April 13, 1948. C. C. BUCKNER 2,439,448

FLUID PUMP

Filed Nov. 12, 1943 3 Sheets-Sheet 1

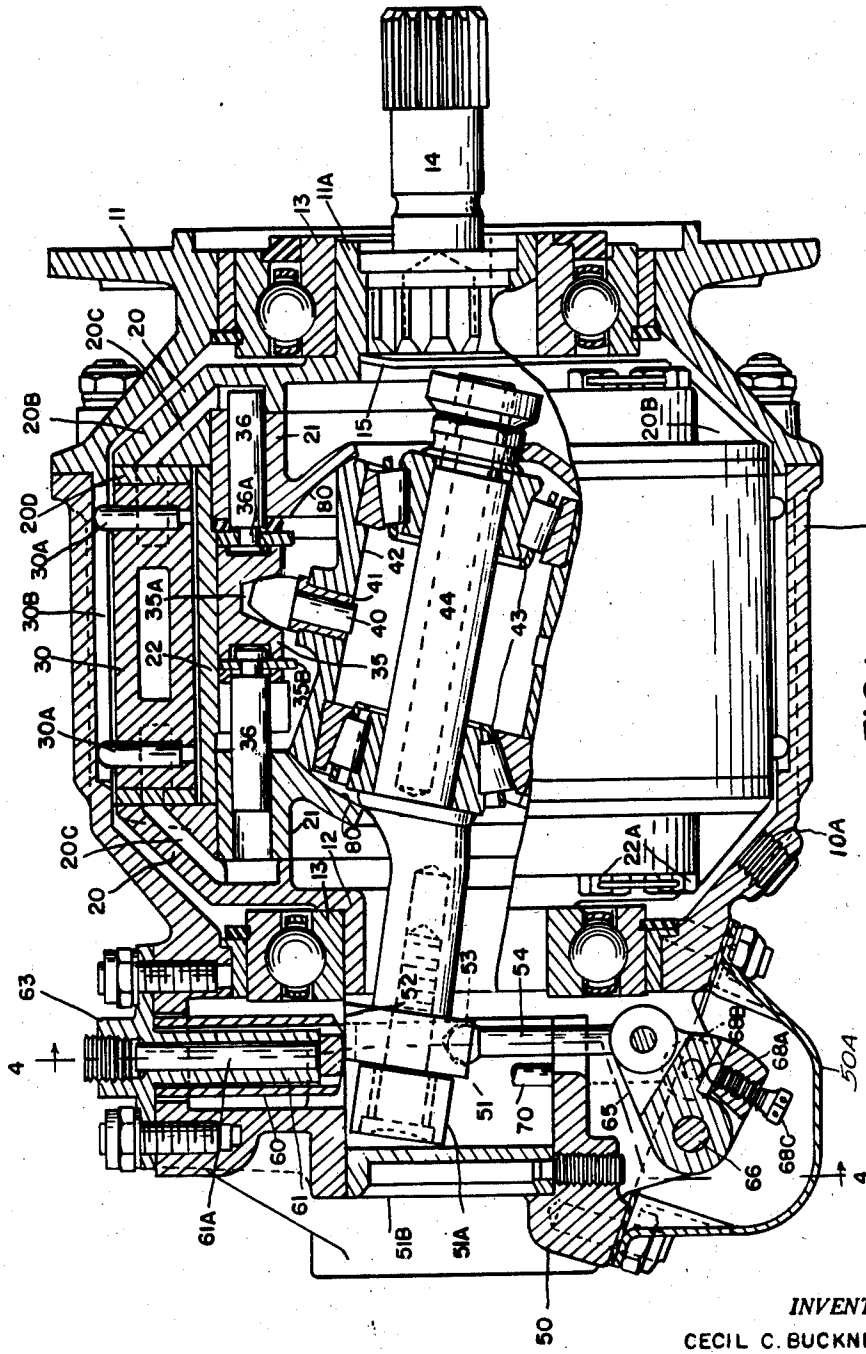


FIG. 1.

