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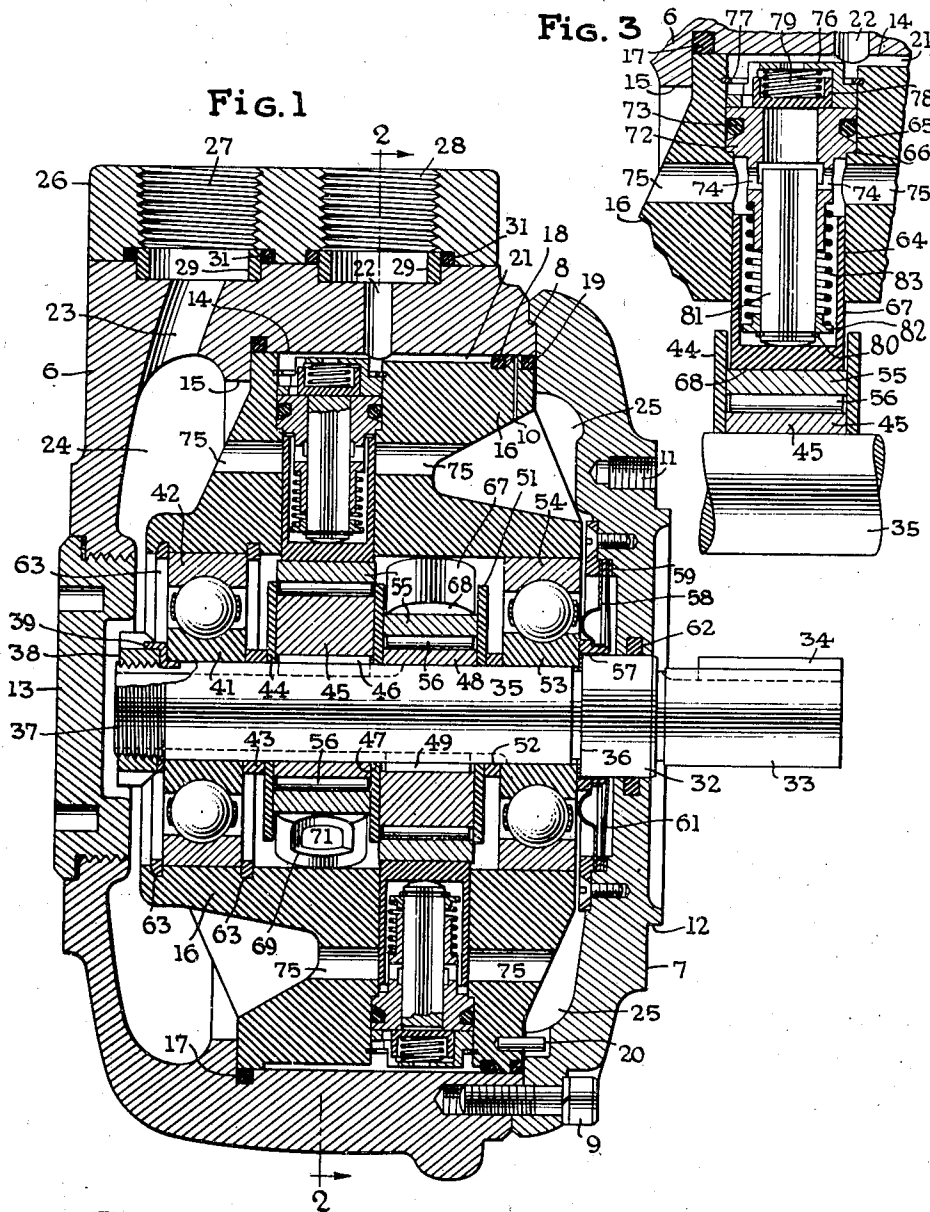
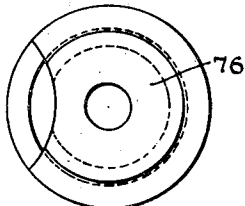


FIG. 4

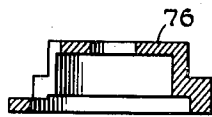


FIG. 5

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This invention relates to radial cylinder pumps and will be described as embodied in an 18 cylinder pump having two groups each of 9 radial cylinders, the cylinders of the two sets being angularly displaced 20° of arc so that an even flow is assured. More groups or only one could be arranged in a single unit and still avail of most of the features of the invention.

