Aug. 29, 1961 P. V. WYSONG, JR 2,997,962

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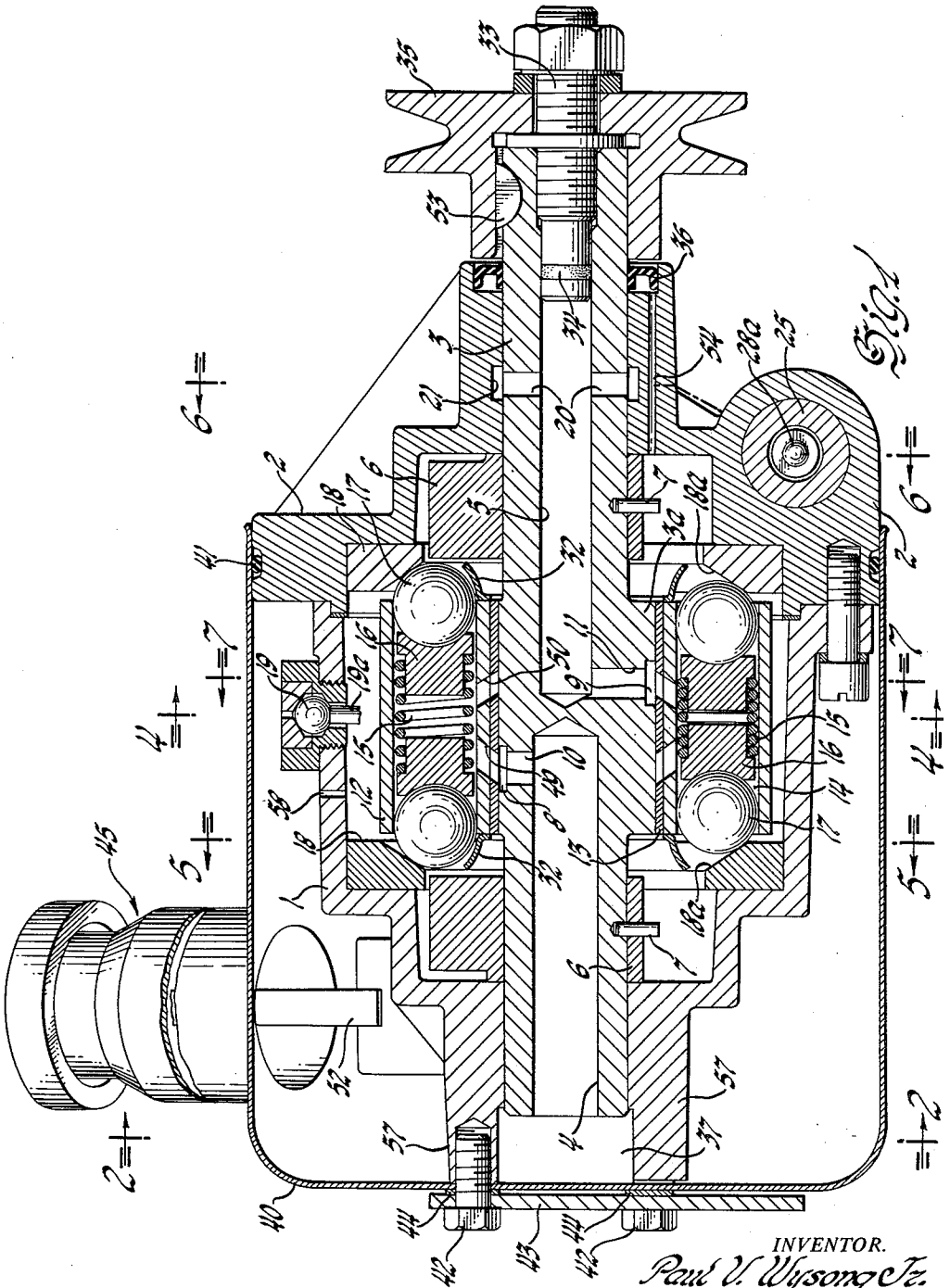


