June 26, 1934. E. K. BENEDEK 1,964,244

VARIABLE DELIVERY RADIAL PUMP

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Fig. 1.

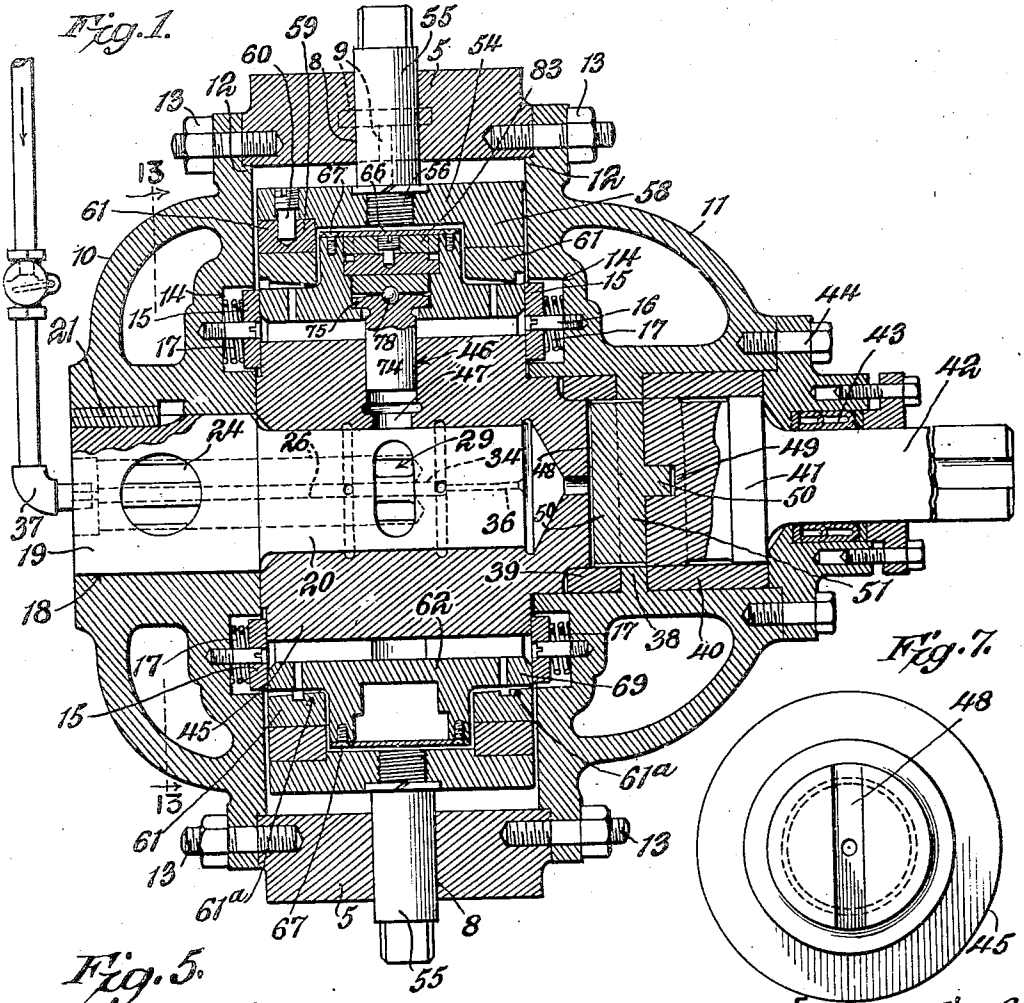


Fig. 5.

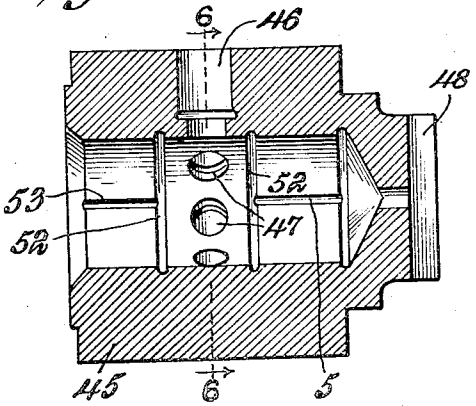
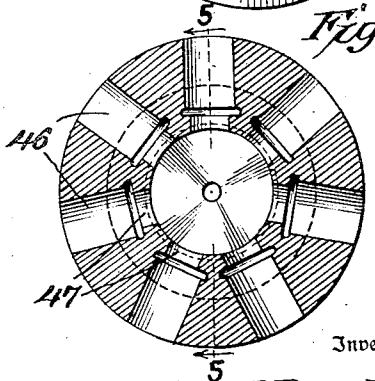


Fig. 7.

Fig. 6.



Inventor,
Elek K. Benedek,
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VARIABLE DELIVERY RADIAL PUMP

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Fig. 2.

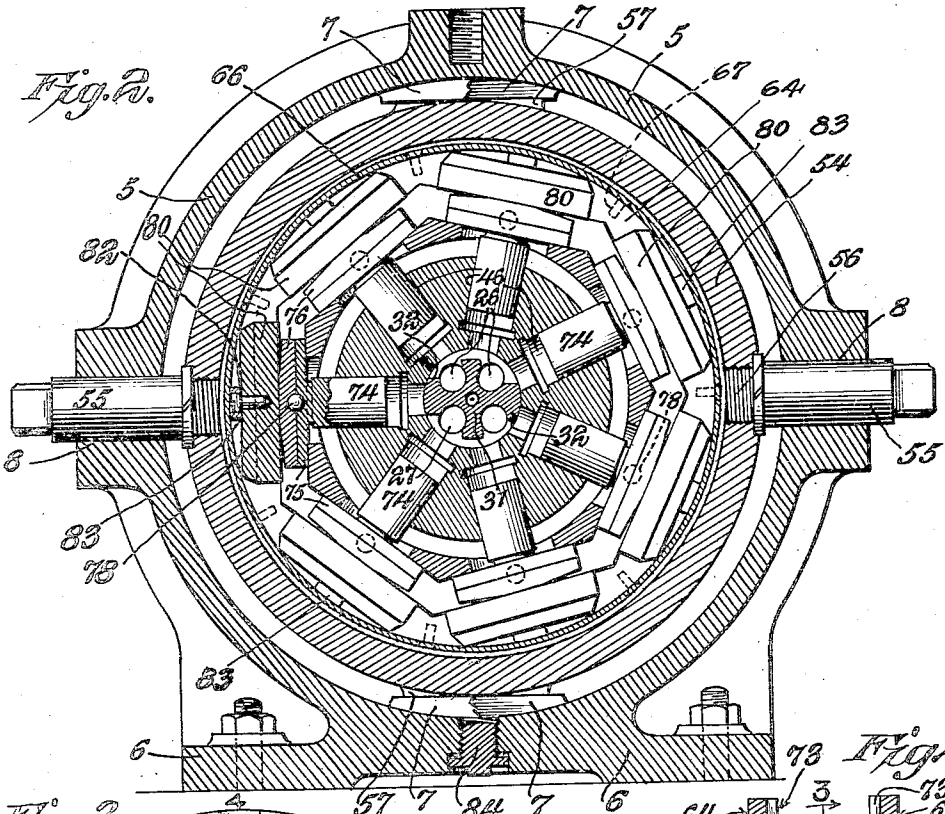


Fig. 3.

