Aug. 15, 1950 M. W. HUBER 2,518,619

CYLINDRICAL RING VALVE FOR MULTICYLINDER PUMPS

Filed Aug. 16, 1948

Fig.1

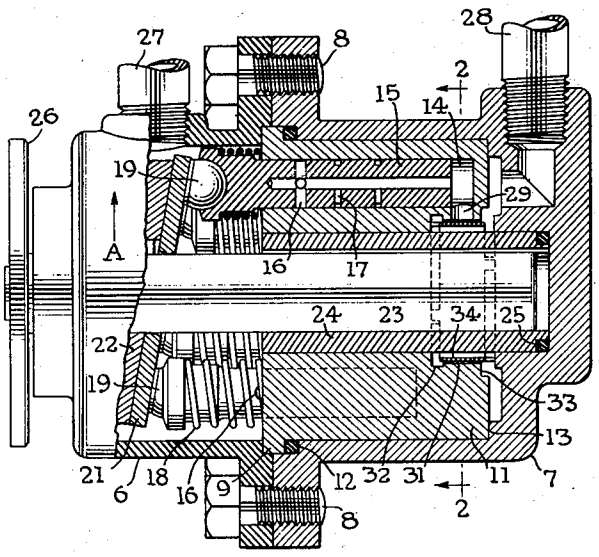
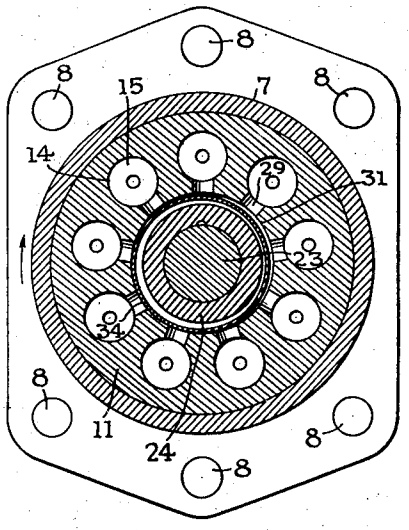


Fig.2



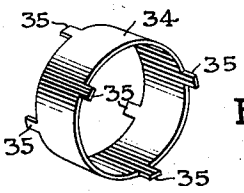


Fig.3

Fig.4

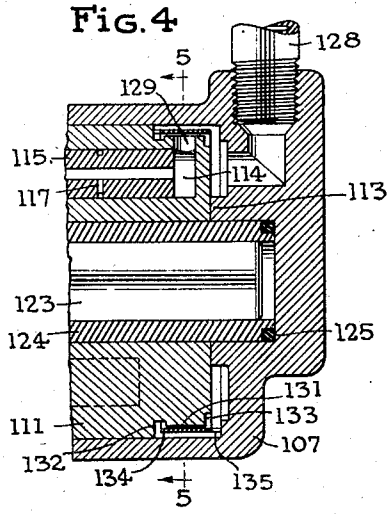
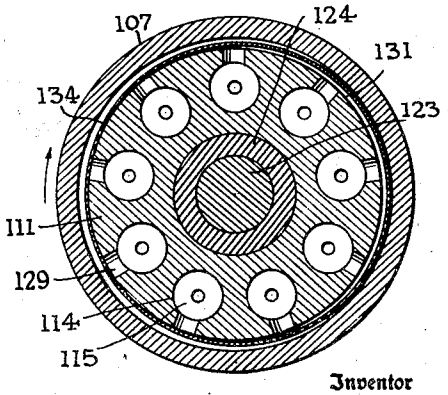


Fig.5



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CYLINDRICAL RING VALVE FOR MULTI-CYLINDER PUMPS

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7 Claims. (Cl. 103—173)

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This invention relates to automatic discharge valves for multiple cylinder pumps. It will be described as used with a parallel plunger type of pump, because with this the invention affords a very compact arrangement, characterized by short discharge ports of excellent form. A single valve sleeve controls discharge flows from any desired number of cylinders, functions as its own spring, and can be mounted in the head of the pump cylinders. The improved valve can, however, be used with almost any multi-cylinder pump where automatic discharge valves are practicable.

According to the invention, discharge ports from the various cylinders all terminate on a cylindrical valve seat, and are arranged in a circumferential series in the order in which these cylinders discharge. The ports are controlled by an annular valve sleeve of flexible sheet material, such as thin elastic bronze or steel. The circumferential dimension of the valve differs from that of the seat by an amount sufficient to permit it to open the ports from half the total number of cylinders (i. e. those cylinders which are discharging), while closing the ports to the remaining cylinders (i. e. those cylinders in which the suction stroke is in progress).

As a consequence the pressure of fluid discharging from half the cylinders reacts on the valve and causes it to close tightly the ports to those cylinders which are subject to suction. The elasticity of the valve assures a tight seal. In effect the valve rolls on the seat, flexing as it rolls, so that wear is minimized and evenly distributed over valve and seat. While the material of the valve is properly described as elastic, its operation does not depend on circumferential elongation, and it does not elongate measurably in the performance of its normal valve functions.

Two embodiments are possible. A very compact arrangement may be had by making the valve seat concave. In such case the circumference of the valve is less than that of the seat and the valve is encircled by the seat. In some cases it is preferred to use a convex cylindrical seat, and an encircling valve of greater circumference. With such an arrangement the valve is flexed less severely, and is always stressed in tension. The machining operations on the seat are simpler. These advantages often outweigh the advantage of compactness inherent in the first arrangement.

Embodiments typical of the two arrangements will now be described by reference to the accompanying drawing.

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In the drawing:

Fig. 1 is a view, chiefly in axial section of a swash-plate actuated parallel-cylinder pump in which the discharge valve is surrounded by its seat.

