

Feb. 23, 1960

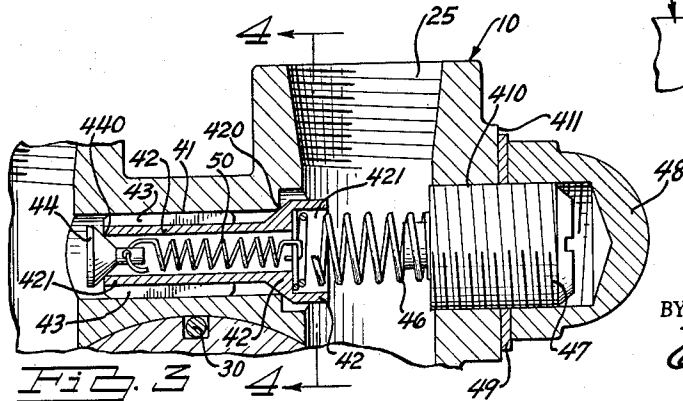
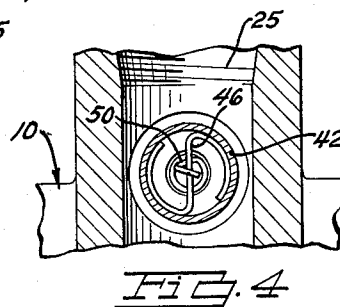
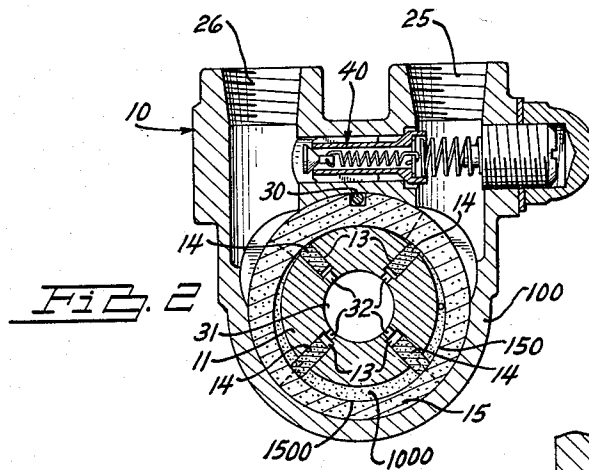
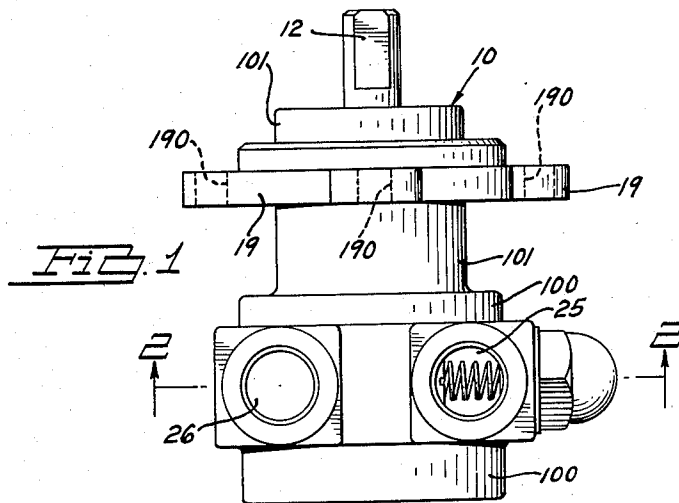
E. J. HILL

