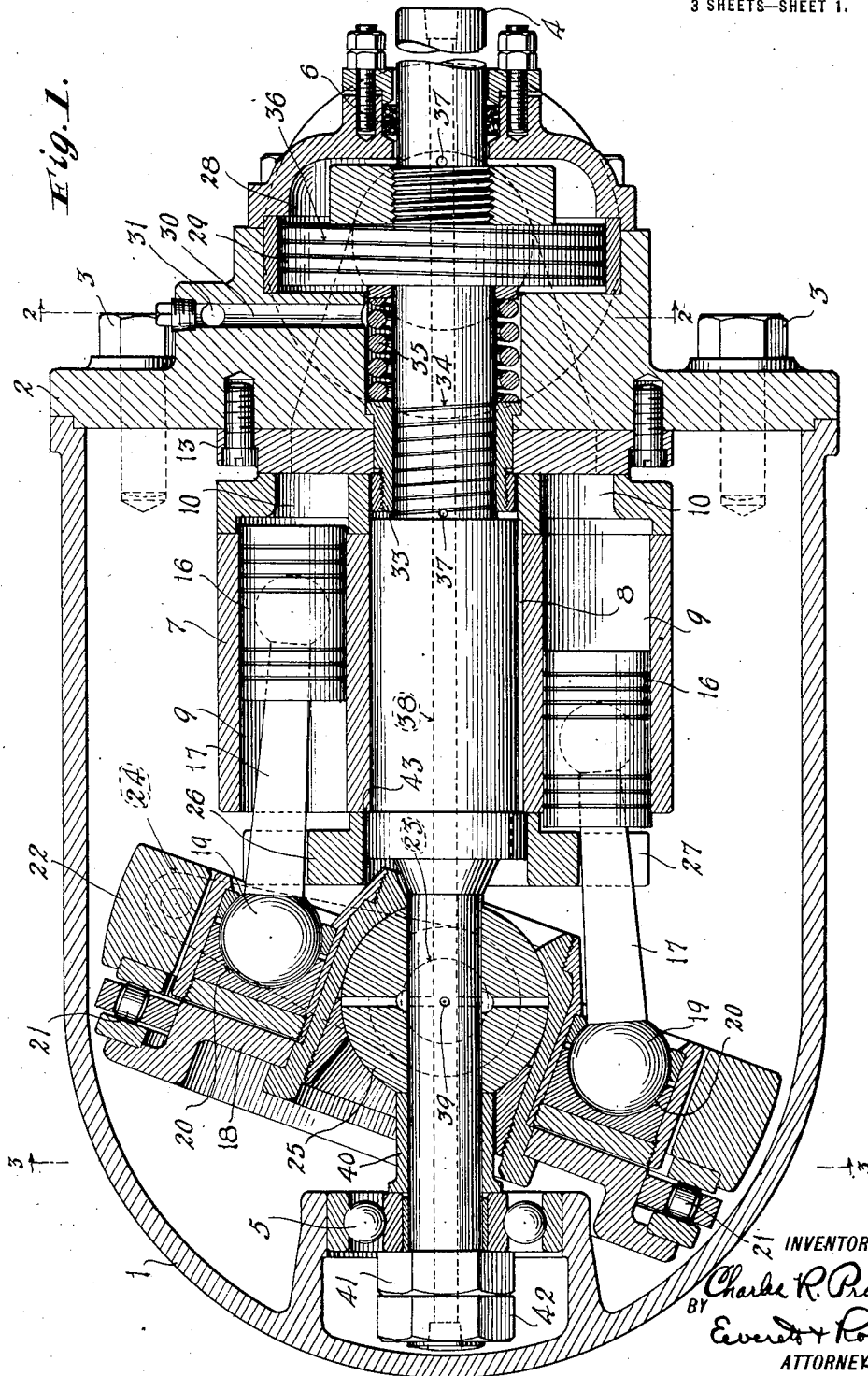


C. R. PRATT.
 FLUID POWER TRANSMISSION PUMP OR MOTOR.
 APPLICATION FILED FEB. 16, 1920.

1,362,040.

Patented Dec. 14, 1920.

