

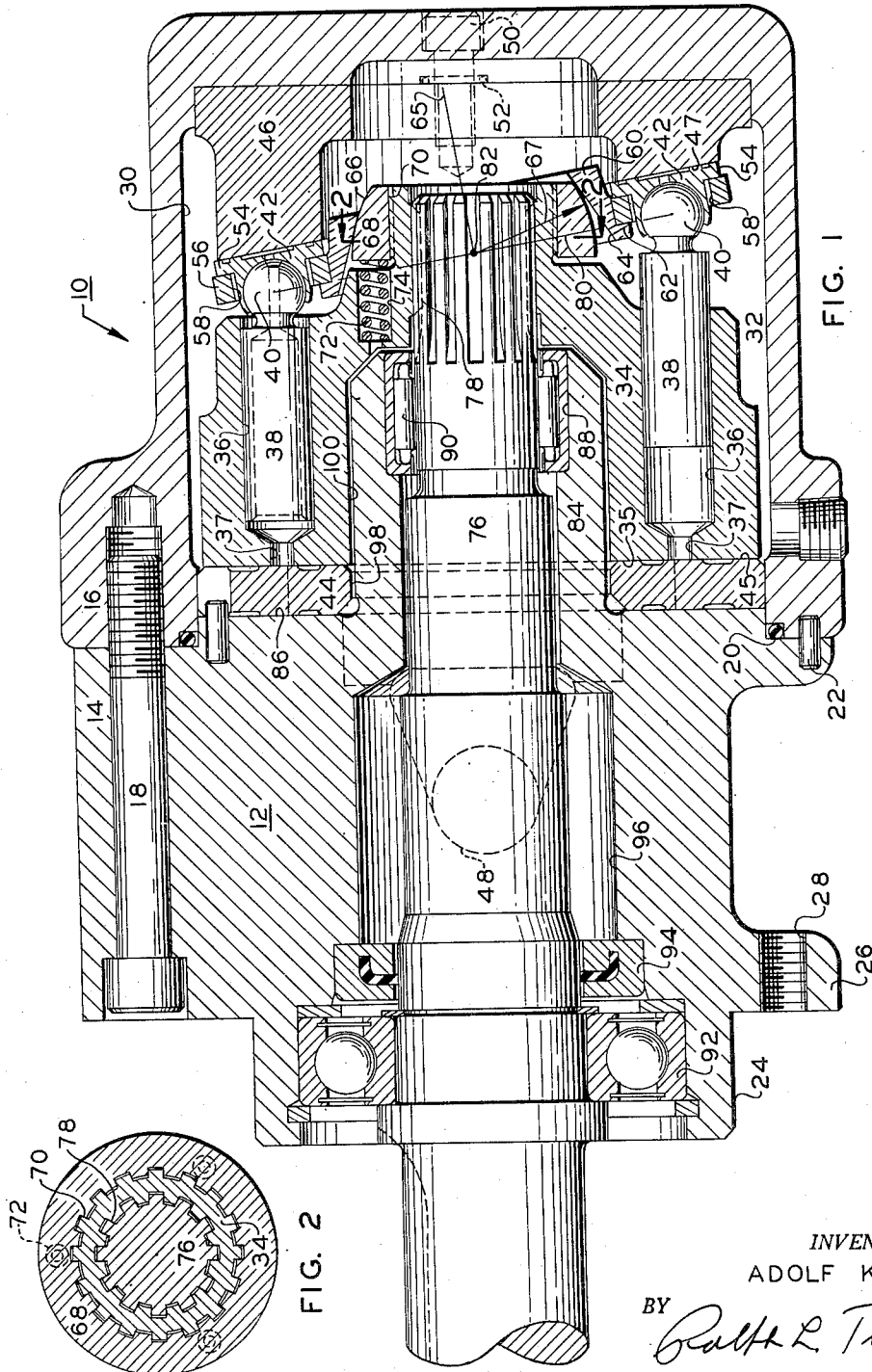
Jan. 8, 1957

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2,776,627

POWER TRANSMISSION

Filed July 10, 1952



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1

2,776,627

POWER TRANSMISSION

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Application July 10, 1952, Serial No. 298,079

4 Claims. (Cl. 103—162)

This invention relates to power transmissions, and is particularly applicable to those of the type comprising two or more fluid pressure energy translating devices, one of which may function as a pump and another as a fluid motor.