2,925,786

PUMP

Filed Nov. 23, 1956

2 Sheets-Sheet 1



INVENTOR.
EDWARD J. HILL
BY *Everett F. Wright*
ATTORNEY

Feb. 23, 1960

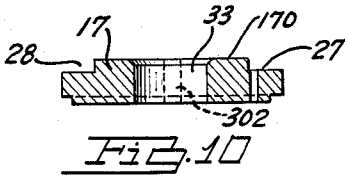
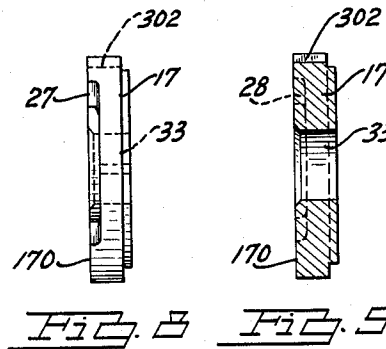
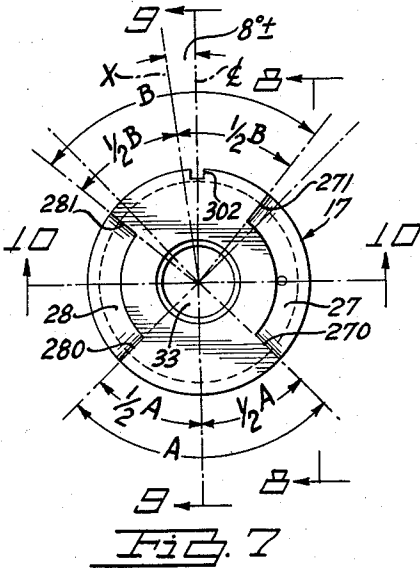
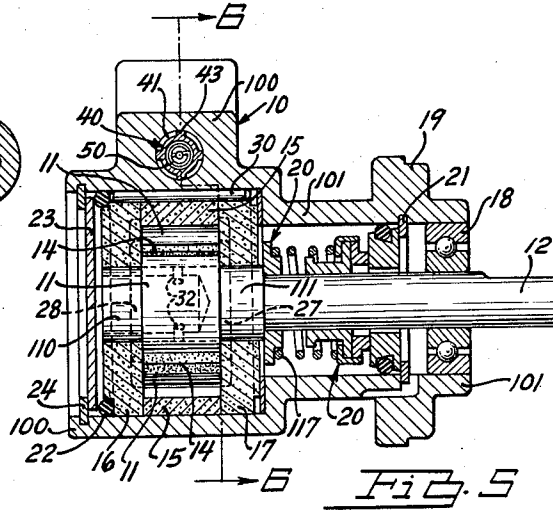
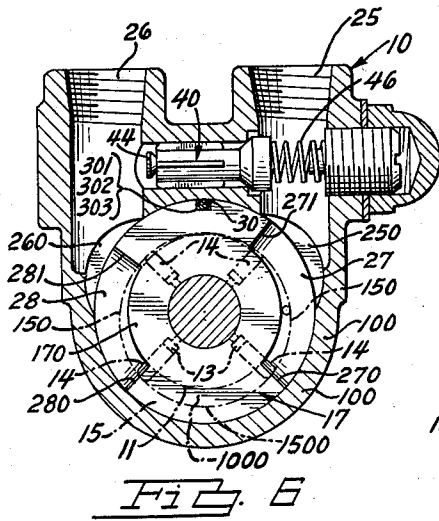
E. J. HILL

2,925,786

PUMP

Filed Nov. 23, 1956

2 Sheets-Sheet 2



INVENTOR.
EDWARD J. HILL
BY
Everett Wright
ATTORNEY

1

2,925,786

PUMP

Edward J. Hill, Birmingham, Mich., assignor to Procon Pump & Engineering Co., a corporation of Michigan

Application November 23, 1956, Serial No. 624,106

2 Claims. (Cl. 103—136)

This invention relates to improvements in vane type pumps.

Prior art vane type pumps when used in hospitals, laboratories and elsewhere where quietness is essential and required are considered noisy. With this in view, the primary object of the present invention is to provide an improved highly efficient vane type pump which is extremely quiet in operation as compared to like and similar pumps of conventional construction.

Other objects of the invention will become apparent by reference to the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 is a top view of an improved pump embodying the invention.

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

Fig. 3 is an enlarged fragmentary sectional view of a combination by-pass and relief valve preferably employed.

Fig. 4 is a fragmentary sectional view taken on the line 4—4 of Fig. 3.

Fig. 5 is a longitudinal sectional view.

Fig. 6 is a transverse sectional view taken on the line 6—6 of Fig. 5.

Fig. 7 is an end elevational view of the rear bearing showing the formation thereof to provide inlet and outlet passages, the front bearing (not shown) being similar but opposite hand.

