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HYDRAULIC SERVO-MOTORS

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Fig.1

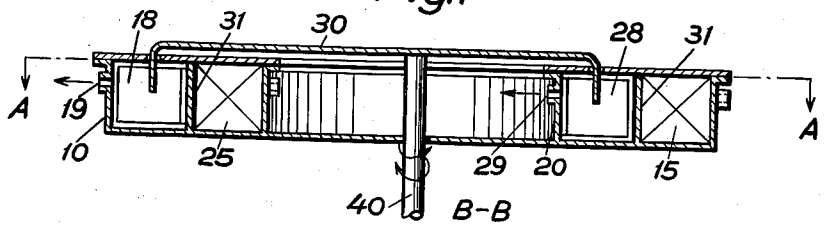
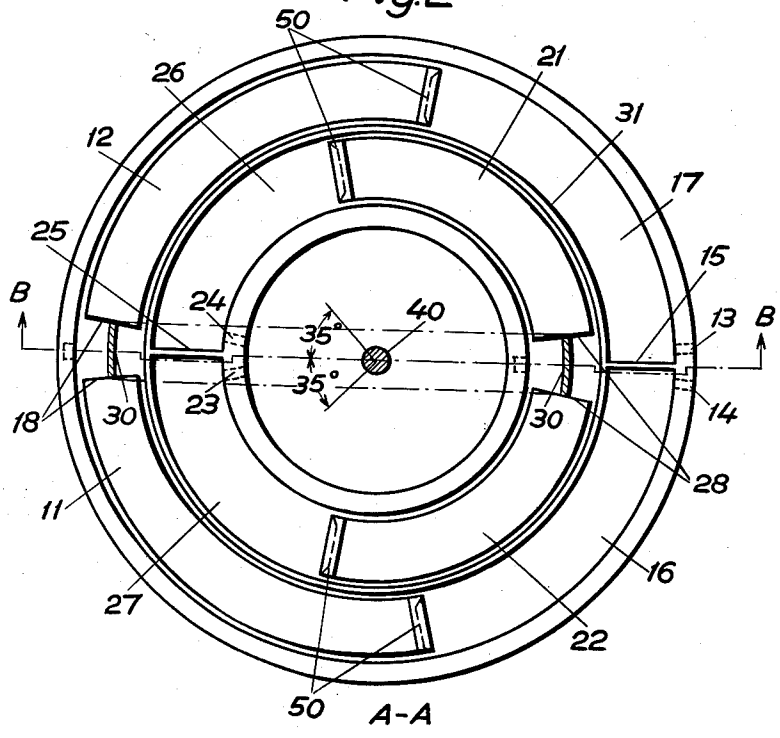


Fig.2



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HYDRAULIC SERVO-MOTORS

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5 Claims. (Cl. 121—98)

This invention relates to hydraulic servo-motors of the kind wherein pump, valve and conduit means are adapted to supply fluid under pressure to cylinders in which the pressure fluid actuates circularly movable pistons which manoeuvre an operating member connected to an oscillatory steering member. Motors of this kind are particularly suitable for operating the rudder of a ship.

The invention has for an object the production of a steering gear of simple and durable construction which may be employed for either light or heavy duty.

In a known construction of this type a single annular cylinder is disposed on an axis co-axial with that of a rudder shaft and the cylinder is interrupted by a partition and comprises a semi-annular movable piston; to move the piston, fluid under pressure is forced into and out of the cylinder, respectively, through ports on either side of the said partition. In the known construction a tiller is operatively connected to the rudder shaft and is operatively connected with the piston by projecting its outer end into a recess in the piston through an aperture in the side wall of the cylinder. In another proposed construction of this type a single annular cylinder comprises two arcuate counteracting pistons, the opposite ends of which freely engage or press against the outer end of the tiller, which projects into the cylinder through an aperture in the side wall of the cylinder.

A series disadvantage of these constructions is that the servo-motor only comprises a single cylinder and the whole ship depends on the faultless function of this. Another disadvantage is that the servo-motor is asymmetrical in construction, so that the forces applied to the tiller will cause serious radial stresses in the rudder shaft, the effect of these stresses being heavy wear in the shaft bearing which may later on, result in oil leakage through said bearing. As the said bearing and servo-motor, in the known constructions, constitute a unit assembly, the maintenance of either the bearing or the servo-motor will also be troublesome.

The said disadvantages are eliminated according to the invention where the servo-motor comprises at least two separate concentric cylinders disposed on a common axis co-axial with that of the oscillatory steering member, which cylinders each comprise either a single semi-annular piston or two semi-annular counteracting pistons.

According to the invention the operating member may be in the form of a member extending diametrically across the steering member, i.e. two radial arms on a common axis projecting from the steering member. In this way it is possible to apply the forces to the operating member as a turning couple of forces and with all the pistons having the same cross-sectional area the stresses in the radial bearing of a steering member will all be eliminated and as a result it is possible to omit the radial bearing by using the two concentric cylinders which are disposed in the same plane.

According to the invention, where the pistons preferably have rectangular cross-section, the operating member extends above the top of the cylinders and the ends of the said member, to engage the pistons, extend downward through apertures in the top of the cylinders. This construction simplifies the lubrication of the cylinders, because the body of the cylinders constitutes an oil chamber. Preferably two annular concentric cylinders with rectangular cross-section have a common intermediate side wall and thereby the top of the cylinders may constitute a single cover.

