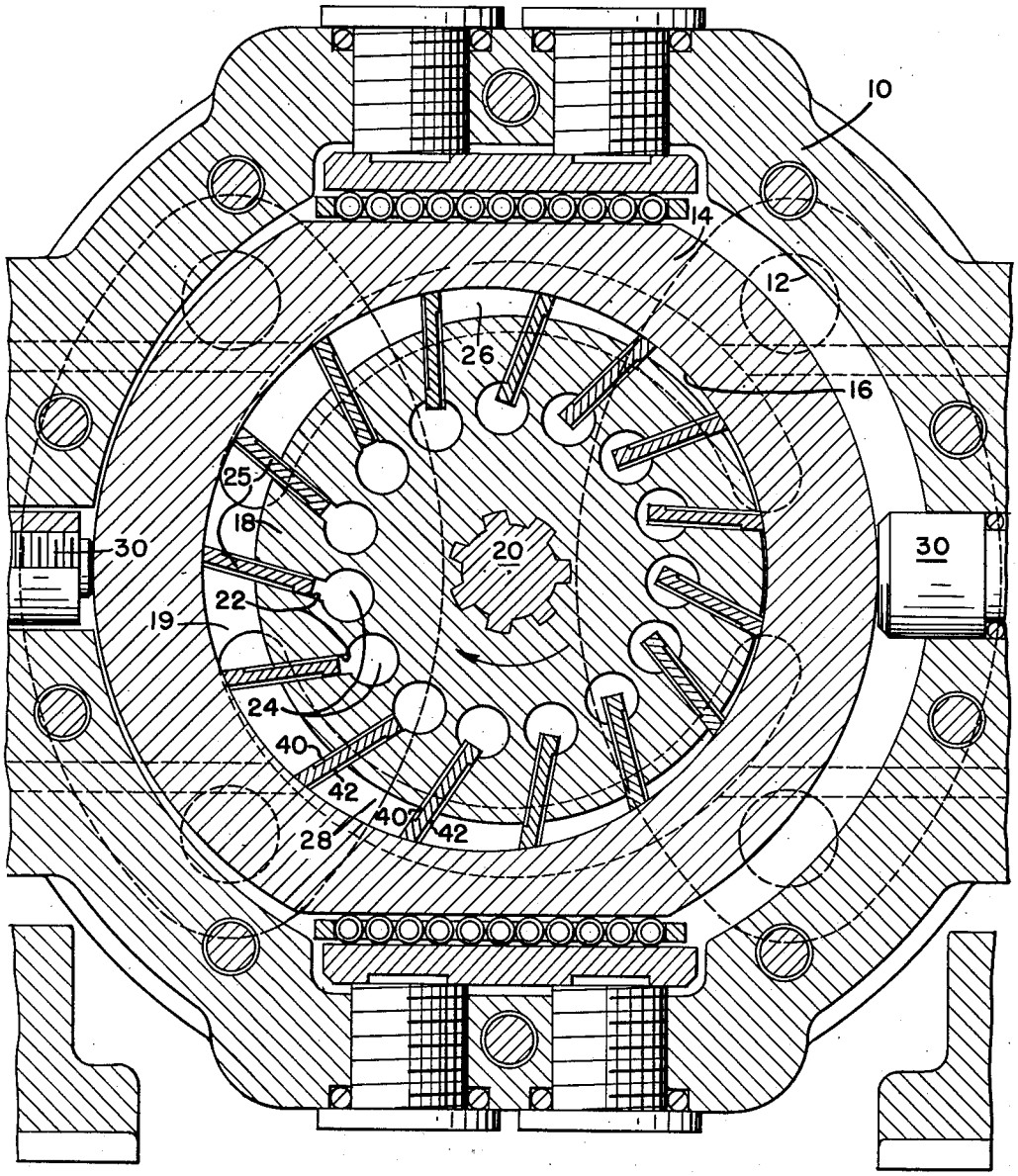
Sept. 30, 1952 W. ERNST 2,612,115

VANE PUMP AND VANE THEREFOR

Original Filed April 6, 1948 2 SHEETS—SHEET 1

FIG. 1



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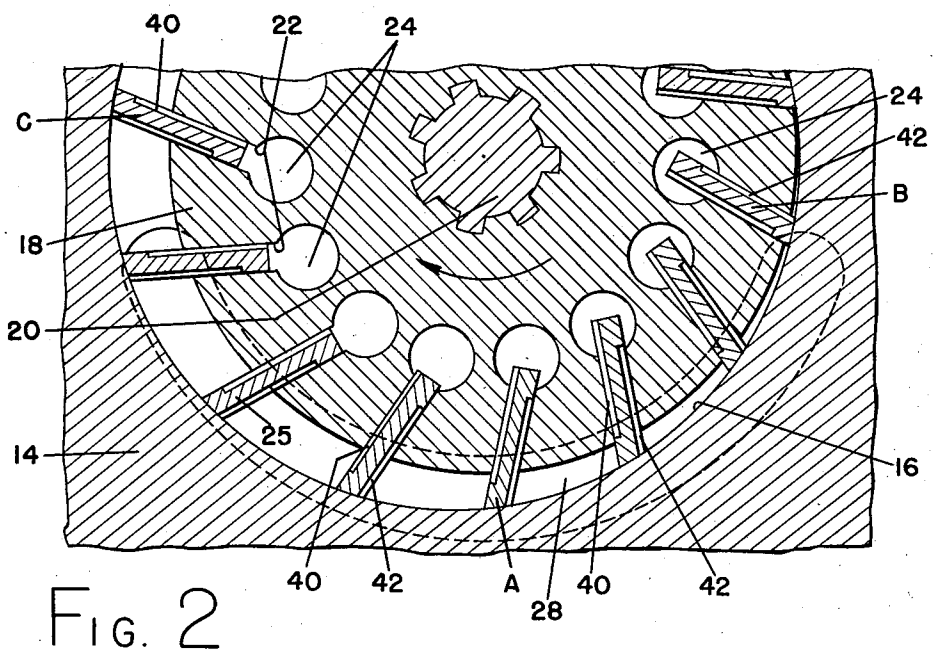


FIG. 2

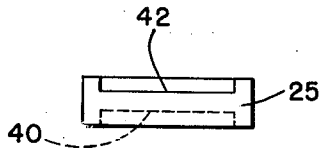


FIG. 3

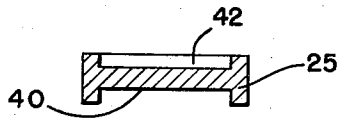


FIG. 4

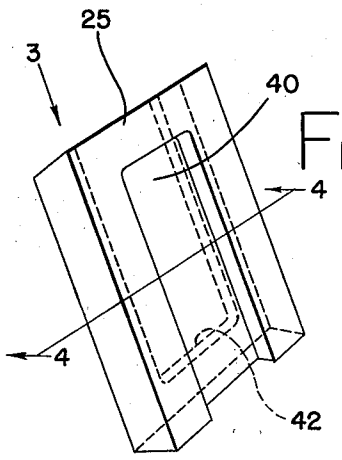


FIG. 5

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VANE PUMP AND VANE THEREFOR

Walter Ernst, Dayton, Ohio, assignor, by mesne assignments, to The Thompson Grinder Company, Springfield, Ohio, a corporation of Ohio

Original application April 6, 1948, Serial No. 19,410. Divided and this application July 25, 1949, Serial No. 106,545

6 Claims. (Cl. 103—135)

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This invention relates to hydraulic devices, and particularly to vaned hydraulic devices such as vane pumps and vane motors.

This application is a division of my copending application Serial No. 19,410, filed April 6, 1948 and assigned to the same assignee as the instant application.

In connection with vaned hydraulic devices, such as the pumps and motors referred to above, it is necessary to effect a sealing at the outer edges of the vanes as the rotor of the device turns in order to effect good isolation of the pressure side of the pump or motor from the suction side thereof. If this sealing is not effectively accomplished the device will operate inefficiently with a loss of volume if the unit is a pump and a loss of power if the unit is a motor.

Many different arrangements have been tried for accomplishing this desirable result of sealing at the outer edges of the vanes but most thereof are either ineffective or are so complex and complicated that it is not desirable to employ them in connection with commercial devices.

The particular object of this invention is the provision of an improved arrangement for maintaining the vanes of a vane pump or motor in sealing engagement with the periphery of the cylinder in which they move and without the use of complicated spring devices, special borings and the like.