Fig. 1

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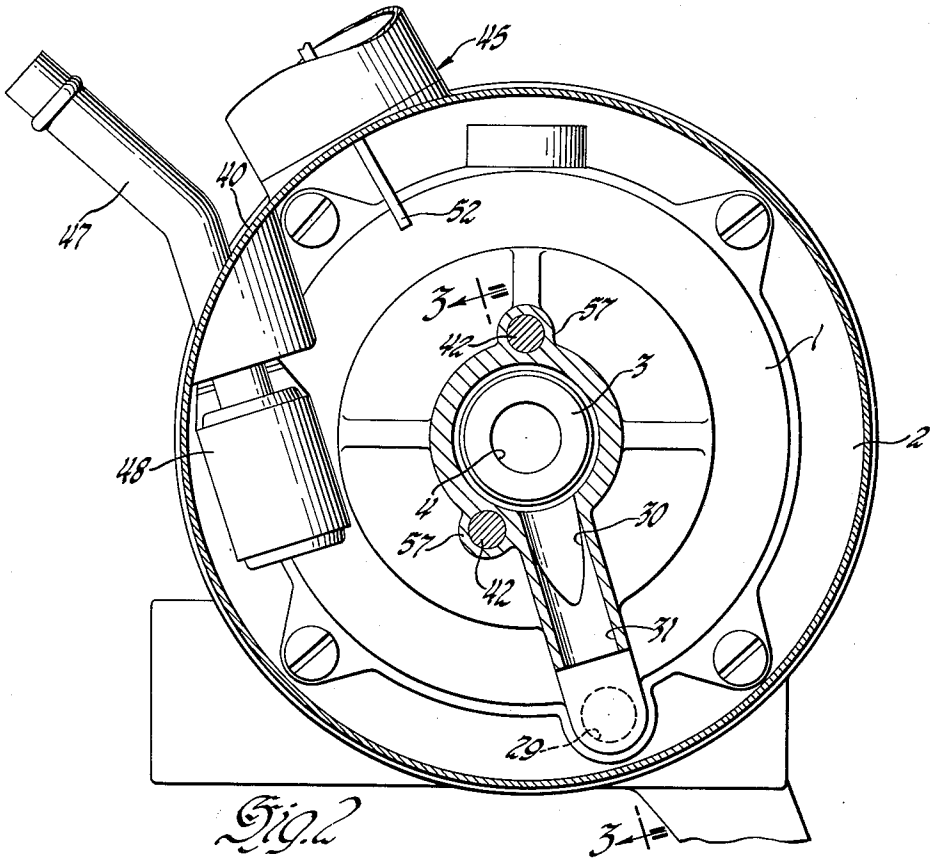