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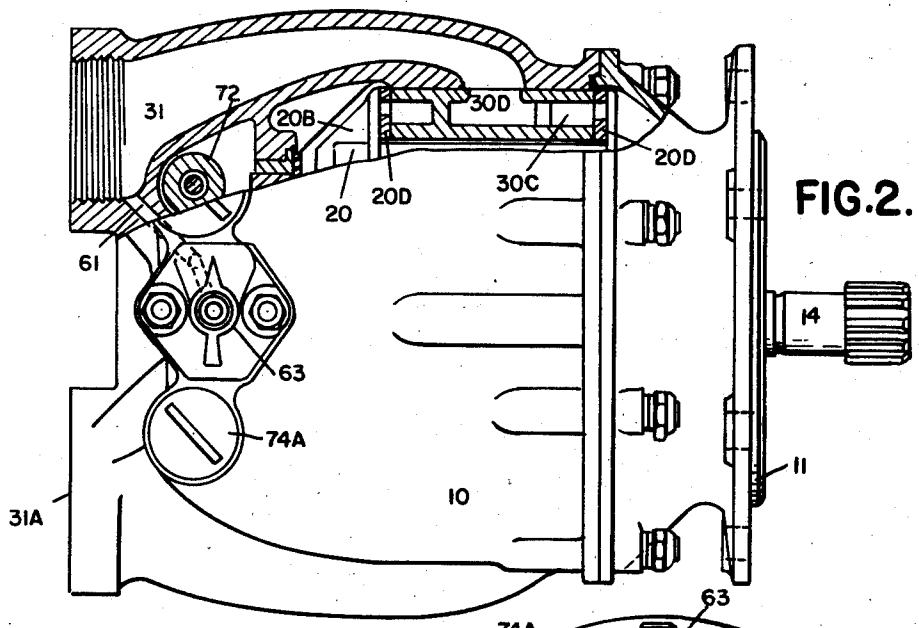


FIG.2.

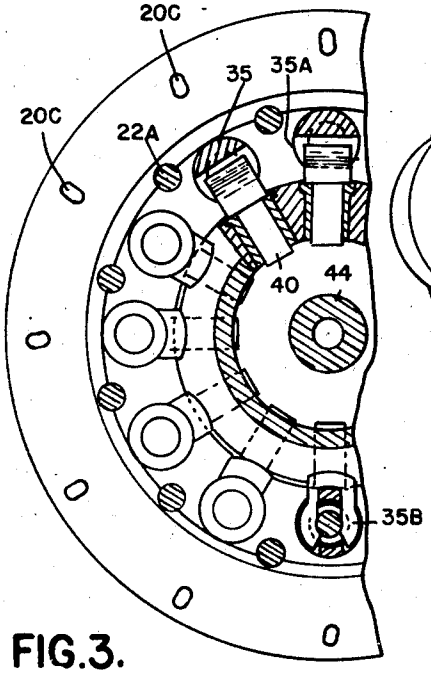


FIG.3.

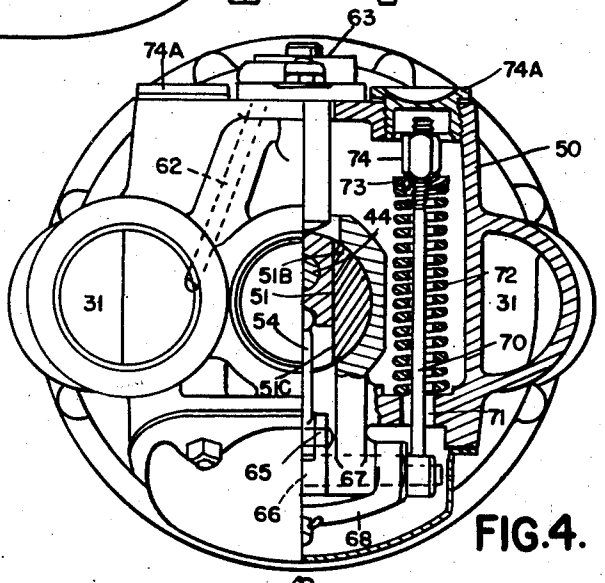


FIG.4.

