

Aug. 18, 1942.

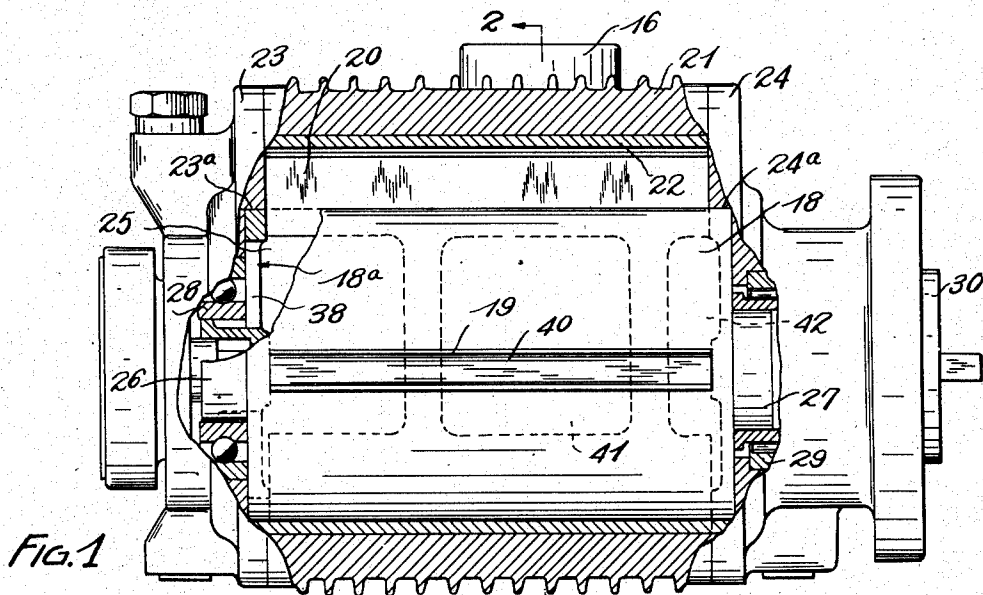
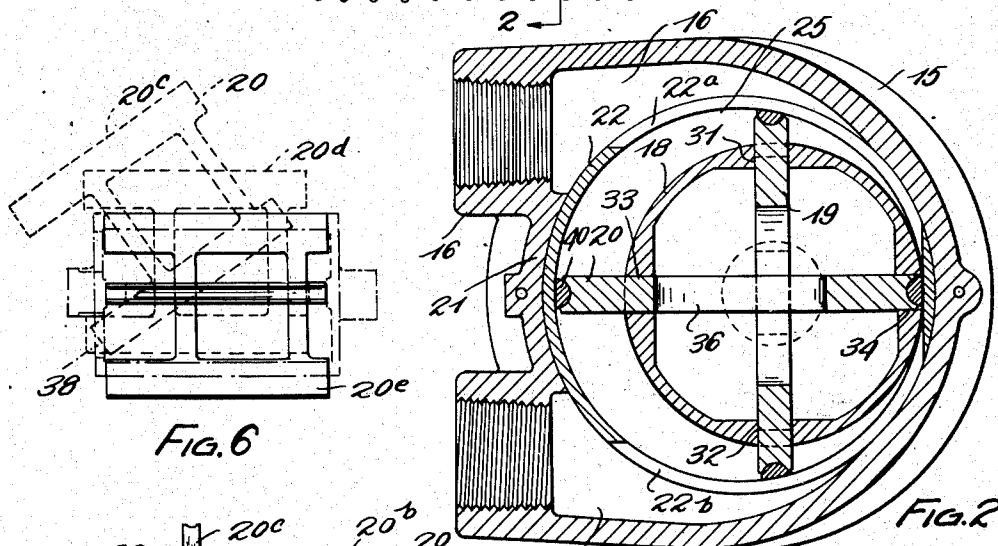
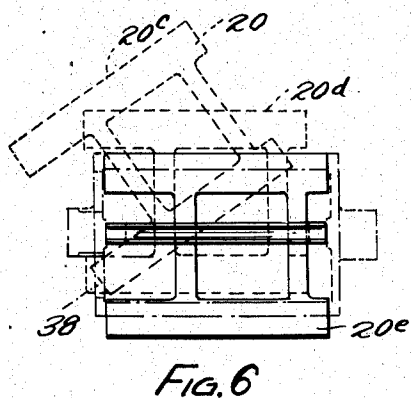
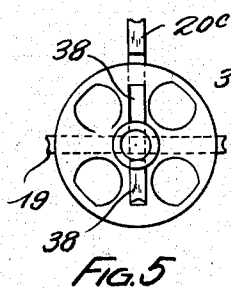
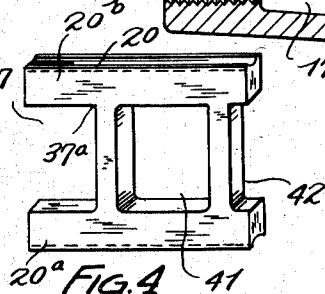
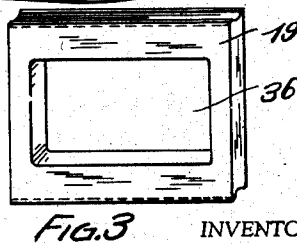
W. L. DAVIS

