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3,034,451

PINTLE PORT CONSTRUCTION FOR PUMPS

Filed April 23, 1959

2 Sheets-Sheet 1

FIG. 1

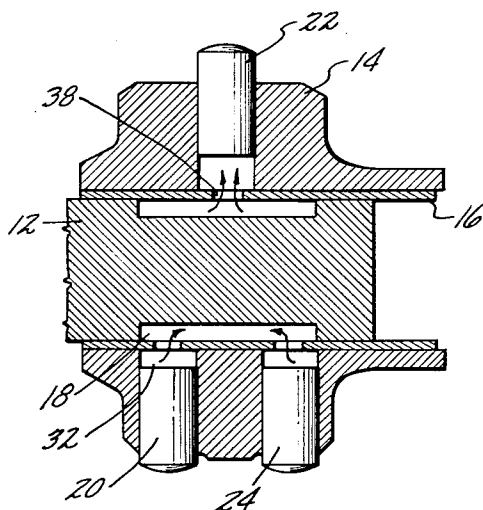


FIG. 2

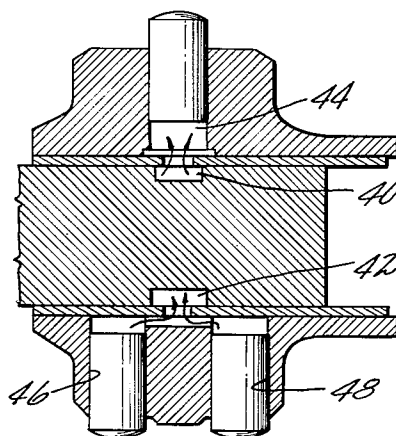


FIG. 1A

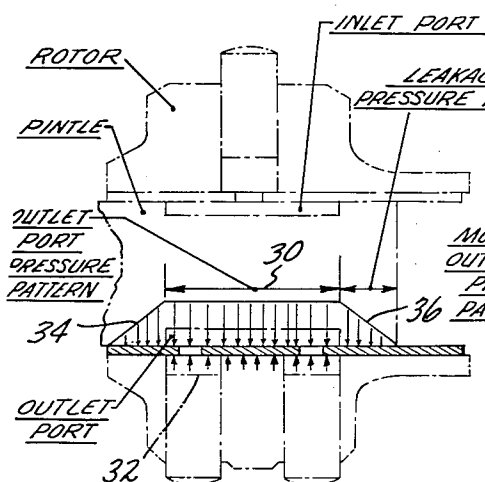
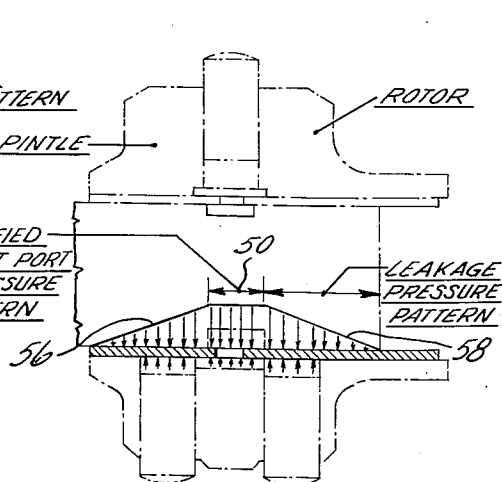


FIG. 2A



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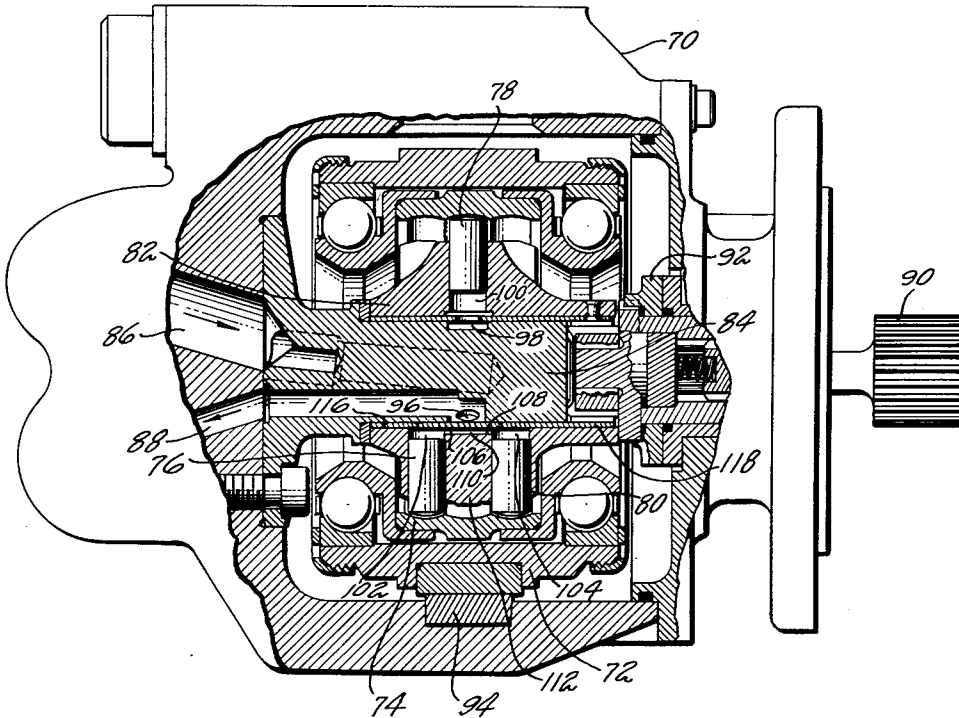
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FIG. 3