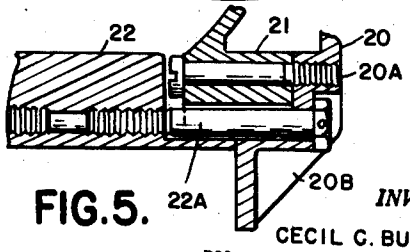


FIG.5.

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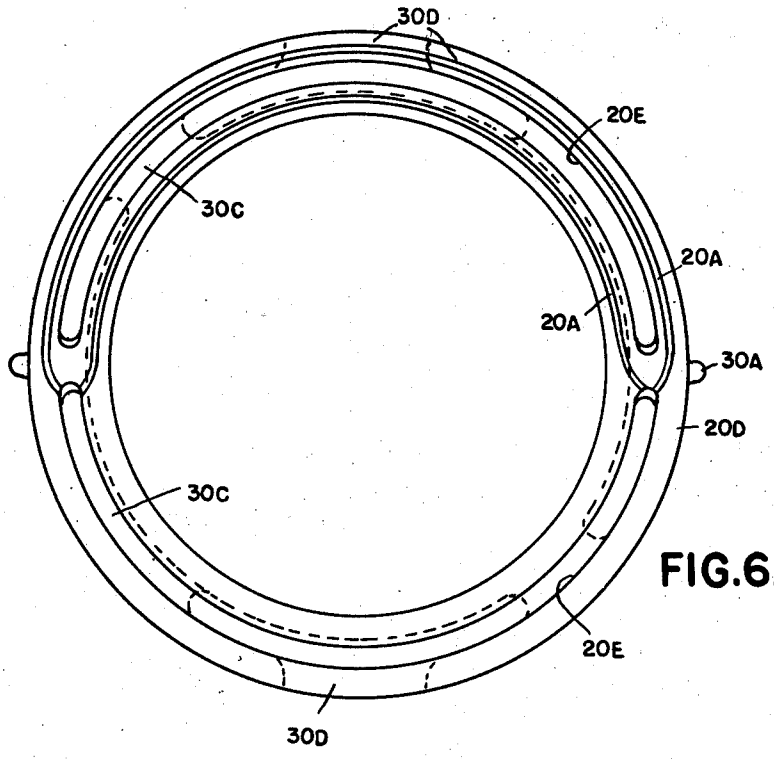


FIG.6.

FIG.8.

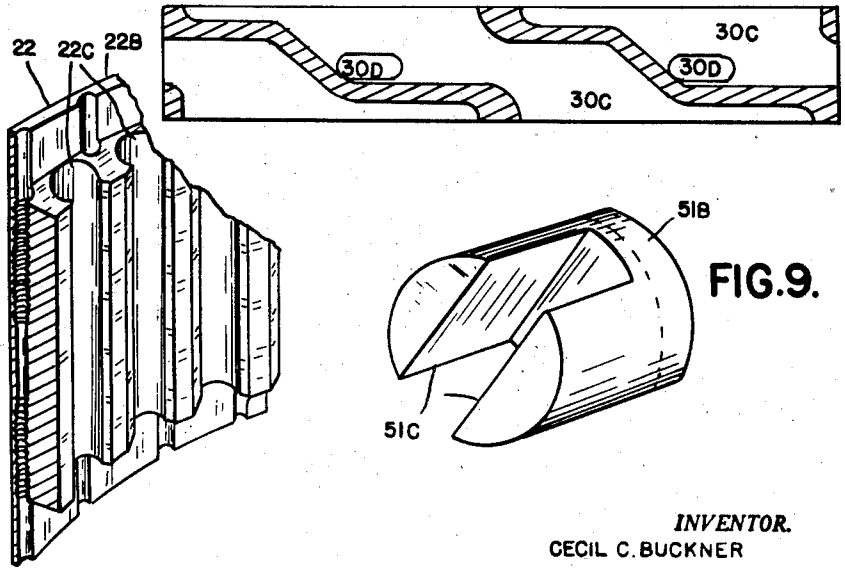


FIG.7.