In the construction according to the invention the maintenance is simplified because the radial bearing of the steering member is omitted and it is very easy to disengage the operative member connected to the steering member from the pistons and the cylinders, by lifting the operating member vertically after it is disconnected from the steering member.

In order that the invention may be more readily understood, reference is made to the accompanying drawings, which illustrate diagrammatically and by way of example, one embodiment of the hydraulic servo-motor with co-operative or counteracting circularly movable pistons in each of the cylinders, the servo-motor applied to a rudder shaft of a ship and in which:

Fig. 1 is a sectional view of the servo-motor taken along the line B—B of Fig. 2; and Fig. 2 is a sectional view taken along the line A—A of Fig. 1.

The pump, valve and conduit means adapted to supply fluid under pressure to and from the cylinders can be of conventional type and are not shown in the drawings.

The servo-motor illustrated in the drawing consists of two annular, concentric cylinders 10 and 20 with a rectangular cross-section, a common side wall 31, counteracting pistons 11, 12 and 21, 22 respectively, with opposite ends 18 and 28 respectively of the pistons, freely engaging a tiller 30 connected to a rudder shaft 40. Each cylinder 10 and 20 respectively, is interrupted by a partition 15 and 15 respectively and the spaces behind the pistons 11, 12, 21, 22 are indicated by 16, 17, and 26, 27 respectively. The cylinders have ports 13, 14 and 23, 24 respectively on either side of the partitions 15 and 25 respectively. In addition, the cylinders have ports 19 and 29 respectively, for the escape of the superfluous oil. In the figures, the tiller 30 is shown in its middle position and can be turned clockwise or anti-clockwise at least 35° from this position. To obtain a clockwise movement the oil is forced in through the ports 14 and 24. The increase in the pressure, obtained in this way, in the spaces 16 and 26 respectively, will exert a pressure on the pistons 11 and 21, which turn clockwise and the tiller 30, which freely engages the end areas 18 and 28 will also be turned clockwise. By turning clockwise, the tiller 30 moves the pistons 12 and 22 and thereby the pressure oil is freed from the spaces 17 and 27 through the ports 13 and 23 respectively. The movement of the tiller comes to an end as, with the help of the rudder shaft and rudder torque counter-balances the difference in pressure between the spaces 16 and 17, 26 and 27 respectively. To obtain equality between the forces exerted by the pistons 11 and 21 on the tiller 30, in which way the forces constitute a turning couple and the radial stresses are minimized, the pressure in the said spaces 16 and 26 should be equal. It should be the same for the counter pressures in the spaces 17 and 27. Owing to the steady counteraction of the pistons with a certain force, the advantage is obtained that no bad contact between the pistons and tiller will emerge and the source of the wear and the disturbing noise will be eliminated in this way.

Should it be desired to turn the tiller in an anti-clockwise way, the oil should be forced in through the ports 13 and 23 respectively and out through the ports 14 and 24

respectively. The function of the servo-motor is on this occasion just the same as for the clockwise turning.

The lubrication of the cylinders **10** and **20** is obtained with the help of the oil found between the ends **18** and **28** of the pistons. Should the quantity of oil between the said ends **18**, **28** increase owing to leakage through the packing **50** of the pistons, the superfluous oil will leak out through the ports **19** and **29** and later accumulate in an appropriate way.

As the servo-motor according to the invention consists of at least two cylinders, this implies that a breakdown of one of the cylinders will not imperil the safety of the ship.

The invention is not restricted to the embodiment described above, but can be modified in various ways and other forms of construction are also possible. For example it would be possible to arrange the servo-motor for operating valves, doors or similar devices.

I claim as my invention:

1. A hydraulic steering apparatus for a ship's rudder shaft, comprising two annular cylinders having a rectangular cross-section, the said cylinders being concentrically disposed in the same plane and on a common axis co-axial with that of the rudder shaft, each of said cylinders having a radially disposed partition and on either side of said partition having connections in the cylinder-wall for a pressure medium, the said cylinders having a covering means, semi-annular pistons circularly movable in said cylinders, a tiller connected to said rudder shaft and extending diametrically across said shaft and above said covering means, and the said tiller having downwardly projecting ends, the said ends passing through apertures in the covering means of said cylinders to engage the said pistons.

2. A hydraulic steering apparatus comprising the features as set out in claim 1, in which the said semi-annular pistons comprise a pair of counteracting pistons in each of said cylinders, the opposite ends of said pair of pistons freely pressing against one of said downwardly projecting ends of said tiller.

3. A hydraulic steering apparatus for a ship's rudder shaft, comprising two annular cylinders having a rectangular cross-section, the said cylinders being concentrically disposed in the same plane and on a common axis co-axial with that of the rudder shaft, each of said cylinders having a radially disposed partition and on either side of said partition having connections in the cylinder-wall for a pressure medium, the said cylinders having a common top cover, semi-annular pistons circularly movable in said cylinders, a tiller connected to said rudder shaft and extending diametrically across said shaft and above said common top cover and the said tiller having downwardly projecting ends, the said ends passing through apertures in the said common top cover to engage the said pistons.

4. A hydraulic steering apparatus comprising the features as set out in claim 3, in which the said semi-annular pistons comprise a pair of counteracting pistons in each of said cylinders, the opposite ends of said pair of pistons freely pressing against one of said downwardly projecting ends of said tiller.

5. A hydraulic steering apparatus as claimed in claim 4, in which said cylinders have a common side wall.

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