The object of the invention is to simplify the construction and assembly of the parts, secure compactness with adequate bearings, and produce a pump which can readily be modified by interchange of cylinder bushings and pistons so as to operate with the same power input at different volumetric outputs suited to different head pressures.

To change the pump over, all that is necessary is to release one cover plate, withdraw the shaft and cylinder body assembled as a unit, and substitute, in the body, cylinder units which are manually insertible and each of which comprises a cylinder bushing, a plunger and return spring. Each cylinder bushing is held in place by the discharge valve assembly, which is unchanged and which is removable by unseating a snap ring.

Ready removability of the cylinder bushings implies a rather free fit. This is made practicable by the use of crosshead sleeves each of which delivers thrust to its plunger while absorbing all side thrust.

The pump as illustrated is rated at 7.5 G. P. M. at 1200 R. P. M. against a head pressure of 3000 p. s. i. By substituting smaller cylinder bushings and plungers the same pump at 1200 R. P. M. will deliver 4.5 G. P. M. against a head pressure of 5000 p. s. i. The maximum permissible speed for either setup is established at 1750 R. P. M. These figures are merely illustrative.

An important feature of the pump is that all separable parts of the cylinder, cylinder body and housing are sealed by gaskets or O-rings of resilient rubber-like material positioned in grooves, so that the parts are in metal-to-metal contact, and precise location and alinement are absolutely assured.

Referring to the drawings, which illustrate a commercial embodiment of the invention:

Fig. 1 is an axial section of the complete pump taken on the line 1—1 of Fig. 2.

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

Fig. 3 is a fragmentary view, similar to a portion of Fig. 1 but showing a plunger and related

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parts fully retracted, so that the inlet port is open.

Fig. 4 is an elevation of the outer side of a discharge valve cage.

Fig. 5 is a section through the cage shown in Fig. 4.

The pump housing comprising a cup-like shell 6 and a cover plate 7 centered thereon by circular shoulder 8 and held by machine screws, one of which appears at 9. A circular series of threaded holes, one of which appears at 11, and the annular flange 12 are used to attach and position any suitable supporting bracket (not shown). A central hole in shell 6, opposite to cover plate 7 is closed by a threaded plug 13.

Shell 6 is bored to afford a cylindrical seat 14 leading to shoulder 15. Closely fitting seat 14 and mounted between shoulder 15 and cover 7 is the cylinder body or spider 16 which supports all cylinder bushings and discharge valves and the bearings for the pump shaft, all as will hereafter be described.

In seat 14 at shoulder 15 is an annular groove which receives gasket 17. In body 16 are two annular grooves which receive gaskets 18 and 19. All three gaskets are toric in form and each is formed of resilient rubber-like material which will deform under the discharge pressure developed by the pump and thus develop a good seal. Gaskets 17 and 18 seal the body 16 to the shell 6 on opposite sides of a relief groove 21 which functions as an annular discharge passage and leads to discharge port 22. Gasket 19 forms a double seal between the body 16 and shell 6 on the one hand and cap 7 on the other; see Fig. 1. A port 10 vents the space between gaskets 18 and 19 to space 25. A pin 20 set in body 16 and engaging a slot in cap 7 determines the position of body 16 in shell 6.

Inlet passage 23 leads to space 24 within shell 6 and communicates with all shaft and eccentric bearings with the cylinder inlet ports and with space 25, as will be readily understood from Fig. 1.

A fitting 26 with pipe threaded openings 27 and 28 offers connections to inlet passage 23 and discharge passage 22. Fitting 26 is held by countersunk machine screws, not visible in the drawing and each connection is sealed by a corresponding nipple 29 with soft toric gasket 31 of rubber-like material.