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PINTLE PORT CONSTRUCTION FOR PUMPS

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1 Claim. (Cl. 103—161)

This invention relates to rotary piston hydraulic pumps and more particularly to the pintle and port construction for such pumps.

The normal design practice for radial piston pumps is to provide a separate port in the rotor for each row of pistons and to make the outlet port in the pintle long enough in the axial direction to span the piston ports in the rotor. This results in a projected pintle port area (projected in the direction away from the pintle pressure port toward the adjacent piston) which is approximately equal to the projected area of the pistons that are under pressure. When these projected areas, i.e., the port and the piston areas, are equal there is no tendency for the rotor to be forced eccentric on the pintle by the pressure in the outlet port. This statement holds true if leakage conditions were perfect.

There is, however, a leakage pressure between the pintle and the rotor in the bearing areas adjacent to the outlet port on either side thereof. As one moves further from the port along the pintle the leakage tends to drop to zero. However, this pressure does force the rotor to an eccentric position and creates a bearing pressure on the opposite side of the pintle adjacent to the inlet port.

It is therefore an object of this invention to provide a pintle-port construction for rotary piston hydraulic pumps and the like wherein the outlet and inlet ports in the pintle are substantially smaller in projected area than the projected area of the pistons under pressure at any particular time.

It is a further object of this invention to provide a multiple row radial piston pump wherein the outlet port is connected to only one of the rows of pistons with the other adjacent rows being connected to said one row by means of passages externally of the pintle.

These and other objects of this invention will become readily apparent from the following detailed description of the drawing in which:

FIG. 1 is a schematic showing of a pump pintle of the prior art construction;

FIG. 1A is a diagrammatic illustration of the pressure pattern of a pintle such as shown in FIG. 1;

FIG. 2 is a schematic illustration of a pump rotor and pintle showing the improved port construction of this invention;

FIG. 2A is a diagrammatic illustration of the pressure pattern of a pintle such as shown in FIG. 2; and

FIG. 3 is a side elevation in partial cross section of a pump embodying the principles of this invention.

In describing the prior art and the principles of this invention with respect to the drawing a conventional three-row piston rotor construction will be referred to. As described herein, the adjacent pistons of adjacent rows are slightly staggered so as to permit shortening of the rotor along its axis. However, the adjacent pistons of adjacent rows may be in-line as clearly shown in Patent No. 2,673,526 issued to R. F. Horton on March 20, 1954.

In a pump operating, at for example, 3000 p.s.i., the leakage pressure will vary between 3000 p.s.i. and zero in very nearly a linear fashion across the bearing surface and will average about 1500 p.s.i. This will create a bearing load of about 1500 p.s.i. on the opposite side of the pintle. In actual designs this bearing load may be-

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come 2000 p.s.i. due to a narrower bearing surface at the inlet side of the pintle than is presented at the outlet side and due possibly to a difference between the projected areas of the pintle outlet and the pistons which are under pressure. A wide (axial dimension) pintle outlet port of the type described above also tends to weaken the pintle in a critical area leading to high stresses and high pintle deflections which tend to cause binding between the pintle and rotor.

As seen in FIG. 1, a pintle 12 is illustrated as being surrounded by a rotor 14 which may have a bearing sleeve 16 therebetween. In this construction the outlet port 18 is approximately equal to the area of the pistons 20, 22, 24 which are subject to outlet pressure in each of the three rows. The piston 22 is shown above the center line in the cross section of FIG. 1 but actually there is a piston adjacent to the pistons 20, 24 but staggered with respect thereto and hence not seen in a vertical section. As seen herein the pressure pattern 30 for the outlet port approximately equals the pattern 32 for the total effective cylinder area so that these pressures balance out. However, to the left and right of these patterns are leakage pressure patterns 34 and 36 respectively which impose an eccentric load between the pintle and the rotor. These pressures cause a high bearing load on the other side of the pintle near the inlet port 38.

