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(72) Inventors:
• **Plough, Kurt**
9900 Frederikshavn (DK)
• **Pedersen, Arne Flemming**
9300 Sæby (DK)
• **Boesen, Kenneth**
9900 Frederikshavn (DK)
• **Hvoldal, Mads**
9000 Aalborg (DK)

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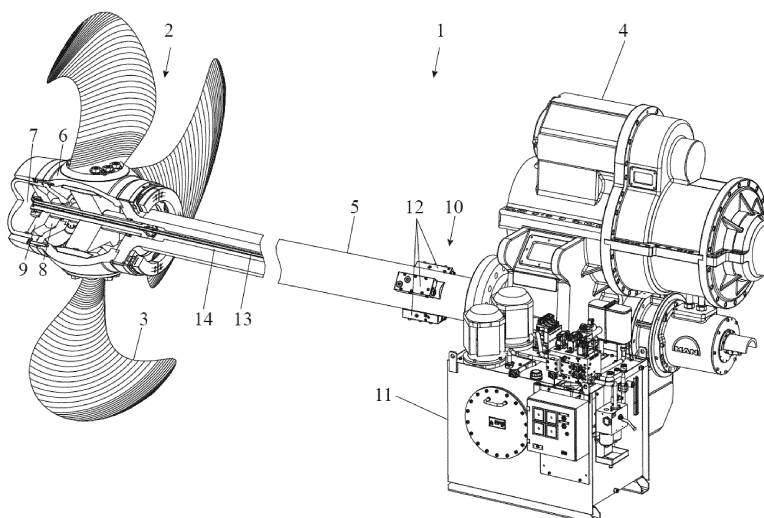
(71) Applicant: **MAN DIESEL & TURBO, FILIAL AF MAN DIESEL & TURBO SE, TYSKLAND**
2450 Copenhagen SV (DK)

(54) **Ship propulsion system**

(57) Described is a ship propulsion system (1) comprising a propeller arrangement (2) having at least one adjustable propeller blade (3) connected to a hub (6) housing a hydraulic cylinder arrangement comprising a first pressure chamber (7) and a second pressure chamber (8) separated by a piston (9) connected to and operating an regulating device for the at least one adjustable propeller blade (3) and a propeller shaft (5) located between the hub (6) and a torque transmission unit (4) where the propeller shaft (5) comprises a valve arrangement (10) provided with fluid from a hydraulic power unit

(11) and having a number of valve fluid channels (17,18,19,20) connected to a number of check valves (15,16) for controlling a flow of fluid through a first duct (13) and a second duct (14) to the first pressure chamber (7) and from the second pressure chamber (7), respectively, or vice versa. The ship propulsion system is characterized in that the valve arrangement (10) comprises at least one check valve (15,16) arranged in a valve housing (12) being mounted to an outside surface of the propeller shaft (5) and rotating together with the propeller shaft (5).

Fig. 1



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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a ship propulsion system comprising a propeller arrangement having at least one adjustable propeller blade connected to a hub housing a hydraulic cylinder arrangement comprising a first pressure chamber and a second pressure chamber separated by a piston connected to and operating a regulating device for the at least one adjustable propeller blade and a propeller shaft located between the hub and a torque transmission unit where the propeller shaft comprises a valve arrangement provided with a fluid from a hydraulic power unit and having a number of valve fluid channels connected to a number of check valves for controlling a flow of fluid through a first duct to the first pressure chamber and through a second duct from the second pressure chamber or vice versa.

BACKGROUND OF THE INVENTION

[0002] Ship propulsion systems of the above-mentioned kind are well known for adjusting propeller blades on controllable pitch propellers. It is known to arrange an oil distribution arrangement, comprising a stationary oil distribution ring and a valve box, on the input shaft side of a gearbox where an external hydraulic power unit supplies servo oil to two hydraulic inlet ports connected to the stationary oil distribution ring which encloses the valve box. Usually a number of check valves are mounted in the valve box for holding the oil pressure in the two servo oil chambers in a propeller hub to lock a piston when no change in pitch is desired. The piston is connected to and operates an adjusting device for the propeller blade. An oil distribution arrangement of this type is disclosed in the Korean patent application 20120003058. A disadvantage with such a ship propulsion system is that the check valves, which regularly require service and maintenance, are difficult to access as they are located in the valve box which is enclosed by the stationary oil distribution ring and housing. This means that service and maintenance of the check valves will require much dismantling which is time-consuming and thus costly. A further disadvantage relating to this oil distribution arrangement is that the rotating motion between the stationary oil distribution ring and the rotating valve box will induce some leakage between these elements. Moreover, it is disadvantageous that the oil distribution arrangement is located between the gearbox and the engine as the space in that area is very narrow and thus difficult to access for service and maintenance.