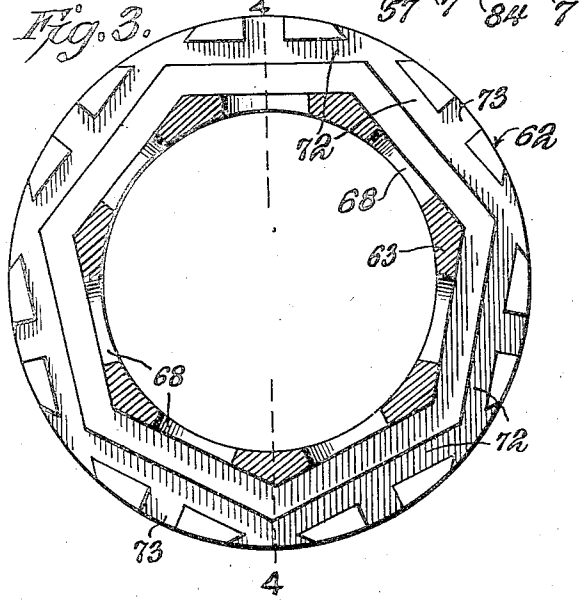
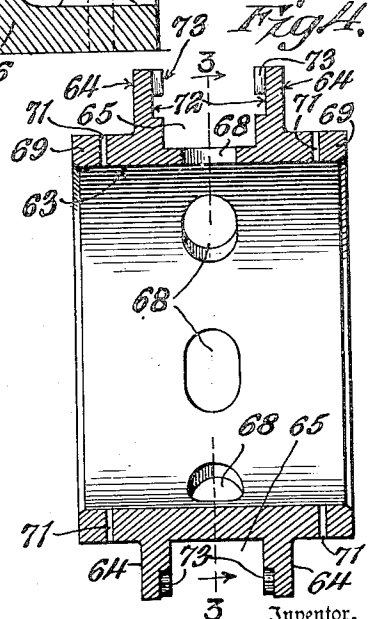


Fig. 4.



Inventor,
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VARIABLE DELIVERY RADIAL PUMP

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Fig. 8.

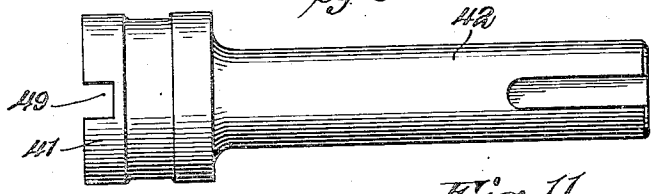


Fig. 9.

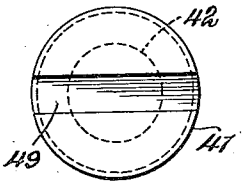


Fig. 10.

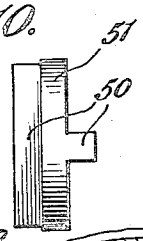


Fig. 11.

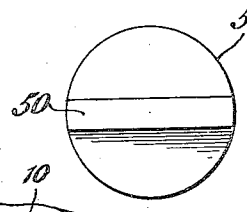


Fig. 12.

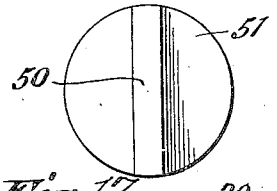


Fig. 13.

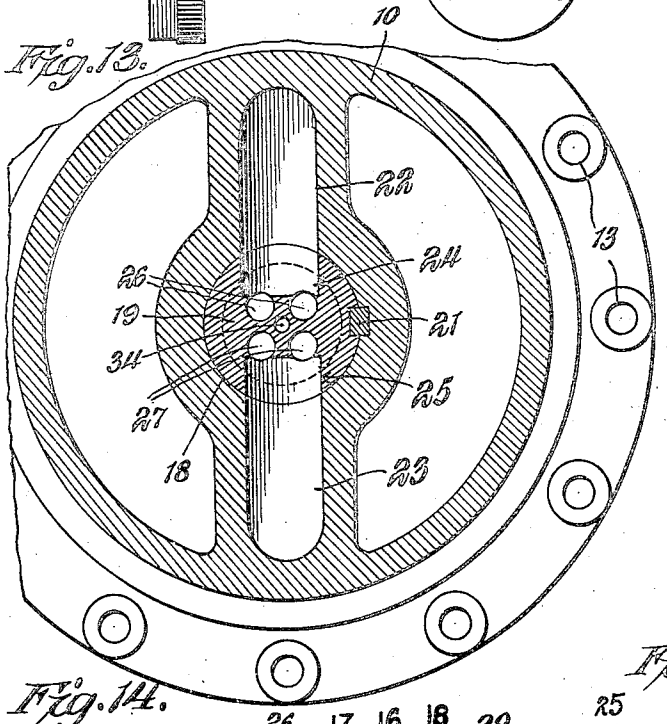


Fig. 17.

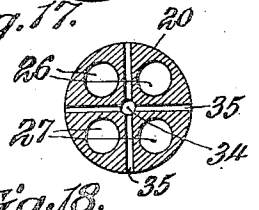


Fig. 18.

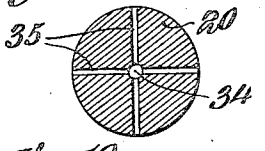


Fig. 19.

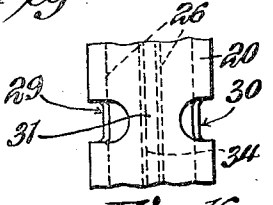


Fig. 14.

