July 8, 1947. W. CZARNECKI 2,423,639

ROTARY PUMP

Filed March 15, 1945 2 Sheets-Sheet 1

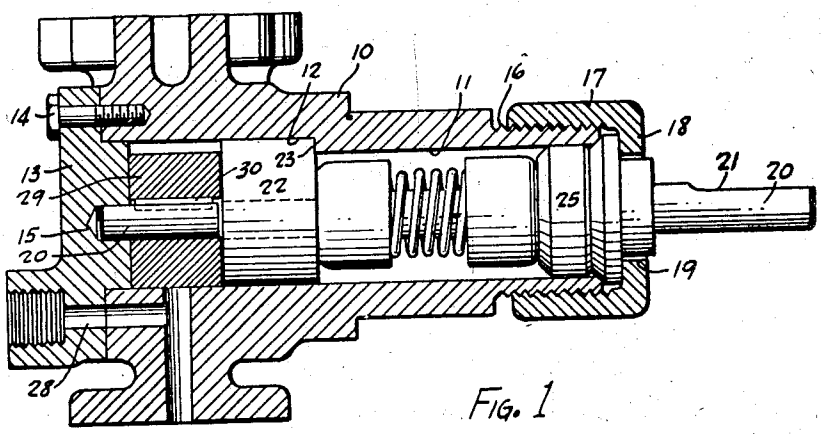


FIG. 1

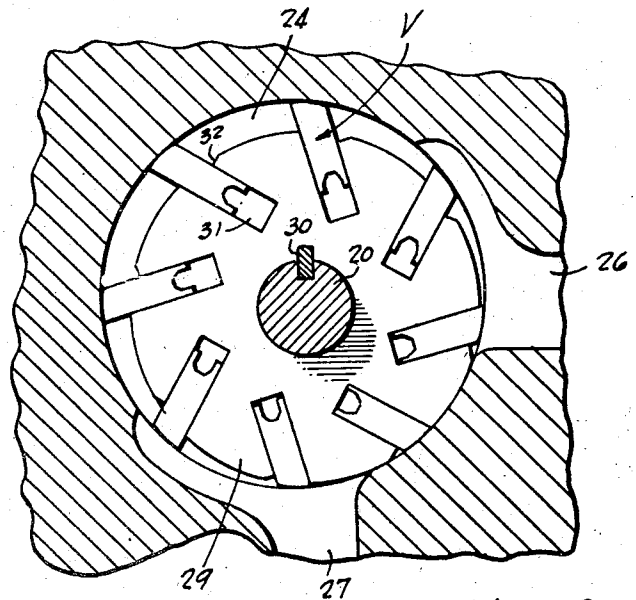


FIG. 2

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ROTARY PUMP

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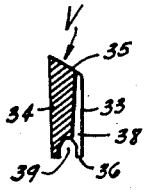