Fig. 2 is a section on the line 2—2 of Fig. 1.

Fig. 3 is a perspective view of the discharge valve used in the pump of Figs. 1 and 2.

Fig. 4 is a fragmentary view similar to a portion of Fig. 1 showing an arrangement in which the valve encircles its seat.

Fig. 5 is a section on the line 5—5 of Fig. 4.

Refer to Figs. 1 to 3.

The pump housing comprises two parts 6 and 7 whose form is clearly shown in the drawing. They are held together by machine screws 8 which engage mating flanges. At their junction an internal rebate is formed to receive and position flange 9 which surrounds cylinder block 11. The flange is sealed by a ring 12 also received in the rebate. The block 11 seats marginally on a shoulder 13 formed in part 7 of the housing, and hence is positively positioned.

In the pump chosen for illustration nine parallel cylinder bores 14 are formed in circular series in block 11 and each receives a plunger 15 of known form. Each plunger 15 has an axial bore leading from its inner end to cross bores 16 which are the inlet ports to the cylinder. Other radial bores 17 are for lubricating purposes. Each plunger has at its outer end a head which is flanged to serve as a seat for the plunger spring 18, and is socketed to receive a universally tiltable shoe 19. The shoes 19 coact with a creep plate 21 seated on the swash-plate 22. Swash-plate 22 seats on a thrust bearing not visible in the drawing and turns with shaft 23 which is journaled in bearing bushing 24. Bushing 24 is mounted in block 11 and the head of part 7 of the housing, in which its end is sealed by ring 25. Shaft 23 carries at its outer end a driving disc 26.

An inlet connection 27 leads to the interior of housing part 6 and a discharge connection 28 leads from the space within part 7 beyond the end of block 11.

The general arrangement of swash-plate, plungers, plunger springs and drive shaft closely resembles Huber Patent No. 2,381,056, August 7, 1945. In that patent the cylinder bores extend clear through the cylinder block and individual discharge valves are used.

In the pump here illustrated the cylinder bores 14 are closed at their ends and each has a side discharge port 29 which terminates on a concave

cylindrical seat 31. Rebates 32 and 33 are formed at each lateral margin of the seat and the annular space within the seat is in free communication with discharge connection 28.

A thin tubular or cylindrical valve 34 is mounted within the seat, overhangs the lateral margins thereof and coacts therewith. The valve has stand-off lugs 35 to position it axially, and is quite thin and elastic. It is impossible to illustrate accurately in a Patent Office drawing the thinness desired to secure free flexing action, and Figs. 1, 2 and 3 all exaggerate thickness of valve 34.

Operation

Assume shaft 23 turns in the direction of arrow A in Fig. 1. That would mean that the shaft turns clockwise in Fig. 2. At the instant the swash-plate is positioned as in Fig. 1, all plungers to the right of the vertical center line of Fig. 2 would be at some phase of their respective displacement strokes. All to the left would be at some phase of their suction strokes. In Fig. 2 the valve is shown forced to the left by liquid discharging from the right hand ports, so that the valve closes the left hand ports.

As a practical matter the valve simply rolls around the seat being deformed or bowed as it goes. This gives precise timing, gradual opening and closing, with small losses from friction and eddying flow.

Modification, Figs. 4 and 5

In these figures the discharge ports lead outward instead of inward and the valve encircles its seat.

In these figures parts which correspond to parts in Figs. 1–3 are given the same reference numerals increased by 100.

The operative characteristics are the same.

The parallel arrangement of the cylinders and their grouping in circular series permits all the ports 29 (or 129) to be short and of uniform length. The same advantages could be had with the so-called "star" arrangement of cylinders. Cylinders arranged radially around a shaft would require rather long ports which, however, could be uniform in length. With most other cylinder arrangements, for example with cylinders in line, the ports to different cylinders would vary in length but this is not a fatal defect. The inventive novelty resides in the valve and its seat, and such a valve can be used with a plurality of cylinders arranged in any of the known ways, provided the ports are so connected that discharge progresses serially around the circular valve seat.

I claim:

1. The combination of a multiple-cylinder pump; means forming a cylindrical valve-seat having a circumferential series of cylinder discharge ports, each connected with a corresponding pump cylinder and arranged in said circumferential series in the order in which their respective cylinders discharge; and an annular valve sleeve of flexible sheet material, associated with said seat, of sufficiently different circumferential dimension to permit said valve to flex into port-closing contact with the seat throughout approximately half the circumferential extent thereof, while spaced therefrom throughout the remainder of the seat's circumference to open the ports in said remainder.

2. The combination defined in claim 1 in which the seat is convex and the valve sleeve encircles the seat.

3. The combination defined in claim 1 in which the seat is concave and encircles the valve sleeve.

4. The combination defined in claim 1 in which the ported valve seat is formed as an annular rib, and the valve is wider than said rib and overhangs both edges thereof.

5. The combination of a multiple-cylinder pump in which the cylinders discharge serially; means forming a cylindrical valve seat having a circumferential series of cylinder discharge ports each connected with a corresponding cylinder, the ports in the series being arranged circumferentially of the seat in the order in which their cylinders discharge; and a cylindrical annular valve of elastic sheet material which is circular when free of distortion by hydraulic pressure and of a circumferential dimension so differentiated from the circumferential dimension of said seat that when said valve is displaced by liquid discharged through certain of said ports it flexes into port-sealing contact with the seat over the remainder of said ports.

6. The combination defined in claim 5 in which the seat is convex and the annular valve encircles the seat.

7. The combination defined in claim 5 in which the seat is concave and encircles the annular valve.

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The following references are of record in the file of this patent:

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