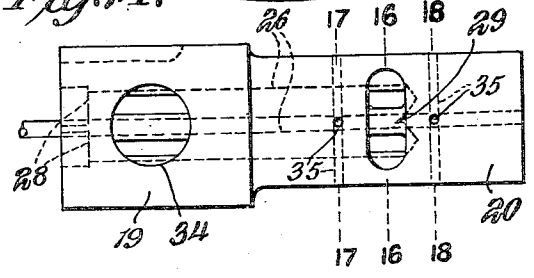


Fig. 15.

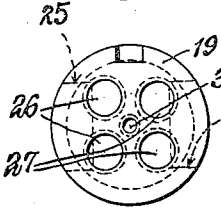
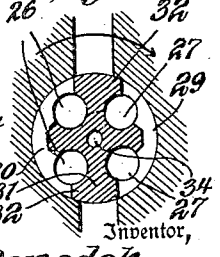


Fig. 16.



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June 26, 1934. E. K. BENEDEK 1,964,244

VARIABLE DELIVERY RADIAL PUMP

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Fig. 20.

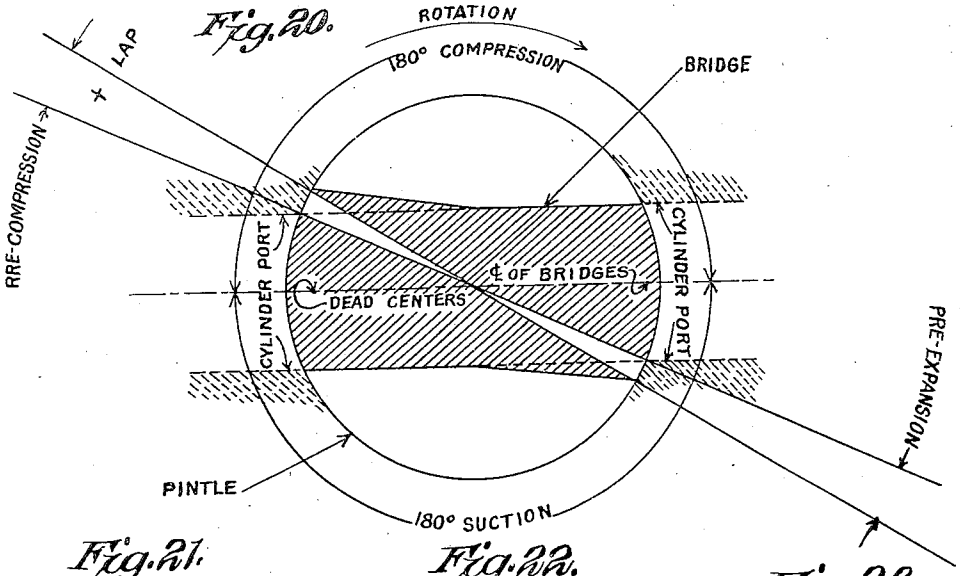


Fig. 21.

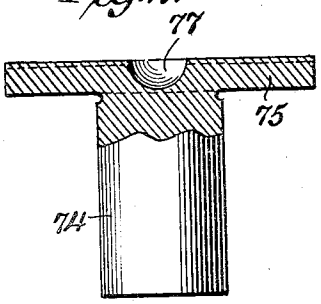


Fig. 22.

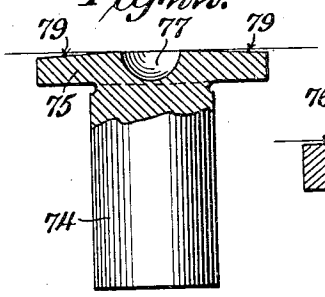


Fig. 23.

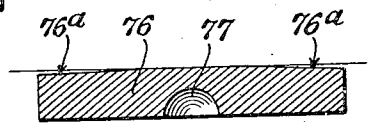


Fig. 24.

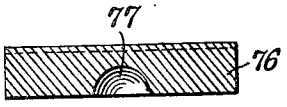


Fig. 25.

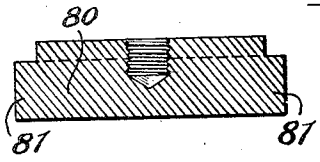


Fig. 26.

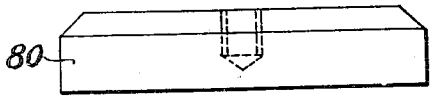


Fig. 27.

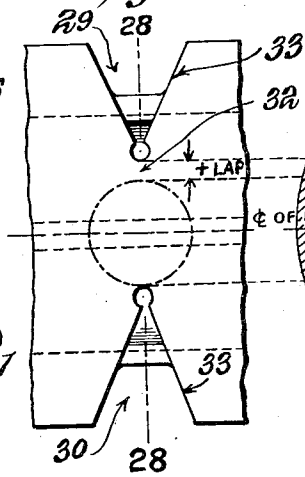
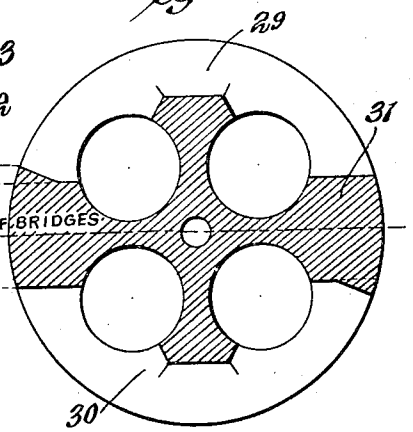


Fig. 28.



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Patented June 26, 1934 1,964,244

UNITED STATES PATENT OFFICE

1,964,244

VARIABLE DELIVERY RADIAL PUMP

Elek K. Benedek, Mount Gilead, Ohio, assignor to The Hydraulic Press Manufacturing Company, Mount Gilead, Ohio

Application September 22, 1931, Serial No. 564,404

11 Claims. (Cl. 103—161)

This invention relates generally to rotary, multiple, radial piston pumps and primarily seeks to provide a novel construction of pump of this character in which provision is made for readily varying the output and which is capable of high speed and substantially silent operation under all normal conditions of use.