It is still a further object to provide an arrangement for holding the vanes of a vaned pump or motor outwardly as the rotor of the pump or motor rotates and to accomplish this without any auxiliary bores in the rotor and without the use of special valves, conduits, etc., other than those with which the unit is normally provided.

A still further object is the provision of an arrangement of the type referred to above and which arrangement is contained entirely within the vanes of the units.

These and other objects and advantages will become more apparent upon reference to the following description taken in connection with the accompanying drawings in which:

Figure 1 is a vertical section taken through a vaned hydraulic unit constructed according to this invention:

Figure 2 is a view similar to Figure 1 but considerably enlarged so the operation of the arrangement of this invention can be more clearly seen;

Figures 3, 4 and 5 are views showing a vane constructed according to this invention and of the type illustrated in Figures 1 and 2, with Figure 3 being a view looking in the direction of

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arrow 3 on Figure 5, and Figure 4 being taken on line 4—4 of Figure 5.

Referring to the drawings somewhat more in detail the unit shown therein, and which may comprise either a pump or a motor, consists of an outer housing or frame part 10 having a cavity 12 therein and receiving a cylinder block 14 that is also centrally axially bored as indicated at 16.

Mounted within cylinder bore 16 is a rotor 18 and this is supported in driving engagement with a suitable shaft 20 according to well known practices.

The rotor 18 comprises a plurality of slots 22 extending axially therealong and formed so as to be tangent to a reference circle inscribed about the center of the rotor. The slots 22 are inclined in the direction of rotation of the rotor as indicated, and it will be evident that the rotor could be turned 180° in the plane of its axis, or end for end, in the cylinder block so the slots inclined in the opposite direction if it were desired to cause the rotor to turn in the other direction.

Each of slots 22 terminates in an inner chamber 24 and these chambers may comprise bores extending axially through the rotor and positioned so as to intersect the inner ends of the said slots.

As is customary in the art, the rotor 18 has side plates bearing against its opposite sides and these side plates, one of which is indicated at 19 in Figure 1, together with the cavity in cylinder block 14 define a closed space within which the rotor turns. Means are provided for admitting fluid to and withdrawing fluid from the aforementioned space and this means comprises the ports indicated at 26 and 28 in side plate 19. The side plates referred to are stationary as is customary when they are employed for porting the fluid to and from the cylinder.

The pump or motor illustrated may be of variable capacity and to this end cylinder block 14 is shiftable by plunger means 30 engaging opposite sides of the said block and movable by springs, by pistons, by manual means, or in any other manner desired.

When the rotor is turning in the direction indicated by the arrow in Figure 1, assuming the device to be operating as a pump, port 28 is the suction port where fluid enters the cavity in which the rotor rotates, and port 26 is the pressure port from which fluid is discharged from the cavity.

It will be evident that these ports must be effectively isolated by the vanes, indicated at 25, as the rotor rotates so that there is a minimum of leakage of fluid between the said ports. Accord-

ing to this invention, this is accomplished by admitting pressure fluid from pressure port 26 into each of bores 24 as the rotor rotates, and at least during the time the vanes are passing across the lap between the pressure and suction ports.

Thus, as each vane moves across the lap between the suction port 28 and pressure port 26 at the left side of Figure 1, pressure fluid from the said pressure port is conveyed to and stands in the bore 24 associated with the vane, and is effective for thrusting outwardly on the vane and maintaining it in sealing engagement with the periphery of cylinder bore 16 in block 14.

Similarly, as the vanes pass from the pressure port to the suction port at the right side of Figure 1, pressure fluid from port 26 is similarly conducted to and stands in the bores 24. Bores 24 are also subjected to pressure during the movement of the vanes through the pressure zone of the device but sealing of the vanes against the cylinder wall is not critical during this period.

The conducting of pressure fluid to the bores 24 is accomplished by porting formed directly in the faces of the vanes themselves.

Additionally, each vane provides for a valving action that alternately connects its leading and trailing sides with the pressure port 26 while simultaneously relieving the associated bore 24 of entrapped fluid when the vane moves downwardly in its slot.

This valving and porting arrangement is best illustrated in Figures 2, 3, 4 and 5. In these figures it will be noted that the leading side of each vane has a groove or slot 40 therein and which is open at the inner edge of the vane but which only extends part way to the other end of the vane and is therefore closed at the said other end or outer edge of the vane.