FIG.9.

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2,439,448

UNITED STATES PATENT OFFICE

2,439,448

FLUID PUMP

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Application November 12, 1943, Serial No. 509,959

5 Claims. (Cl. 103—162)

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The present invention relates to fluid pumps and specifically to multicylinder pumps adapted to deliver a flow of fluid substantially free from cylinder impulses.

Among the objects of the invention is a large capacity pump of small size and weight.

Another object is a pump capable of delivering fluid under a constant pressure and accordingly capable of automatically varying the output to provide for and permit such constant pressure.

Another object is a pump of relatively simple construction and one that is easy to construct and repair and which does not easily get out of order.

Another object is a pump in which the parts common to all the cylinders are relatively few and of rugged construction.

Still other objects and advantages will be apparent to those skilled in the art upon reference to the following description and the accompanying drawings in which

Figure 1 is a central longitudinal section of a pump constructed in accordance with the present invention.

Figure 2 is a top plan view with parts in central horizontal section.

Figure 3 is a central vertical section on an irregular line showing connections between the pistons and actuating elements.

Figure 4 is an end view and part section on line 4—4 of Figure 1.

Figure 5 is a sectional view showing a detail of construction.

Figure 6 is a view in elevation of the valve ring.

Figure 7 is a view in perspective of a portion of the connecting ring and cylinder aligner.

Figure 8 is a development of a central section of the valve ring.

Figure 9 is a view in perspective of a detail of construction.

In the drawings, showing an embodiment of the invention, the pump is indicated as including a housing 10 and cover plate, the latter being provided with a suitable flange 11 by which it may be secured to a suitable support, for example, the housing of a motor or other drive means (not shown).

Inside of the housing 10 is a rotor provided with end flanges 11A and 12 serving to support the rotor in suitable antifriction bearings 13 in the two ends of the housing 10 while the flange 11A is splined on its inner face and coacts with a similarly splined drive shaft 14, the interior of

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the rotor being sealed at this end by means of a suitable sealing disc 15.

The rotor is shown as made up of two substantially identical end pieces 20 carrying the flanges 11A and 12, and having mounted on their inner faces two substantially identical cylinder blocks 21, the cylinder blocks and end pieces being spaced from each other by a ring 22, the form of which is indicated in Figure 7.

As indicated in Figure 5, the end pieces 20 and the cylinder blocks 21 are fixed together by means of screws 20A while the assembly of these parts is fixed to the ring 22 by screws 22A. The ring 22 is shown in Figure 7 to have an outer continuous portion 22B and an inner portion of less width but of greater thickness and to have this thicker portion provided with a plurality of grooves 22C adapted to be arranged opposite the inner ends of the cylinders and provide guides for the pistons as described below.

As indicated in Figure 1, the end pieces 20 extend radially outward beyond the ring 22 and have a plurality of ribs 20B, one for each cylinder in the block 21, each provided with a passage 20C leading from the inner end of a cylinder to the face of the extending portion.

Between these faces is a valve ring 30, fixed against circumferential movement by pins 30A which extend outwardly into grooves 30B in the housing 10, the valve ring being provided with bearing surfaces in the form of rings 20D fixed to the valve ring in any suitable manner, as by brazing.

One of these bearing rings 20D is shown in elevation in Figure 6 and is shown as having through slots 20E extending substantially the entire 360° of the ring and also with a pair of grooves 20H in its outer face connecting the two ends of one of the slots 20E. The particular slot is the outlet slot.