The invention is more particularly concerned with a fluid pump or motor construction of the type having a rotary cylinder barrel abutting a stationary valve plate and provided with axial cylinders and pistons reciprocal therein which abut against a thrust plate, the axis of which is inclined to the axis of rotation of the cylinder barrel. It is particularly concerned with that class of devices wherein the pistons abut directly against the inclined thrust plate without the use of articulated connecting rods so that the driving torque is transmitted to the pistons acting as cantilevers by reason of that component of piston thrust against the inclined thrust plate which is normal to the shaft axis.

When a unit of this type is operating under pressure, certain related areas are so proportioned that the cylinder barrel is positively biased toward the valve plate by that pressure in a manner well known in the art. For purposes of starting, however, it is necessary that the barrel be mechanically biased against the valve plate. Further, it is necessary that the pistons be biased outwardly toward the thrust plate to provide proper operation of the device.

In such devices, the normal thrust component or side thrust on the piston not only creates the driving torque but also results in a substantial lateral force on the cylinder barrel tending to displace it from its normal position. In counteracting this lateral force it is important that the cylinder barrel be maintained flatly against the valve plate or it will frequently lift off completely due to fluid flow conditions let up when it starts to lift off slightly. This of course renders the whole device inoperative and may be very hazardous where the device is connected to operate certain types of loads. The axial position of the point of application of the cylinder barrel supporting force may be so selected as to minimize tilting forces on the barrel as hereinafter described.

In prior art devices of this class, support for the cylinder barrel against lateral displacement has been provided by two general schemes. The first of these provides a radial bearing encircling the cylinder barrel directly interposed between the cylinder barrel and the housing. The second scheme has been to support the cylinder barrel directly on the shaft at the driving connection therewith, and transmit the lateral thrust thereon to the housing through the shaft and shaft support.

The second of these schemes has an advantage in that the size and weight of the unit can be reduced, and its cost lowered. However, in the past, when the cylinder barrel was shaft supported, the means utilized for biasing the cylinder barrel into engagement with the valve plate and for biasing the pistons outwardly against the thrust plate were generally unsatisfactory.

It is an object of the present invention to provide

2

an improved cantilever piston type pump or motor of rugged, low cost construction.

More specifically, it is an object to provide such a device having improved means for biasing the cylinder barrel against the valve plate and the pistons outwardly against the thrust plate.

A further object is to provide such means which are particularly well suited for use with a cantilever piston pump in which the cylinder barrel is drive shaft supported.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred form of the present invention is clearly shown.

In the drawing:

Figure 1 is a longitudinal transverse section of a fluid pressure energy translating device incorporating a preferred form of the present invention.

Figure 2 is a partial section taken on line 2—2 of Figure 1.

The embodiment of the invention selected for illustration comprises pump 10 of the cantilever piston type. The housing 12 of pump 10 comprises two parts 14 and 16 secured together by bolts 18. An O ring seal 20 insures a fluid tight juncture of the two parts and the dowel pin 22 maintains proper angular alignment between them. Body 12 includes a pilot portion 24 and a mounting flange 26 having mounting holes 28 therein.

A bore 30 in housing 12 provides a chamber 32 having a cylinder barrel 34 positioned therein. Cylinder barrel 34 is provided with a plurality of bores 36, each having a piston 38 axially slidable therein and a cylinder port 37. Pistons 38 have spherical ends 40 on which are swaged the socketed shoes 42. The cylinder barrel 34 is positioned axially between a valve plate 44 and an inclined thrust plate 46. Valve plate 44 may be the type described in the patent to Harry F. Vickers et al., 2,313,407, and serves in a well known manner to provide properly phased fluid connection between ports 37 of bores 36 and the external inlet and outlet connection ports of the device, one of which is indicated at 48. Thrust plate 46 is secured to the housing 12 by a number of screws 50 sealed against leakage from chamber 32 by O rings 52.