Fig. 2

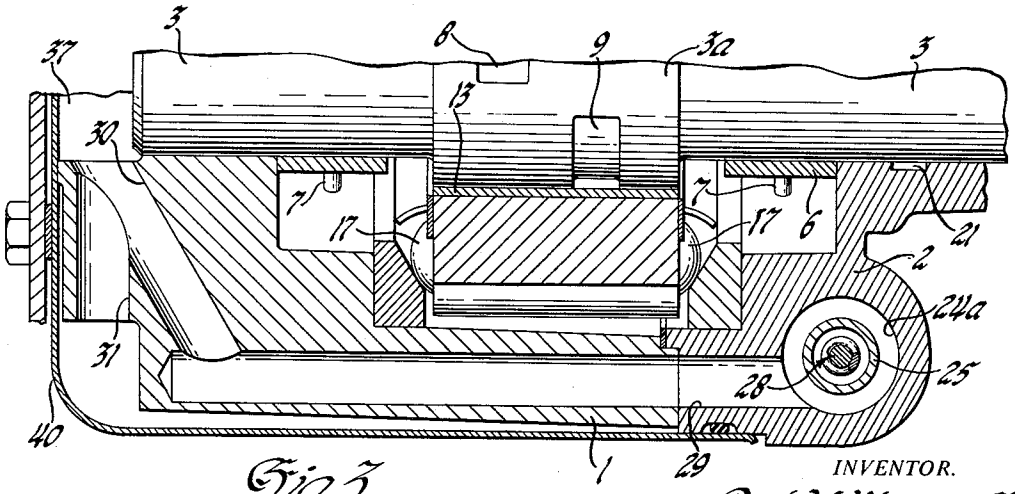


Fig. 3

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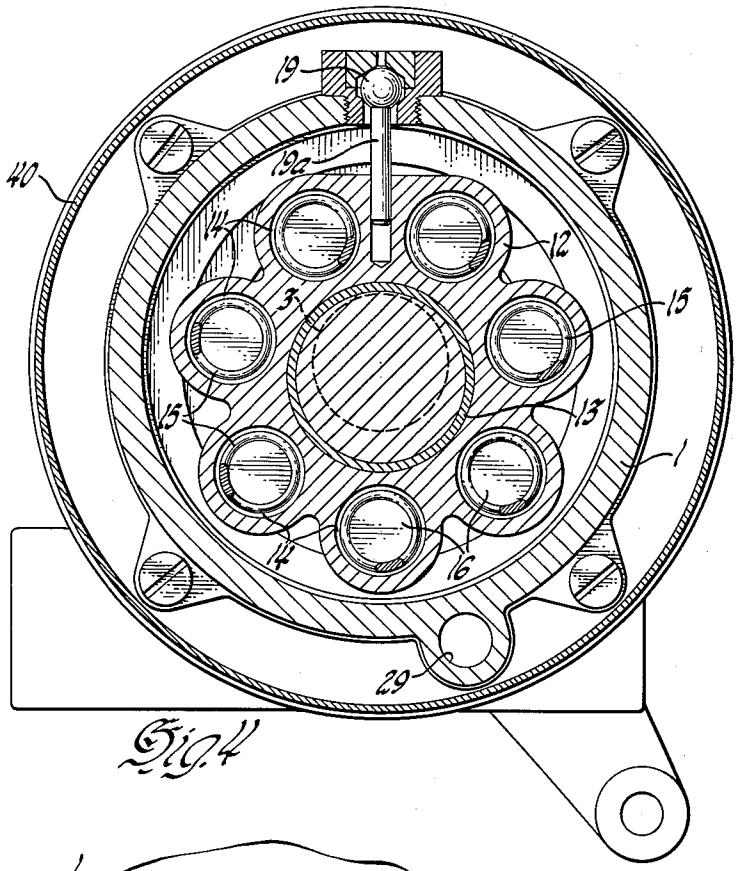