FIG. 4

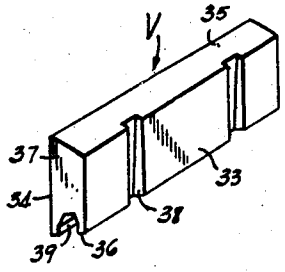


FIG. 5

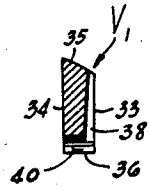


FIG. 6

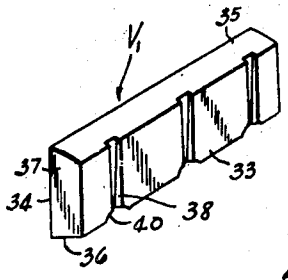


FIG. 7

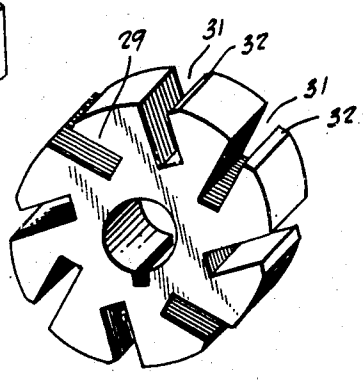


FIG. 3

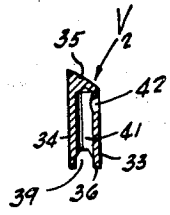


FIG. 8

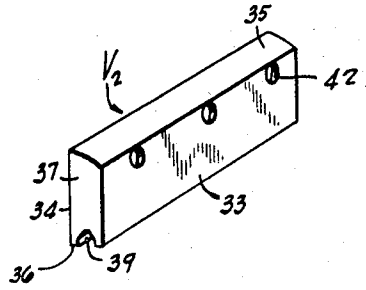


FIG. 9

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ROTARY PUMP

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Application March 15, 1945, Serial No. 582,837

2 Claims. (Cl. 103—135)

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This invention relates to rotary pumps and is concerned primarily with a rotary pump including movable vanes as the elements which build up pressure on the fluid.

The rotary pump of the type with which this invention is concerned and which is now meeting with widespread use, comprises essentially a casing or housing which provides a substantially cylindrical chamber with which communicates the inlet and the outlet. Rotatably mounted in this casing is a rotor which is also substantially cylindrical in shape. The axis of the rotor is disposed eccentrically with respect to the axis of the chamber to establish a crescent shape space between the rotor and the housing, and which space extends from the inlet to the outlet.

The rotor is slotted and slidably mounted in the rotor are vanes which may be moved from a retracted position to one spanning the space between the rotor and the housing.

In some of the older types of pumps, centrifugal force was the only means relied upon to move the vanes outwardly. As a result, under many conditions, the outward movement of the vanes would be delayed and the efficiency of operation seriously impaired.

In a more developed pump of this type, springs have also been employed as means for actuating the vanes. However, any mechanism of this type including springs is rendered highly complex because of the very presence of the springs and considerable difficulty has been experienced not only in originally assembling the pumps but also in servicing them.

A still more refined development embodied in the known art, is the use of end rings which cooperate with the vanes to maintain the outer edges thereof in engagement with the wall of the board defining the chamber. The use of such end rings is, doubtlessly, an improvement over earlier pumps of this type, but the presence of the end rings increases the size of the assembly for any given size rotor, and, in addition, considerable difficulty and inconvenience is experienced in properly assembling the vanes with respect to the rings in the original production and also in any later service operations which might be necessary.

In view of the condition of the art of rotary pumps as above outlined, and particularly because of the complex nature of the efficient pumps now available, this invention has, as its foremost objective, the provision of a rotary pump of the type above set forth, in which the operating mechanism is highly simplified, the number of

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moving parts maintained at an absolute minimum, and the efficiency of operation kept at a maximum. In attaining this end, the invention achieves the complete elimination of springs, end rings or other moving parts employed for actuating the vanes, which heretofore have been deemed necessary to efficient operation.

A further object of the invention is the provision of a rotary pump of the character aforesaid in which the rotor and vanes are constructed so as to supplement the centrifugal force developed by rotation of the rotor, by pressure fluid to move the vanes outwardly.

In order for a pump of this type to operate with required efficiency, it is necessary that the vanes fit into the rotor slots with a fairly snug fit. When the meeting parts are machined into a smooth condition, a seal is effected which, not only tends to bind the engaging surfaces, but which also creates a partial vacuum beneath the vanes when the latter tend to move outwardly, and this sealing effect is greatly increased when the pump is employed on a hydraulic medium, such as oil, which forms a sealing film between the surfaces.

With this particular condition in mind, the invention has in view, as a further object, the provision of a rotary pump of the type above described, which includes means for breaking the seal between the vanes and the walls of the slot which receive them.

Both the objects of breaking this seal, which impairs the sliding action of the vanes, and that of utilizing fluid pressure, as a supplemental actuating force for moving the vanes outwardly, are accomplished by the particular construction of the rotor and vanes which is obtained by this invention.