3 SHEETS—SHEET 1.

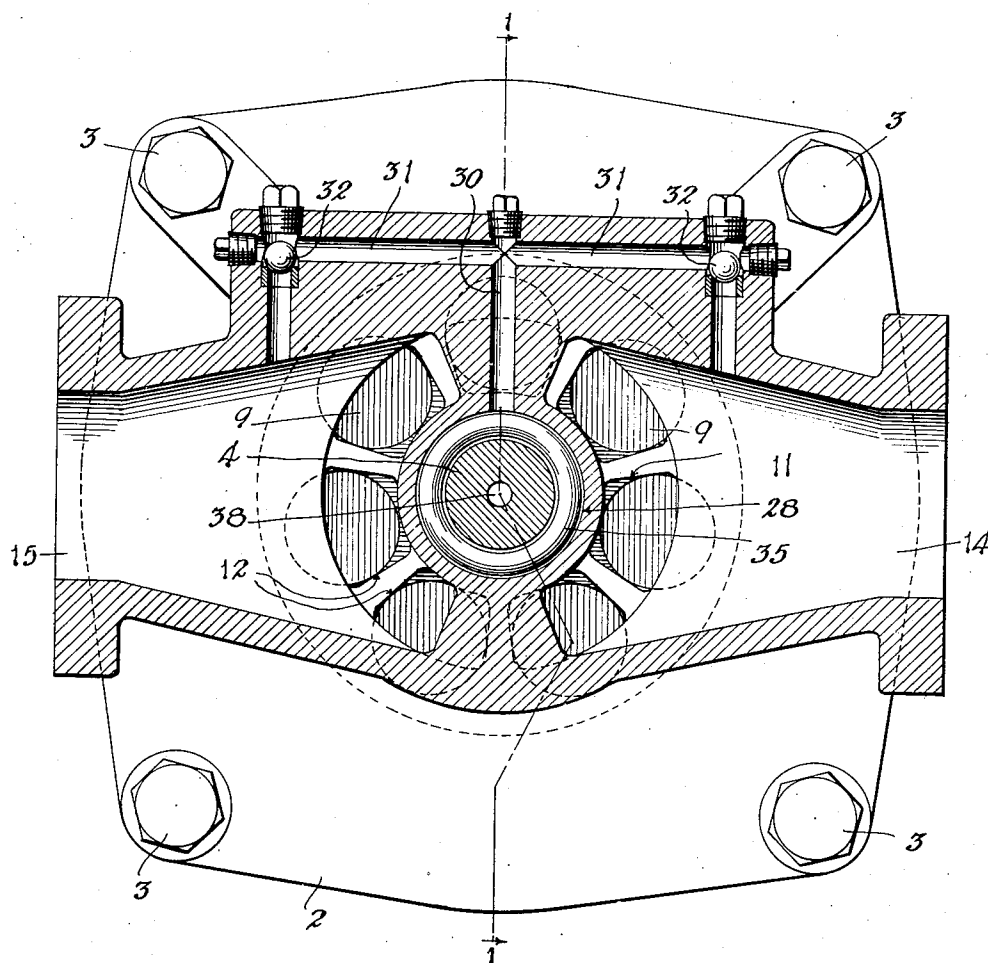


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Fig. 2.



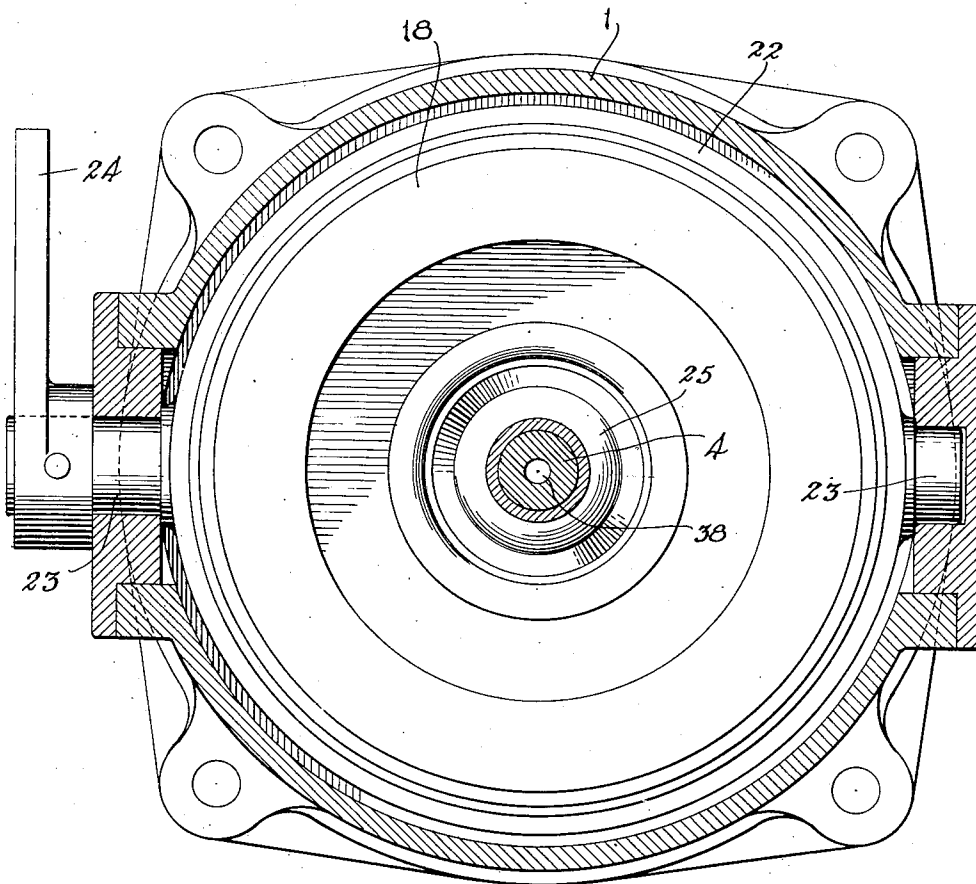
INVENTOR:
Charles R. Pratt,
BY
Everett & Cook,
ATTORNEYS.