2,293,119

ROTARY PUMP

Filed Nov. 3, 1939

3 Sheets-Sheet 1



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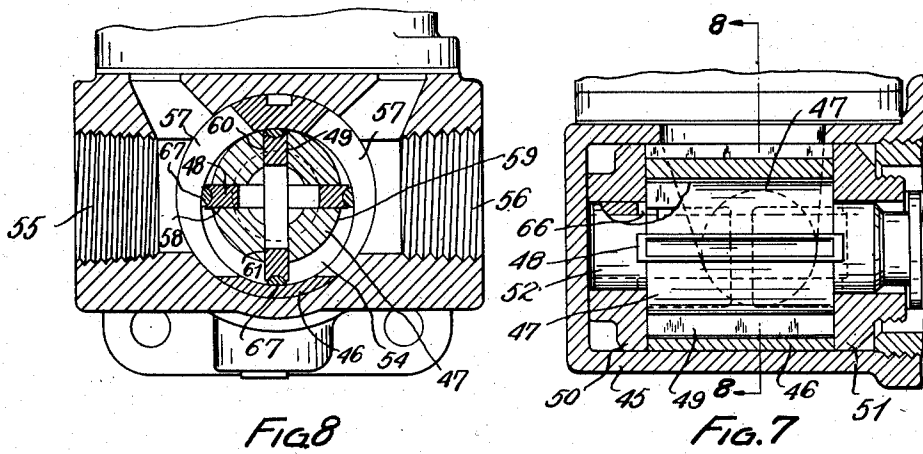
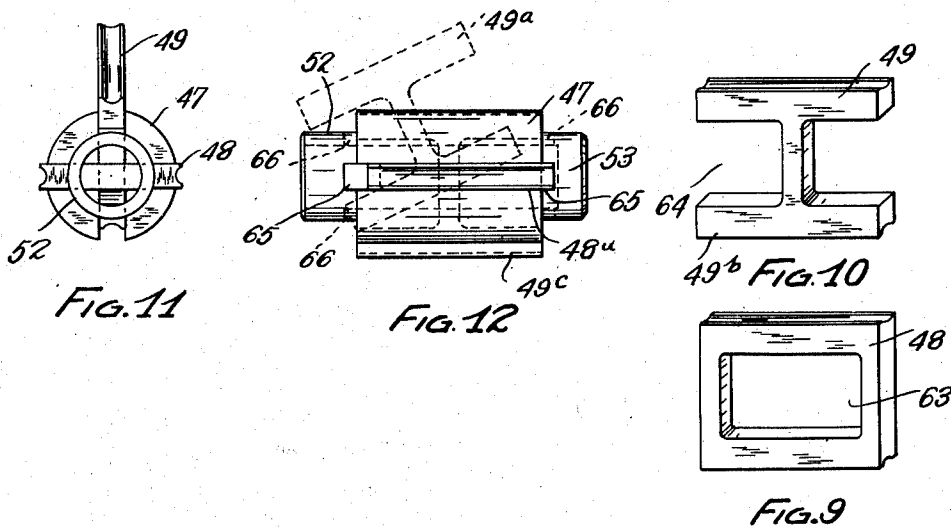
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**2,293,119**

