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2,621,607

PUMP

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2 SHEETS—SHEET 1

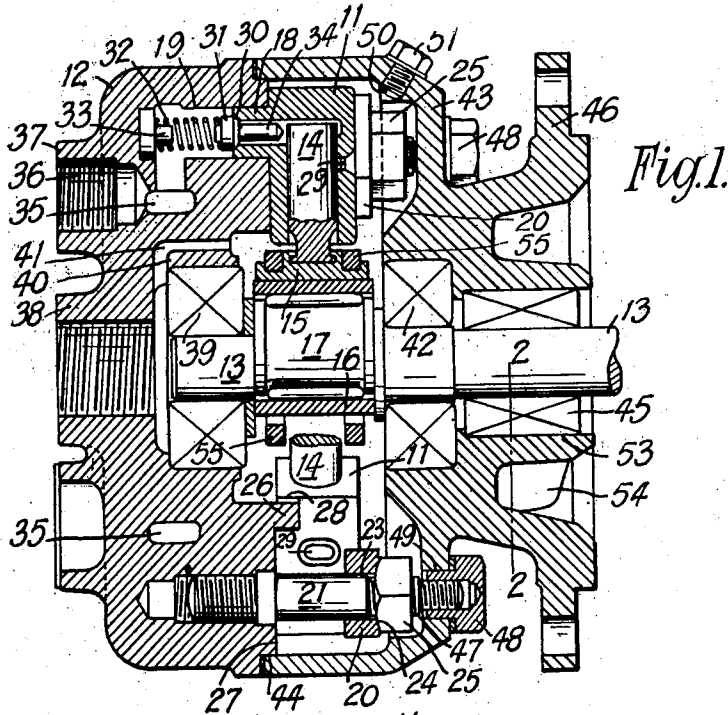


Fig. 1.

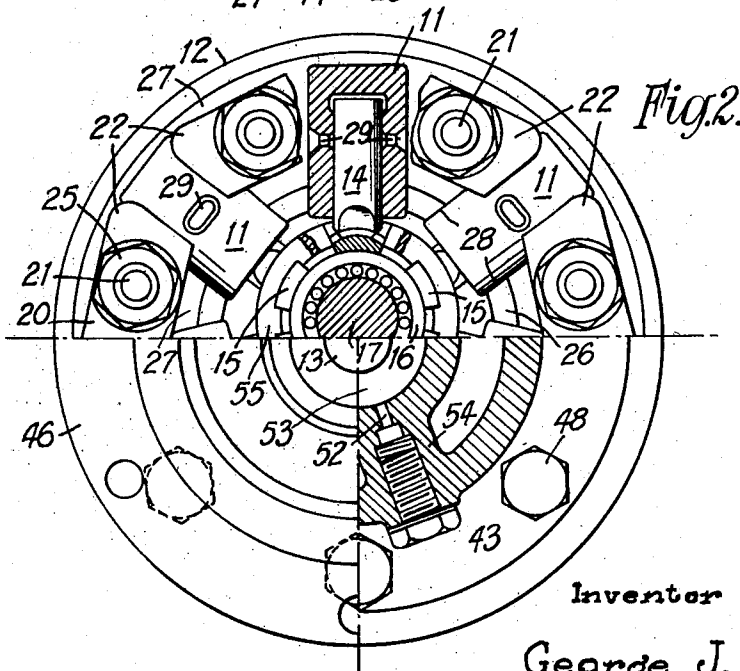


Fig. 2.