This valve ring is shown in Figure 6 and consists of a cylindrical ring of substantial thickness having two cored passages 30C each extending circumferentially, and each opening to both edges of the ring. Each passage 30C is also provided with an opening 30D to the outer periphery of the ring, these openings being diametrically opposite each other. In operation, one of these is the intake and the other the outlet of the pump and each opens to a pipe or channel 31 or 31A which may be connected to other apparatus as desired. The opening 30D connected to the pipe 31 is the outlet.

As shown in Figure 1, each of the passages 20C communicates with one of the cylinders in a block

21 and the two cylinder blocks are so arranged, with the ring 22 between them, as to have each of the cylinders in one block in alignment with a cylinder in the other block and both in alignment with one of the grooves 22C in the ring 22. In each of the grooves 22C is a slidable block or piston connecting member 35 to which, at each end, is connected a piston 36 and in which is a notch 35A.

Each end of the block 35 is drilled axially for a short distance and suitably slotted to receive a horseshoe shaped key 35B (see Fig. 3) and each piston 36 is provided with a peripheral groove 36A which registers with the slot and coacts with the key 35B to provide a unit consisting of a block and two pistons.

While it would be possible to make each pair of pistons 36 and their connecting block 35 as an integral unit, it is preferred to produce them as separate parts and connected as described. This construction will allow for slight misalignment of the cylinders with each other and therefore a longer wearing and more perfect fit.

Extending into each notch 35A is a piston actuating pin 40, this being a short headed pin mounted in a cage or pin holder 42 rotatably carried on suitable antifriction bearings 43 on a shaft 44. Each of the pins 40 has its headed portion preferably in the form of an involute gear tooth, as indicated in Figures 1 and 3, so that it will maintain a line contact with the walls of the notch 35A and thus be less subject to wear.

The shaft 44 is free at the end near the drive shaft 14 but extends from the other end of the rotor through the opening surrounded by flange 12 into the end of the housing 10 designated by numeral 50, this being open centrally and closed by the plug 51B and also open at its bottom and closed by a suitable cover member 50A.

The end of the shaft 44 is formed with or provided with an enlarged portion 51 which has an upper inclined face 52 and is bored at the bottom as at 53 to receive the head of the ball headed pin 54.

Acting upon the inclined surface 52 is a hollow plunger 60 surrounding a close fitting stationary tube 61, inside of which is fitted a piston 61A while the upper end of the chamber in tube 61, above the piston, is connected to the outlet pipe 31 by means of a passage 62 (Fig. 4). The element 63 may be used to indicate the direction of fluid flow.

The pressure of fluid from the high pressure side of the pump thus tends to move the enlarged portion 51 and shaft 44 down to a position in which the axis of the shaft coincides with the axis of the rotor but such movement is resisted by the pin 54 which is shown as spring-pressed upwardly by the following means.

As shown in Figures 1 and 4, the pin 54 is pivoted at the end of a short arm 65 loosely mounted upon this shaft 66 mounted in fixed bearings 67. Also loosely mounted upon this shaft is a yoke 68 having its arms extending in the same general direction, the central portion 68A being below the arm 65. The other two portions or arms 68B are provided with laterally extending pins forming pivotal connections for links 70 which extend upwardly through openings 71 in the framework and carry springs 72 acting between the frame and collars 73 upon their upper ends. The tension of the springs 72 is adjustable through the nuts 74, the latter being accessible through suitable openings by removing the screw plugs 74A.

The center arm 68A of the yoke underlies the pin carrying arm 65 and carries an adjusting screw 68C so as to fix the relation between the two arms.

In order to provide for the easy movement up and down of this end of shaft 44, the extension 51 is flattened on the sides as indicated in Figure 4 and a roller 51A mounted at the end of the shaft. This roller is of a diameter substantially the same as the lateral dimension of the part 51 and both operate between the walls of the slot 51C in a suitable plug member 51B, this member being shown in Figure 9. A suitable set screw 51D may be used to fix the member 51B against movement.