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Fig. 3.



Charles R. Pratt, INVENTOR,
BY
Everett & Rook
ATTORNEYS.

UNITED STATES PATENT OFFICE.

CHARLES R. PRATT, OF MONTCLAIR, NEW JERSEY, ASSIGNOR TO UNIVERSAL SPEED CONTROL COMPANY, A CORPORATION OF NEW YORK.

FLUID-POWER-TRANSMISSION PUMP OR MOTOR.

1,362,040.

Specification of Letters Patent.

Patented Dec. 14, 1920.

Application filed February 16, 1920. Serial No. 359,111.

To all whom it may concern:

Be it known that I, CHARLES R. PRATT, a citizen of the United States, and a resident of Montclair, in the county of Essex and State of New Jersey, have invented new and useful Improvements in Fluid-Power-Transmission Pumps or Motors, of which the following is a specification.

This invention relates to rotary pumps or motors in which an annular series of pistons mounted in the cylinders of a rotary barrel are connected to a power or drive shaft by means adapted to cause said pistons to move in an elliptical path, whereby rotation of said shaft will cause the pistons to reciprocate and pump a fluid or the admission of a fluid under pressure to said cylinders will cause the pistons to rotate said shaft to which they are connected. A pump or motor of this general character is shown in my prior Patents, No. 1,137,283 of April 27, 1915, No. 1,156,433 of October 12, 1915, and No. 1,163,849 of December 14, 1915.

The objects of the present invention are to provide means whereby the vibration or "chattering" of the mechanism, due to the continually changing registry of the various cylinders with the inlet and outlet passages of the device and the successive entry of the various cylinders into communication with each of said passages, is taken up or absorbed by the fluid pressure itself; to thus provide means for relieving the casing or bearings of the device of such jars or vibrations and reducing the noise and violence of said jars or vibrations incident to operation of the device; to provide novel means for the utilization of the fluid pressure to maintain the cylinder barrel against its seat and reduce leakage, thus relieving the necessity for reducing the ports of said cylinders and causing throttling or retarding of the passage of fluid to and from said cylinders; to secure means for transmitting such thrusts through the cylinder barrel shaft against the same fluid pressure which is delivered by or to the pistons; to provide the shaft with a balance piston for said purposes, and to secure means for keeping such piston chamber always in communication with the pressure side of the device; to provide initial spring pressure for seating the cylinder barrel; to retard leakage from the balance piston chamber; to provide with a tilting disk mounted on a spherical bearing

on the cylinder shaft tilting means free from said disk radially; to enable the leakage from the balance piston chamber to lubricate said spherical bearing, and to obtain other advantages and results as may be brought out in the following description.

Referring to the accompanying drawings, in which like numerals of reference indicate the same parts throughout the several views,

Figure 1 is a vertical longitudinal sectional view through a pump or motor embodying my invention, on the line 1—1 of Fig. 2;

Fig. 2 is a transverse sectional view taken on the line 2—2 of Fig. 1, and

Fig. 3 is a similar view taken on the line 3—3 of Fig. 1, the power transmission disk and its carrier ring being shown in front elevation.