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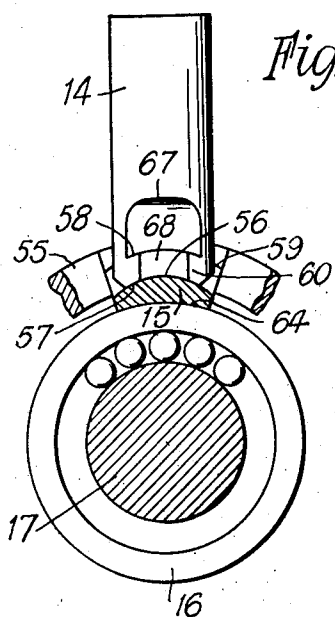
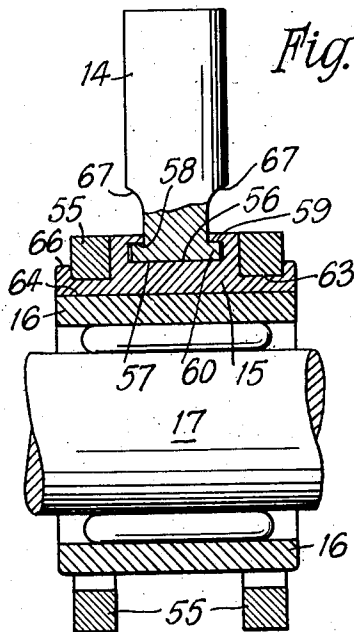
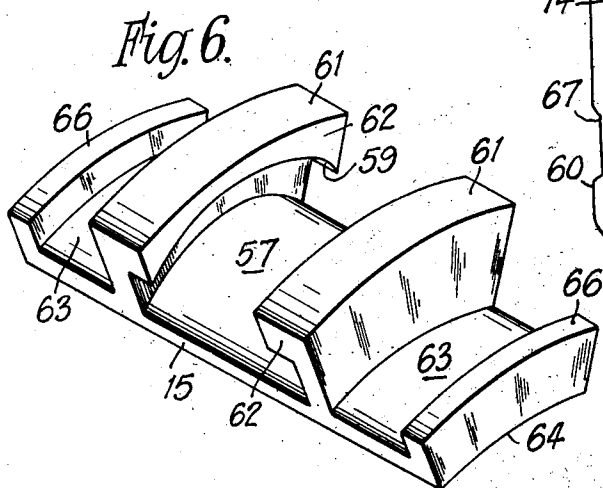
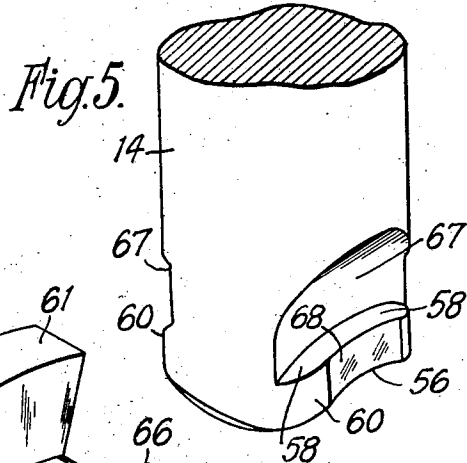
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2 SHEETS—SHEET 2



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1

This invention relates to reciprocating pumps with radial cylinders having the pistons operated by a rotary crank shaft, eccentric shaft or eccentric track.

The invention has for its main object to provide an improved pump of this character capable of operating continuously at high speed and pressure with a relatively low weight per horse power, the pump being especially suitable for use on aircraft in the supply of pressure liquid for actuating various accessory mechanisms, for example landing carriages.

An important object of the invention is to provide a pump of the above-mentioned character, having the inlet to each cylinder controlled by the piston uncovering a port in the cylinder wall and the outlet taking place through a non-return or delivery valve, and having separate cylinders detachably mounted in the pump body, in which improved means for mounting the cylinders serve to locate them in their correct positions and at the same time to transmit to the pump body the thrust due to the pumping action.

A specific object is to provide a pump of this character in which each cylinder has its non-return valve seat formed integrally with it upon a spigot-like projection from the side of the cylinder, the several projections being adapted for engagement in holes or sockets in the pump body.

Another object of the invention is to provide a pump of this character in which the pump body has a detachable cover fitting over the cylinders, the presence of the cover ensuring the locking of the means employed for clamping the cylinders in place, so that no loosening can take place due to vibration during operation of the pump.