The free movement of the shaft 44 in varying its angle with the rotor axis is provided for by forming the cylinder blocks with inwardly extending flanges 80 and producing on the faces of such flanges portions of a spherical bearing adapted to cooperate with mating spherical surfaces on the ends of the cage element 42.

Since it is impractical to maintain all of the working surfaces against leakage, suitable means such as a drain opening 10A and plug or conduit (not shown) may be provided.

In the operation of the pump, with the casing fixed to a suitable support as indicated and therefore not rotatable, driving torque applied to shaft 14 rotates cylinder assembly and carries with it the cage 42 while the shaft 44 is stationary, that is, it does not rotate.

The effect of this arrangement, of course, is to oscillate each piston and block assembly, in the corresponding cylinders since the circular orbit of the pins 40 is inclined to the axis of rotation of the cylinder assembly. Fluid is therefore drawn in through the inlet 31A through an opening 30D in the valve ring and into the cylinders and then out of the other opening 30D to the outlet 31. As pressure builds up in the outlet 31, some of the fluid backs up through passage 62 and forces the sleeve piston 60 down, thereby forcing the end of the shaft 44 to move toward a position in which the axis of the orbit of travel of pins 40 coincides with the axis of rotation of the cylinder assembly. As this condition is approached, the piston oscillation travel becomes less and less until they remain stationary and delivery ceases. By changing the tension on springs 72, variation of maximum pressure may be made.

It should be noted that the arrangement of the arm 65 which is acted on by the pin 54 as the shaft 44 moves up and down is somewhat above center while the lower ends of rings 70 coacting with springs 72 are somewhat below the center of pivot 66.

The effect of this arrangement is to produce through a short range a reduction of the leverage of the springs arms with an increase of leverage of the arm 65 carrying the pin 54. This enables the pressure being built up in the outlet side to overcome the building up of spring resistance and the reduction of flow from the pump to zero when the back pressure becomes so high that the pump cannot overcome it. Of course, the point at which the flow stops may be regulated by adjustment of the spring tension, that is, the tension of springs 72.

As the pump is being operated there is a slight tendency for the valve ring 30 to assume a position somewhat askew. This is due to the fact that the back pressure acts on the ring 30 at diagonally opposite points. For example, in Figure 1 the back pressure might be acting upon the ring at the upper left hand corner of the

figure and at the lower right hand corner. In order to overcome this, the bearing ring 20D is grooved as shown in Figure 6 so that the pressure is applied to the outer face of the bearing ring throughout the entire 360°. These grooves 20A should equal in area the area of the slot 20E so that the pressure is the same all the way around the ring.

It will be noted that the present construction produces a pump in which all of the endwise thrust forces are completely balanced out, and due to the arrangement of the cylinders and the outlet and inlet ports, the torque reaction on the shaft 44 is substantially all directed laterally of the shaft and in consequence, the vertical movement of the free end by the fluid pressure and/or springs 72 is accomplished freely and smoothly.

Now having described the invention and the preferred embodiment thereof, it is to be understood that the said invention is to be limited, not to the specific details herein set forth, but only by the scope of the claims which follow.

What I claim is:

1. A fluid pump consisting of a substantially cylindrical casing provided with centrally located inlet and outlet ports diametrically opposite each other, a non-rotatable valve ring within said casing and having inlet and outlet ports in its periphery registering with the casing ports, said valve ring enclosing two passages extending through said ring from edge to edge and separated by helically arranged walls so that the beginning of one passage lies opposite the ending of the other longitudinally of the ring, each passage communicating with one of the peripheral ports, a rotor within said casing and valve ring and carrying a plurality of pairs of pump cylinders, each pair having its members in axial alignment and parallel with the axes of said rotor and valve ring, and its outer ends in communication with the passage ends in said valve ring, said pairs arranged as a cylindrical assembly, a piston in each of said pump cylinders, a rotatable cage within said assembly and carrying a plurality of projecting pins each of which is adapted to coact with the pistons of a pair of pump cylinders whereby to oscillate the same, a shaft about which said cage is rotatable, said shaft having a portion projecting from one end of said rotor and adapted to be movable from a position wherein its axis coincides with the axis of the rotor to a position wherein the axis of said shaft is at an angle to the axis of said rotor, means for determining the position of said shaft and thereby the amount of oscillation of said pistons, said means consisting of a plunger actuable by fluid pressure from the pump outlet to move said shaft toward rotor-concentric position and adjustable spring means arranged to oppose the action of said plunger, and means to rotate the rotor.

