Feb. 12, 1952 L. T. REYNOLDS 2,585,406

SOLID CROSS VANE ROTARY PUMP

Filed Aug. 4, 1947 2 SHEETS—SHEET 1

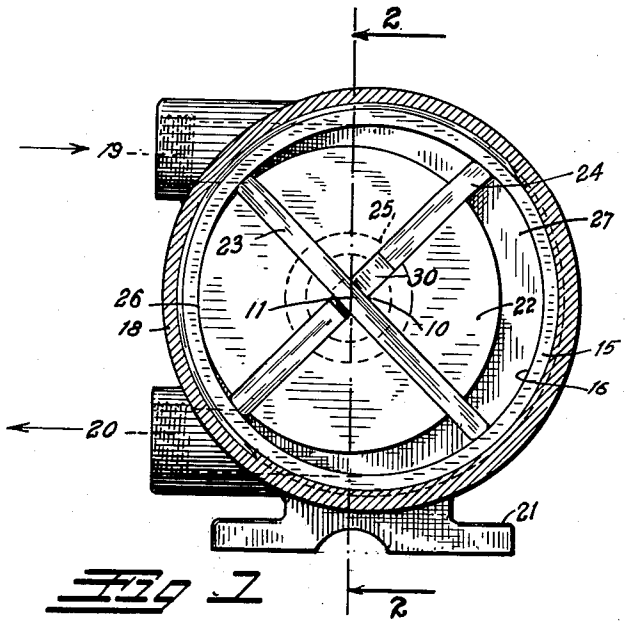


FIG. 1

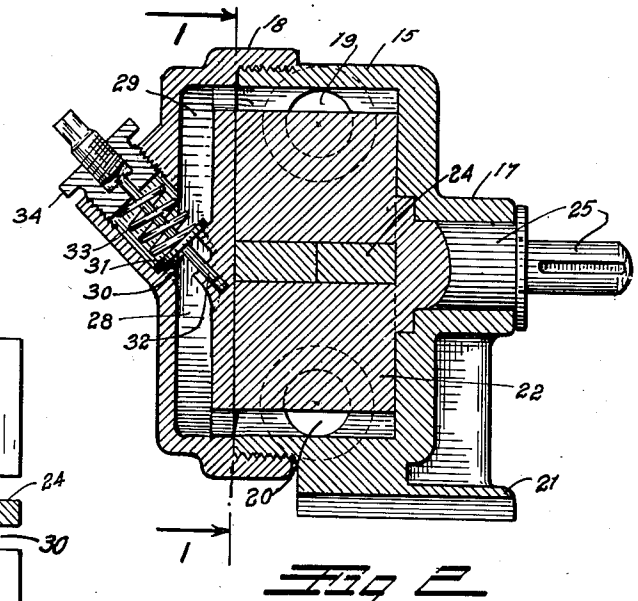


FIG. 2

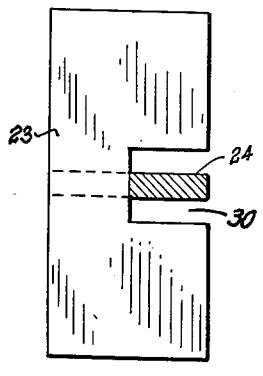


FIG. 3

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SOLID CROSS VANE ROTARY PUMP

