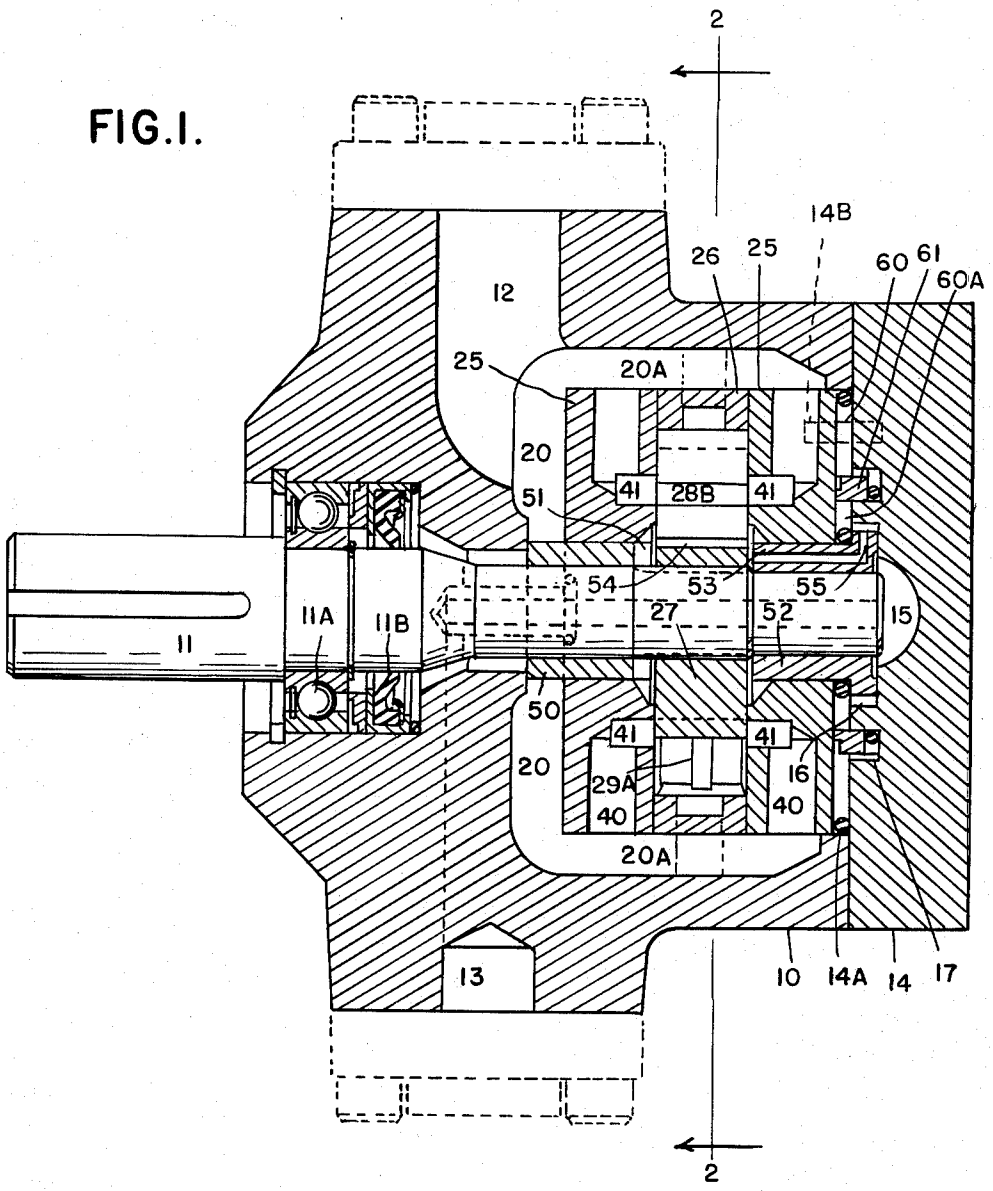
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FLUID PUMPS

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FIG. 1.



INVENTOR.
OSCAR E. ROSAEN
BY Hauke & Horstedt
ATTORNEYS

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FIG.2.