Pumps of the type to which my present invention relates include a cylinder barrel rotatable about a pintle and containing a plurality of radially disposed bores each of which communicates alternately with inlet and outlet passages of the pintle, together with a piston reciprocable in each bore and driven by an impeller which surrounds and rotates with the cylinder. The pistons in these pumps sometimes are connected to the impeller through the medium of load transmitting T-heads which are freely reciprocable in the impeller in a direction normal to the axes of reciprocation of the pistons and which in some cases bear against sets of anti-friction rollers provided in the impeller to sustain the transmitted piston loads and to insure freedom of reciprocation of the T-heads of the pistons. In these pumps it is customary also to mount the impeller and the cylinder barrel on anti-friction bearings, or the cylinder barrel on a partially lubricated pintle and the impeller on anti-friction bearings, all of which contribute toward providing for a more or less limited load carrying capacity.

Pumps of the general type above alluded to are inclined to be very noisy at high speed and high pressure operation. At high speeds the working fluid is not given time to fill out the individual piston cylinders due to the fact that the intake passages usually employed are too complicated. For example, in some of these pumps the central valve is located in a rotatable pendulum, and therefore no direct fluid passage connection at the rotatable arm is possible. In order to secure fluid connection, the fluid has to pass through passages in the pendulum and then through the stationary rocker shaft which serves as the center of the rocking pendulum. The inlet and outlet passages can join only to the headers in which the rocker shaft is mounted. It should be evident that such designs of high speed pumps in which the inlet fluid is subjected to a change of direction of ninety degrees three times before it reaches the bottom of the cylinder will not operate as efficiently as pumps of this type should be capable of operating.

Seeking to remedy the errors and disadvantages of the constructions above referred to my present invention has for an object to provide a novel form of pintle which is stationarily mounted whereby the bridge center always coincides with the line of stroke shift, in which the bridges and fluid passages are so proportioned and arranged as to properly cooperate with the cylinder ports at all positions of the parts and provide for free flow of fluid assuring complete filling out of the pump cylinders and eliminating noise occasioning trapping of fluid, and which is submerged in the working fluid so that during the suction periods of the pistons no air is permitted to be drawn into the piston cylinders.

Another object of the invention is to provide a novel means for lubricating and cooling the pintle.

Another object of the invention is to provide means for insuring ample supply of lubricant under pressure to the coacting bearing surfaces including the provision in said surfaces of high pressure oil film building equipments designed to greatly reduce friction and at the same time to retain high pressure in the pump and prevent ingress of air.

Another object of the invention is to provide a novel piston, T-head, thrust slide block and reaction plate construction and assembly embodying a simple but highly efficient high pressure film bearing equipment.

Another object of the invention is to provide a novel cylinder barrel construction having vibration damping flywheel qualities.

Another object of the invention is to provide novel means for assuring the desired straight line shifting of the eccentric when effecting output adjustments of the pump.

Another object of the invention is to provide a flexible coupling between the driving shaft and the driven elements of the pump whereby transmission of the ills born of a misaligned drive shaft to the remainder of the pump elements is effectively eliminated.

Other objects will in part be obvious and in part be pointed out hereinafter.

To the attainment of the aforesaid objects and ends, the invention still further resides in the novel details of construction, and the combination and arrangement of the parts, all of which will be first fully described in the following detailed description, then be particularly pointed out in the appended claims, reference being had to the accompanying drawings, in which:—

Figure 1 is a horizontal section taken through the axis of the pump, parts being shown in elevation.

Figure 2 is a vertical cross section of the pump taken through the axis of the control rods, parts being shown in elevation.

Figure 3 is a vertical cross sectional view of the eccentric taken on the line 3—3 of Figure 4.

Figure 4 is a vertical longitudinal section taken on the line 4—4 on Figure 3.

Figure 5 is a longitudinal sectional view of the cylinder barrel taken on the line 5—5 on Figure 6.

Figure 6 is a vertical cross section taken on the line 6—6 on Figure 5.

Figure 7 is an end view of the cylinder barrel looking toward the coupling end thereof.

Figure 8 is a detail side elevation of the drive shaft.

Figure 9 is a left end elevation of the shaft shown in Figure 8.

Figures 10, 11 and 12 are side elevation and opposite end views respectively of the intermediate coupling element.

Figure 13 is a detail vertical cross section taken on the line 13—13 on Figure 1.

Figure 14 is a detail plan view of the pintle.

Figure 15 is a left end elevation of the pintle.

Figures 16, 17 and 18 are detail cross sections taken on the lines 16—16, 17—17 and 18—18 on Figure 14.

Figure 19 is a detail plan view of the bridge portion of the pintle.

Figure 20 is a diagrammatic cross sectional view illustrating the bridge overlap feature.

Figures 21 and 22 are detail part elevations and part vertical cross sections of one of the T-headed pistons, the views bearing 90° angular relation.

Figures 23 and 24 are detail longitudinal and transverse sectional views of one of the thrust slide blocks.

Figures 25 and 26 are detail longitudinal and transverse sectional views of one of the reaction plates.

Figure 27 is a detail side view of the bridge portion of the pintle and illustrates a modified form thereof.

Figure 28 is a detail cross section taken on the line 28—28 in Figure 27.

In the practical development of the invention I provide a pump casing comprising a cylindrical ring 5 having an integral supporting base 6, and upper and lower pairs of spaced slide guide pads 7. The casing ring is also provided with horizontal diametrically, oppositely disposed hubs in which shifter rod guides 8 are formed, and drain back ducts 9 which communicate with the guides and with the interior of the casing defined by the ring to enable fluid tending to leak past the shifter rods and out of the casing to return into the casing.

The pump casing is completed by end casing bells 10 and 11, which have a centering shoulder 12 to fit within the casing ring 5, and which are flange secured as at 13 to the respective ends of the casing ring. Each casing bell is also provided with an annular recess 14 adapted to receive a sealing and bearing ring 15. As will be observed by reference to Figure 1 of the drawings the rings 15 are apertured to receive and enable them to slide axially on screws 16 secured in the casing end bells. In the space between each ring 15 and the adjacent casing bell recess wall, spring elements 17 are interposed and serve to press the rings toward the pump chamber formed within the casing ring 5 and end bells 10 and 11.

The casing end bell 10 is provided with an axial bore 18 in which the enlarged head 19 of the cylindrical pintle 20 is secured and held against rotation by means of a key 21. The end bell 10 is also provided with diametrically oppositely disposed combined intake and exhaust ports designated 22 and 23 respectively and which lead vertically into the bore 18 and there register with like size ports 24 and 25 formed in the enlarged head of the pintle. See Figures 1 and 13.