In the specific embodiment of the invention illustrated by the drawings, the numeral 1 designates a pump or motor casing provided with a removable head 2 fastened thereon as by the screws 3. Disposed axially of said casing 1 and extending substantially the full length thereof is a shaft 4, said shaft being journaled in a ball bearing 5 at the inner end of the casing and in the head 2 thereof, said shaft extending through a stuffing box 6 out of the casing and serving as a drive shaft for the machine when the same is running as a pump and as a power shaft when running as a motor.

A cylinder barrel 7 is fitted over said shaft and mounted to rotate therewith in any suitable manner, as by the key 8, said cylinder barrel being provided with an annular series of longitudinally extending cylinders 9 axially parallel with the said shaft 4. Each of said cylinders 9 is provided with a port 10 which during rotation of the barrel registers successively with the inlet and outlet ports 11 and 12, respectively, of a seat plate 13 secured to the inside of the casing head 2 and against which the ported end of the cylinder barrel fits in the manner of a valve. The said ports 11 and 12 of the seat plate 13 are arranged in communication with the inlet and outlet passages 14 and 15 of the machine which are disposed in the casing head 2.

Mounted within the cylinders 9 are pistons 16 which are connected by piston rods

17 to a power transmission disk 18, the extremities of said piston rods having spherical ends 19 which fit within corresponding sockets 20 in the disk 18. This power transmission disk is mounted centrally of itself upon a spherical bearing 25 on the shaft 4 held by suitable means against movement on said shaft away from the cylinder barrel, and thus the longitudinal thrust of the pistons on the transmission disk is taken by the shaft 4. Preferably, the spherical bearing 25 is slidably loose on the shaft 4 and a spacing sleeve 40 on said shaft between it and the ball bearing 5 on the casing for the shaft enables adjustment of the spherical bearing longitudinally of the shaft to be made by nuts 41, 42 at the end of the shaft. Only slight adjustment is necessary, so as to take up wear between the disk 18 and its tilting ring, and any other suitable means can be employed.

The transmission disk 18 is positively driven by the pistons to rotate with the cylinder barrel 7 by means of a drive plate 26 substantially the same in construction and operation as the drive plate disclosed in my Patent No. 1,137,283, above-mentioned, said drive plate being fastened upon the end of the cylinder barrel 7 and provided with notches or slots 27 to receive the respective piston rods 1. For tilting the transmission disk 18, I have shown a ring 22 at the side of the disk next the cylinder barrel, free from said disk radially and engaging the same only in a direction perpendicular to the planes of said disk and ring, as by an annular anti-friction bearing 21 between the disk and ring. The tilting ring 22 is journaled upon trunnions 23 in the casing 1, and is adapted to be tilted by any suitable means, such as a handle lever 24 upon one of said trunnions 23 exteriorly of the casing 1.

In the operation of the device as a pump, it will be obvious that upon power being applied to the shaft 4 from a suitable source, the cylinder barrel and transmission disk will be rotated to cause reciprocation of the pistons 16, and that the rotation of the cylinder barrel 7 will cause successive registry of the cylinders with the inlet and exhaust passages 14 and 15. The cylinders as they register with the inlet passage will be filled with fluid by the reciprocation of the pistons outwardly of the cylinders, while as the cylinders register with the outlet passage 15, the pistons will be reciprocating in the opposite direction to force or pump the fluid under pressure through the outlet passage 15. On the other hand, when fluid under pressure is admitted to the inlet passage 14 and cylinders, the pistons will operate as motors to drive the shaft 4, the exhaust of the fluid taking place through the outlet passage 15. Obviously if the transmission disk 20 is swung at an angle opposite to that

shown in Fig. 1 the direction of rotation of the shaft 4 will be reversed, and the inlet passage 14 and outlet passage 15 then become the outlet and inlet, respectively. It will be noted that during rotation of the cylinder barrel, first three and then four cylinders will be in registry with the inlet and outlet passages 14 and 15; that is, at certain points in the rotation of the cylinder barrel there will be only three cylinders in registry with either the inlet or the outlet passage, as shown by Fig. 2, and as one of these cylinders is about to pass out of registry with the passage another or fourth cylinder will be just coming into registry with said passage. This change in the number of cylinders in communication with the inlet and outlet passages, and also the constant entering and leaving of the various cylinders into and from communication with the inlet and outlet passages, causes a vibration of the mechanism which if the transmission disk were mounted directly upon the casing 1 would produce a chattering noise and disturbance, as well as injury to and undue wear upon the mechanism.