Fig. 4

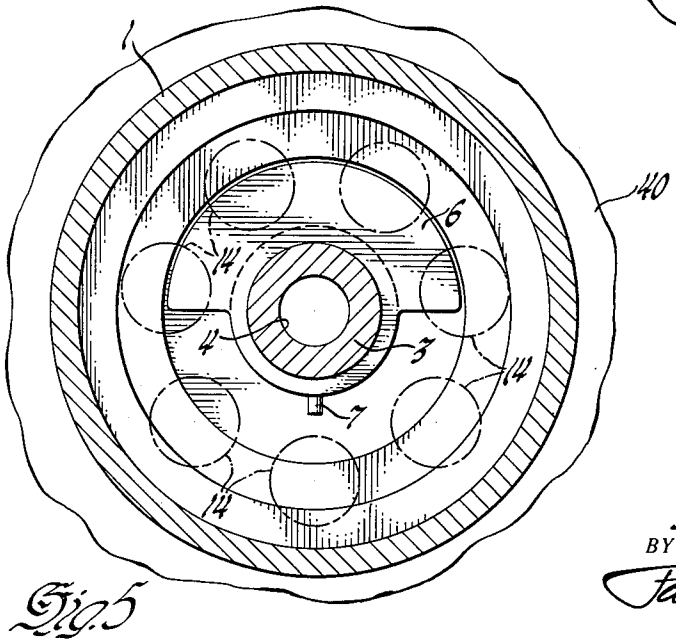


Fig. 5

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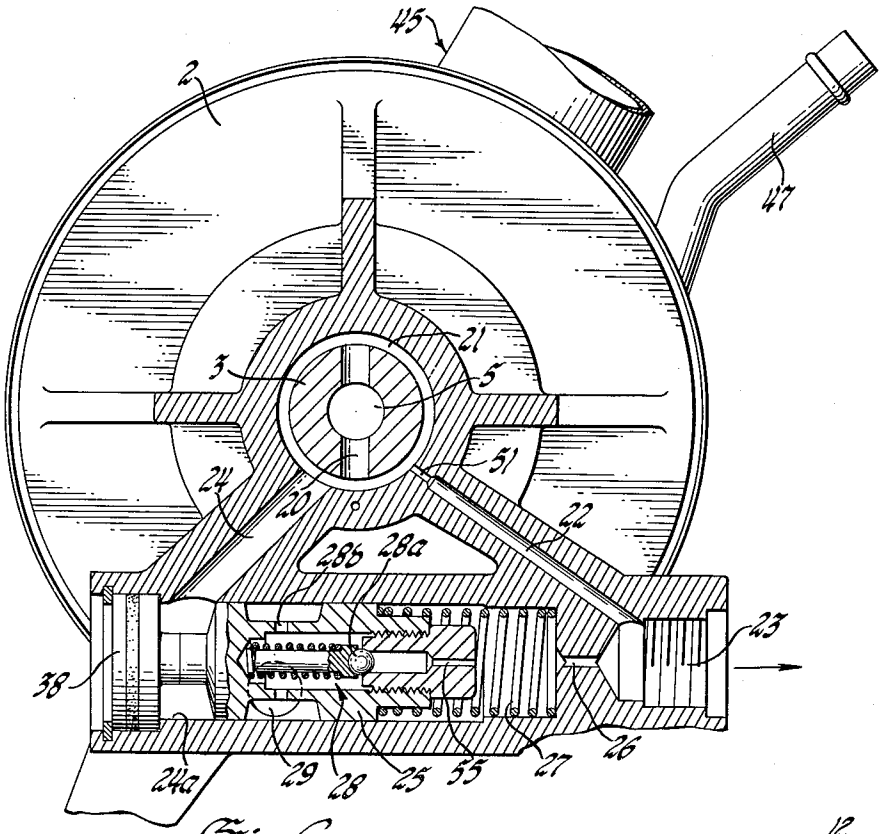


Fig. 6

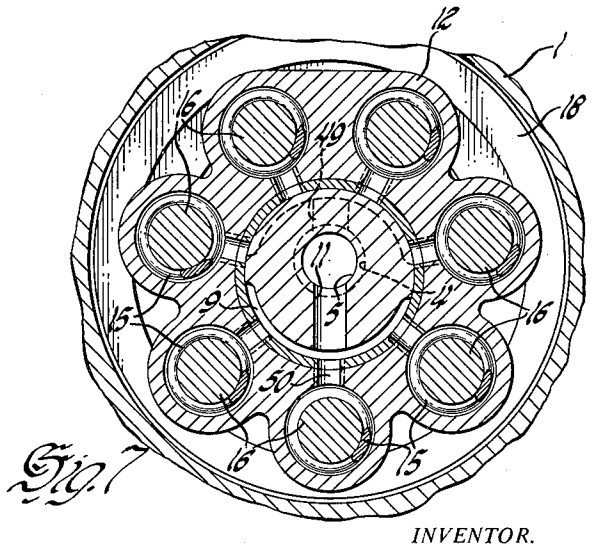


Fig. 7

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2,997,962
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9 Claims. (Cl. 103—158)

This invention relates to fluid pumps and more particularly pertains to a multi-cylinder pump suited for high speed operation.

Although the pump herein has a wide field of application, it was developed with a view toward its use in automotive vehicles to provide fluid pressure for the operation of various accessories, e.g., power steering apparatus, power brakes, trunk lift mechanism, etc. So applied, it may with advantage be employed to serve an accumulator from which the several accessories draw or it may be operated to directly supply an accessory without the intervention of an accumulator.

An important advantage of the instant pump resides in the fact that it may be powered directly by the armature shaft of the generator component of the vehicle electrical system.

The principal objects of the invention being implicit in the foregoing, the same will be specifically described in terms of a preferred embodiment thereof illustrated by the accompanying drawings wherein:

FIGURE 1 is a view showing parts of the pump in longitudinal section;

FIGURE 2 is a view on the line 2—2 in FIGURE 1;

FIGURE 3 is a view on the line 3—3 in FIGURE 2;

FIGURE 4 is a section on the line 4—4 in FIGURE 1;

FIGURE 5 is a section on the line 5—5 in FIGURE 1;

FIGURE 6 is a view on the line 6—6 in FIGURE 1; and

FIGURE 7 is a section on the line 7—7 in FIGURE 1.

Referring first to FIGURE 1, a drive shaft 3 having an eccentric lobe 3*a* rotates in outboard solid bearings bored in the pump housing 1 and cover 2. Axial holes 4 and 5 are drilled in the shaft 3 to provide suction and discharge passages respectively. Two balance weights 6 (see also FIG. 5) are pinned to the shaft 3 on either side of the cylinder block 12 by roll pins 7. The outside faces of the balance weights shoulder against the cover 2 and housing 1, the axial thrust loads thus being transmitted to the housing members.