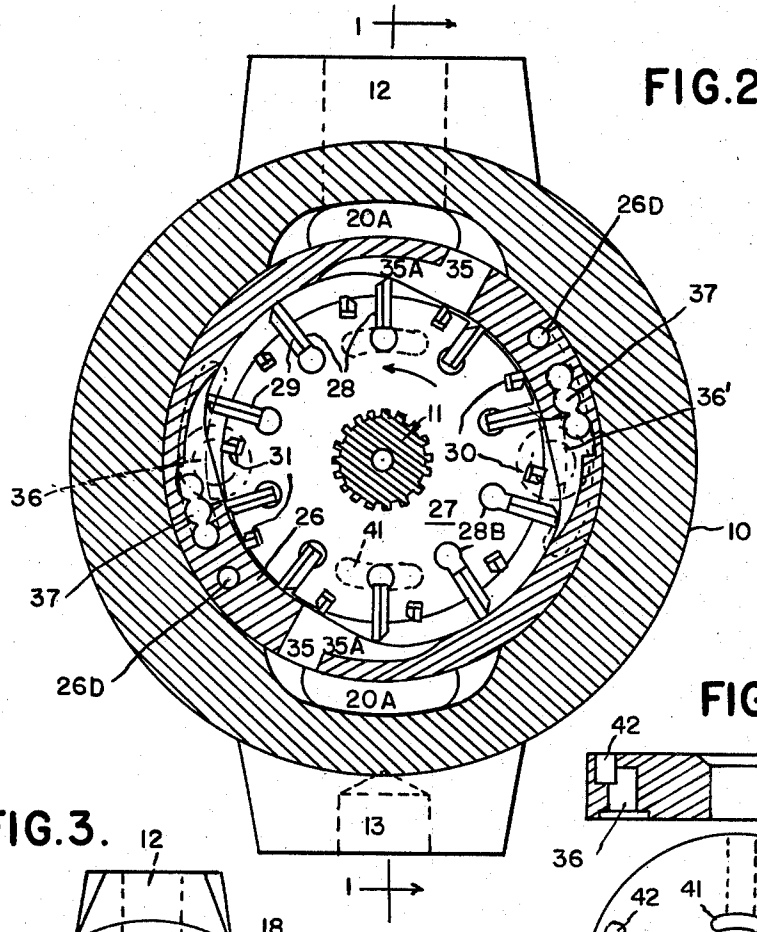


FIG.3.

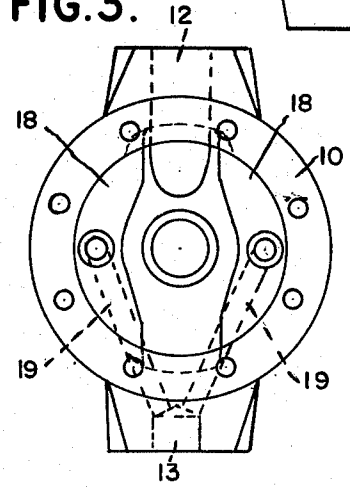


FIG.5.

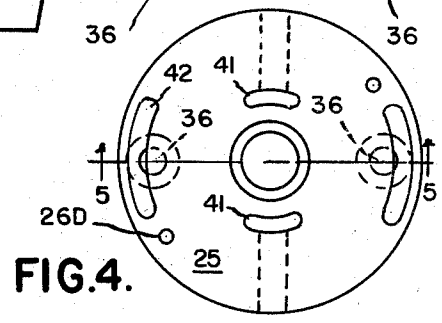


FIG.4.

INVENTOR.