One step toward the elimination of these difficulties is the mounting of transmission disk 18 directly upon the shaft 4 by the spherical bearing 25, and to further eliminate the jar, vibrations and noise incident thereto, I provide means for absorbing the vibrations by the fluid pressure produced in or driving the machine. To this end, the casing head 2 is formed with a piston chamber 28 surrounding the shaft 4, and a piston 29 secured upon the shaft is mounted to revolve in this piston chamber. This piston chamber is in communication with the inlet and outlet passages 14 and 15 through the duct 30 which communicates with the duct 31 communicating with each of said passages. A ball valve 32 is arranged in said duct 31 at each end thereof, so that only fluid under pressure is admitted to the piston chamber 28 at any time, the said ball valves allowing for a reversal of the inlet and outlet passages due to changes in direction of rotation of the cylinder barrel. It will thus be seen that the longitudinal thrusts and vibrations of the pistons upon the transmission disk 18 will be transmitted through the spherical bearing 25 to the shaft 4, and the fluid in the piston chamber 28 acting upon the piston 29 will effectively absorb them. It will also be noted that the fluid pressure acting on the balance piston 29 being the same as that produced in or driving the machine, the shocks and jars cannot be greater than this pressure and thus may be thoroughly absorbed by the fluid pressure. Furthermore, the radial thrusts of the piston rods on the transmission disk are transmitted to the shaft 4 by the spherical bearing 25.

The function of tilting ring 22 and roller

thrust bearing 21 is first to vary the angle of transmission disk 18 to the axis of shaft 4 in the direction which controls the stroke of the pump, and this angular motion is not opposed by the thrust of piston rods 17 for the reason that owing to the high rotary speed of the cylinder barrel the average thrust pressure of rods 17 is substantially the same at equal radii from the axis in this plane of disk 18. Its second function is to hold the axis of disk 18 coincident with the axis of trunnions 23 against the thrust of all pistons 16 which are under pressure, but this thrust is transmitted through spherical bearing 25 as a fulcrum and the three or four pistons under pressure only transmit the resultant pressure of one piston to the thrust roller diametrically opposite to the pressure pistons. This is the only pressure transmitted to the casing 1, and because it is only about one-quarter of the total piston pressure, and also because it is not caused by pistons entering and leaving the pressure chamber, it produces little if any vibration in casing 1.

As is well known in the art relating to pumps of this general type, vibrations originate at the points of intake and cut off, and means to eliminate the same have been tried with only partial success by special forms of ports, relief grooves, and so forth. By my invention, these vibrations are caused to react directly on the pressure which caused them, as for example in the pump shown in Fig. 1, the lower and outer piston has just entered the pressure port and gives a sudden thrust against disk 18; this is first transmitted to spherical bearing 25, shaft 4 and piston 29, and then to the diametrically opposite piston. We therefore have these three pistons, 16, 16 and 29, reacting against the same pressure fluid, and transmitting the vibrations in tension through the axis of shaft 4 and in compression through rods 17, thereby eliminating the objectionable metallic vibrations and noise when such vibrations are transmitted to the casing through a roller thrust bearing and a tilting ring as has been done heretofore.

It is also a feature of my invention to utilize the fluid pressure upon the balance piston 29 to seat the cylinder barrel 7, either entirely or partly, and this I have shown accomplished by having the cylinder barrel held against movement away from its seat on the shaft 4, as by a shoulder 43 on the shaft engaging the end of the barrel away from its seat. Then by having the effective area of the piston 29 greater than the sum of the areas of the cylinder ports 10, the pressure on the fluid acting on said piston will maintain the cylinder barrel seated against the plate 13 as closely as desired. To seat the cylinder barrel when there is no pressure in the piston chamber 28, a spring 35 is interposed between the piston

and the end of said chamber next the cylinder barrel, the tendency of said spring being to hold the cylinder barrel against the seat plate.