Two grooves 8 and 9 separated axially will be seen formed in the eccentric lobe 3*a* of the shaft 3. Groove 8 is a suction groove, the same being connected radially to suction passage 4 via a radial passage 10. Groove 9 is a pressure groove and is connected to the pressure passage 5 by a radial passage 11.

The cylinder block 12 has a bearing sleeve 13, desirably formed of aluminum alloy, which runs on the eccentric lobe 3*a*. In the particular embodiment, seven cylinders 14 (FIGURE 4) are formed in the block 12, these cylinders being equally spaced with their center lines parallel to the center line of the central bore in the block.

Each cylinder 14 contains a spring 15, a pair of plugs 16 and two balls 17. A hole 49 is provided in the wall of each cylinder in axial alignment with the groove 8. Similarly, each cylinder has in the wall thereof a hole 50 in axial alignment with the groove 9.

A cam ring 18 is mounted in the cover 2, while another such ring is carried in the housing 1. The axes of the cam rings lie along the major axis of the shaft 3, with the ramp faces 18*a* in contact with the balls 17. On rotation of shaft 3, a drag mechanism made up of a pin having a ball head 19 carried in a plug threaded into the housing 1 and a shank portion 19*a* slidably accommodated (FIGURE 4) in a hole in the block 12, so constrains the block that the movement thereof is of an oscillating or nutating character.

Two annular retainers 32 serve at assembly to prevent dislodgement of the balls 17 and the associated plugs and springs. Incident to the assembly operation, that is, upon addition of the cover 2, following locating of the cam rings 18 and balance weights 6, the balls 17 are forced toward each other so that they leave their seats on the retainers, which are not thereafter functional.

Shaft 3 has therein radial passages 20 providing a connection between the pressure passage 5 and an annular groove 21 formed in the cover 2. A passage 22 including a restriction 51 connects the annular groove 21 to the discharge port 23, while passage 24 in the cover 2 extends from the annular groove 21 to a bore 24*a* in the cover. Within the latter bore is disposed a by-pass valve spool 25. A passage 26 opens the bore 24*a* to the discharge port 23.

As shown, spool 25 is loaded by a spring 27 in a direction toward a backing plug 38. Within the spool 25 is confined a conventional relief valve assembly 28 consisting essentially of a spring-loaded ball 28*a* normally closing off radial passages 28*b* to passage 55. A passage 29 (see also FIGURE 3) extends from bore 24*a* to make connection with a passage 30 opening to the cavity or chamber 37 (note FIG. 1) at the end of the shaft 3. Passage 30 will be seen as having communication with passage 31 opening to the reservoir 40, which encompasses the pump housing 1 and the parts therein contained.

Reverting to FIGURE 1, a threaded member 33 carrying a seal 34 will be observed as closing off the pressure passage 5 in the shaft 3. Such member 33 also serves in the attachment of a drive pulley 35. A key 53 is used in the making of the connection between the pulley and shaft, which is sealed about its outer diameter inward of the pulley by a lip seal 36 carried in the pump cover 2. The pump, of course, may be driven otherwise than through a pulley.

The left-hand portion of the reservoir 40 is shown attached to two lugs 57 which, with the wall of the reservoir, form the previously mentioned cavity or chamber 37. An O-ring seal 41 is accommodated in a recess in the cover 2, being retained in such recess by the reservoir wall. The bolts 42, through which the reservoir is secured to the lugs 57, extend through sealing washers which may with advantage be formed of soft copper. Bolts 42 also serve to make fast a mounting bracket 43 by means of which the pump assembly is secured on installation thereof.

Reservoir 40 is filled with fluid through a cap and filler tube assembly 45. Fluid returned to the reservoir is introduced thereinto via a tube 47 which carries at its end within the reservoir a filter 48. A dip stick 52, included in the assembly 45, may be removed to indicate the level of the fluid in the reservoir.

A passage 54 in the boss portion of the cover 2 allows for recovery of oil bleeding from groove 21 into the cavity in which the seal 36 is located. A vent 58 in the housing 12 serves to prevent any pressure build-up in the pump cavity.