OSCAR E. ROSAEN

BY Hauke & Hardesty

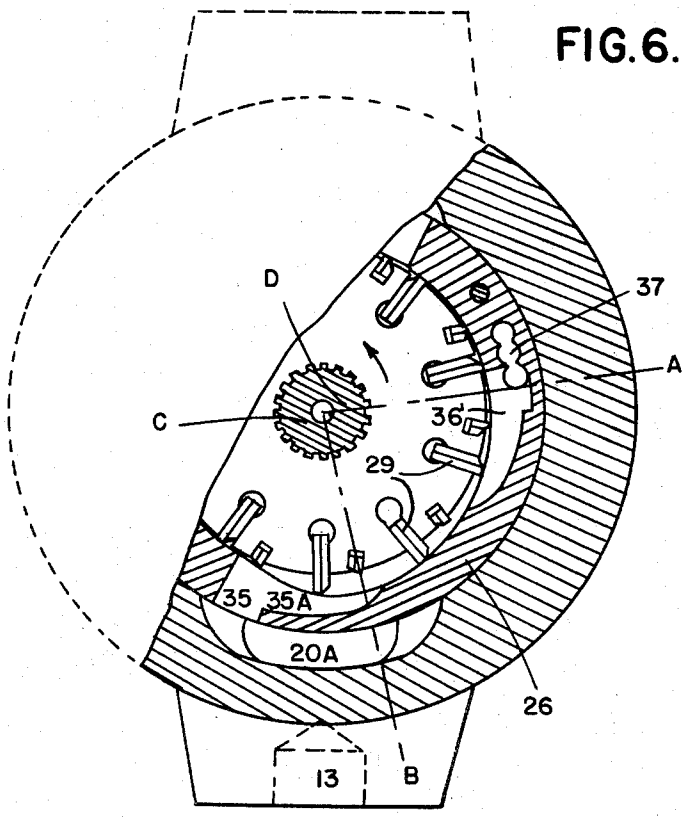
ATTORNEYS

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FIG.6.



INVENTOR.
OSCAR E. ROSAEN
BY Hauke & Hardesty
ATTORNEYS

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3,194,168

FLUID PUMPS

Oscar E. Rosaen, Grosse Pointe Farms, Mich., assignor, by mesne assignments, to Borje Rosaen, Ann Arbor, Mich.

Filed Oct. 6, 1958, Ser. No. 765,606
4 Claims. (Cl. 103—136)

The present invention relates to fluid pumps of the vane type.

Among the objects of the invention is to improve the efficiency of such pumps by providing a pump that at higher speeds will deliver fluid at higher pressures than those heretofore produced.

Another object is to provide a pump that will deliver fluid at high pressure when operated at low speeds.

Still another object is to provide means to prevent bending of the rotor and vanes at high delivery pressures due to deflection of the cheek or orifice plates between which the rotor rotates.

Other objects and advantages will appear to those skilled in the art upon reference to the following description and the accompanying drawings in which:

FIG. 1 is a section on the line 1—1 of FIG. 2.

FIG. 2 is a section on line 2—2 of FIG. 1 but showing the rotor in elevation.

FIG. 3 is a view on a somewhat smaller scale of the housing casting viewed as from the right of FIG. 1.

FIG. 4 is a view showing the inner face of one of the cheek or orifice plates.

FIG. 5 is a section of the same on line 5—5 of FIG. 4.

FIG. 6 is a sectional view similar to FIG. 2 but with one exaggerated showing of one of the features of the pump.

In the drawings, a pump embodying the present invention is shown as having the active pump parts enclosed in a housing comprising a cylindrical portion or casing 10 with one integral end wall provided with an axial opening through which extends the pump drive shaft 11 provided with suitable bearings and a shaft oil seal indicated at 11A and 11B respectively. The housing is also provided with a fluid inlet 12 and outlet 13.

The open end of casing 10 is closed by a suitable cover plate 14, having a central depression 15 counterboard as at 15 and spaced from the counterbore an annular channel 17.

The inner face of the integral end of housing member 10 is shown in FIG. 3 to be provided with faces 18 against which the pumping unit is seated. And from each of the faces 18 a conduit 19 leads to the outlet 13.

Between the faces 18 the channel 20 leads to the outer portion of the cylindrical part of the housing and is extended by longitudinal channels 20A to near the outer end of this cylindrical portion. Channels 20–20A constitute the inlets leading to the upper and lower portion of the pumping unit.

The pumping unit comprises two cheek or orifice plates 25 having between them the cam ring 26, within which is mounted the rotor 27, the latter being splined upon shaft 11, which extends through suitable central openings in the plates 25.

The rotor 27 consists of a disc having in its periphery equispaced radially arranged slots 28 in which are slidably carried pumping vanes 29 and midway between the slots

28 are located shallow slots 30 in which are slidably carried short vanes 31, the latter being limited in their outward movement by any suitable means such as an overhanging edge of the slot. The outward movement of vanes 31 should be sufficient to allow them to contact the inner face of ring 26 throughout the idle or non-pumping zones of the ring.

Both vanes 29 and 31 are provided with channels extending from their outer edges to their inner edges; that is, to the bottoms of their respective slots. Such channels in the vanes 29 are shown in FIG. 1 at 29A on the forward face of the vane. Each of the slots 28 is enlarged at its bottom by a through passage 28B.

The ring 26 consists of a hardened steel ring circular in its outer contour but having its inner contour consisting of two diametrically opposite pumping zones which are arcs, the radius of which is substantially greater than the radius of the enclosed rotor, two diametrically opposite idle zones, also arcs but on a radius only slightly greater than the radius of the rotor, and ramp portions joining adjacent zones.