Other objects and advantages of the invention will hereinafter appear from the following description of a preferred embodiment, given with reference to the accompanying drawings, in which:

Fig. 1 is a sectional elevation of the pump.

Fig. 2 is an end view, the upper half having the cover removed, and the crank pin, one of the cylinders and its piston shoe being shown in section; in the lower half, the right-hand side is a section on the line 2-2 of Fig. 1.

Fig. 3 is a cross-section on a larger scale, showing the driving crank or eccentric pin, one of the pump pistons being shown with its shoe fitting against the rotatable bearing ring.

Fig. 4 is a corresponding section on an axial plane of the crank or eccentric pin.

Figs. 5 and 6 are perspective views of the inner end of a piston and of the co-operating shoe respectively.

2

As illustrated in Figs. 1 and 2, the pump comprises seven cylinders 11, spaced evenly around the axis of the pump body 12 and shaft 13, which latter drives the pistons 14 in these cylinders by means of shoes 15 engaging with a bearing ring 16 rotatably mounted on the crank or eccentric pin 17. The cylinders, which are preferably of square or rectangular section externally (as seen in the case of the lowermost cylinder 11 in Fig. 1), are each provided with a lateral spigot-like hollow projection 18 at right angles to the axis of the respective cylinder; each projection 18 is engaged in a circular hole or socket 19 in the pump body 12, parallel on the shaft 13, the projection thus serving to locate the respective cylinder in its radially spaced position and also to transmit to the pump body the thrust on the cylinder due to pumping action.

The cylinders are clamped in place by means of yoke-pieces 20, each fitted upon a stud 21 located between two adjacent cylinders, the extremities 22 of each yoke bearing upon two cylinders and its middle portion being apertured at 23 with a part-spherical seating 24 engaged by a correspondingly shaped nut 25. The yokes 20 are arranged towards the head ends of the cylinders 11, their studs 21 being spaced upon a pitch circle of approximately the same radius as that of the circle on which the sockets 19 are spaced. In order to prevent the cylinders from moving sideways, that is, out of the radial position, by swinging upon their projections 18, the crank-ends of the cylinders are arranged to fit between guiding projections in the pump body; for example, these projections may be afforded by an annular flange 26 at the inner periphery of the flat face 27 on the pump body against which the cylinders are clamped, the flange being notched or slotted out at appropriate regular intervals to form recesses 28 into which the cylinders fit snugly so that they are held in the correct radial position by the projecting parts of the flange left between the notches.

Inlet ports 29 in the cylinder walls, uncovered by the pistons 14 towards the end of their admission strokes, are disposed clear of the yokes, for example one port between the adjacent extremities of two yokes 20 and two ports in the same cylinder at 90 degrees on either side of the first, the two latter ports being thus located between the yokes 20 and the flat face 27 against which the cylinders are clamped.

Non-return or delivery valve seats 30 are arranged upon the spigot-like projections 18, which communicate internally with the respective cylinders (as seen in Fig. 1, in the case of the upper-

most cylinder); the non-return valve 31, located in the hole or socket 19, is pressed upon its seating 30 by a coiled spring 32 centred by a peg or stud 33 mounted in the opposite end of the socket, the valve 31 being provided with a stem or vanes 34 acting as guide in the interior of the spigot-like projection 13. The several sockets 19, spaced around the pump body, communicate with a circular duct 35 leading to a common outlet 36; the latter is provided by a hollow boss 37 on the end of the pump body, located above a central inlet boss 38 leading to the interior of the body in alignment with the driving shaft 13.

An end bearing 39 for the driving shaft is inserted in a housing 40 within the notched annular flange 26, suitable ducts or spaces 41 being provided around the housing to allow the entrance of liquid from the inlet boss 33 into the chamber where the crank or eccentric pin 17 revolves, so that the liquid may reach the cylinder inlet ports 29. Another bearing 42 for the shaft 13 is housed in a cover 43 which fits over the cylinders and engages a rabbeted surface 44 on the exterior of the pump body; the shaft extending through this bearing is packed by suitable glands or the like at 45 in the center of the cover, its projecting end being splined or otherwise adapted to receive the drive. The cover 43 is shown as provided with a shouldered flange or facing 46 to allow of bolting the entire pump to the driving means, for example an aircraft engine.