Shoes 42 have outwardly extending flanges 54 which are contacted by an annular cage 56 provided with holes 58 corresponding to each piston 38. A sleeve 60 is provided with a shoulder 62 to contact cage 56 and has a truncated conical bore 64 therein. Conical bore 64 contacts the spherical outer surface 66 of a collar 68 which is provided with a female spline to engage a male spline on the cylinder barrel at 70. A plurality of springs 72 in recesses 74 in cylinder barrel 34 act through collar 68, sleeve 60, and cage 56 to bias the shoes 42 into engagement with the face 47 of thrust plate 46. The reaction force of springs 72 biases face 35 of the cylinder barrel 34 into engagement with face 45 of valve plate 44.

A drive shaft 76 is effective to transmit torque from a prime mover, not shown, to the cylinder barrel through a driving connection at 78. Further, it can be seen that the only radial support for cylinder barrel 34 is provided by the contact between the barrel and the shaft 76 at connection 78. Connection 78 is illustrated as a spline connection and preferably is of the universal type, that is, it prevents relative radial movement at the point of connection between shaft 76 and barrel 34 but permits axial movement of the barrel and existence of angularity between the shaft and cylinder barrel axes. Thus juncture of the faces 35 and 45 locates cylinder barrel 34 as to axial position and determines the angular posi-

3

tion of its axis, and connection 78 locates the barrel radially.

Referring to Figure 2, it can be seen that the spline connection 70 between the collar 68 and cylinder barrel 34 is concentric with the spline connection 78 between barrel 34 and shaft 76. Spline connection 70 provides, in a short axial distance, strong support for collar 68 against cocking relative to cylinder barrel 34.

Neglecting friction, torque applied to cylinder barrel 34 by drive shaft 76 is resisted by a force exerted on shoes 42 and hence pistons 38 by thrust plate 46. The force on each piston acts in a direction normal to face 47 of thrust plate 46 and has an effective point of application at the center of the spherical ends 40 of the pistons 30. This force on each piston can be resolved into an axial force and a radial force acting at the center of the spherical piston end. The summation of the radial forces is the radial force which must be supported by shaft 76 at the connection 78.

It is well known in the art that tipping forces on the cylinder barrel of such a unit can be kept to a minimum by providing its radial support as close as possible to a radial plane through the point of intersection of the drive shaft axis and the plane which includes the centers of the spherical ends of the pistons. The plane containing the centers of the piston ends is indicated at 80 and the point of intersection with the shaft axis at 82. It can be seen that connection 78 is axially centered about the intersection 82 thus minimizing tipping forces on the barrel 34.

The axis 65 of the conical bore 64 intersects the axis of shaft 76 at the point 82 and point 82 is also the center of the spherical surface 66 of collar 68 as indicated by the radius 67. The geometrical arrangement described insures that sleeve 60 and collar 68 can rotate freely about their respective axes while at the same time full circle contact is maintained between spherical surface 66 and conical bore 64. Further, relative motion between cage 56 and shoes 42 is thus minimized. Springs 72 are effective to bias the cylinder barrel 34 against valve plate 44 and shoes 42 against thrust plate 46 without appreciable flexure during operation of the unit. Long, trouble free life is thus assured.

A cylindrical extension 84 is provided, on the portion 14 of housing 12, which protrudes from the face 86 against which face the valve plate 44 rests. Extension 84 has a bearing bore 88 at its outward end and carries a shaft support bearing 90 therein. A second shaft support bearing 92 and a shaft seal 94 are provided in the shaft bore 96. Valve plate 44 and cylinder barrel 34 are provided with clearance bores 98 and 100, respectively, through which extension 84 passes. Bearing 90 is thus positioned in axial proximity to the connection 78 and the bending moment created by the radial load of barrel 34 on shaft 76 is minimized.

It will thus be seen that the present invention provides a rugged, low cost, and compact cantilever piston pump or motor having improved means for biasing the cylinder barrel against the valve plate and the pistons outwardly toward the thrust plate. Further, the invention provides such means especially well suited for use in a unit having a shaft supported cylinder barrel since the barrel support and the piston biasing mechanism may both be positioned at their optimum location without interference.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A fluid pressure energy translating device comprising: a drive shaft; a housing having a stationary valve plate; a rotatable cylinder barrel in abutment with the valve plate and in driving relation with the drive shaft,