To lessen leakage of the pressure fluid from the piston chamber 28, a bearing bushing 33 is fitted in the casing head 2, and the shaft 4 passing through this bushing is formed with a helical groove 34 the convolutions of which are such that any fluid around the shaft tends to be forced back into the chamber 28, said groove also distributing the fluid as a lubricant over the bearing in the bushing 33. Similarly, to prevent the pressure fluid from escaping from the chamber 28 around the piston 29 the piston is provided with a peripheral helical groove 36, which groove tends to force the fluid back into the chamber 28 and thoroughly distributes it as a lubricant over the piston. Fluid which actually escapes through the helical grooves 34 and 36 passes through transverse ducts 37, 37 in the shaft 4 into a duct 38 extending longitudinally of the shaft and so by other radial ducts 39 at the spherical bearing 25 to lubricate the joint between said spherical bearing and the transmission disk 18 before entering the casing.

Obviously, detail modifications and changes may be made in manufacturing my invention by those skilled in the art without departing from the spirit and scope of the invention, and I do not wish to be understood as restricting myself except as required by the following claims when construed in the light of the prior art.

Having thus described the invention, what I claim is:

1. In a device of the character described, a shaft, a cylinder barrel mounted on said shaft to turn therewith, fluid inlet and outlet means communicating with the cylinders, pistons in said cylinders, means for causing said pistons to move in an elliptical path, and means for transmitting to said shaft thrust of said pistons longitudinally of the shaft.

2. In a device of the character described, a casing, a shaft normally held against longitudinal movement with respect to said casing, a cylinder barrel mounted on said shaft to turn therewith, fluid inlet and outlet means communicating with the cylinders, pistons in said cylinders, means for causing said pistons to move in an elliptical path, and means for transmitting to said shaft thrust of said pistons longitudinally of the shaft.

3. In a device of the character described, a shaft, a cylinder barrel mounted on said shaft to turn therewith, fluid inlet and outlet means communicating with the cylinders, pistons in said cylinders, means for causing said pistons to move in an elliptical path, and means for transmitting to said

shaft thrust of said pistons both longitudinally of the shaft and radially of the disk.

4. In a device of the character described, a shaft, a cylinder barrel mounted on said shaft to turn therewith, fluid inlet and outlet means communicating with the cylinders, pistons in said cylinders, means for causing said pistons to move in an elliptical path, and means for transmitting to said shaft all thrust of the pistons other than that which transmits power through the device.

5. In a device of the character described, a shaft, a cylinder barrel mounted on said shaft to turn therewith, fluid inlet and outlet means communicating with the cylinders, pistons in said cylinders, a spherical bearing on said shaft, means normally preventing movement of said spherical bearing longitudinally of the shaft, a transmission disk for said pistons mounted upon said spherical bearing, means for causing said disk to turn with the cylinder barrel, and means for tilting said disk.

6. In a device of the character described, a shaft, a cylinder barrel mounted on said shaft to turn therewith, fluid inlet and outlet means communicating with the cylinders, pistons in said cylinders, a spherical bearing on said shaft, means holding said spherical bearing against movement away from the barrel longitudinally of said shaft, a transmission disk for said pistons mounted upon said spherical bearing, means for causing said disk to turn with the cylinder barrel, and means for tilting said disk.

7. In a device of the character described, a shaft, a cylinder barrel mounted on said shaft to turn therewith, fluid inlet and outlet means communicating with the cylinders, pistons in said cylinders, a spherical bearing on said shaft, means adjustably holding said spherical bearing against movement away from the barrel longitudinally of said shaft, a transmission disk for said pistons mounted upon said spherical bearing, means for causing said disk to turn with the cylinder barrel, and means for tilting said disk.

8. In a device of the character described, a shaft, a cylinder barrel mounted on said shaft to turn therewith, fluid inlet and outlet means communicating with the cylinders, pistons in said cylinders, a spherical bearing on said shaft, means holding said spherical bearing against movement away from the barrel longitudinally of said shaft, a transmission disk for said pistons mounted upon said spherical bearing, means for causing said disk to turn with the cylinder barrel, and a tilting ring for said disk free from the same radially.

9. In a device of the character described, a shaft, a cylinder barrel mounted on said shaft to turn therewith, fluid inlet and out-

let means communicating with the cylinders, pistons in said cylinders, a spherical bearing on said shaft, means holding said spherical bearing against movement away from the barrel longitudinally of said shaft, a transmission disk for said pistons mounted upon said spherical bearing, means for causing said disk to turn with the cylinder barrel, and a tilting ring for said disk at the side of the same next the cylinder barrel.