The cover 43 is held in place upon the pump body by utilizing the studs 21 which clamp the cylinder yokes 20 in place; for this purpose, the studs are reduced in diameter at 47, beyond the threaded portions engaged by the yoke-clamping nuts 25, the reduced portions being screw-threaded to receive sleeved cap-nuts 48 fitting in holes 49 in the cover. This reduction in stud diameter will ensure that when the cap-nuts 48 are tightened, there is no risk of reducing the tension on the nuts 25 holding the cylinder-yokes in place to any serious extent. When the pump is closed, these nuts 25 are prevented from loosening under vibration by a reduction of the internal diameter of the pump cover 43 adjacent to the nuts so that the latter cannot turn, their flat sides being engaged by internal faces of the cover.

The cover 43 may include an air venting hole 50 at its highest point, this hole being normally occupied by a screw-plug 51; a drain for removal of liquid leaking through the glands at 45 may be provided between two of the cap-nuts 48, for example by a radial or inclined hole 52 leading into the tunnel 53 which houses the glands, the said hole being drilled through a web 54 connecting the outside of the tunnel to the inside of the flange 46.

The number of cylinders employed in the pump may be as desired; preferably a prime number is employed, seven cylinder being shown in the construction illustrated.

The coupling between the driving crank or eccentric 17 and the several pistons or plungers 14, by means of the shoes 15 retained by rings 55, must be designed to suit the standard of performance required from the pump; the form of coupling shown in Figs. 1 and 2 is particularly suitable for a pump of this kind where high performance is desired.

In this coupling device, as shown on a larger scale in Figs. 3 to 6 inclusive, each of the pump pistons 14, of which only one is shown, has direct engagement with the respective shoe 15 through a concave surface 56 on the inner end of the pis-

ton fitting against a convex surface 57 on the shoe at the middle of its length, this middle portion of the shoe being of crescent section, as seen in Fig. 3. The pumping thrust is thus carried by the mating pair of arcuate surfaces 56, 57 in contact with one another. The piston also has direct engagement with the shoe through other arcuate surfaces, concentric with the surfaces 56, 57, and carrying in contact with one another the return thrust which occurs upon the suction or intake stroke of the piston; these return-thrust bearing surfaces comprise a convex surface 58 on each side of the piston mating with a concave surface 59 upon the shoe.

As seen more clearly in Figs. 5 and 6, the return-thrust bearing surfaces 58, 59 are provided by two arcuate shoulders 60 formed upon opposite sides of the piston 14, and by two radial wings 61 spaced towards opposite ends of the shoe 15; in the operative position, the piston fits between the two wings 61 and has its shoulders 60 overlapped by arcuate projections 62 left by recessing or undercutting the adjacent faces of the wings. The shoulders 60 provide the arcuate surfaces 58 concentric with the concave surface 56 on the inner end of the piston, while the projections 62 provide the mating surfaces 59 concentric with the outer surface 57 of the middle portion of the shoe.

Beyond the wings 61, and towards each end, the shoe is formed with a convex outer surface 63, concentric with the concave inner surface 64 which engages upon the rotatable bearing ring 16; the convex surfaces 63 receive the retaining rings 55 which engage the several shoes of the pump coupling. At each end of the shoe, a segmental flange 66 projects radially outwards, similarly to the wings 61 but not necessarily to the same radial extent, the two flanges 66 serving to maintain the retaining rings 55 in place within the part-grooves formed between these flanges 66 and the adjacent wings 61.