2. A fluid pump consisting of a substantially cylindrical casing provided with centrally located inlet and outlet ports diametrically opposite each other, a non-rotatable valve ring within said casing and having inlet and outlet ports in its periphery registering with the casing ports, said valve ring enclosing two passages extending through said ring from edge to edge and separated by helically arranged walls so that the beginning of one passage lies opposite the ending of the other longitudinally of the ring, each passage communicating with one of the peripheral ports, a rotor within said casing and valve

ring and carrying a plurality of pairs of pump cylinders, each pair having its members in axial alignment and parallel with the axes of said rotor and valve ring, and its outer ends in communication with the passage ends in said valve ring, said pairs arranged as a cylindrical assembly, a piston in each of said pump cylinders, a rotatable cage within said assembly and carrying a plurality of projecting pins each of which is adapted to coact with the pistons of a pair of pump cylinders whereby to oscillate the same, a shaft about which said cage is rotatable, said shaft having a portion projecting from one end of said rotor and adapted to be movable from a position wherein its axis coincides with the axis of the rotor to a position wherein the axis of said shaft is at an angle to the axis of said rotor, means for determining the position of said shaft and thereby the amount of oscillation of said pistons, said means consisting of a plunger actuable by fluid pressure from the pump outlet to move said shaft toward rotor-concentric position and adjustable spring means arranged to oppose the action of said plunger, said spring means including a helical spring under compression and means to compensate for the increase in tension as said spring is compressed.

3. In a fluid pump a rotor carrying a plurality of pairs of cylinders containing oscillatable pistons, the members of each pair having their axes in alignment and parallel with the axis of the rotor, a pair of flanges on said rotor extending radially outward from said cylinders, there being passages in said flanges connecting the outer ends of said cylinders with the opposing faces of said flanges, a valve ring provided with an inlet and an outlet port lying between said flanges, said ring having passages open to the passages in said flanges, means to fix said ring against rotation while allowing said ring to float between the flanges, and means to equalize the pressure during pumping over the entire area of the faces of said ring adjacent the flanges.

4. In a fluid pump, a valve ring consisting of a thick walled cylinder having a pair of passages within the wall and extending endwise of said cylinder, diametrically opposite ports in the outer face of said ring each open to one of the passages, helically arranged walls separating said passages in such fashion that the beginning of one passage is opposite the ending of the other axially of the ring, and bearing rings fixed to the end faces of said cylinder and each provided with circumferentially arranged slots of slightly less than 180° each, the portions between slots registering with the ends of said helical walls, each of said bearing rings being provided in its outer face with a groove extending from one end of one slot to the other end of the same slot while lying parallel to the other slot.

5. In a fluid pump in which a plurality of cylinders are arranged in parallel relation as an annulus and as a part of a rotor in which pistons are oscillated by a plurality of elements rotatable about the axis of a shaft variable in position from coaxial with said rotor to an angular relation, means for fixing the position of said shaft in accordance with the pump delivery pressure, said means consisting of a plunger actuable by fluid from said delivery to move said shaft toward coaxial position and adjustably tensioned spring means adapted to oppose such movement, said spring means consisting of a spring, a fixed abutment therefor, and a lever, the short arm of which is connected to said spring, to thereby

resist resiliently the movement of the lever, and the long arm of which is connected to said shaft, said long arm being so positioned that its effective leverage increases as said shaft is moved toward its coaxial position.

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