ROTARY PUMP

Filed Nov. 3, 1939

3 Sheets-Sheet 2



Aug. 18, 1942.

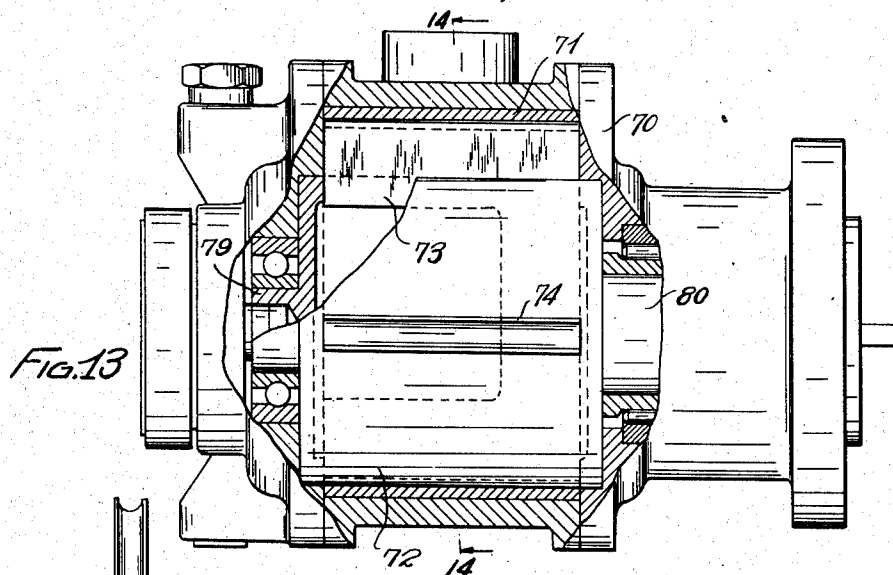
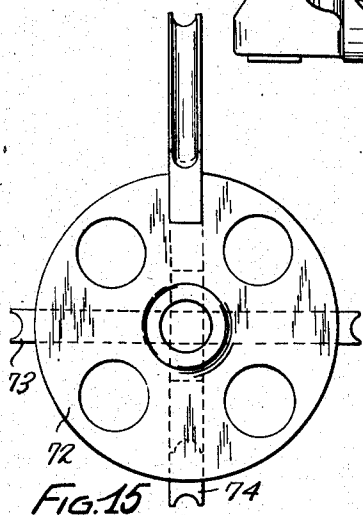
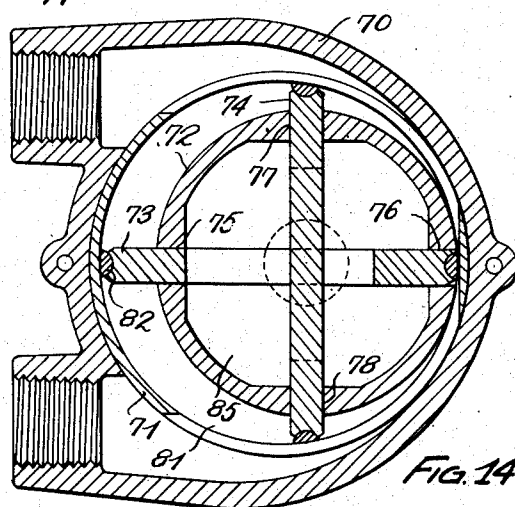
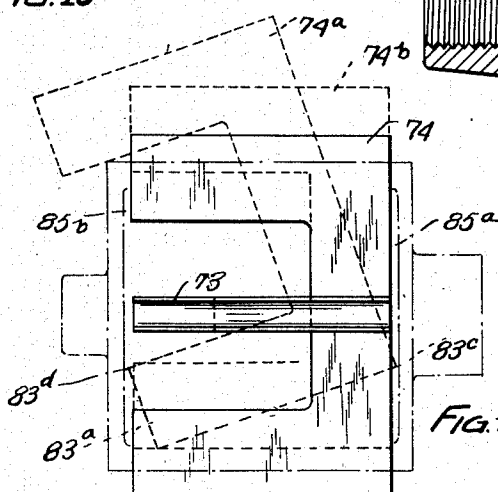
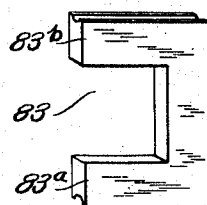
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2,293,119