In order to simplify and cheapen manufacture, it is desirable that the diameter of the shouldered end of the piston 14 should not exceed that of the piston as a whole; with this object in view, the shoulders 60 are preferably formed by milling or otherwise producing two recesses 67 on opposite sides of the piston, at a short distance from its inner end, one face of the recess constituting the return-thrust bearing surface 58, concentric with the concave surface 56 and parallel thereto in the direction of their common axis. The radial distance between these concentric surfaces 56, 58 will represent the depth of the shoulders 60, which in turn is made equal to the radial depth of the recess or undercut below the projections 62 of the wings.

The shoulders 60 are preferably made with two parallel flats 68, of a length equal to about half the diameter of the piston, these flats having a suitable working clearance from the interior faces of the recesses or undercuts in the wings; the axial length of the mating surfaces 56, 57 will then be slightly less than the diameter of the piston, as seen in Fig. 4, these surfaces being provided at the middle of the length of the shoe, but the contacting surfaces of the shoe 15 and bearing ring 16 extend for the entire length of the shoe.

What I claim is:

1. A pump comprising a casing, a driving shaft mounted in said casing, a plurality of pumping cylinders spaced radially around said shaft, pistons reciprocable in said cylinders, eccentric

5

means for reciprocating said pistons by operation of said shaft, each of said cylinders having an inlet port uncovered by the respective piston towards the end of its admission stroke, and a delivery valve for each of said cylinders, each of said cylinders including a lateral spigot-like projection engaging in a socket in said casing to locate the respective cylinder spaced radially from said shaft and to transmit the pumping thrust of said cylinder directly to said casing, and each of said delivery valves having its seat upon the spigot-like projection of the respective cylinder.

2. A pump comprising a casing, a driving shaft mounted in said casing, a plurality of pumping cylinders spaced radially around said shaft, pistons reciprocable in said cylinders, eccentric means for reciprocating said pistons by operation of said shaft, each of said cylinders having an inlet port uncovered by the respective piston towards the end of its admission stroke, and a delivery valve for each of said cylinders, each of said cylinders including a hollow lateral projection engaging in a hole in said casing to locate the respective cylinder spaced radially from said shaft and to transmit the pumping thrust of said cylinder directly to said casing, and each of said delivery valves being arranged in the lateral projection of the respective cylinder.

3. A pump comprising a casing, a driving shaft mounted in said casing, a plurality of pumping cylinders spaced radially around said shaft, pistons reciprocable in said cylinders, eccentric means for reciprocating said pistons by operation of said shaft, each of said cylinders having an inlet port uncovered by the respective piston towards the end of its admission stroke, and a delivery valve for each of said cylinders, each of said cylinders including a lateral spigot-like projection formed integrally with it, said projections engaging in spaced holes in said casing to locate said cylinders spaced radially from said shaft and to transmit the pumping thrusts of said cylinders directly to said casing, and said projections having seats for said delivery valves arranged thereon.

4. A pump comprising a casing, a driving shaft mounted in said casing, a plurality of pumping cylinders spaced radially around said shaft, pistons reciprocable in said cylinders, eccentric means for reciprocating said pistons by operation of said shaft, each of said cylinders having an inlet port uncovered by the respective piston towards the end of its admission stroke, and a delivery valve for each of said cylinders, each of said cylinders including a hollow lateral spigot-like projection formed integrally with it, said projections engaging in spaced holes in said casing to locate said cylinders spaced radially from said shaft and to transmit the pumping thrusts of said cylinders directly to said casing, said delivery valves being mounted co-axially with the respective projections and holes, and seats for said delivery valves upon said projections.

5. A pump comprising a casing, a driving shaft mounted in said casing, a plurality of pumping cylinders spaced radially around said shaft, pistons reciprocable in said cylinders, eccentric means for reciprocating said pistons by operation of said shaft, each of said cylinders having an inlet controlled by the reciprocation of the respective piston, a lateral spigot-like projection from each of said cylinders, said projections engaging in spaced holes in said casing, means for clamping said cylinders in place, said clamping

6

means comprising yokes each engaging two of said cylinders and screwed members connecting said yokes to the said casing, and a delivery valve for each of said cylinders, said delivery valve being seated upon the respective projection.