Operation

With shaft 3 rotating, the eccentric lobe 3*a* causes the cylinder block 12 to nutate in a path, approximately circular, whose diameter is twice the eccentricity. The drag means constituted of the pin 19, 19*a*, as previously indicated, brings about the nutating or oscillating motion of the block, which would otherwise tend to rotate with the eccentric lobe. As the block 12 nutates, balls 17 ride up and down the ramp surfaces 18*a*, this action, of course,

being accompanied by in and out movement of the balls in the cylinders. When the balls move inward, the volume of the cylinder is decreased with discharge of fluid—note the lower cylinder in FIGURE 1. Conversely, when the balls move outward (upper cylinder FIG. 1) the volume of the cylinder increases and fluid is drawn into the cylinder.

As should be clearly apparent, the purpose of the spring **15** is to maintain the balls in contact at all times with the ramp surfaces of the cam rings. Plugs **16**, in addition to providing seats for the ends of the spring, decrease the free volume of the cylinder and thus increase the compression ratio, making for ready starting of the pump.

With the pump in operation, fluid from the cavity **37**, which is open to the reservoir **40** via passage **31** (FIGURE 3), flows through the passage **4** into the suction groove **8** via hole **10**. Any cylinder **14** whose suction connecting hole or port **49** is open to groove **8** thus draws in fluid, the groove being so circumferentially located on the eccentric lobe **3***a* that when a cylinder port **49** is in registry with the groove the balls in the cylinder are in suction phase, that is, the balls are moving outwardly. A supercharging effect aiding the filling of the cylinders results through the centrifugal force imparted to the fluid by the rotation of the shaft **3**. Also, since the level of the fluid in the reservoir **40** is above the passage **4**, a static head is provided which aids in the filling of the cylinders.

As the balls in a cylinder start to move inwardly as is the case on their discharge stroke, the eccentric lobe **3***a* blocks the cylinder port **49** while the groove **9** in the lobe gains registry with the cylinder port **50**. The discharged fluid follows passageways **5** and **20** to the annular groove **21** which, as before noted, has communication with the discharge port **23** (FIGURE 6) via the restriction **51** and the passage **22**. Restriction **51** determines the discharge flow rate which may be, for example, of the order of 2–3 gallons per minute.

A portion of the fluid discharge is conveyed from groove **21** via passage **24** to the bore **24***a* where it reacts against the left-hand end of the by-pass spool or plunger **25**. Depending upon the magnitude of the discharge pressure, the spool may be forced rightwardly against the resistance of the spring **27** so that passageway **24** becomes open to passage **29**, which communicates via passages **30** and **31** (FIGURE 3) with the reservoir. With the passages **24** and **29** interconnected the pump, of course, idles until the pressure of the fluid reacting against the left-hand end of the spool decreases to a predetermined value.

Should the system pressure, i.e., the pressure at **23** (FIGURE 6) become excessive, the fluid entering behind the ball **28***a* via passages **26** and **55** displaces the ball, port **23** thus becoming connected to the reservoir return port **29** via the radial passages **28***b*. Once the system pressure becomes reduced to normal, ball **28** is restored to its shown position by the action of the associated spring.

What is claimed is:

1. A pump structure comprising a housing, a block within said housing providing a plurality of open-ended cylinders each having an inlet port and a discharge port in the wall thereof, a pair of pistons confined within each said cylinder, one at each open end thereof, yieldable means within each cylinder loading the corresponding pistons outwardly, cam means within said housing having ramp surfaces engaging said pistons outwardly of said cylinders, eccentric drive means within said cylinder block, and drag means carried by said housing and including a portion operably connected to said block whereby on rotation of said eccentric drive means said block is caused to nutate with reciprocation of said pistons in their respective cylinders, as induced by said surfaces.

2. A pump structure comprising a housing, a block within said housing providing a plurality of open-ended cylinders disposed with their axes paralleling the axis of the block, each of said cylinders having an inlet port and an outlet port in the wall thereof, a pair of pistons confined within each said cylinder, one at each open end thereof, yieldable means within each cylinder loading the corresponding pistons outwardly, cam means within said housing having ramp surfaces engaging said pistons outwardly of said cylinders, eccentric drive means within said cylinder block, and drag means carried by said housing and including a portion operably connected to said block whereby on rotation of said eccentric drive means said block is caused to nutate with reciprocation of said pistons in their respective cylinders, as induced by said surfaces.