ROTARY PUMP

Filed Nov. 3, 1939

3 Sheets-Sheet 3



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## UNITED STATES PATENT OFFICE

2,293,119

## ROTARY PUMP

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Application November 3, 1939, Serial No. 302,736

4 Claims. (Cl. 103—138)

This invention has to do with rotary pumps of the type having a piston carrying vanes arranged in intersecting diametrically extending planes and, as its principal object, aims to provide an improved and simplified construction for pumps of this type in which fewer parts are required than heretofore by reason of the use of vanes of one-piece construction so formed that they can be assembled into or removed from the piston by simply inserting them through the piston slots.

Another object of my invention is to provide an improved rotary pump of the type having a piston slotted intermediate its ends and carrying a pair of vanes arranged in intersecting diametrically extending planes, in which the vanes are of one-piece construction with one vane extending through an opening or recess of the other vane and cooperating portions of the piston and said one vane are so formed that the latter can be assembled into or removed from the piston by edgewise movement through a slot of the piston and the opening or recess of the other vane.

Other objects and advantages of my invention will be apparent from the following description when taken in conjunction with the accompanying sheets of drawings in which:

Fig. 1 is an elevation, with parts broken away, showing a rotary pump constructed according to my invention;

Fig. 2 is a transverse sectional view taken through the pump as indicated by line 2—2 of Fig. 1;

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

Fig. 4 is a similar perspective view showing the other vane of the pump;

Fig. 5 is an end view of the piston with the vane of Fig. 3 in position therein and showing the vane of Fig. 4 being inserted into the piston by edgewise movement through one of the slots thereof;

Fig. 6 is a view, more or less diagrammatic in form, showing how the vanes of my pump can be inserted into or removed from the piston;

Fig. 7 is an elevation, with parts broken away, showing another rotary pump constructed according to my invention;

Fig. 8 is a transverse sectional view through the pump taken substantially on line 8—8 of Fig. 7;

Fig. 9 is a perspective view showing one of the vanes used in the pump of Fig. 7;

Fig. 10 is a perspective view showing the other vane of this pump;

Fig. 11 is an end view of the piston with the vane of Fig. 9 assembled therein and showing the vane of Fig. 10 being assembled into or removed from the piston by edgewise movement through one of the slots thereof;

Fig. 12 is a side elevation of the piston further illustrating the construction thereof and the manner in which the vanes are assembled into or removed from the piston;

Fig. 13 is a side elevation, with parts broken away, showing another rotary pump embodying my invention;

Fig. 14 is a transverse sectional view taken through the pump on line 14—14 of Fig. 13;

Fig. 15 is an end view of the piston removed from the pump and illustrating the operation of assembling the vanes into the piston;

Fig. 16 is a side view, more or less diagrammatic in form, further showing how the vanes can be inserted into or removed from the piston; and

Fig. 17 is a perspective view showing one of the vanes removed from the piston.