More in detail, the invention has as its object the provision of a rotary pump of the character aforesaid, which includes a sliding vane, the forward face of which is formed with a slot communicating between the upper and lower edges of the vane. In a preferred embodiment of the invention, two or more of these slots may be employed and they serve to break the seal between the faces of the rotor slot and vane, and also to bring the fluid under pressure down beneath the inner edge of the vane, to move it outwardly.

Yet another object of the invention, is the provision in a rotary pump of the character aforesaid of a vane having its forward face slotted together with a channel on the inner edge of the vane which establishes communication between the slots.

To the end of rendering the slots more effec-

tive, the invention has as a further object, the provision of a rotary pump of the type indicated, which includes a rotor formed with slots receiving vanes, with the cylindrical face of the rotor cut away immediately in front of the forward faces of the vanes. Thus, as the rotor is turned, the fluid under pressure is readily admitted to the slots.

Another object of the invention is the provision in a rotary pump of the character aforesaid, of a vane which includes a closed channel extending upwardly from the inner or bottom edge thereof and which communicates with an aperture that opens on to the front face of the vane at, or immediately adjacent to, the upper or outer edge thereof. In this form of the invention two or more of these closed channels may also be employed and they may be connected at the bottom or inner edge by a cross channel formed on the inner edge of the vane.

Various other more detailed objects and advantages of the invention, such as arise in connection with carrying out the above noted thoughts in a practical embodiment, will in part become apparent, and in part be hereinafter stated as the description of the invention proceeds.

The invention, therefore, comprises a rotary pump including a slotted rotor, together with vanes slidably assembled in the slots. The rotor is designed for rotation in one direction, and the forward face of each vane is formed with a plurality of slots extending from the outer edge of each vane to the inner or bottom edge, and this inner or bottom edge is formed with a channel establishing communication between the several slots.

For a full and more complete understanding of the invention, reference may be had to the following description and accompanying drawings, wherein:

Figure 1 is a section through those parts of a rotary pump with which this invention is immediately concerned;

Figure 2 is another sectional view taken at right angles to the showing of Figure 1;

Figure 3 is an enlarged detailed perspective of the rotor per se;

Figure 4 is a detailed cross section through one of the vanes;

Figure 5 is a detailed perspective of one of the vanes;

Figure 6 is a detailed cross sectional view similar to Figure 4, of one modification;

Figure 7 is a detailed perspective of the vane, the cross section of which is shown in Figure 6;

Figure 8 is a cross section through yet another form of vane; and

Figure 9 is a detailed perspective of the form shown in Figure 8.

Referring now to the drawings wherein like reference characters denote corresponding parts, and first more particularly to Figures 1 and 2, a rotary pump embodying the improvements of this invention is shown as comprising a housing or casing 10, which is formed with a cylindrical bore 11 and a second cylindrical bore 12 that communicates with the bore 11. It is important to note that the axes of the bores 11 and 12 do not align, but rather are eccentric or offset with respect to each other. The end of the bore 12 is closed by a cover plate 13 which may be secured to the housing in any preferred manner, such as by screw fastening elements of the type indicated at 14. The cover plate 13 is formed with a circular socket 15, the axis of which is in alignment with the axis of the bore 11.

The end of the casing 10 opposite to the cover plate 13 is reduced and threaded as indicated at 16, and screwed on to these threads is a cup-shaped member 17 having an end wall 18 formed with an opening 19. The axis of the opening 19 is also in alignment with the axis of the bore 11. A shaft 20 extends entirely through the casing 10 from the opening 19 to the socket 15, and the outer end of the shaft 20 is deformed out of a true circle to provide for engagement, by suitable source of power, for rotating the shaft. Such deformation may take the form of the flat indicated at 21.

The large ring 22 is tightly fitted in the bore 12 and abuts the shoulder 23 which divides the bores 11 and 12. This ring 22 is provided with an opening through which the shaft 20 extends. That portion of the bore 12 between the cover plate 13 and the ring 22, together with these elements, define the pressure chamber of the pump which is designated 24. It is notable that the shaft 20 carries a bearing 25 adjacent to the outer end of the bore 11.