The main pump shaft has a portion 32 which turns in a central aperture in cap 7, a projecting outer end 33 with key 34, and a main portion 35 on which the bearings and eccentrics are

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mounted. The portion 35 is of smaller diameter than portion 32 so that a shoulder 36 is formed at a point spaced inward from the inner face of cap 7. Portion 35 has two keyways diametrically opposed, as shown in dotted lines in Fig. 1 and is threaded at 37 to receive nut 38. A lock washer 39 of known form retains the nut.

Clamped between nut 38 and shoulder 36 and in the order stated are the inner race 41 of a radial annular ball bearing (whose outer race is shown at 42), spacer 43, needle bearing guard 44, eccentric 45 (keyed to the shaft at 46), needle bearing guard 47, eccentric 48 (keyed to the shaft at 49), needle bearing guard 51, spacer 52 and inner race 53 of a second annular ball bearing (whose outer race appears at 54). The eccentrics 45 and 48 are not quite opposed. In a nine cylinder pump one trails the other at 160° so that the discharge strokes in the two circular series of cylinders alternate. Mounted on eccentrics 45 and 48 are straps or rings 55 spaced therefrom by bearing needles 56. The guards 44, 47 and 51 are metal discs which prevent escape of the needles and confine rings 55. The body or spider 16 is axially bored to fit the peripheries of outer races 42 and 54, so that the shaft is supported by and centered in body 16.

Since the eccentrics are nearly diametrically opposed the pump is very nearly in running balance and the reaction of the eccentrics approximately neutralize one another so that the loads on the shaft bearings are moderate.

The outer face of race 53 is lapped and is engaged by the lapped face of a sealing ring 57. This encircles freely portion 32 of the shaft and is sustained by a flexible metal diaphragm 58 whose outer margin is clamped to cap 7 at 59. Ring 57 is held in sealing engagement by spring disc 61. Thus a running oil-seal is provided. An auxiliary seal 62 is also provided. To retain the shaft and bearing assembly against motion in the direction of the shaft axis, two snap rings 63 are mounted in grooves in body 16, one at either side of outer race 42. The outer ring 63 has a wedging action in a V-shaped groove as shown in Fig. 1.

Body 16 has two series of radial bores approximately centered respectively on eccentrics 45 and 48. There are nine bores in each series, the bores of the two series being staggered. In other words, the bores of each series radiate at 40° intervals and the two sets are offset 20° with respect to one another.

Each bore has a guide portion 64 and at its outer end a larger counterbore 65 ending at an annular shoulder 66. Working in each guide portion 64 is a cup-like crosshead 67. Each has a slightly inclined thrust face 68 which engages the corresponding one of rings 55 and each is cut away at 69 (see Figs. 1 and 2) to permit the crossheads to clear each other at the low side of the eccentric (note how the four lower crossheads appear to overlap in Fig. 2). The cut-away at 69 affords a through port 71 (see Fig. 1) so that the crossheads never cut off flow to the inlet ports of the cylinder bushings. The obliquity improves the thrust reaction as will readily be appreciated.

Seated in each counterbore 65 against shoulder 66 is an externally flanged cylinder bushing 72. Each has an external groove with toric, rubber-like sealing gasket 73 and each is provided with opposed inlet ports 74 which communicate with cross-bores 75 in body 16. These cross-bores connect spaces 24 and 25.

Each cylinder bushing 72 is held in place by a

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discharge valve cage 76 held by a snap ring 77 (see Figs. 4 and 5). The discharge valve 78 is cup-shaped, is guided in cage 76 and is seated by a coil compression spring 79 against the outer open end of the cylinder bushing 72.

Reciprocable in the cylinder bushings and in thrust engagement with corresponding cross-heads 67 are plungers 81, each with a flanged ring 82 against which a coil compression spring 83 reacts. Ring 82 is sustained by snap ring 80.

Each crosshead 67 has a long bearing surface, as compared to its overhang and so is well adapted to absorb lateral thrust. The effect is to protect plungers 81 from lateral thrust. Hence the cylinder bushings can be held aligned by the simple arrangement shown and can be rather freely fitted. Since the outer end of the cylinder bushings and the discharge valves are subject to the head pressure, rings 77 can be quite light. The hydraulic pressure holds the bushings seated on shoulders 66.