DISCLOSURE OF THE INVENTION

[0003] It is an object of the present invention to provide a ship propulsion system where the above-mentioned disadvantages are eliminated or significantly reduced.

[0004] This is achieved by a ship propulsion system of the kind mentioned in the introduction being characterized in that the valve arrangement comprises at least one check valve arranged in a valve housing being mounted on an outside surface of the propeller shaft and rotating together with the propeller shaft.

[0005] Hereby it is obtained that the check valves are easy accessible as the valve housings are located on the outside surface of the propeller shaft which is open to the environment in the engine room. No cover or surrounding oil distribution ring for the valve housings is needed, thus, service and maintenance can be carried out quickly without much dismantling resulting in less downtime and reduced costs. Moreover, as no relative rotational movement is present no leakage caused by such movement will occur in the arrangement.

[0006] It is preferred that the valve arrangement is provided with fluid from the hydraulic power unit via a number of central fluid channels located inside the propeller shaft. This ensures that at very compact design can be obtained.

[0007] Furthermore, it is preferred that the check valves are arranged in at least two separate valve housings distributed on the circumference of the propeller shaft. In this way the needed amount of fluid can be directed via several check valves meaning that the size of the individual check valves may be reduced and, furthermore, in case of failure of a single check valve in a valve housing the other check valves will still be able to provide enough fluid to the pressure chambers in the hydraulic cylinder arrangement for moving the piston which adjusts the propeller blades.

[0008] In principle the valve housings may be fixed to the propeller shaft by any suitable means e.g. by means of welding, gluing or any kind of mechanically locking arrangements. However, it is preferred that at least one valve housing is fixed to the propeller shaft by means of demountable fastening means, such as screwed connections. By mounting the valve housings, in which one or more check valves are arranged, with screwed connections, it will be easy to demount a valve housing when required, e.g. for maintenance.

[0009] In one embodiment at least one valve housing is configured as a sleeve or ring enclosing the propeller shaft. Such a sleeve or ring may be shrink-fitted to the propeller shaft. In this way one or more valve housings may be integrated in a single sleeve. The sleeve may be divided into two half sections, or more sections, for easy assembling around the propeller shaft.

[0010] In another embodiment the valve arrangement comprises an outer tube enclosing at least a portion of an inner tube device configured for axial movement and comprising a first pipe portion, an intermediate solid portion and a second pipe portion where the inner tube device is configured for directing fluid through the number of check valves to or from the hydraulic cylinder arrangement and where the first pipe portion and the second pipe portion each are provided with a radial fluid channel con-

nected to a first intermediate fluid chamber and a second intermediate fluid chamber, respectively, provided between a portion of the outer tube and a portion of the inner tube device and where the intermediate fluid chambers are located separately from each other and connected to the number of check valves via the valve fluid channels. In this way the valve arrangement can be made very compact as the fluid from the hydraulic power unit may be supplied via a number of central fluid channels located inside the propeller shaft. The first and second intermediate fluid chambers may comprise a first recess and a second recess, respectively, provided internally in the outer tube or provided on the circumference of a portion of the inner tube device.

[0011] It is preferred that sealing means configured to allow axial movements between the inner tube device and the outer tube are provided at both ends of each intermediate fluid chamber. This will effectively seal the intermediate fluid chambers from each other even when the inner tube device moves axially relative to the outer tube. The sealing means are preferably also suitable for rotatable movements between the outer tube and the inner tube device.

[0012] Furthermore, it is preferred that the inner tube device is connected to the piston at a first end and connected to means indicating the position of the piston at a second end. Thereby it is obtained that an axial movement of the piston in the hydraulic cylinder arrangement will move the inner tube device the same distance as the piston is moved and when connected to means indicating the position of the piston it will be possible to read off the position of the propeller blades. The means for indicating the position of the piston may in principle be constituted by any means as long as it is possible to read off the position of the piston. However, it is preferred that the means comprise a ring surrounding the propeller shaft and being connected to the inner tube device via a rod through a longitudinal hole in the propeller shaft. Preferably, the ring interacts with feed-back means for on-line control and regulation of the position of the propeller blades.

[0013] The axial extend of each intermediate fluid chamber should preferably at least be equal to the length of the stroke of the piston to ensure that the intermediate fluid chambers at the maximum and minimum position of the piston are located within the outer tube.