As seen in FIG. 2, it is the purpose of the present invention to have the cylinders and pistons connected in groups of three to a single row of ports approximately in the center of the rotor. Both the inlet port 40 and the outlet port 42 are made only long enough along the axis to permit proper port opening for the single row of cylinders 44. As mentioned previously in connection with FIG. 1 the cylinder 44 is shown above the center line but a similar cylinder in the same row will be located adjacent and substantially between the cylinders 46, 48 shown below the center line according to the construction of this invention.

This projected area of the pintle outlet port 42 is less than the projected areas of the adjacent cylinders of adjacent rows. Thus the pressure pattern for the port 42 is indicated along the line 50 while the pressure pattern for the cylinders is indicated as extending along the line 52. Hence, there is a net force on the rotor upward toward the pintle outlet. This force is then in a direction that tends to counterbalance the leakage pressure force indicated by the patterns 56 and 58 between the rotor and pintle and therefore reduces the bearing pressure at the top of the pintle. This permits an arrangement of outlet port length, bearing lengths and piston areas such that there is a zero net bearing pressure between the rotor and the pintle. Where exact dimensioning is not feasible, compromise dimensions will permit reductions of bearing loads as high as 50%.

A typical embodiment of this invention is better shown in FIG. 3. As shown herein a pump casing 70 is illustrated as surrounding a track ring 72 which includes an inner ring 74 engaging the outer ends of a plurality of rows of pistons 76, 78 and 80 carried by a rotor 82. A central fixed pintle 84 is fixedly mounted in the casing 70 and carries inlet passage 86 and outlet passage 88. The rotor 82 may be suitably driven by a gear 90 through a suitable grouping 92 which may be of the type shown and described in the above-referred-to patent. A track ring 72 may be pivotally mounted for movement about a pivot 94 by a suitable stroke control device as also shown in the above-referred-to patent. The outlet port 96 and the inlet port 98 are substantially of the same projected area or axial length of the area of the cylinder 100 and its corresponding piston 78. The pistons 76 and 80 have their corresponding pressure areas 102 and 104 connected to the adjacent cylinder and the outlet port 96 by means

of recessed passages 106 and 108 respectively. These passages are formed externally of the pintle 84 by cutting back the inner end 110 of the wall 112 of the rotor which separates adjacent pistons. Thus the inner end 110 of the wall 112 of the rotor is spaced away from the pintle axis a distance farther than the remaining inner wall portions 116, 118 of the rotor on either side of the wall portion 112 and the adjacent pistons 76 and 80.

As a result, then the fluid under pressure from the chambers 102 and 104 can pass through the passages 106 and 108 respectively to the adjacent cylinder of the central row and then out through the outlet port 96.

As a result of this invention it will be apparent that a very simple highly effective means has been provided for hydraulically balancing the bearing loads of a pintle-rotor combination in a rotary piston hydraulic pump. This provides for relieved bearing loads, reduction in pintle deflection, with the deflecting force having a shorter moment arm if deflecting pressures do exist. Furthermore, there is a better distribution of the bearing stress between the pintle and the rotor while also a longer leakage path is provided. This immediately results in a more uniform clearance along the leakage path due to the reduced pintle deflection.

Although one embodiment of this invention has been illustrated and described herein, it will be apparent that various changes may be made in the construction and arrangement of the various parts without departing from the scope of the novel concept.

We claim:

In a rotary hydraulic pump

(a) a casing,

(b) a rotor rotatably supported in said casing having three rows of cylinders each spaced apart along the axis of rotation of the rotor, said cylinders of said rows being arranged such that the adjacent cylinders along said axis are arranged in staggered groups,

(c) piston in said cylinders adapted to be reciprocated therein to provide a pumping action,

(d) a pintle running along the axis of rotation of the rotor about which the rotor rotates,

(e) a sleeve mounted in the bore of the rotor and extending the length of the bore,

(f) means for securing the sleeve to the rotor,

(g) inlet and outlet passageways including inlet and outlet ports in said pintle communicating in timed relation with said cylinders, said sleeve having a single row of ports registering with the center row of cylinders and intermittently with said outlet ports, the projected area of pintle outlet port being less than the projected area of the adjacent cylinders of an adjacent group,

(h) and wall means between adjacent cylinders in said one group forming part of said rotor, said wall means being spaced at its inner end further from said sleeve than the remainder of said rotor thereby providing communication between said adjacent cylinders of said one group, said spaced wall means formed for each of said group and extending solely between the cylinders formed within said group.

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