other end portion 31b within the casing 11. The inner conduit 31 is connected to the receptacle 22 in a manner to rotate the propeller through a desired arc for pitch adjustment. Such an arrangement is shown in detail at FIG. 5 of Strandell Patent 2,798,564 and comprises generally, as shown in FIG. 3 of this application, linkage in the form of a radial arm 32 which has its inner end fixed to conduit 31 and its other end connected to a jaw bolt 33 which has a pivotal connection 34 with a connecting rod 35, the connecting rod 35 in turn being mounted for pivotal movement to a pin 36 which is fixed to the receptacle 22 but would not be seen in the view of FIG. 2. Reciprocative movement of shaft 31 rotates the receptacle 22 and thus provides for pitch adjustment of the propeller P.

A strengthening plate 40 is disposed transversely of the casing 11 and is centrally apertured to receive therein a cylindrical housing 41 having a closed rear end 42 which is disposed adjacent the closed end of the casing 11 and an open end 43 through which the end portion 31b of the inner conduit extends. The cylindrical housing 41 is of relatively small diameter and is aligned with the inner conduit 31 and is sufficiently large to receive the end portion 31b and preferably sufficiently large to provide a confined annular space 44 having the approximate size of the annular space formed between the outer conduit S and end portion 31a of the inner conduit. The end portion 31b of the inner conduit 31 is provided at its extremity with a gland 45 which is affixed thereto by screws 46 to provide a seat for an expansion ring 47 which has a seal ring 48 about its outer periphery to form a seal between the cylinder 41 and the end portion 31b of the inner conduit. This seal arrangement provides an end lubricant compartment 49 which communicates with
the inner conduit 31 while the transverse partition 40 and annulus 44 provide an inner lubricant chamber or space 50 which communicates with the axial bore 15 and with the cavities G by openings 51 in the hub wall through which the connecting rods 35 extend. Referring again to FIGS. 1 and 2, oil for the conduit portion of the lubricating system is supplied, for example, by a gravity tank T and line 51a to a compartment or manifold 52 which is sealed about the outer conduit S to permit rotation of S relative thereto. From the compartment or manifold 52 the oil by openings 53 enters the annular space formed between the outer conduit S and the annulus 31a of the inner conduit 31. The annular space is provided with bushings 54 and 55, which form another compartment or manifold 56 and oil passes therefrom to the inner conduit 31 by passageways 57 formed in the end portion 31a of inner conduit and into the end compartment 49. In addition to seal 48, other seals are shown at 58 between the propeller shaft S and hub housing 10 and at 59 between the hub housing and spacer ring 12. Oil for the chamber or space 50 is supplied by an oil inlet 60 in the casing 11 from which it passes by openings 51 to cavities G, and directly to the axial passageway 15 and into the outer conduit S to the bushing 54.

The bushings 54 and 55 are spaced a distance approximating the length of the stroke of reciprocation of the inner conduit 31 and during reciprocation oil moves between the gravity tank T and end chamber 49 and provides an arrangement for taking care of any pressure surges which may occur in this portion of the lubricating system. It will be understood that the lubricant chambers, cavities and conduits of the system will be filled with lubricating oil during operation of the equipment and that there will be some leakage of oil between end compartment 49 and oil chamber 50 and between the manifold 56 and chamber 50 and thus maintain a substantially constant pressure within the entire lubricating system. 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. Marine propulsion equipment comprising
   (a) a propeller hub having an axial bore and a group of radial cavities each having mounting structure for a propeller device;
   (b) a casing having an open inner end secured to one end face of the hub and a closed outer end;
   (c) a transverse partition in the casing spaced from said one end face of the hub and having a central opening therein;
   (d) a cylindrical housing extending axially through the central opening in the partition having an open inner end facing said one end face of the hub and a closed outer end;
   (e) said partition and housing providing a lubricating oil compartment in communication with the hub axial bore;
   (f) apertures in said one face of the propeller hub providing communication between the lubricating compartment and said cavities;
   (g) an outer conduit secured to the other end face of the hub and communicating with the hub axial bore;
   (h) an inner conduit having one end portion concentric with the outer conduit providing an annular space therewith;
   (i) said inner conduit extending through the hub axial passageway in spaced relation therewith and having its other end portion within said cylindrical housing;
   (j) sealing means between said other end portion of the inner conduit and the cylindrical housing providing an outer lubricant chamber in communication with said inner conduit;
   (k) an oil reservoir in communication with the annular space between the outer conduit and inner conduit;
   (l) said inner conduit for the passage of oil from said annular space to the outer lubricant chamber whereby the inner conduit may be reciprocated without increasing pressure of the lubricating oil in the lubricating oil compartment and hub cavities.

2. Marine propulsion equipment comprising
   (a) a propeller hub having an axial bore and a group of radial cavities each having mounting structure for a propeller device;
   (b) a casing having an open inner end secured to one end face of the hub and a closed outer end;
   (c) a transverse partition in the casing spaced from said one end face of the hub and having a central opening therein;
   (d) a cylindrical housing extending axially through the central opening in the partition having an open inner end facing said one end face of the hub and a closed outer end;
   (e) said partition and housing providing a lubricating oil compartment in communication with the hub axial bore;
   (f) apertures in said one face of the propeller hub providing communication between the lubricating compartment and said cavities;
   (g) an outer conduit secured to the other end face of the hub and communicating with the hub axial bore;
of the hub and communicating with the hub axial bore;

(h) an inner conduit having one end portion concentric with the outer conduit providing an annular space therewith;

(i) said inner conduit extending through the hub axial passageway in spaced relation therewith and having its other end portion within said cylindrical housing;

(j) sealing means between said other end portion of the inner conduit and the cylindrical housing providing an outer lubricant chamber in communication with said inner conduit;

(k) an oil reservoir in communication with the annular space between the outer conduit and inner conduit;

(l) apertures in the inner conduit for the passage of oil from said annular space to the outer lubricant chamber;

(m) said cylindrical housing having a smaller diameter providing with the end portion of the inner conduit an annulus substantially the size of said annular space; and

(n) linkage between the inner conduit and said mounting structure whereby the inner conduit may be reciprocated to rotate the propeller devices without increasing pressure of the lubricating oil in the lubricating oil compartment and hub cavities.

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