To interchange bushings and plungers, cap 7 is removed and body 16 is withdrawn. Removal of plug 13 permits body 16 to be pushed out, if necessary. Removal of the valve cages 76 permits withdrawal of the bushings, plungers and cross-heads while the shaft assembly remains undisturbed. To set the pump for rotation in the opposite direction, the crossheads 67 may be reversed. To change pump capacity differently dimensioned cylinder bushings and plungers may be substituted.

The operation of the pump will be obvious from the description above given. The pump may be constructed with different numbers of cylinders and the specific form of the parts may be considerably varied within the scope of the invention. Hence, the embodiment above described in detail is meant to be illustrative.

What is claimed is:

1. A radial multicylinder pump comprising in combination, a two part closed hollow shell having means for connecting an inlet line and a discharge line and having a shouldered seat; a body mounted in said seat and clamped between the parts of said shell, said body having radial bores and means forming with the shell an annular passage surrounding the body and connecting the outer ends of said bores with said discharge connecting means, said body also having passages connecting other portions of said bores with said inlet connecting means; at least two resilient annular sealing rings compressed between the body and shell along the opposite margins of said annular passage and serving to isolate the inlet and discharge spaces within the shell; a radial pump mechanism comprising shaft, shaft bearings, eccentric cam, plungers, cylinders and valves, all sustained by said body, said shaft extending through an opening in the shell, and the body being removable from the shell upon separation of the parts thereof, while all the body-sustained parts remain in assembled relation; and a seal between said shaft and the shell around said opening.

2. The combination defined in claim 1, in which each radial bore has a guide portion at its inner end and has at its outer end a counterbored seat; and each bore contains a pump assembly comprising a removable cylinder bushing open at both ends positioned by said counterbore, a valve cage releasably fixed in said counterbore and serving to retain the bushing, a discharge valve in the cage, a plunger reciprocable in the cylinder bushing, a cup-like crosshead guided in said

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guide portion reciprocable by said eccentric cam and in thrust engagement with the plunger and a spring biasing said plunger toward said crosshead.

3. In a pump, the combination of a body having a bore formed at one of its ends as a guide-way and provided with inlet ports and formed at the other of its ends with a counterbore leading to a shoulder; means connecting said counterbore with a discharge passage; a cylinder bushing smaller than said bore removably mounted in said bore and having a flange seated against said shoulder, said flange fitting said counterbore and serving to center and align the bushing, said bushing being open at both ends and having lateral inlet ports; a resilient annular gasket sealing said bushing to said body; a valve cage releasably fixed in said counterbore and serving to hold said flange against said shoulder; a discharge valve arranged to seat against one end of said bushing and guided by said cage; a spring for seating said valve; a plunger reciprocable in said bushing and projecting through the other end thereof; a cup-like crosshead reciprocable in said guide-way surrounding and in thrust engagement with the projecting end of said plunger; means biasing said plunger toward said crosshead; and means for reciprocating the crosshead.

4. The combination defined in claim 3 in which the means for reciprocating the crosshead comprises a rotatable eccentric and a ring freely rotatable thereon, and the crosshead has an oblique

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end face with which the ring enters into thrust engagement.

5. A radial multicylinder pump comprising in combination a body having a series of radial bores radiating from an axial bore; a drive shaft rotatably mounted coaxially in said axial bore sustained by said body and having an eccentric opposed to the inner ends of said radial bores; pump assemblies each insertible through the outer end of a corresponding radial bore and each comprising a crosshead guided by the bore and reciprocable by the eccentric, a cylinder bushing, a plunger therein, a spring urging the plunger toward the crosshead, a valve cage releasably locked in the outer end of the bore and confining the bushing and a discharge valve in the cage; a multi-part hollow shell clamped around the body and forming therewith inlet and discharge passages for the pump assemblies, said shell having an opening through which said shaft projects; and a seal between the shaft and shell.

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