3. A pump structure comprising a housing, a block within said housing providing a plurality of open-ended cylinders disposed with their axes paralleling the axis of the block, each of said cylinders having an inlet port and an outlet port in the wall thereof, a pair of balls confined within each said cylinder, one at each open end thereof, yieldable means within each said cylinder loading the corresponding balls outwardly through a pair of plug elements, cam means carried by said housing and having ramp surfaces engaging said balls outwardly of said cylinders, eccentric drive means within said cylinder block, and drag means carried by said housing and including a portion operably connected to said block whereby on rotation of said eccentric drive means said block is caused to nutate with reciprocation of said balls in their respective cylinders, as induced by said surfaces.

4. A pump structure comprising a housing, a block within said housing providing a plurality of radially arranged open-ended cylinders disposed with their axes paralleling the axis of the block, each of said cylinders having an inlet port and an outlet port in the wall thereof, a pair of pistons confined within each said cylinder, one at each open end thereof, a spring within each said cylinder loading the corresponding pistons outwardly, cam means carried by said housing and having ramp surfaces engaging said pistons outwardly of said cylinders, eccentric drive means within said cylinder block, and drag means carried by said housing and including a portion operably connected to said block whereby on rotation of said eccentric drive means said block is caused to nutate with reciprocation of said pistons in their respective cylinders, as induced by said surfaces.

5. A pump structure comprising a housing, a block within said housing providing a plurality of radially arranged open-ended cylinders disposed with their axes paralleling the axis of the block, each of said cylinders having an inlet port and an outlet port in the wall thereof, a pair of balls confined within each said cylinder, one at each open end thereof, a spring within each said cylinder loading the corresponding balls outwardly through a pair of plug elements operating to decrease the free volume of the cylinder thereby to increase the compression ratio when the pump is initially started, cam means carried by said housing and having ramp surfaces engaging said balls outwardly of said cylinders, eccentric drive means within said cylinder block, and drag means carried by said housing and including a portion operably connected to said block whereby on rotation of said eccentric drive means said block is caused to nutate with reciprocation of said balls in their respective cylinders, as induced by said surfaces.

6. A pump structure comprising a housing, a block within said housing providing a plurality of radially arranged open-ended cylinders disposed with their axes paralleling the axis of the block, each said cylinder having intake and discharge ports in the wall thereof, a pair of balls confined within each said cylinder, one at each open end thereof, yieldable means within each said cylinder loading the corresponding balls outwardly through a pair of plug elements, a pair of cam rings carried by said housing and spaced apart a distance set by the length of said cylinder, said cam rings having ramp surfaces engaging said balls, a drive shaft extending into said housing and

carrying an eccentric lobe surrounded by said cylinder block, said shaft having intake and discharge passages therein registering with said ports in operation of the pump, and drag means carried by said housing and including a portion operably connected to said block whereby on rotation of said shaft said block is caused to nutate with reciprocation of said balls in their respective cylinders, as induced by said surfaces.

7. A pump structure comprising a housing, a block within said housing providing a plurality of open-ended cylinders each having an inlet port and an outlet port in the wall thereof, a pair of pistons confined within each said cylinder, one at each open end thereof, yieldable means within each cylinder loading the corresponding pistons outwardly, cam means within said housing having ramp surfaces engaging said pistons outwardly of said cylinders, eccentric drive means within said cylinder block and a ball-headed pin seated by said housing with the shank portion thereof slidably accommodated in a hole formed in said block, whereby on rotation of said eccentric drive means said block is caused to nutate with reciprocation of said pistons in their respective cylinders, as induced by said surfaces.

8. A pump structure comprising a housing, a block within said housing providing a plurality of open-ended cylinders, each said cylinder having intake and discharge ports in the wall thereof, a pair of pistons confined within

each said cylinder, one at each open end thereof, yieldable means within each cylinder loading the corresponding pistons outwardly, cam means within said housing having ramp surfaces engaging said pistons outwardly of said cylinders, a drive shaft extending into said housing and carrying an eccentric lobe surrounded by said cylinder block, said shaft having intake and discharge passages therein registering with said ports in operation of the pump, and drag means carried by said housing and including a portion operably connected to said block whereby on rotation of said shaft said block is caused to nutate with reciprocation of said pistons in their respective cylinders, as induced by said surfaces.

9. A pump structure according to claim 8 wherein said drag means takes the form of a pin having a ball head seating in said housing and a shank portion slidably accommodated in a hole in said block.

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