10. In a device of the character described, a casing having a head providing fluid inlet and outlet passages and a seat plate and a piston chamber communicating with said passages, a shaft having a piston in said piston chamber, a cylinder barrel on said shaft held against movement thereon away from its seat, means keeping said piston chamber at the side of the piston toward the said barrel always open to the pressure side of the device and closed to the other side, pistons in said cylinder barrel, and means for causing said pistons to travel in an elliptical path as they rotate with the cylinder barrel.

11. In a device of the character described, a casing, a shaft in said casing, a cylinder barrel on said shaft held against movement thereon away from its seat, and automatic means for exerting force upon said shaft to seat the cylinder barrel.

12. In a device of the character described, a casing, a shaft in said casing, a cylinder barrel on said shaft held against movement thereon away from its seat, and means for exerting fluid pressure on said shaft to seat the cylinder barrel.

13. In a device of the character described, a casing, a shaft in said casing, a cylinder barrel on said shaft held against movement thereon away from its seat, and means for causing the fluid passing under pressure through the device to act on said shaft to seat the cylinder barrel.

14. In a device of the character described, a casing, a shaft in said casing, a cylinder barrel on said shaft held against movement thereon away from its seat, a spring acting on said shaft to seat the cylinder barrel, and means for causing the fluid passing under pressure through the device to act on said shaft to seat the cylinder barrel.

15. In a device of the character described, a casing having a head providing a seat, a shaft extending through said head, a cylinder barrel on said shaft and seat and held against movement on the shaft away from the seat, a piston on the shaft at the opposite side of the seat from the barrel, and means for causing the fluid passing under pressure through the device to act on said piston to seat the cylinder barrel.

16. In a device of the character described, a casing having a head providing a seat, a shaft extending through said head, a cylinder

der barrel on said shaft and seat and held against movement on the shaft away from the seat, a piston on the shaft at the opposite side of the seat from the barrel, a spring acting to seat the cylinder barrel, and means for causing fluid passing under pressure through the device to act on said piston to seat the barrel.

17. In a device of the character described, a casing having a head providing a seat, a shaft extending through said head, a cylinder barrel on said shaft and seat and held against movement on the shaft away from the seat, a piston on the shaft at the opposite side of the seat from the barrel, and means for causing fluid passing under pressure through the device to act on said piston to seat the cylinder barrel, said piston having peripheral helical grooves tending to force leakage back to the pressure side of the piston.

18. In a device of the character described, a casing having a head providing a seat, a shaft extending through said head, a cylinder barrel on said shaft and seat and held against movement on the shaft away from the seat, a piston on the shaft at the opposite side of the seat from the barrel, and means for causing fluid passing under pressure through the device to act on said piston to seat the cylinder barrel, said shaft where it passes through the head having peripheral helical grooves tending to force leakage back toward the piston.

19. In a device of the character described, the combination with an annular series of pistons and means for causing them to move in an elliptical path, of fluid pressure means for opposing the longitudinal thrust of said pistons.

20. In a device of the character described, the combination with an annular series of pistons and means for causing them to move in an elliptical path, of fluid pressure means for balancing the longitudinal thrust of said pistons.

21. In a device of the character described, the combination with an annular series of pistons and means for causing them to move in an elliptical path, of fluid pressure means for overcoming the longitudinal thrust of said pistons.

22. The combination with a shaft and an annular series of pistons around said shaft longitudinally thereof and operatively connected thereto, of fluid pressure means for opposing the longitudinal thrust of said pistons on said shaft.

23. In a device of the character described, the combination with an annular series of pistons and means for causing them to move in an elliptical path, of means for utilizing the pressure of fluid passing through the device to oppose the longitudinal thrust of said pistons.

24. In a device of the character described, the combination with an annular series of pistons and a disk for causing them to move in an elliptical path, of a fluid chamber in communication with the pressure side of the device, and means for transmitting longitudinal thrust of the pistons on said disk to the fluid in said chamber.

25. In a device of the character described, the combination of a shaft, an annular series of pistons around said shaft longitudinally thereof, means for transmitting to said shaft longitudinal thrust of said pistons, and means for transmitting to said shaft, in opposition to said thrust, pressure from the fluid passing through the device.

26. In a device of the character described, a cylinder barrel, pistons in the cylinders, a disk for causing said pistons to move in an elliptical path, and fluid pressure means opposing longitudinal thrust of said piston on said disk and seating the cylinder barrel.