The pintle port 24 communicates with an upper pair of longitudinal ducts 26 with which the pintle is provided, and the port 25 communicates with a similar lower pair of ducts 27 formed in the pintle. The pairs of ducts 24 and 25 extend only part way through the pintle and have their outed ends blocked as at 28 so that communication with said ducts through the pintle head may be had only through the ports 22—25. It should be understood that each of the pairs of ducts 26 and 27 are at times intake ducts and at other times exhaust ducts, according to the adjustment of the pump during the particular interval.

At their ends opposite the blocks 28 the upper and lower pairs of ducts 26 and 27 lead into or communicate with upper and lower pintle cut outs respectively designated 29 and 30, which afford communication between the respective pairs of ducts and the cylinder barrel ports in a manner which will become apparent as the description progresses. The remainder of the cut-outs 29 and 30 results in the provision of a solid bridge piece 31, and it is a feature of my present invention to so construct and arrange the parts that the center line of this bridge piece is always in line with the axis of the shifter ring, or in other words, the line on which the shifter ring moves in varying the output of the pump always coincides with the center line of the bridge piece.

It will also be observed by reference to Figures 2, 16, 19 and 20 that the bridge 31 is unsymmetrical and is provided at each of its upper and lower faces with an overlap extension disposed in the direction of rotation of the cylinder barrel and generally designated 32 and which so cooperate with the ports in the rotating cylinder barrel as to effect fluid communications under equalized pressure and, therefore, without detonation. It is preferred that the degree of overlap should be positive and determined by the pressure desired in the particular use to which the pump is to be put. Obviously the extent of this overlap will vary in pumps of different speeds, and in order to operate at full efficiency the degree of overlap should be accurately determined in accordance with the pressure desired.

In Figure 27 of the drawings I have illustrated a slight modification of the bridge portion cut-outs in which the ends of the cut-outs are V-notch shaped as indicated at 33. I have found that while the form of bridge cut-out disclosed in Figure 19 is to be preferred when the overlap is formed in accordance with operation at a particular speed the V-notch formation 33 will serve to provide for substantially silent operation at all speeds.

The pintel 20 is also provided with an axial bore 34 which communicates through radial bores 35 with the interior of the pump casing and also through a reduced axial bore 36 through the free end of the pintle into the interior of the casing in a manner and for a purpose that will be described later.

At its entrant end the bore 34 is connected as at 37 with a pipe line leading from an auxiliary pump (not shown) or other source of lubricant under force-feed pressure as distinguished from a mere gravity feed. By this means a suitable

supply of lubricant is force-fed into the interior of the pump casing and serves not only to lubricate the pump parts, but also to keep the pintle cool and prevent burning out of the cylinder barrel bearing provided thereon in a manner which will become apparent as the description progresses. A check valve is preferably provided in the pipe line connected as at 37 to the pintle bore so that presure may be maintained in the pump casing during any temporary inoperative conditions of the auxiliary pump which may be occasioned.

The casing end bell 11 is bored from its opposite ends to form an intermediate shoulder 38 and to provide seats for bearing rings 39 and 40 disposed one at each side of said shoulder. The bearing ring 40 forms a plain film bearing for the head 41 of a drive shaft 42 which extends from the casing through a packing gland bearing 43 for attachment with suitable driving connections not shown. The gland bearing 43 is flange-secured as at 44 to the end bell 11.

A cylinder barrel 45 is rotatably mounted in the pump casing, having its principal bearing, a plain oil film bearing, on the main cylindrical body portion 20 of the pintle. The cylinder barrel has bearing also in the bearing ring 39, and laterally, on the sealing and bearing rings 15 which are pressed tightly against the lateral faces thereof by the spring elements 17.

The cylinder barrel 45 is provided, in its central transverse plane, with a plurality (seven being shown) of radial cylinder bores 46 spaced equidistantly around the circumference thereof and extending through the outer wall. At their inner ends the cylinder bores 46 communicate, through ports 47, with the pintle and the cut-outs 29 and 30 with which it is provided. Thus, as the cylinder barrel is rotated about the pintle each cylinder bore 46 thereof will communicate alternately with the pintle cut-outs 29 and 30 and the upper and lower pairs of ducts 26 and 27 with which they communicate.

At its closed end the cylinder barrel is provided with a cross groove 48, and the drive shaft head 41 is provided with a similar cross groove 49 lying in a plane normal to the plane of the groove 48, and these grooves 48 and 49 are adapted to receive correspondingly positioned coupling ribs 50 extending from the opposite faces of the coupling head 51 which is interposed between the cylinder barrel and the shaft head 41. See Figures 1, 5, and 7 through 12. By reason of the provision of this loose coupling, suitable means is provided for imparting rotation to the cylinder barrel and yet the cylinder barrel and the pump parts which rotate therewith are not subjected to any of the ills to which they would otherwise be occasioned by reason of any misalignment of the drive shaft. The bore of the cylinder barrel 45 which fits the pintle 20 is provided with annular lubricant grooves 52 and longitudinal communicating lubricant grooves 53 which tend to collect and hold lubricant in the plain film bearing provided between the periphery of the pintle 20 and the inner walls of the cylinder barrel bore. The cylinder barrel is disclosed in detail in Figures 5, 6 and 7.

A shifter ring or annulus 54 is mounted within the pump casing, and shifter rods 55 are secured to this ring as at 56 and extend through the rod guides 8 beyond the casing ring 5 where they are attached to any suitable shifting devices which are not shown but the purpose and function of which are well understood to workers in this art. The shifter ring 54 is provided with upper and lower pairs of spaced slide guide pads 57 adapted to be guided by the casing ring pads 7 so that whenever the ring 54 is shifted its center will always lie in the line of the axis of the pintle.

The shifter ring 54 is provided at one side edge with a flange ring 58 and is annularly recessed at its other side edge to receive a flange ring 59 which is removably secured thereto as at 60. Each of the flange rings 58 and 59 carries a bearing ring 61 the inner face or wall of which is equipped with a high pressure lubricant film bearing generally designated 61*a* and preferably of the type disclosed in my copending application for patent filed August 18, 1931, Serial No. 557,888.