An important feature of the pumping zones of the ring 26 is that the arcs are struck from a center disposed a short distance from the true center so that as a vane contacting the ring moves through the zone, it is also moved inwardly a short distance from about .001 to about .015 inch.

This construction as shown in FIG. 6 is an exaggerated form, the portion of the ring 26 between about the lines A and B, and of course the zone diametrically opposite and not shown, being arcs struck from the centers C and D respectively.

Ring 26 is also provided with radial inlet openings 35 which at their inner ends are open at the end of an idle or short radius zone of the ring and are extended as at 35A throughout the ramp to a short distance beyond the start of the pumping or long radius portion.

The outlet opening in ring 26 is at 36' and extends peripherally from near the end of a long radius or pumping zone throughout the ramp to the beginning of an idle or short radius zone, and opens to a through passage 37.

The cheek or orifice plates 25 are identical except that one of them is provided with a threaded socket to receive threaded end of a screw (not shown) which passes through the other plate 25, and ring 26 through openings 26D to hold the parts together.

Plates 25 are provided with radial inlet openings 40 open to channels 20A and to arcuate slots 41 in their inner faces which slots are so located as to register with the bottoms 28B of the vane slots 28.

The plates 25 are also provided with arcuate slots 42 near their outer edges which open to the outlet passages 37, in ring 26, and communicating with slots 42 are through passages 36 which, when the parts are in operative assembly register with passages 19 leading to the outlet 13.

In addition to the ball or roller bearing 11A supporting shaft 11, the portion of the shaft extending through the pump unit has also a plain bearing bushing 50 within the central opening of first plate 25 being of such length as to abut the integral end wall of the housing and to extend to near the rotor but be spaced therefrom sufficiently to provide a small annular chamber 51 around the shaft. In the further plate 25 the shaft end

portion is within a flanged bushing 52, which is also spaced a short distance from the rotor disc to provide another annular chamber 53 around the shaft, which communicates with chamber 51 through a small passage 54 through the rotor. The bushing 52 will also be provided in its side wall and flange with a passage 55 communicating with annular chamber 53 and counterbore 16 in the closure plate 14, the counterbore being of such size as to provide a small annular chamber between its wall and the flange of the bushing.

It should be noted that the pump unit when abutted against the housing faces 18 does not abut the closure plate 14 but is spaced therefrom a short distance, a suitable gasket 14A closing the space 60 at its perimeter.

The outer portion of this space 60 communicates with the pumping zone of the pump unit through the outlet openings 42 in the adjacent plate 25 but the space 60 is divided by a ring 61 in the annular channel 17 in plate 14 which ring is of such thickness as to lie against the face of plate 25 and the radially inner wall of the channel so as to divide the space 60 into inner and outer portions 60 and 60A, the outer being subjected to full pump discharge pressure and the inner portion opening through passage 55 to the annular chambers 51 and 53 into which some of the fluid travels from the pump chambers through leakage inwardly along the face of the rotor, since the latter must have some clearance in order to rotate freely. This fluid is also under pressure but much less than that developed in the pump chambers.

The effect of the fluid pressure in chambers 60 and 60A is in the first instance to hold the pump components tightly together and against the faces 18 and in the second instance, that is the fluid in chamber 60A, to provide a static pressure on the outer face of the plate 25 to balance the internal pressure adjacent the shaft.

Attention is drawn to the fact that the parts of the pump unit are so designed that, if for any reason the shaft 11 is to be rotated clockwise, instead of counterclockwise, as shown in FIGS. 2 and 6, the pump unit may be reversed and will operate in the same fashion.

In the normal operation of the pump, the fluid is drawn in through inlet 12, passage 20A to pass into the spaces between the vanes through port 35 and to the slots under the vanes through passages 40 and 41.

As the pressure builds up in the outlet, it also builds up in chamber 60 which is open to the outlet through the opening 36 in the adjacent cheek or orifice plate 25. Also, due to leakage radially inward from the pressure zones, the annular chambers 51 and 53 are filled with fluid under pressure and through conduit 55 such fluid is conducted into chamber 60A. The latter fluid pressure is somewhat less than that in chamber 60. These pressure chambers 60 and 60A, tend to maintain the pump unit against the faces 18 and also balance the pressure on the adjacent plate 25 on both faces and thereby prevent buckling or warping under the higher delivery pressures.

The feature shown in exaggeration in FIG. 6, that is, the gradual rise of the ring surface in the pumping zone, between, for example, the lines A and B, provides means whereby the pump may be operated at high efficiency at comparatively slow speed.