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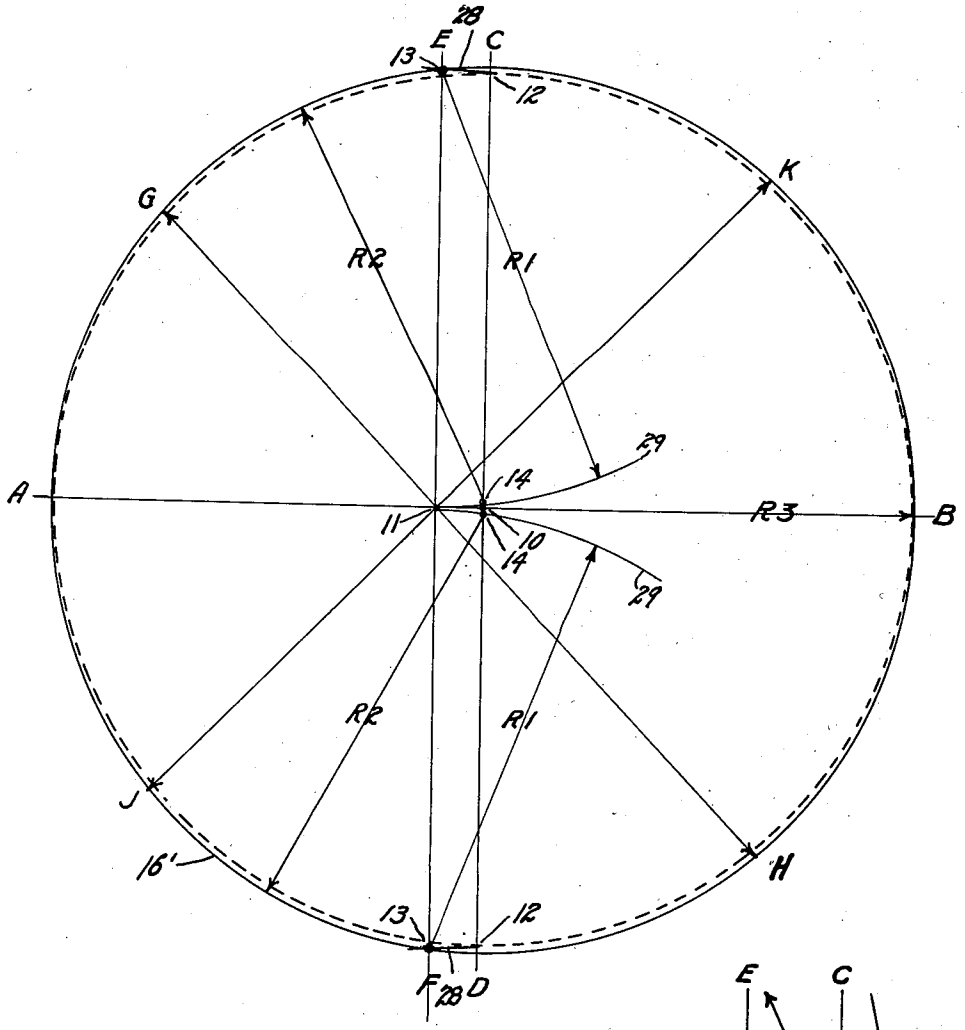


Fig 4

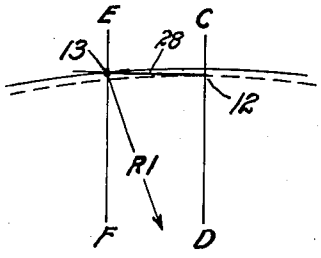


Fig 6

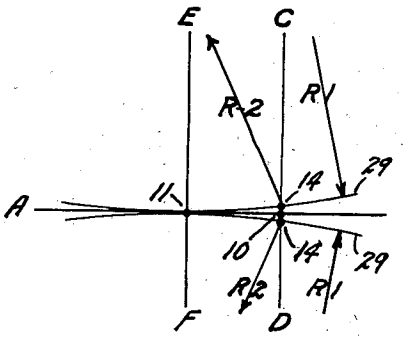


Fig 5

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SOLID CROSS VANE ROTARY PUMP

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2 Claims. (Cl. 103—138)

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This invention relates to an eccentric rotary pump or compressor of the solid cross vane type. Rotary eccentric pumps and compressors of this type are not new. All of them employ a casing having an eccentrically mounted rotor with diametrically extending blades or vanes. Such pumps will operate inefficiently in a circular housing. It is impossible, however, with the circular housing, to have both ends of each diametric blade contact the casing throughout the circumference. This is due to the fact that the eccentric position of the rotary center shortens the distance from wall to wall of the housing on a line intersecting the eccentric center and at right angles to the axis of eccentricity.

The principal object of this invention is to provide a pump of this type in which solid diametric vanes in an eccentric rotor will substantially contact the inner wall of the housing at both ends of the vanes at all angles of rotation and to provide a method for plotting the internal wall contour of a pump of this character so as to provide a pump of the above improved characteristics.