Interposed between the ring 22 and the bearing 25 is a sealing assembly which is no particular part of the invention. It merely serves to prevent leakage of the hydraulic fluid along the shaft 20.

As is clearly shown in Figure 2, the casing 10 is formed with a fluid outlet 26 which communicates with the pressure chamber 24, and the fluid inlet indicated at 27 also communicates with the pressure chamber 24, and also with a by-pass channel shown at 28. This by-pass channel is also not particularly pertinent to the present invention, and is merely illustrated because it is employed in one practical adaptation which by-passes fluid. The present invention is concerned primarily with what takes place in the action on the fluid between the inlet 27 and outlet 26, within the chamber 24.

Referring now more particularly to Figures 2 and 3, a rotor 29 is shown as being keyed to the shaft 20, as indicated at 30. The rotor 29 is thus drivably mounted on the shaft 20 for rotation on an axis eccentric to the axis of the bore 12. The rotor 29 is provided with a plurality of slots 31 which, it will be noted, are disposed at an angle to any radius of the rotor. This angular disposition of the slots 31 is a feature of particular importance as will be later pointed out.

At this point it is well to note that a rotary pump of this type will ordinarily be designed for rotation in one direction. This direction may be either clockwise or counterclockwise, but unless the direction of rotation is determined, the pump is not susceptible of operation in a reverse direction to build up pressure of fluid. In the embodiment of the invention shown in Figures 2 and 3, the rotor is designed for rotation in a clockwise direction.

Speaking with reference to this direction of rotation, the forward edges of each of the slots 31 are cut away as indicated at 32. This cut away or flat is of great importance, as will later become apparent.

The number of slots 31 may, of course, vary in accordance with the engineering requirements of any particular installation. The number shown in the drawing is taken purely for illustrative purposes.

Fitted in each of the slots 31 is the novel form of vane which is provided in accordance with the

teachings of this invention. A preferred vane construction is shown in Figures 4 and 5. Here the vane which is referred to in its entirety by the reference character V comprises a substantially solid block, preferably of metal, having a front face 33 and a rear face 34, a top or outer edge 35, a bottom or inner edge 36 and end walls 37. It will be noted that the top or outer edge 35 is curved to conform to the curvature of the bore 12, as the edges 35 of all the vanes V are intended to slidably engage the wall of bore 12.

Extending from the top edge 35 to the bottom edge 36, and formed in the front face 33 of the vane V, are a pair of channels 38, and it is particularly important to note that the channels 38 are most shallow at the outer edge and deepest at the inner edge, providing in effect tapered or flared channels that enlarge in cross section from the outer edge to the inner edge.

Formed on the bottom or inner edge 36, and extending between the end walls 37, is a communicating channel 39 which provides a space for pressure fluid beneath the entire length of the vane V.

Figures 6 and 7 show one modification in the construction of the vanes. In this form the vane is identified by the reference character V_1. This vane V_1 includes the same front and rear faces, top and bottom edges and end walls described above in connection with the vane V. However, three of the channels 38 are illustrated rather than only two. The point of distinction between the forms of invention shown in Figures 4 and 5 on one hand and Figures 6 and 7 on the other is that in Figures 6 and 7 the communicating channel 39 is eliminated and the lower ends of the channels 38 terminate in enlarged recesses 40 which, as is clearly shown in Figure 6, extend between the front and rear faces 33 and 34.

Figures 8 and 9 show still another embodiment in which the vane is identified by the reference character V_2. The vane V_2 also includes the same front and rear faces, top and bottom edges and end walls above described. The communicating channel 39 is also formed on the bottom edge 36. However, each of the vanes V_2 has a plurality of passages 41 extending upwardly from the channel 39 to a point spaced from the top edge 35. Apertures 42 communicate between the upper ends of the passages 41 and the front face 33.