I claim:

1. A fluid pump of the vane type comprising a housing having an inlet and an outlet both located at one end thereof, a pump unit within said housing having a disc-like rotor provided with radially extending slots in its periphery, vanes slidably carried therein, a cam ring surrounding said rotor and contacting the ends of said vanes, the inner periphery of said ring determining the radial position of said vanes and forming with said rotor alternate pumping chambers and idle zones, and a pair of substantially identical cheek plates fixed to said ring and enclosing said rotor, fluid inlet and outlet passages through said cam ring to said pumping chambers and located at the beginning and end respectively of each pumping

chamber, each cheek plate being provided with diametrically oppositely disposed radial inlet passages and associated channels registering with the inner ends of said slots for subjecting the inner end of said vanes to inlet pressure fluid and also provided with diametrically oppositely disposed outlet passages for receiving the fluid discharged from said pumping chambers through said outlets in said cam rings, the outlet passages of either one of said cheek plates being capable of registering with the said outlet located at one end of said housing, means for retaining said pump unit fixed with reference to said housing, a drive shaft extending through and journaled in said one end of said housing and passing through said cheek plates and rotor and splined to the latter for rotating the same within the pump unit, said housing having a detachable closure plate located at the other end thereof affording access to said pump unit so that said unit may be readily axially removed from said drive shaft, reversed and replaced thereon to thus provide for the rotation of said rotor in either direction.

2. In a fluid pump of the vane type, a disc-like rotor provided in its periphery with radially arranged slots, radially slidable vanes carried in said slots, a cam ring surrounding said rotor and having its inner periphery contacting the outer ends of said vanes, said inner periphery being divided into at least two diametrically opposite pumping zones, in which the surface of the ring is spaced a substantial distance from the rotor disc to allow the vanes to project therefrom, a similar number of interposed idle zones, in which the surface of the ring is close to the rotor disc to thereby force the vanes inwardly, and ramp portions connecting the idle and pumping zone sections of said periphery, a separate inlet and outlet for each pumping zone disposed at the beginning and end respectively thereof, each of the idle zones being arcs drawn about the center of the rotor disc and each of the pumping zones being arcs drawn about a center displaced laterally from the center of the rotor, so that the arc of said inner periphery of said cam ring becomes progressively closer to the rotor center from the inlet end to the delivery end of each pumping zone.

3. In a fluid pump of the vane type, a disc-like rotor provided in its periphery with radially arranged slots, radially slidable vanes carried in said slots, a cam ring surrounding said rotor and having its inner periphery contacting the outer ends of said vanes, said inner periphery being divided into at least two diametrically opposite pumping zones in which the surface of the ring is spaced a substantial distance from the rotor disc to allow the vanes to project therefrom, a similar number of interposed idle zones in which the surface of the ring is close to the rotor disc to thereby force the vanes inwardly, and ramp portions connecting the idle and pumping zone sections of said periphery, a separate inlet and outlet for each pumping zone disposed at the beginning and end respectively thereof, each of the idle zones being arcs drawn about the center of the rotor disc and each of the pumping zones being arcs drawn about a center displaced laterally from the center of the rotor so that the arc of said inner periphery of said cam ring becomes progressively closer to the rotor center from the inlet end to the delivery end of the pumping zone, by from .001 to .015 inch.

4. In a vane type fluid pump, a pump unit comprising a rotor provided with radially slidable vanes in its periphery, a cam ring surrounding said rotor and having its inner periphery contacting the ends of said vanes and having its inner peripheral surface contoured to provide with said rotor at least two diametrically opposite pumping zones and a similar number of interposed idle zones, means for admitting fluid to said pumping zones, a cheek plate at each side of said ring, each cheek plate having fluid outlets from the pumping zone extending through said plate to its outer face, a housing for said pump unit, said housing having an integral end wall including fluid outlets registering with the fluid outlets of one of said

cheek plates, a drive shaft extending through said integral end wall supporting and drivingly connected to said rotor, a closure plate for said housing axially spaced from said pump unit to provide a chamber open to the outlets from the other one of said cheek plates to thereby subject said chamber to fluid at pump discharge pressure, a ring dividing said chamber and located radially inward of said cheek plate outlets, and passage means for supplying fluid from said pump unit to the space within said ring at a pressure less than the pressure at said outlets.

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JOSEPH H. BRANSON, JR., *Primary Examiner.*

LAURENCE V. EFNER, *Examiner.*