[0014] The fluid may in principle be any kind of fluid as long as it is suitable for the hydraulic operation of the components in the ship propulsion system. However, it is preferred that the fluid is an oil.

[0015] The engine powering the ship propulsion system may be a two-stroke internal combustion engine, e. g. a large low speed turbocharged crosshead engine, or a four-stroke internal combustion engine. The engine may be connected directly to the propeller shaft or connected to the propeller shaft via a gear. The in the introduction mentioned torque transmission unit is preferably the gear or the engine itself when the propeller is directly

connected to the engine.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] In the following detailed portion of the present description, the invention will be explained in more detail with reference to the exemplary embodiments shown in the drawings, in which:

Fig. 1 shows a ship propulsion system according to an exemplary embodiment of the invention, and

Fig. 2 shows a cross-sectional view of a section of the ship propulsion system according to an exemplary embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0017]

Fig. 1 shows a ship propulsion system 1 for adjusting propeller blades 3 on a controllable pitch propeller 2. A main engine (not shown), preferably an internal combustion engine, is connected to a gear 4 which is connected to a propeller shaft 5. The adjustable propeller blades 3 are connected to a hub 6 housing a hydraulic cylinder arrangement comprising a first pressure chamber 7 and a second pressure chamber 8 separated by a piston 9 connected to and operating a regulating device for the adjustable propeller blades 3. The propeller shaft 5 is located between the hub 6 and the gear 4 and comprises a valve arrangement 10 provided with fluid through the propeller shaft 5 from a hydraulic power unit 11. Valve housings 12 with check valves 15, 16 (see Fig. 2) for controlling a fluid flowing to the first pressure chamber 7, through a first duct 13 arranged centrally inside the propeller shaft 5, and from the second pressure chamber 8 through a second duct 14, comprising the surrounding space between the first duct 13 and a hollow portion of the propeller shaft 5, or vice versa, are mounted by means of screwed connections (not shown) on the circumference of the propeller shaft 5. Thus, the valve housings 12 and the check valves 15, 16 rotate with the propeller shaft 5.

Fig. 2 shows a cross-sectional view of a section of the ship propulsion system and it is seen that the valve arrangement 10 is provided with a number of valve fluid channels comprising a first 17, a second 18, a third 19 and a fourth valve fluid channel 20 located inside and in the propeller shaft and connected to the check valves 15, 16 for controlling the fluid flow through the first duct 13 and the second duct 14 to move the piston 9 and thereby the propeller blades 3 (see fig. 1).

[0018] The valve arrangement 10 comprises an outer tube 21 arranged inside the propeller shaft 5 and enclosing a portion of an inner tube device configured for axial and rotational movement in relation to the outer tube 21 and comprising a first pipe 22 portion, an intermediate solid portion 23 and a second pipe portion 24. The inner tube device is configured for directing fluid through the check valve 16 to or from the first pressure chamber 7 (see Fig. 1). The first pipe portion 22 is provided with a first radial fluid channel 26 and the second pipe portion 24 is provided with a second radial fluid channel 25 which, respectively, are connected to a first recess 27 and a second recess 28 provided in the outer tube 21. The recesses 27,28 are provided on the inside of the outer tube 21 and located separately from each other and connected to the check valve 15 via the valve fluid channels 17,18. Sealing and steering means 29 configured to allow axial movements between the inner tube device and the outer tube 21 are provided at both ends of each recess 27, 28.

[0019] When a certain adjustment of the propeller blades 3 is required a directional valve on the hydraulic power unit 11 (see Fig. 1) directs fluid into a first central fluid channel comprising the first pipe portion 22 so as to make the fluid flow through the first radial fluid channel 26, the first recess 27, the first valve fluid channel 17, the check valve 16, the second valve fluid channel 18, the second recess 28, the second radial fluid channel 25, the second pipe portion 24, the first duct 13 and into the first pressure chamber 7 (see Fig. 1) thereby moving the piston 9 axially towards the gear 4 and thus via the regulating device adjusting the pitch of the propeller blades 3. The movement of the piston 9 will force an amount of fluid, equivalent to the movement of piston, to flow out of the second pressure chamber 8 and through the second duct 14, the third valve fluid channel 19, the check valve 15, the fourth valve fluid channel 20 and through a second central fluid channel 30 comprising the space between the outer circumference of the outer tube 21 and a hollow portion of the propeller shaft 5 and back to the tank of the hydraulic power unit 11. When an adjustment of the propeller blades 3 in the opposite direction is required the fluid flow is reversed according to the before-mentioned sequence. The check valves 15,16 are preferably pilot controlled check valves where an increase in pressure on the engine side of a pilot controlled check valve will force a pilot opening of the check valve controlling the return flow. The pilot fluid channels are not shown.