A further object is to provide a pump of this character which will deliver fluid at a predetermined pressure regardless of the volume demand on the discharge.

Other objects and advantages reside in the detail construction of the invention, which is designed for simplicity, economy, and efficiency. These will become more apparent from the following description.

In the following detailed description of the invention, reference is had to the accompanying drawing which forms a part hereof. Like numerals refer to like parts in all views of the drawing and throughout the description.

In the drawing:

Fig. 1 is a side view of the improved eccentric, solid vane type rotary pump, with the side plate removed on the line 1—1, Fig. 2;

Fig. 2 is a cross section through the pump, taken on the line 2—2, Fig. 1;

Fig. 3 is a detail view of one of the pump vanes;

Fig. 4 is an enlarged lay-out diagram illustrating the method for determining the inner contour of the pump housing of Fig. 1; and

Figs. 5 and 6 are still further enlarged portions of the diagram of Fig. 4.

Conventional parts of a cross vane eccentric pump are designated by numeral as follows: pump housing 15, inner wall of pump housing 16, shaft bearing 17, side plate 18, intake 19, discharge 20, supporting base 21, rotor 22, rotor vanes 23 and 24, and rotor shaft 25.

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The vanes 23 and 24 are notched as shown at 30 so as to by-pass each other at the axis of the rotor 22, and are slidably fitted into close receiving slots in the rotor. The axis of the rotor 22 is offset from the axis of the housing 15 so that the rotor will contact the inner wall 16 at one side, as shown at 26, and will be spaced from the inner wall 16 at the other side to provide a crescent-shaped pumping chamber 27.

The difficulty in conventional pumps has been to make both ends of each vane 23 and 24 contact, or even substantially contact, the inner wall 16 at all points of rotation. If the inner wall 16 is circular, the vanes must have a length equal to a diameter on the line 2—2 of Fig. 1. This diameter is less than the true vertical diameter of the circular inner wall 16, due to the approaching curvature of the inner wall.

The difference in length depends, of course, on the amount of offset or eccentricity. With vanes equal in length to the diameter on line 2—2 the extremities cannot touch the inner wall at both ends when the vanes are in the position of Fig. 1. This results in leakage past the vanes, reducing the efficiency of the pump.

In order for the vanes to touch the walls at both extremities, it is necessary that the inner wall be ground or turned eccentrically to a slightly oval shape so as to increase its diameter at points parallel to the line 2—2 of Fig. 1. The points of increase in diameter and the amount of increase are determined graphically, as shown in Figs. 3, 4, and 5.

The lay-out is made by scribing a circle with a radius R3 from an original center 10, to the approximate diameter of the desired inner wall 16, as indicated by the broken line circle in Figs. 4 and 6. The circle is then divided into quadrants by the diameters A—B and C—D, the former diameter intersecting the point of contact 26, between the rotor 22 and the wall 16.

The amount of eccentricity desired in the pump is set off on the diameter A—B and an eccentric center 11 is located. A secondary diameter E—F is scribed parallel to the vertical diameter C—D through the eccentric center 11. The diameter A—B cuts the original center 10 and the center of eccentricity 11 which corresponds to the axis of the shaft 25.

Two tangent lines 28 are drawn from points, see 12, of intersection between the diameter C—D and the original broken line circle at right angles to the diameter C—D to intersect the secondary diameter E—F at the points 13. The points 13 are now used as centers and arcs 29

are scribed from them on radii R1 equal to the radii R3. The arcs 29, scribed from the centers 13 on a radius corresponding to the radius of the original broken line circle, cut the original diameter C—D at points 14 on each side of the original center 10.

The points 14 form centers for the finish turning or grinding of the inner wall 16 of the housing. The inner wall at one side of the diameter A—B is ground concentric to the point 14 on that side to a radius R2 equal to the original radius R3. The wall of the housing 10 on the other side of the diameter A—B is similarly ground concentric to the other point 14 and to the radius R2 corresponding to the original radius R3. This imparts an ovate contour to the inner wall 16, as shown in solid line at 16' in Fig. 4.