6. A pump comprising a casing, a driving shaft mounted in said casing, a plurality of pumping cylinders spaced radially around said shaft, pistons reciprocable in said cylinders, eccentric means for reciprocating said pistons by operation of said shaft, each of said cylinders having an inlet controlled by the reciprocation of the respective piston, a lateral spigot-like projection from each of said cylinders, said projections engaging in spaced holes in said casing, means for clamping said cylinders in place, said clamping means comprising yokes each engaging two of said cylinders and screwed members connecting said yokes to said casing, guide surfaces arranged in spaced pairs within said casing, each of said cylinders fitting between the guide surfaces of one pair thereof, and a delivery valve for each of said cylinders, said delivery valve being seated upon the respective projection.

7. A pump comprising a casing, a driving shaft mounted in said casing, a plurality of pumping cylinders spaced radially around said shaft, pistons reciprocable in said cylinders, eccentric means for reciprocating said pistons by operation of said shaft, each of said cylinders having an inlet controlled by the reciprocation of the respective piston, a lateral spigot-like projection from each of said cylinders, said projections engaging in spaced holes in said casing, means for clamping said cylinders in place, said clamping means comprising yokes each engaging two of said cylinders and screwed members connecting said yokes to said casing, a detachable cover for said casing, said cover being normally held in place by said screwed members, and a delivery valve for each of said cylinders, said delivery valve being seated upon the respective projection.

8. A pump comprising a casing, a driving shaft mounted in said casing, a plurality of pumping cylinders spaced radially around said shaft, pistons reciprocable in said cylinders, eccentric means for reciprocating said pistons by operation of said shaft, each of said cylinders having an inlet controlled by the reciprocation of the respective piston, a lateral spigot-like projection from each of said cylinders, said projections engaging in spaced holes in said casing, means for clamping said cylinders in place, said clamping means comprising yokes each engaging two of said cylinders, screwed studs engaged in said casing and nuts screwed upon said studs for connecting said yokes to said casing, a detachable cover apertured to pass over said studs into the vicinity of said nuts, said cover normally enclosing said cylinders and clamping means, and said cover having internal faces adapted to lock said nuts upon said studs, means for holding said cover in place upon said casing by engagement with said studs, and a delivery valve for each of said cylinders.

9. A pump comprising a casing, a driving shaft mounted in said casing, a plurality of separate pumping cylinders spaced radially around said shaft, said cylinders including flat and parallel external surfaces, pistons reciprocable in said cylinders, eccentric means for reciprocating said pistons by operation of said shaft, each of said cylinders having an inlet controlled by the reciprocation of the respective piston, a lateral spigot-like projection from each of said cylinders

7

ders, said projections engaging in spaced holes in said casing, means for clamping said cylinders in place, said clamping means comprising yokes each engaging two of said cylinders and screwed members connecting said yokes to said casing, 5 guide surfaces arranged in spaced pairs within said casing, the guide surfaces of each pair being parallel, each of said cylinders having its parallel external surfaces fitted between the parallel guide surfaces of one pair thereof, and a delivery valve 10 for each of said cylinders, said delivery valve being seated upon the respective projection.

10. In a radial pump of the character set forth, a plurality of separate cylinders each provided with an integral lateral projection, a casing formed with holes spaced on a circle, each of said projections engaged in one of said holes, and guide surfaces within said casing, said guide surfaces engaging with said cylinders to locate them radially with respect to the axis of said casing, and the combination of said projections and guide surfaces locating said cylinders in positions spaced radially around the axis of said casing.

11. In a radial pump of the character set forth, 25 a plurality of separate cylinders each provided

8

with an integral lateral projection, a casing formed with holes spaced on a circle, each of said projections engaged in one of said holes, a circular duct in said casing, all of said holes communicating with said duct, non-return valves arranged upon said projections and controlling delivery from the respective cylinders to said duct, an outlet from said duct, and guide surfaces within said casing, said guide surfaces engaging with said cylinders to locate them radially with respect to the axis of said casing.

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