Within the annular chamber formed in the pump casing between the shifter ring 54 and the periphery of the cylinder barrel 45 is a shiftable ring or eccentric 62, the center of rotation of which is adapted to be shifted relative to the axis of the pintle by movement of the shifter ring 54. The ring or eccentric 62 includes a central bore 63 surrounding the periphery of the cylinder barrel 45 in spaced relation and a centrally disposed enlarged peripheral shoulder 64 having an annular recess 65 closed by a shell casing 66 removably secured to the flanges defining the recess 65 as indicated at 67 and which cooperates with the sealing rings 15 in retaining lubricating fluid in the annular chamber between the periphery of the cylinder barrel 45 and the ring or eccentric 62 and including the recess 65. It will be observed by reference to Figures 1 through 4 that the annular recess 65 communicates with the interior of the ring or eccentric 62 through elongated openings 68, one of which is provided for each cylinder bore provided in the cylinder barrel 45.

The provision of the central shoulder enlargement on the ring or eccentric 62 provides lateral bearing flanges 69 which are adapted to ride in the oil film bearings 61*a* and to have lateral engagement with the bearing and sealing rings 15 for bearing purposes and for the purpose of retaining lubricant as hereinbefore described. The flanges are apertured as at 71 so that free passage of lubricating fluid to the oil film bearings 61 is provided for.

It will be observed by reference to Figures 2, 3 and 4 that the ring or cylinder 62 is provided, in the flanges thereof which define the annular recess 65, with a plurality of opposed pairs (one for each cylinder bore in the cylinder barrel 45) of tangentially disposed reaction plate receiving grooves 72 and similar pairs of radially disposed reaction plate locking grooves 73 which pass through the periphery of said ring or eccentric and the purposes for all of which will become apparent as the description progresses.

Solid cylindrical pistons 74 are reciprocable in the cylinder barrel bores 46 and extend through the openings 68 formed in the ring or eccentric 62. Each of the pistons is equipped with an integral T-head 75 which, together with the block 76, constitutes a thrust slide block. The opposed faces of each pair of elements 75 and 76 are provided with hemispherical recesses 77 which provide a spherical seat or keyway to accommodate a ball key 78. The ball key 77 holds the elements 75 and 76 together so that they will reciprocate tangentially in the eccentric or ring grooves but permits a slight degree of relative rocking movement of the block 76 during operation of the pump designed to draw into the space beneath and above the block 76 sufficient lubricant to form

a high pressure film capable of sustaining enormous operation loads and of assisting in rendering the operation of the pump substantially silent under all condidtions of operation. In order to facilitate the drawing in of oil just referred to, the upper face of the block 76 is shaped to slant slightly from center to ends in the tangential direction as indicated at 76*a*, and the upper face of the T-head 75 is shaped to slant slightly from center to side in the transverse direction as indicated at 79. In practice the degree of inclination of the slanting surfaces 76*a* and 79 is very slight. The inclination of these surfaces has been exaggerated considerably in this disclosure for the purpose of illustrating the principle involved as clearly as is possible.

The upper or outer face of each block 76 engages a stationary reaction plate 80 having lateral tenons 81 extending into the tangential grooves 72 provided therefor in the flanges of the ring or eccentric and each such plate is provided with a threaded bore to receive the screw 82 by which a lock plate 83 having its ends extended into the radial grooves 73 of said ring or eccentric is secured to position upon said reaction plate. By reason of the extensions of the ends of the locking plates into the radial grooves 73, they serve to secure the reaction plates against tangential movement relative to the thrust slide blocks 75, 76. The tenons 81 serve to hold the reaction plates against radial movement and thus enable them to take up the radial thrusts incident to operation of the pistons 74.

The casing ring 5 may be provided with a drain 84, if desired, so that fluid leaking into the pump chamber surrounding the shifter ring 54 may be drained from the pump casing.

It should be understood that while I have disclosed one specific shaping of the solid piston T-heads and the block 76 which together form the thrust slide block, and the arrangement of the slanting faces thereof, these parts may be modified as to their specific shape and the arrangement of the slanting surfaces without departing from the scope of my present invention.

It will be understood that with the pump parts positioned as illustrated in Figure 2 of the drawings, with the shifter ring center coinciding with the axis of the pintle, the cylinder barrel 45, the ring or eccentric 62 and connected parts will rotate freely within the casing without effecting any pumping action. In other words, Figure 2 illustrates a neutral position of the pump parts.

By means of the shifter rods 55 the shifter ring 54 may be shifted so that the center line of the eccentric 62 will be moved to one side or the other of the center line or axis of the pintle 20. Let us assume that the ring is shifted to the right in Figure 1, and that the direction of rotation of the cylinder barrel 45 is clockwise. In this position of the parts all of the pistons above the center line will be moved radially outward and will suck fluid through the intake port 22 and the upper pair of ducts 26 and the pistons below the center line will be moved radially inward and will expel fluid through the lower pair of ducts 27 and the exhaust port 23.

Obviously, when the eccentric 62 is shifted toward the left of the center line of axis of the pintle the cycle will be reversed and the pistons above the center line will expel fluid while those below the center line will draw fluid into the cylinder bores.

One of the main purposes of my present invention has been to eliminate noise in the operation of pumps of the character described. I find that the inability of pump structures, of which I am now aware, to fill out the cylinders with the pressure fluid is one of the principal sources of high frequency vibration and noise. Partially filled out cylinders develop gaseous fluids in the portion of their chambers unfilled and the solidity of the working fluid charge is thus spoiled and a phenomena similar to air hammer detonation takes place. When cylinder chambers filled with a liquid and gas mixture communicate with the high pressure port or pintle cut-out, considerable time loss is occasioned during the interval necessary to compress the gas and liquid mixture to the pressure of the incoming solid fluid, and an undesirable pressure vibration is occasioned.

In my improved pump I provide for substantially silent operation at all times due to the proper coordination of the bridge walls and cylinder ports during all conditions of operation. The position of the bridge piece 31, is set in my improved pump by the key 21. As hereinbefore stated the bridge piece 31 is provided at each side, in the direction of rotation of the cylinder barrel 45, with an overlap extension 22. If we consider the shifter ring 54 as shifted to the right in Figure 2 of the drawings and observe the position of the cylinder bore, which is positioned horizontally at the left of Figure 2, it will be obvious that communication into this cylinder bore is closed by the bridge piece portion with which it is in immediate association. As this piston bore starts to move upwardly its piston will, of course, move radially outward and will tend to expand and thus reduce the pressure of the fluid within the chamber beneath said piston, and by the time the extent of the overlap 32 has been covered and communication thus afforded between the cylinder bore and the upper pintle cut-out 29, the fluid just referred to will have been reduced in pressure to a pressure equal to that of the fluid entering the upper cylinder bores through the cut-out 29 and thus shock and vibration will be effectively avoided. In like manner as each cylinder passes downwardly at the opposite side of the bridge piece its communicating port 47 will be momentarily closed by the associated bridge piece portion, and during its travel beyond the dead center the piston, starting to move inwardly, will compress the fluid beneath it and for which no outlet is afforded, so that by the time the advancing edge of the port 47 passes over the extension or lap 32 of this portion of the bridge piece said fluid will have been compressed to the same pressure present in the fluid being expelled through the lower pintle cut-out 30. In this manner it will be understood that the center valve or pintle cut out opening and closing is effected always at equalized pressure and no undesirable vibration or detonation is occasioned in this phase of the operation of my improved pump.