[0020] The term "comprising" as used in the claims does not exclude other elements or steps. The term "a" or "an" as used in the claims does not exclude a plurality.

[0021] The reference signs used in the claims shall not be construed as limiting the scope.

[0022] Although the present invention has been described in detail for purpose of illustration, it is understood that such detail is solely for that purpose, and variations can be made therein by those skilled in the art without departing from the scope of the invention.

Claims

1. Ship propulsion system (1) comprising a propeller arrangement (2) having at least one adjustable propeller blade (3) connected to a hub (6) housing a hydraulic cylinder arrangement comprising a first pressure chamber (7) and a second pressure chamber (8) separated by a piston (9) connected to and operating a regulating device for the at least one adjustable propeller blade (3) and a propeller shaft (5) located between the hub (6) and a torque transmission unit (4) where the propeller shaft (5) comprises a valve arrangement (10) provided with a fluid from a hydraulic power unit (11) and having a number of valve fluid channels (17,18,19,20) connected to a number of check valves (15,16) for controlling a flow of fluid through a first duct (13) to the first pressure chamber (7) and through a second duct (14) from the second pressure chamber (8) or vice versa **characterized in that** the valve arrangement (10) comprises at least one check valve (15,16) arranged in a valve housing (12) being mounted on an outside surface of the propeller shaft (5) and rotating together with the propeller shaft (5).
2. Ship propulsion system according to claim 1 **characterized in that** the valve arrangement (10) is provided with fluid from the hydraulic power unit (11) via a number of central fluid channels (22, 30) located inside the propeller shaft (5).
3. Ship propulsion system according to claim 1 or 2 **characterized in that** at least two check valves (15,16) are arranged in at least two separate valve housings (12) distributed on the circumference of the propeller shaft (5).
4. Ship propulsion system according to any preceding claim **characterized in that** at least one valve housing (12) is mounted on the propeller shaft (5) by means of demountable fastening means.
5. Ship propulsion system according to claim 1 or 2 **characterized in that** the valve housing (12) is configured as a sleeve enclosing the propeller shaft (5).
6. Ship propulsion system according to any preceding claim **characterized in that** the valve arrangement (10) comprises an outer tube (21) enclosing at least a portion of an inner tube device configured for axial movement and comprising a first pipe portion (22), an intermediate solid portion (23) and a second pipe portion (24) where the inner tube device is configured for directing fluid through the number of check valves (16) to or from the hydraulic cylinder arrangement (7,8,9) and where the first pipe portion (22) and the second pipe portion (24) each are provided with a radial fluid channel (25, 26) connected to a first in-

intermediate fluid chamber (27) and a second intermediate fluid chamber (28), respectively, provided between a portion of the outer tube (21) and a portion of the inner tube device and where the intermediate fluid chambers (27,28) are located separately from each other and connected to the number of check valves (16) via the valve fluid channels (17,18). 5

7. Ship propulsion system according to claim 6 **characterized in that** sealing means (29) configured to allow axial movements between the inner tube device (22,23,24) and the outer tube (21) are provided at both ends of each intermediate fluid chamber (27,28). 10

8. Ship propulsion system according to claim 6 or 7 **characterized in that** the inner tube device (22,23,24) is connected to the piston (9) at a first end and connected to means indicating the position of the piston (9) at a second end. 15 20

9. Ship propulsion system according to any of claims 6-8 **characterized in that** the axial extend of the first intermediate fluid chamber (27) and the second intermediate fluid chamber (28) at least is equal to the length of the stroke of the piston (9). 25