27. In a device of the character described, a cylinder barrel, pistons in the cylinders, a disk for causing said pistons to move in an elliptical path, and means for utilizing the pressure of fluid passing through the device to oppose longitudinal thrust of said pistons on said disk and to seat the cylinder barrel.

28. In a device of the character described, the combination of a shaft, a cylinder barrel on said shaft held against movement thereon away from its seat, pistons in the cylinders, a disk for causing said pistons to move in an elliptical path, and means for exerting fluid pressure on said shaft to oppose longitudinal thrust of said pistons on said disk and seat the cylinder barrel.

29. In a device of the character described, a casing having a head providing a seat, a shaft extending through said head, a cylinder barrel on said shaft and seat and held against movement on the shaft away from the seat, pistons in the cylinders connected to said shaft to move in an elliptical path, a piston on the shaft, and means for causing fluid passing under pressure through the device to act on said piston in opposition to the longitudinal thrust of the cylinder pistons.

30. In a device of the character described, a casing having a head providing a seat, a shaft extending through said head, a cylinder barrel on said shaft and seat and held against movement on the shaft away from the seat, pistons in the cylinders connected to said shaft to move in an elliptical path, a piston on the shaft at the opposite side of the seat from the cylinder barrel, and means for causing fluid passing under pressure through the device to act on said piston in opposition to the longitudinal thrust of the cylinder piston.

31. In a device of the character described, a casing having a head providing a seat, a

shaft extending through said head, a cylinder barrel on said shaft and seat and held against movement on the shaft away from the seat, pistons in the cylinders connected to said shaft to move in an elliptical path, a piston on the shaft, and means for causing fluid passing under pressure through the device to act on said piston to seat the cylinder barrel and oppose the longitudinal thrust of the cylinder pistons on the shaft.

32. In a device of the character described, a casing having a head providing a seat, a shaft extending through said head, a cylinder barrel on said shaft and seat and held against movement on the shaft away from the seat, pistons in the cylinders connected to said shaft to move in an elliptical path, a piston on the shaft at the opposite side of the seat from the cylinder barrel, and means for causing fluid passing under pressure through the device to act on said piston to seat the cylinder barrel and oppose the longitudinal thrust of the cylinder pistons on the shaft.

33. In a device of the character described, a casing having a head providing a seat, a shaft extending through said head, a cylinder barrel on said shaft and seat and held against movement on the shaft away from the seat, pistons in the cylinders connected to said shaft to move in an elliptical path, a piston on the shaft at the opposite side of the seat from the cylinder barrel, means for causing fluid passing under pressure through the device to act on said piston to seat the cylinder barrel and oppose the longitudinal thrust of the cylinder pistons on the shaft, and spring means for seating said cylinder barrel when the device is idle.

34. In a device of the character described, a casing having a head providing a seat, a shaft extending through said head, a cylinder barrel on said shaft and seat and held against movement on the shaft away from the seat, pistons in the cylinders connected to said shaft to move in an elliptical path, a piston on the shaft, and means for causing

fluid passing under pressure through the device to act on said piston in opposition to the longitudinal thrust of the cylinder pistons, said piston having peripheral helical grooves tending to force leakage back to the pressure side of the piston.

35. In a device of the character described, a casing having a head providing a seat, a shaft extending through said head, a cylinder barrel on said shaft and seat and held against movement on the shaft away from the seat, pistons in the cylinders connected to said shaft to move in an elliptical path, a piston on the shaft at the opposite side of the seat from the cylinder barrel, and means for causing fluid passing under pressure through the device to act on said piston in opposition to the longitudinal thrust of the cylinder pistons, said shaft where it passes through the head having peripheral helical grooves tending to force leakage back toward the piston.

36. In a device of the character described, a shaft, an annular series of pistons disposed longitudinally of said shaft, a spherical bearing on said shaft, a disk on said bearing for causing the pistons to move in an elliptical path, a piston on the shaft, means for exerting fluid pressure on said piston in opposition to the longitudinal thrust of the other pistons, and means for conducting leakage from the shaft piston chamber to said spherical bearing to lubricate the same.

37. In a device of the character described, a shaft, an annular series of pistons disposed longitudinally of said shaft, a spherical bearing on said shaft, a disk on said bearing for causing the pistons to move in an elliptical path, a piston on the shaft, means for exerting fluid pressure on said piston in opposition to the longitudinal thrust of the other pistons, and ducts in the shaft and spherical bearing for receiving leakage from the shaft piston chamber for lubrication purposes.

CHARLES R. PRATT.