Fig. 8 is a side elevational view of the rear bearing taken on the line 8—8 of Fig. 7.

Fig. 9 is a vertical sectional view taken on the line 9—9 of Fig. 7.

Fig. 10 is a horizontal sectional view taken on the line 10—10 of Fig. 7.

Referring now to the drawings wherein like numerals refer to like and corresponding parts throughout the several views, the particular rotary power driven vane type pump disclosed for the purpose of illustrating the invention consists of a housing 10 having a pump chamber portion 100 and a seal chamber portion 101 axially disposed with respect to each other and concentrically bored to accommodate a rotor 11 having a drive shaft 12 extending therefrom. The rotor 11 is radially slotted at 90 degrees at 13 to accommodate suitable carbon or graphite vanes 14 which are centrifugally forced radially outwardly against an eccentrically bored carbon or graphite liner 15 disposed in the pump chamber portion 100 between front and rear disc type carbon or graphite bearings 16 and 17 therein into which the said rotor 11 is rotatably mounted on its front and rear concentric bearing bosses 110 and 111. The drive shaft 12 extending from the rotor 11 is rotatably mounted on a ball bearing 18 pressed into the outer end of the seal chamber portion 101 of the housing 10. The said seal chamber portion 101 of the housing 10 is preferably provided with a mounting flange 19 having apertures 190 therein to accommodate mounting studs, not shown, for mounting the pump on a motor or other power means to which the drive shaft thereof is suitably connected. A fluid seal assembly generally designated by the numeral 20 is

2

mounted on the drive shaft 12 within the seal chamber portion 101 of the housing 10 between the annular end face of the rear bearing boss 111 of the rotor 11 and a retaining ring 21 to provide a fluid tight seal at the seal chamber portion of the pump housing 10. The front of the pump chamber portion 100 of the housing 10 is suitably sealed by an O-ring 22, cover plate 23 and retainer ring 24.

The pump chamber portion 100 of the housing 10 is provided with an intake port 25 and an outlet port 26 communicating with the eccentric bore 150 of the eccentrically bored liner 15 through scalloped portions 250 and 260, and through intake and outlet passages 27 and 28 respectively in the inner face of each of the rear and front bearings 16 and 17. The eccentrically bored liner 15 is preferably mounted in the pump chamber portion 100 of the housing 10 with the greatest eccentricity 1500 of the bore 150 thereof disposed at the bottom of the pump chamber portion 100 of the housing 10 as viewed in Figs. 2 and 6. The liner 15 and the bearings 16 and 17 are keyed into alignment by means of an alignment pin 30 disposed in key slots 301, 302 and 303 in the liner 15, bearing 16 and bearing 17 respectively after the rear bearing 17 is first properly oriented and pressed into the pump chamber portion 100 of the housing 10. This construction forms an eccentric pump chamber 1000 bounded by the eccentrically bored liner 15 and the front and rear end bearing discs 16 and 17. To assure free reciprocation of the vanes 14 in the radial slots 13 of the rotor 11, the rotor 11 is provided with an axial bore 31 and radial bores 32 communicating between the said axial bore 31 and the said radial vane slots 13.

The particular arrangement of intake and outlet passages 27 and 28 in the inner face of each of the front and rear disc type bearings 16 and 17 are the key to the reduction of noise in the operation of a pump of the type disclosed herein to substantially nil. The front and rear bearings 16 and 17 are alike, except opposite hand, therefore the arrangement of the intake and outlet passages 27 and 28 in only one of the said bearings need be described in detail.

Referring now particularly to Figs. 7—10 inclusive, the rear or inner disc type bearing 17 shown in detail therein consists of a concentric carbon or graphite disc having a central aperture 33 therethrough to accommodate the bearing boss 111 of the rotor 11. The face 170 of the said bearing 17 adjacent the rotor 11 is arcuately scalloped to provide intake and outlet passages 27 and 28 respectively, the adjacent wall of the eccentrically bored liner 15 serving as a wall of the said intake and outlet passages 27 and 28. The said intake and outlet passages 27 and 28 communicate with intake and outlet ports 25 and 26 via the scalloped portions 250 and 260 of the housing 10 as best shown in Fig. 6.