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Fig. 1

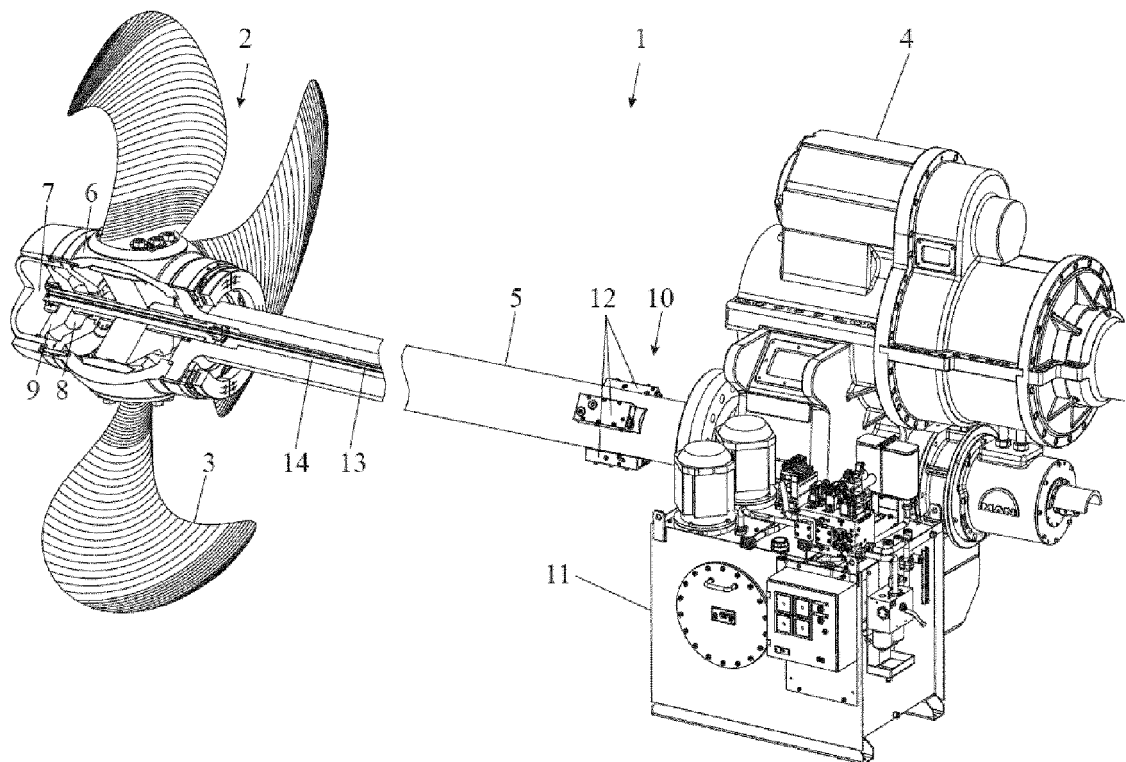
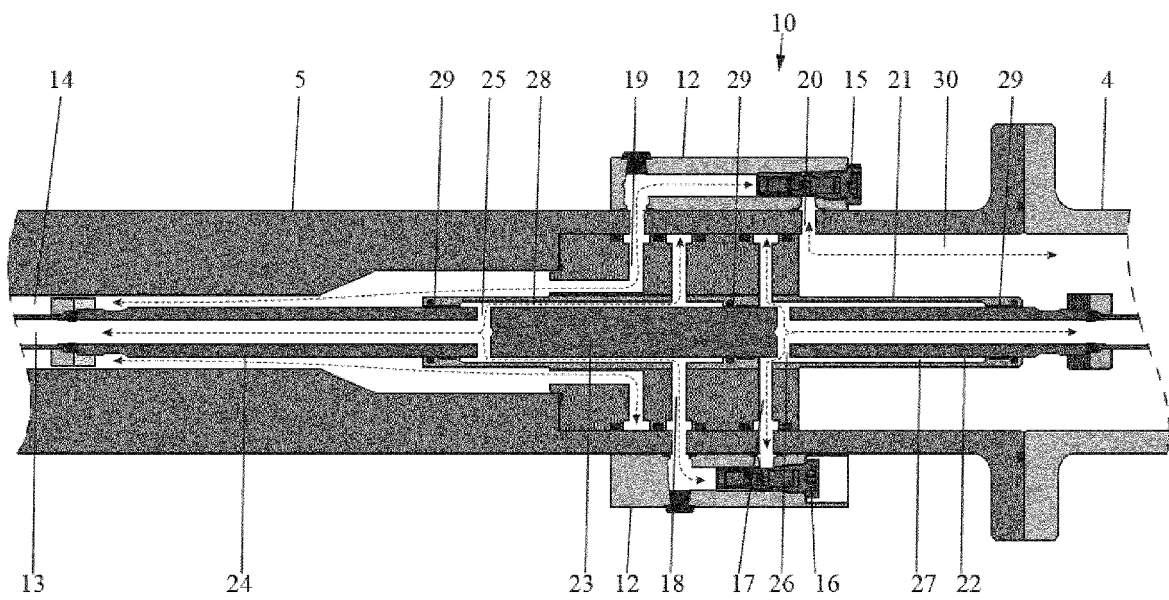


Fig. 2



REFERENCES CITED IN THE DESCRIPTION

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