4

and having a plurality of axial cylinder bores; pistons reciprocable in the bores each having a spherical surface at one end; an inclined thrust plate mounted in the housing in driving relation with the pistons; inlet and outlet ports alternately connectable through the valve plate to said cylinder bores by rotation of the cylinder barrel; means on the shaft for locating the barrel as to lateral position; an axially slidable collar encircling the drive shaft and having a spherical outer surface; a sleeve member having a conical bore contacting the spherical outer surface of the collar, the center of said spherical outer surface being positioned at the intersection of the axis of the conical bore and the axis of the drive shaft, the intersection of said axes being coincident with the point on the shaft axis at which the shaft axis pierces the plane containing the centers of said spherical surfaces at the ends of the pistons; a mechanical force transmitting connection between said sleeve and said pistons; and resilient biasing means exerted between the cylinder barrel and said collar whereby the cylinder barrel is biased against the valve plate and the pistons are biased toward the thrust plate.

2. A fluid pressure energy translating device comprising: a drive shaft; a housing having a stationary valve plate; a rotatable cylinder barrel in abutment with the valve plate and in driving relation with the drive shaft, and having a plurality of axial cylinder bores; pistons reciprocable in the bores and having a spherical surface at one end of each piston; an inclined thrust plate mounted in the housing in driving relation with the pistons; inlet and outlet ports alternately connectable through the valve plate to said cylinder bores by rotation of the cylinder barrel; means on the shaft for locating the barrel as to lateral position, said means including in its axial extent the point on the shaft axis at which the shaft axis pierces the plane containing the center of said spherical surfaces at the ends of the pistons; an axially slidable collar encircling the drive shaft and having a spherical outer surface; a sleeve member having a conical bore contacting the spherical outer surface of the collar, the center of said spherical outer surface being positioned at the intersection of the axis of the conical bore and the axis of the drive shaft, the intersection of said axes being coincident with the point on the shaft axis at which the shaft axis pierces the plane containing the centers of said spherical surface at the ends of the pistons; a mechanical force transmitting connection between said sleeve and said pistons; and resilient biasing means exerted between the cylinder barrel and said collar whereby the cylinder barrel is biased against the valve plate and the pistons are biased toward the thrust plate.

3. A fluid pressure energy translating device comprising: a drive shaft; a housing having a stationary valve plate; a rotatable cylinder barrel in abutment with the valve plate and in driving relation with the drive shaft, and having a plurality of axial cylinder bores; pistons reciprocable in the bores and having a spherical surface at one end of each piston; an inclined thrust plate mounted in the housing in driving relation with the pistons; inlet and outlet ports alternately connectable through the valve plate to said cylinder bores by rotation of the cylinder barrel; means on the shaft for locating the barrel as to lateral position, said means including in its axial extent the point on the shaft axis at which the shaft axis pierces the plane containing the center of said spherical surfaces at the ends of the pistons; an axially slidable collar encircling the drive shaft and having a spherical outer surface; a sleeve member having a central recess contacting the spherical outer surface of the collar, the center of said spherical outer surface being positioned at the point on the shaft axis at which the shaft axis pierces the plane containing the centers of said spherical surface at the ends of the pistons; a mechanical force transmitting connection between said sleeve and said pistons; and resilient

5

biasing means exerted between the cylinder barrel and said collar whereby the cylinder barrel is biased against the valve plate and the pistons are biased toward the thrust plate.

4. A fluid pressure energy translating device comprising: a drive shaft; a housing having a stationary valve plate; a rotatable cylinder barrel in abutment with the valve plate and in driving relation with the drive shaft, and having a plurality of axial cylinder bores; pistons reciprocable in the bores; an inclined thrust plate mounted in the housing in driving relation with the pistons; inlet and outlet ports alternately connectable through the valve plate to said cylinder bores by rotation of the cylinder barrel; means on the shaft for locating the barrel as to lateral position; an axially slidable collar encircling the drive shaft and having a spherical outer surface, said collar being so positioned that the center of said spherical surface lies on the drive shaft axis and approximately coin-

6

cident with the axial center of said means on the shaft; a sleeve member having a central recess contacting the spherical outer surface of the collar; a mechanical force transmitting connection between said sleeve and said pistons; and resilient biasing means exerted between the cylinder barrel and said collar whereby the cylinder barrel is biased against the valve plate and the pistons are biased toward the thrust plate.

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