As before stated the degree of overlapping of the bridge piece portions at 32 is controlled by the intended speed of operation of the pump. It has also been described that in order to adapt the pump for silent operation at varied speeds and pressures, notches 33 may be provided, thus adding to the flexibility in operation of my improved pump.

It will be understood that whenever the eccentric 62 is adjusted off center and the cylinder barrel 45 is rotating, the pistons 74 will be reciprocated radially in their receiving bores, the thrust slide blocks 75 and 76 reciprocating tan-

gentially in the eccentric recess 65 because of the off center relation of that eccentric, and distributing the reactionary stresses and thrusts occasioned by the piston operation to the bottom faces of the recess 65 and the reaction plates 80 respectively.

It should be understood that the pistons reciprocate in their cylinder bores on lines normal to the direction of reciprocation of the thrust slide blocks, and that these blocks transmit the hydraulic load of the piston to the reaction surfaces of the eccentric above referred to in such a way that the resultant piston force is always in a line normal to the reaction faces and thus no lateral force component is occasioned which would subject the cylinder and piston walls to wear. The inclined surfaces 78 and 79, with which the thrust slide block equipment is provided, serve effectively during operation of the pump for drawing in lubricant and sustaining wedge shaped lubricant films at all times. The film bearing thus provided is capable of efficiently sustaining enormous piston loads and at the same time is quieter and lasts longer than other types of bearings.

The advantages of providing pressure feed lubrication for the pintle should be obvious. The relatively cool lubricant thus fed through the bores 34—37 serves not only to provide efficient lubrication for the adjacent surfaces of the pintle and the cylinder barrel, but also keeps this plain film bearing in the cool state and overcomes all normal tendencies of this bearing to burn out. This lubricant also finds its way, by leakage past the pistons and the ends of the cylinder barrel, into the chamber effectively sealed by the rings 15 and the shell casings 66 in a manner hereinbefore described. It will therefore be obvious that the pintle and the valves or cut-outs therein are mounted in a lubricant bath and the eccentric 62 rotates with a similar bath. It should also be obvious that the provision of this type of lubrication and the other high pressure lubricant bearings referred to eliminates the need for using the much less efficient anti-friction bearings and thus provides not only for more efficient lubrication, but also for substantially silent operation. The bearings thus provided in my improved pump also effectively insure against the sucking of air into the cylinder bores through the casing.

Another advantage of the invention resides in the provision of the heavy cylinder barrel. Thus constructed this element operates with flywheel effect and thus decreases the fluctuation of the rotating masses and provides for greater uniformity in the rotation of the cylinder barrel and the other elements which move therewith.

From the foregoing description taken in connection with the accompanying drawings it is thought that the novel details of construction, the manner of use and the advantages of my invention will be readily apparent to those skilled in the art to which it relates.

I claim:

1. In a rotary piston pump, the combination of a casing, a pintle rigidly supported in the casing and having a fluid ingress duct and a fluid egress duct in the body thereof and a peripheral cut-out communicating with each duct, a cylinder barrel rotatable on said pintle and having a plurality of radially arranged cylinders open at their outer ends and adapted to communicate through ports at their inner ends with the pintle cut-outs, an eccentric rotatable with the cylinder barrel on an axis eccentric to that of the cylinder barrel and surrounding said barrel in spaced relation, pistons reciprocable in said cylinders and connected at their outer ends to said eccentric, means whereby lubricant may be supplied and find its way into the space between the cylinder barrel and the eccentric and into engagement with said piston connections, and non-rotatably supported sealing rings for retaining lubricant in said space.

2. In a rotary piston pump, the combination of a casing, a pintle rigidly supported in the casing and having a fluid ingress duct and a fluid egress duct in the body thereof and a peripheral cut-out communicating with each duct, a cylinder barrel rotatable on said pintle and having a plurality of radially arranged cylinders open at their outer ends and adapted to communicate through ports at their inner ends with the pintle cut-outs, an eccentric rotatable with the cylinder barrel on an axis eccentric to that of the cylinder barrel and surrounding said barrel in spaced relation, pistons reciprocable in said cylinders and connected at their outer ends to said eccentric, force-feed means whereby lubricant may be supplied and find its way into the space between the cylinder barrel and the eccentric and into engagement with said piston connections, and spring pressed sealing rings laterally engaging said eccentric and cylinder barrel for retaining lubricant in said space.

3. In a rotary piston pump, the combination of a casing, a pintle rigidly supported in the casing and having a fluid ingress duct and a fluid egress duct in the body thereof and a peripheral cut-out communicating with each duct, a cylinder barrel rotatable on said pintle and having a plurality of radially arranged cylinders open at their outer ends and adapted to communicate through ports at their inner ends with the pintle cut-outs, an eccentric rotatable with the cylinder barrel on an axis eccentric to that of the cylinder barrel and surrounding said barrel in spaced relation, pistons reciprocable in said cylinders and connected at their outer ends to said eccentric, force-feed means whereby lubricant may be supplied and find its way into the space between the cylinder barrel and the eccentric and into engagement with said piston connections, said connections including stationary reaction plate and reciprocable multipiece thrust slide block equipment having provision for forming intervening high pressure lubricant film bearings, and sealing rings for retaining lubricant in said space.

4. In a rotary piston pump, the combination of a casing, a pintle rigidly supported in the casing and having a fluid ingress duct and a fluid egress duct in the body thereof and a peripheral cut-out communicating with each duct, a cylinder barrel rotatable on said pintle and having a plurality of radially arranged cylinders open at their outer ends and adapted to communicate through ports at their inner ends with the pintle cut-outs, an eccentric rotatable with the cylinder barrel on an axis eccentric to that of the cylinder barrel and surrounding said barrel in spaced relation, pistons reciprocable in said cylinders and connected at their outer ends to said eccentric, force feed means whereby lubricant may be supplied and find its way into the space between the cylinder barrel and the eccentric and into engagement with said piston connections, each said piston and eccentric connection including a stationary reaction plate, an integral T-head carried by the piston, and an intervening block forming with the T-head a reciprocable thrust slide block and mounted for rocking movement relative to the T-

head and reaction plate to provide high pressure lubricant film bearings, and sealing rings for retaining lubricant in said space.