Similarly, the trailing side of each vane has a slot 42 therein but this slot opens at the outer edge of the vane and is closed adjacent to the inner edge thereof.

As will be seen in Figure 2 by the vane indicated at "A," the spacing of the closed ends of the slots 40 and 42 is such that as the closed end of slot 40 emerges from the periphery of the rotor on the leading side of the vane during outward movement of the vane in its vane slot, the closed end of slot 42 passes into the vane slot on the trailing side of the vane and communication thereof with the bore 24 is thus interrupted. It will therefore be seen that as the vanes move inwardly and outwardly in their vane slots they alternately connect the bores 24 at the inner edge of the slots with the leading and trailing sides of the vanes. This change from connection of the leading side with the bores 24 to connection of the trailing sides with the bores, and vice versa, takes place for each vane when the said vane is about midway in its travel through whichever of the suction or pressure zone it is passing through. Thus, there is no interruption in the supply of pressure fluid to the inner ends of the vanes during their passage across the laps of the device. However, no direct communication is ever had from the leading side of any of the vanes with the trailing side via slots 40 and 42. An effective seal is therefore maintained between opposite sides of the vanes at all times.

Referring again to Figure 2, it will be noted that the vane indicated at "B" is approaching the suction zone of the device, it having been assumed that the device is operating as a pump, and that, accordingly, vane "B" has pressure conducted to the bore 24 at the inner end of its vane slot from the pressure zone of the pump by means of the

groove or slot 42 formed in the trailing side of the said vane. This pressure fluid in bore 24 acts on the inner end of vane "B" and urges it outwardly to sealing engagement with the outer periphery of the bore and cylinder 14 and thereby prevents any leakage of fluid past the vane during its travel across the lap between ports 26 and 28.

During the time that the vane is passing through the suction zone of the device it is relatively immaterial whether it is urged outwardly against the periphery of the cylinder block or not, and also, normally, the centrifugal force acting on the vane due to the rotation of the rotor would maintain it in sliding engagement with the cylinder block.

However, when the vanes leave the end of port 28, it again becomes imperative for the vane to bear against the periphery of the cylinder block to prevent leakage of fluid. As will be noted, at this time the vanes have moved outwardly in their slots far enough to establish communication, via their leading slots 40, between the spaces at their leading sides and the bores 24 at their inner edges. A vane part-way across the lap between ports 28 and 26 is indicated at C in Figure 2.

Pressure ahead of the vanes is therefore conducted down the slots 40 to the bores 24 and serves to urge said vanes outwardly into engagement with the periphery of the bore 16 and block 14 during the time the said vanes are passing across the lap from the suction side of the device to the pressure side thereof.

In addition to fulfilling the function of maintaining the vanes in sealing engagement with the cylinder block during the passage of the said vanes across the laps between the pressure and suction zones, the slots 40 and 42 also prevent the entrapping of fluid in the bores 24, which trapping of fluid might lead to the development of excessively high pressures during movement of the vanes inwardly in their slots and thereby inducing high rates of wear between the ends of the vanes and the cylinder block. Similarly, the said slots also admit fluid into inner ends of the vane slots during outward movement of the vanes in their slots and thereby prevent a condition where the vanes would be restrained from moving outwardly. It will be evident that the rotor could be turned end for end in the cylinder so the vanes would be inclined in the opposite direction, if it were desired to drive the rotor in the opposite direction for operation as a pump. When the rotor is so turned end for end and is driven in the opposite direction, then the functions of the pressure and suction ports are interchanged, and port 26 becomes the suction port and port 28 becomes the pressure port.

For operation of the device as a motor to utilize the arrangement of this invention, port 26 would be the inlet or pressure port and port 28 would be the discharge or exhaust port with the rotor arranged as illustrated in Figure 1. It will be noted, however, that when the device operates as a motor, some means must be provided to hold the vanes out until the unit develops sufficient speed for centrifugal force to urge the vanes to their outer position. Such means might comprise light springs.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

I claim:

1. In the vane pump or motor; a cylinder having a cavity, a rotor rotatable in said cavity and having a plurality of vane receiving slots therein, each said slot being enlarged at its inner end, a vane closely fitting in each of said slots, said cylinder, rotor, and vanes defining a plurality of pumping spaces, and passage means in opposite sides of said vanes adapted, as said vanes reciprocate in their respective slots, due to rotation of said rotor, for connecting first the pumping space on the leading side of each vane with the inner end of the respective slot and then the pumping chamber on the trailing side thereof with the inner end of the slot, each said passage means hydraulically connecting two spaced points on the corresponding side of the corresponding vane, on the one side of the vane one point being adjacent the outer end of the vane and the other point being spaced outwardly from the inner end of the vane, and on the other side of the vane, one point being adjacent the inner end of the vane and the other point being spaced inwardly from the outer end of the vane, the spacing of said other points relative to each other in the direction of reciprocation of the vane being not greater than the distance measured in the same direction between the periphery of the rotor and the inner end of the slot where it intersects said enlargement.

2. In a vaned hydraulic unit; a hollow cylinder block, a rotor rotatably mounted in said block and having a plurality of vane slots each with an enlarged chamber at its inner end, a vane closely fitting each of said slots, inlet and outlet ports for the admission and discharge of fluid from the pumping spaces defined by said cylinder block, rotor and vanes, a first groove in the leading face of each vane continuously in communication with the pumping space ahead of the vane and extending to a closed end part spaced outwardly from the inner end of the vane, a second groove in the trailing face of the vane continuously in communication with the chamber of the corresponding vane slot and extending to a closed end part spaced inwardly from the outer end of the vane, said grooves overlapping radially, and the said closed end ports being radially spaced so that in one intermediate radial position of the vane both of the said end parts are within the vane slot immediately adjacent the ends thereof, each said groove comprising less than the axial width of the associated vane whereby the vanes have a bearing on both faces in their slots.

3. In combination in a vaned hydraulic unit having a rotor with vane slots therein; a chamber at the inner end of each slot, a vane closely fitting each slot and reciprocably mounted therein, and a groove in each face of each of said vanes, the groove in the leading face of each of the vanes extending from the inner edge of the vane toward, but not to, the outer edge of the said vane, and the groove in the trailing side of the vane extending from the outer edge toward but not to the inner edge of the vane, said grooves overlapping in the direction of the radial length of said vanes substantially the same amount as the radial extent of said slots between said chambers and the periphery of the rotor, each said groove comprising less than the axial width of the associated vane whereby the vanes have a bearing on both faces in their slots.

4. In a vane pump having a slotted rotor, enlarged chambers at the inner ends of said slots forming a continuation thereof, a vane closely fitting each of said slots, a groove on each of the leading and trailing sides of each of said vanes, the groove on the leading side of each vane extending from the inner edge of said vane toward the outer edge thereof but terminating short of the said outer edge, and the groove on the trailing side of each vane extending from the outer edge toward the inner edge thereof but terminating short of the said inner edge, and the closed ends of said grooves being spaced apart substantially the same distance as the length of said slots between the outer periphery of said rotor and the said enlarged chambers at the inner ends of the slots, so that in one radial position of each vane the closed ends of the said grooves therein are within the corresponding slot immediately adjacent the ends of the slot, each said groove comprising less than the axial width of the associated vane whereby the vanes have a bearing on both faces in their slots.

5. As a new article of manufacture, a vane for a vane pump comprising a flat vane substantially rectangular in cross section and having a groove on one side extending from one edge of the vane toward but terminating short of the other edge, and a groove on the other side extending from the said other edge toward but terminating short of the said one edge, said grooves overlapping radially of the vane and each comprising less than the axial length of said vanes, whereby said vanes will fit closely in a slot having parallel walls in all radial positions.

6. In a vaned hydraulic unit, means forming a cylinder, a rotor rotatably mounted in said cylinder, vane slots extending inwardly from the periphery of said rotor and each having an enlarged chamber portion at its inner end, a vane closely fitting each slot for radial movement therein during operation of said unit, said cylinder, rotor and vanes forming a plurality of pumping spaces, first passage means for establishing communication between the pumping space in front of each vane and the chamber at the inner end of the corresponding vane slot, and second passage means adapted for communicating the pumping space in the cylinder behind the said vane with the said chamber, there being an intermediate position of said vane where both of said passage means are interrupted, and said first passage means being established for all radial positions of the vane outwardly of the said intermediate position, and the second passage means being established for all radial positions of the vane inwardly of said intermediate position.

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