By referring to Fig. 7, it will be noted that the intake and outlet passages 27 and 28 of the rear bearing 17 are formed with their lower abutments 270 and 280 symmetrical about the vertical center line CL of the said bearing 17 while the upper abutments 271 and 281 of the said intake and outlet passages 27 and 28 are symmetrical about an axis X angularly related plus or minus 8 degrees from the center line CL. In other words, if A is the arcuate distance between the lower abutments 270 and 280 of the intake and outlet passages 27 and 28, each of the said abutments is located at an arcuate distance of $\frac{1}{2}A$ from the center line CL. Also, if B is the arcuate distance between the upper abutments 271 and 281 of the intake and outlet passages 27 and 28, each of the said abutments is located an arcuate distance of $\frac{1}{2}B$ from the axis X. Also, the axis X may be disposed

clockwise from the center line CL rather than counter-clockwise as indicated in Fig. 7.

Stated in another manner, the intake or inlet passage 27 and the outlet passage 28 are disposed generally diametrically opposite each other as shown in Fig. 7, but arranged in approximately 8° or from 4° to 12° out-of-phase relationship with respect to each other with one pair of adjacent abutments 270 and 280 of the inlet and outlet passages 27 and 28 spaced 90° apart and located symmetrical about the center line of the pump chamber 100 taken through the center of the rotor 11 and the point of greatest eccentricity of the pump chamber 100 of the pump housing 10 in respect thereto and with the other pair of adjacent abutments 271 and 281 disposed symmetrical about a radial line X extending approximately 8° from the center of the rotor 11 off the said center line of the said pump chamber.

In the foregoing construction, the pump vanes 14 are located in a 90 degree symmetrical angular relationship, and at least one end of the inlet and outlet passages 27 and 28 are located 8 degrees off a 90 degree symmetrical angular relationship, whereby the porting of the pump is sufficiently out-of-phase in respect to the vanes during the operation of the pump to substantially eliminate or greatly reduce pump noise, particularly under relatively heavy loads or pressures. While the disclosure indicates that the angular offset of the upper abutments 271 and 281 with respect to the lower abutments 270 and 280 thereof is preferably 8 degrees, it is pointed out that the land distances A and B may or may not be equal, and that the angular offset of the axis X of the upper abutments 271 and 281 with respect to the center line CL of the lower abutments 270 and 280 may vary as much as 4 degrees from the preferred 8 degree offset shown in the drawings, and the said axis X may be disposed on the opposite side of the center line CL, all according to the size and shape of the vane ends, speed at which the pump operates, and the type of fluid pumped, the precise degree of offset or out-of-phasing of the inlet and outlet passages in respect to the vanes being established in each materially different situation as a result of specific tests.

The pump disclosed for the purpose of illustrating the invention is preferably provided with a two way by-pass and relief valve 40 disposed in a valve passage 41 in the pump chamber portion 100 of the housing 10 between the intake port 25 and outlet port 26. This two way valve 40 consists of a poppet type relief valve element 42 reciprocatingly mounted in the valve passage 41 on a plurality of circumferentially spaced radially disposed fins 43. The relief valve element 42 seats on a seat 420 provided at a counterbore in the pump chamber portion 100 of the housing 10 at the right hand end of the valve passage 41 as viewed in Fig. 3. The said relief valve 42 has a hollow stem 421, the left hand end of which as viewed in Fig. 3 serving as a by-pass valve seat 440 onto which a poppet type by-pass valve element 44 is seated. The relief valve element 42 is resiliently held in its seated position by a compression spring 46 and a compression spring adjustment stud 47 threaded through a threaded aperture 410 in the pump chamber portion 100 of the housing 10 opposite the said valve passage 41. A cap nut 48 is threaded over the extending end of the said adjustment stud 47 with a washer 49 disposed between the said cap nut 48 and a suitable boss 411 formed on the pump chamber portion 100 of the housing 10 around the outer end of the said threaded aperture 410 therein. The inner end of the compression spring 46 is positioned in a cup 421 formed in the right hand end of the relief valve 42 as viewed in Fig. 3. A light tension spring 50 is connected between the inner end of the compression spring 46 and the by-pass valve element 44 resiliently holding the said by-pass valve element 44 closed.