5. In a rotary piston pump, the combination of a casing, a pintle rigidly supported in the casing and having a fluid ingress duct and a fluid egress duct in the body thereof and a peripheral cut-out communicating with each duct, a cylinder barrel having lubricant film rotary bearing on said pintle and having a plurality of radially arranged cylinders open at their outer ends and adapted to communicate through ports at their inner ends with the pintle cut-outs, an eccentric rotatable with the cylinder barrel on an axis eccentric to that of the cylinder barrel and surrounding said barrel in spaced relation, pistons reciprocable in said cylinders and connected at their outer ends to said eccentric, a shifter ring having flanges equipped with high pressure lubricant film bearings to rotatably support the eccentric, force-feed means to supply lubricant to the film bearings and to the space intervening the eccentric and cylinder barrel and likewise to the piston and eccentric connections, and means to retain lubricant in said space.

6. In a rotary piston pump, the combination of a casing, a pintle rigidly supported in the casing and having a fluid ingress duct and a fluid egress duct in the body thereof and a peripheral cut-out communicating with each duct, a cylinder barrel having lubricant film rotary bearing on said pintle and having a plurality of radially arranged cylinders open at their outer ends and adapted to communicate through ports at their inner ends with the pintle cut-outs, an eccentric rotatable with the cylinder barrel on an axis eccentric to that of the cylinder barrel and surrounding said barrel in spaced relation, pistons reciprocable in said cylinders and connected at their outer ends to said eccentric, a shifter ring having flanges equipped with high pressure lubricant film bearings to rotatably support the eccentric, force-feed means to supply lubricant to the film bearings and to the space intervening the eccentric and cylinder barred and likewise to the piston and eccentric connections, and spring pressed sealing rings laterally engaging said eccentric and cylinder barrel for retaining lubricant in said space.

7. In a rotary piston pump the combination of a rotatable cylinder barrel having a plurality of radially disposed cylinders, pistons reciprocable in and projecting from the cylinder barrel, an eccentric surrounding the cylinder barrel and rotatable therewith on an axis disposed eccentrically relative to the cylinder barrel axis and having tangential grooveways therein, and means connecting each piston with the eccentric comprising a reaction plate rigidly supported on the eccentric, a T-head carried by the piston and integral therewith, and a block forming with the T-head a thrust slide block reciprocable in one of the eccentric grooveways, said block being mounted for rocking movement relative to the said T-head and said reaction plate for the purpose specified.

8. In a rotary piston pump the combination of a rotatable cylinder barrel having a plurality of radially disposed cylinders, pistons reciprocable in and projecting from the cylinder barrel, an eccentric surrounding the cylinder barrel and rotatable therewith on an axis disposed eccentrically relative to the cylinder barrel axis and having tangential grooveways therein, and means connecting each piston with the eccentric comprising a reaction plate rigidly supported on the eccentric, an integral T-head carried by the piston, and a block forming with the T-head a thrust slide block reciprocable in one of the eccentric grooveways, said block and said T-head having hemispherical recesses in their opposed faces compositely forming a spherical seat, a ball key in said seat, and clearances provided between the opposed faces of the reaction plate and the block and the T-head and the block to permit slight rocking motion of the block relative to the T-head and the reaction block for the purpose specified.

9. In a rotary piston pump the combination of a rotatable cylinder barrel having a plurality of radially disposed cylinders, pistons reciprocable in and projecting from the cylinder barrel, an eccentric surrounding the cylinder barrel and rotatable therewith on an axis disposed eccentrically relative to the cylinder barrel axis and having tangential grooveways therein, and means connecting each piston with the eccentric comprising a reaction plate rigidly supported on the eccentric, an integral T-head carried by the piston, and a block forming with the T-head a thrust slide block reciprocable in one of the eccentric grooveways, said block and said T-head having hemispherical recesses in their opposed faces compositely forming a spherical seat, and a ball key in said seat, the upper face of the block being provided with slightly inclined clearances from center-to-end thereof and said T-head upper face being provided with slightly inclined clearances from center-to-side thereof to permit slight rocking motion of the block relative to the T-head and the reaction block for the purpose specified.

10. In a rotary piston pump the combination of a rotatable cylinder barrel having a plurality of radially disposed cylinders, pistons reciprocable in and projecting from the cylinder barrel, an eccentric surrounding the cylinder barrel and rotatable therewith on an axis disposed eccentrically relative to the cylinder barrel axis and having tangential grooveways therein, and means connecting each piston with the eccentric comprising a reaction plate rigidly supported on the eccentric, an integral T-head carried by the piston, and a block forming with the T-head a thrust slide block reciprocable in one of the eccentric grooveways, said block and said T-head having hemispherical recesses in their opposed faces compositely forming a spherical seat, a ball key in said seat, and clearances provided between the opposed faces of the reaction plate and the block and the T-head and the block to permit slight rocking motion of the block relative to the T-head and the reaction block, and said T-head and block being in direct contact over their areas adjacent and surrounding the ball key except as separated by a high pressure lubricant film existing between them.

11. In a rotary piston pump the combination of a rotatable cylinder barrel having a plurality of radially disposed cylinders, pistons reciprocable in and projecting from the cylinder barrel, an eccentric surrounding the cylinder barrel and rotatable therewith on an axis disposed eccentrically relative to the cylinder barrel axis and having tangential grooveways therein, and means connecting each piston with the eccentric comprising a reaction plate rigidly supported on the eccentric, an integral T-head carried by the piston and a block forming with the T-head a thrust slide block reciprocable in one of the

ecentric grooveways, said block and said T-head having hemispherical recesses in their opposed faces compositely forming a spherical seat, and a ball key in said seat, the engaging faces of the block and T-head being in direct contact over a considerable area surrounding the ball key except as separated by a high pressure lubricant film, the upper face of the block being provided with slightly inclined clearances from the center-to-end thereof and said T-head upper face being provided with slightly inclined clearances from center-to-side thereof to permit slight rocking motion of the block relative to the T-head and the reaction block for the purpose specified.

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