The operation of the pump will be the same regardless of which of the vanes V, V_1 or V_2 are employed. The shaft 20 will be driven from a suitable source of power and rotates the rotor 29 in a clockwise direction (speaking with reference to showings of the drawings), in that portion of the bore 12 opposite the pressure chamber 24. The outer edges 35 of the vanes due to their engagement with the wall of bore 12 are forced substantially completely within the slots 31.

As these vanes pass the inlet 27 they tend to move outwardly due to the centrifugal force. This tendency is supplemented by the fact that the fluid under pressure is admitted to the upper extremities of the channels 38 and passes downwardly through these channels beneath the bottom edge 36 and, thus, moves the vanes out to their slots. The tendency of the snug interfitting walls of the vanes and slots to create a seal or partial vacuum beneath the vanes is destroyed by the presence of these channels 38. Thus, it will be seen that the vanes V at all times completely bridge the space between the rotor and the bore 12 to provide for maximum efficiency in the operation of the pump.

The angular disposition of the vanes is of particular importance. In many instances it is desirable to employ a rotor of small radius and yet have a comparatively large degree of eccentricity between the rotor and the pressure chamber. This means there is a large space to be spanned by the vane. Not only must the vanes extend completely across the space of eccentricity, but there must be enough of the vanes left in the slots to adequately support them. This means that there must be a sufficient distance between the outer and inner edges of the vanes to accomplish this end. If the slots were true radial slots, in many instances there would not be sufficient depth in the slots to achieve this end. The angular disposition of the slots provides for adequate extent of the vanes.

While preferred specific embodiments of the invention are hereinbefore set forth, it is to be clearly understood that the invention is not to be limited to the exact constructions illustrated and described because various modifications of the details may be provided in putting the invention into practice within the purview of the appended claims.

What is claimed is:

1. In a rotary pump having a rotor and a casing in which the casing is provided with a substantially enclosed cylindrical chamber with inlet and outlet connections, means eccentrically mounting the rotor in the cylindrical chamber of the casing, said rotor having a plurality of slots rectangular-shape in cross section extending inward from the periphery thereof, said slots having parallel sides and said sides positioned at acute angles to radially extending planes from the center of the rotor with the slots sloping backward from the direction of rotation of the rotor, the peripheral surface of the rotor provided with beveled surfaces adjacent the leading edges of the slots, and a plurality of vanes slidably mounted in said slots, said vanes having arcuate outer ends, longitudinally extending recesses in the inner edges and passages across the leading faces thereof providing continuous communicating means between the periphery of the rotor through the spaces provided by the said beveled surfaces and the recesses in the inner edges of the vanes, whereby fluid under pressure in front of the vanes passes inward through the said passages in the vanes building up pressure behind the vanes for forcing the vanes outward accentuating the centrifugal force in the rotor.

2. In a rotary pump having a rotor and a casing in which the casing is provided with a substantially enclosed cylindrical chamber with inlet and outlet connections, means eccentrically mounting the rotor in the cylindrical chamber of the casing, said rotor having a plurality of slots rectangular-shape in cross section extending inward from the periphery thereof, said slots having parallel sides and said sides positioned at acute angles to radially extending planes from the center of the rotor, with the slots sloping backward from the direction of rotation of the rotor, the peripheral surface of the rotor provided with beveled surfaces adjacent the leading edges of the slots, and a plurality of vanes slidably mounted in said slots, said vanes having arcuate outer ends, longitudinally extending recesses in the inner edges and passages across the leading faces thereof providing continuous com-

municating means between the periphery of the rotor through the spaces provided by the said beveled surfaces and the recesses in the inner edges of the vanes, whereby fluid under pressure in front of the vanes passes inward through the said passages in the vanes building up pressure behind the vanes for forcing the vanes outward accentuating the centrifugal force in the rotor, the cross sectional areas of said passages in the leading faces of the vanes enlarging toward the inner edges of the vanes.

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