The foregoing construction provides a two way by-

pass and relief valve 40 between the intake port 25 and the outlet port 26, the relief valve element 42 thereof being adjustable as to its opening pressure by the adjustment stud 47, and the by-pass valve element 44 thereof being openable under light pressure to by-pass fluid from the intake port 25 to the outlet port 26 when the pump is not in operation. While such a two way by-pass and relief valve 40 is desirable in a pump of the class described, it may be omitted in pumps to be installed in locations where excessive pressures are not likely to occur.

Although but a single specific embodiment of the invention has been disclosed and described in detail, it is obvious that many changes may be made in the size, shape, arrangement and detail of the various elements of the invention without departing from the spirit and scope thereof as defined by the appended claims.

I claim:

1. In a vane type pump, a housing having a cylindrical bore therein, a rotor including a concentric shaft extending therefrom, end bearing discs concentrically mounting said rotor in said pump housing, an eccentrically bored liner forming with said end bearing discs and eccentric pump chamber, four 90° circumferentially spaced radially disposed vanes slidably mounted in said rotor extending the full width of said eccentric pump chamber movable radially against the said eccentric liner during rotation of said rotor, an arcuate inlet passage and an arcuate outlet passage formed in the inner face of each said end bearings communicating with said eccentric pump chamber, and inlet and outlet ports formed in said housing communicating with said inlet and outlet passages, the said inlet and outlet passages being disposed generally diametrically opposite each other but arranged in approximately 8° out-of-phase relationship with respect to each other with one pair of adjacent abutments of said inlet and outlet passages spaced 90° apart and located symmetrical about the center line of the pump chamber taken through the center of the rotor and the point of greatest eccentricity of the pump chamber in respect thereto and with the other pair of adjacent abutments disposed symmetrical about a radial line extending from the center of the rotor approximately 8° off the said center line of said pump chamber.

2. In a vane type pump, a housing having a cylindrical bore therein, a rotor including a concentric shaft extending therefrom, end bearing discs concentrically mounting said rotor in said pump housing, an eccentrically bored liner forming with said end bearing discs an eccentric pump chamber, four evenly circumferentially spaced radially disposed vanes slidably mounted in said rotor extending the full width of said eccentric pump chamber movable radially against the said eccentric liner during rotation of said rotor, an arcuate inlet passage and an arcuate outlet passage formed in the inner face of each said end bearings communicating with said eccentric pump chamber, and inlet and outlet ports formed in said housing communicating with said inlet and outlet passages, the said inlet and outlet passages being disposed generally diametrically opposite each other but arranged in a 4° to 12° out-of-phase relationship with respect to each other with one pair of adjacent abutments of said inlet and outlet passages spaced 90° apart located symmetrical about the center line of the pump chamber taken through the center of the rotor and the point of greatest eccentricity of the pump chamber in respect thereto and with the other pair of adjacent abutments disposed symmetrical about a radial line extending from the center of the rotor approximately 4° to 12° off the said center line of said pump chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

1,737,942 Page 1 Dec. 3, 1929

(Other references on following page)

2,925,786

5

UNITED STATES PATENTS

1,855,708	Dilg -----	Apr. 26, 1932
1,980,404	Harman et al. -----	Nov. 13, 1934
2,433,360	Haight -----	Dec. 30, 1947
2,439,241	Curtis et al. -----	Apr. 6, 1948
2,525,619	Roth et al. -----	Oct. 10, 1950
2,528,210	Stewart -----	Oct. 31, 1950
2,588,430	Svenson -----	Mar. 11, 1952
2,611,323	Digney -----	Sept. 23, 1952

2,649,737
2,662,483
2,674,953

5

294,653

6

Hoen et al. -----	Aug. 25, 1953
Smith et al. -----	Dec. 15, 1953
Conde -----	Apr. 13, 1954

FOREIGN PATENTS

Great Britain -----	June 6, 1929
---------------------	--------------

OTHER REFERENCES

National Carbon Co. Catalog M-8000A, October 1944
(20 pages).