The vanes 23 and 24 are cut to the length of the diameter A—B. These vanes radiate from the center 11, as indicated by vane diameters G—H and J—K in Fig. 4. All of the diameters A—B, G—H, and J—K are equal, so that both extremities of each vane will substantially contact the inner wall 16 of the housing at all points of rotation.

Actual models having various diameters and various amounts of eccentricity, have been found to retain a seal throughout 360° within .0001".

The extremities of the vanes 23 and 24 are rounded to correspond to the curvature of the inner surface 16 at the points E and F.

Pumps of this character increase the motor load in proportion to the restriction of the discharge. This is undesirable in services where the volume demand on the pump is variable.

To accommodate the pump to variable demand uniform pressure services, a discharge by-pass passage 28 and an intake by-pass passage 29 are formed in the cover plate 18. The passages 28 and 29 communicate with the intake and discharge extremities of the pumping chamber 27. The two passages communicate with each other through a valve port 30 controlled by means of a pressure relief valve 31 mounted on a valve stem 32. The valve 31 is constantly urged over the port 30 by means of a compression spring 33. The pressure against the valve 31 may be preset by a threaded spring pressure bushing 34 which bears against the spring 33. The valve stem 32 extends through the bushing 34. A threaded stop lug 35 may be brought into contact with the end of the valve stem 32 to hold the valve 31 permanently closed when desired.

The bushing 34 may be set to open at any desired pressure, say 500 p. s. i. Should the discharge be restricted so that the pressure therein reaches 500 p. s. i. the excess fluid will by-pass through the valve port 30 from the discharge side of the pump to the intake side thereof to balance the pressure on the vanes 23 and 24 and relieve the load on the driving motor.

While a specific form of the improvement has been described and illustrated herein, it is desired to be understood that the same may be varied, within the scope of the appended claims, without departing from the spirit of the invention.

Having thus described the invention, what is claimed and desired secured by Letters Patent is:

1. A rotary pump or compressor comprising: a housing having a pumping chamber of generally oval contour, said housing having an inlet port leading to said pumping chamber and an outlet port leading from said pumping chamber; a rotatable cylindrical rotor within said pumping chamber arranged to contact the wall of said pumping chamber at a predetermined point on a theoretical line extending axially of said pumping chamber, the point of theoretical line contact being disposed between said inlet and said outlet ports; and diametrically extending vanes slidably mounted in said rotor and having ends adapted to contact the inner wall of said pumping chamber, the diameter of said pumping chamber at said theoretical line being less than the diameter on a second diametric line positioned at right angles to the theoretical line and intersecting the axis of said housing, the arcuate sides of said pumping chamber at the extremities of the second diametric line being each concentric to an individual secondary center, the individual secondary centers being spaced equally on opposite sides of said theoretical line and lying in said second diameter, the distance between said theoretical line and each of said secondary centers being equal to the distance a tangent line having a length equal to the amount of eccentricity of said pump would deviate from a true circle at its extremity.

2. A method for forming an oval contour in the inner circular wall of an eccentric solid vane pump of the type described, comprising: scribing a circle about the original center of said wall on a radius substantially equaling the radius of said inner wall; locating an eccentric center spaced from said original center a distance equal to the desired eccentricity of said pump; drawing a first diameter through said circle intersecting both centers; drawing a second diameter at right angles to the first diameter through said original center; drawing a third diameter through said eccentric center parallel to the second diameter; drawing a tangent line from each intersection of the second diameter with the original circle to intersecting points with the third diameter; scribing arcs of radii equal to the original circle from said intersecting points to cut said second diameter to locate secondary centers thereon at each side of the first diameter; thence removing material from said wall on a radius about each secondary center equal to the radius of the original circle.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,196,977	Piatt	Sept. 5, 1916
1,626,510	Chase	Apr. 26, 1927
1,938,854	Moulet	Dec. 12, 1933
1,974,112	Johnson	Sept. 18, 1934
2,032,885	Murphy	Mar. 3, 1936
2,046,873	Garrison	July 7, 1936
2,351,817	Johnson	June 20, 1944
2,359,903	Fanning	Oct. 10, 1944