The embodiments of my invention illustrated in the accompanying drawings will now be described in greater detail, but it should be understood that the invention is not limited to the particular constructions and arrangements here shown but may be embodied in various other rotary pumps or similar devices. Certain of the rotary pump improvements herein disclosed but not claimed, are claimed in my copending divisional application Serial No. 416,362, filed October 24, 1941.

In the embodiment of my invention illustrated in Figs. 1 and 2, I show a rotary pump comprising in general a casing or housing 15 provided with fluid inlet and outlet passages 16 and 17, and a piston 18 rotatable in the housing and carrying a pair of vanes 19 and 20 extending diametrically at substantially right angles to each other.

The housing 15 may be formed of connected sections which include an intermediate or cylinder section 21 having a liner 22 therein and cover sections 23 and 24 which may be bolted or otherwise connected to the ends of the cylinder section. The liner defines a working chamber or cylinder 25 and has openings 22a and 22b there-through which connect the passages 16 and 17 with the cylinder.

The piston 18 may comprise an elongated hollow one-piece body of cylindrical cross-section which may be somewhat longer than the cylinder chamber 25 and the liner 22 so that its ends ex-

tend into corresponding recesses 23a and 24a of the end sections or cover members 23 and 24 of the housing and have a running clearance therein. The piston may have axially aligned shaft-like projections 26 and 27 on opposite ends thereof which are received in suitable bearings 28 and 29 of the housing sections 23 and 24 for mounting the piston in the housing 15. The bearings 28 and 29 are offset with respect to the axis of the liner 22 so as to support the piston 18 in eccentric relation therein with the outer surface of the piston tangent to the inner surface of the liner, as shown in Fig. 2. One of the shaft-like extensions of the piston, in this instance the extension 27, may have a flange 30 connected therewith by which the piston of the pump can be connected with a power shaft or other suitable driving means.

As shown in Figs. 1 and 2, the piston 18 has a pair or set of diametrically opposed radial slots 31 and 32 through which the vane 19 extends and a second pair or set of diametrically opposed radial slots 33 and 34 spaced substantially 90° from the first pair of slots and through which the vane 20 extends. These slots extend axially of the piston but terminate inwardly of the ends thereof and, as shown in Fig. 1, are of substantially the same axial length as the cylinder chamber 25. The vanes 19 and 20, which are freely slidable in the piston slots, are of a length substantially equal to the liner 22 and, at their ends have running clearance with the end walls of the cylinder chamber.

With the construction and arrangement thus far described, it will be seen that rotation of the piston 18 in the housing will drive the vanes and cause fluid to be drawn in through one of the passages, for example the passage 16 herein designated the inlet passage, and to be discharged from the housing through the other passage 17 thereof.

To reduce the number of parts required in my improved pump and to insure more efficient running cooperation between the tips or side edges of the vanes and the cylinder liner 22, I construct the vanes 19 and 20 so that the body of each vane consists of a single piece. In this way I eliminate the need for springs such as have been commonly used heretofore for holding the vanes in engagement with the cylinder wall and also avoid the need for making the vanes out of several pieces which must be held together by screws or other connecting means.

In order to have the vanes 19 and 20 extend diametrically through the piston 18 in intersecting relation, I provide the vane 19 with an opening or recess 36 lying wholly within its edges and through which the vane 20 extends. To be able to assemble the vanes into or remove the same from the piston 18, I construct the vanes and the piston so that relative axial shifting can take place between the vanes and so that by imparting edgewise tilting or angular movement to the vane 20 it can be moved through the slot 33 of the piston and through the opening 36 of the vane 19 and thereby assembled into or removed from the slots 33 and 34 of the piston. To this end I construct the vane 20 with a generally quadrangular clearance recess 37 which opens through the end of the vane between the side portions or elements 20a and 20b thereof. As will be more fully understood hereinafter, this recess or end opening 37 has dimensions axially and transversely of the vane such as to permit the vane to be inserted into the piston 18 and through the

opening of the vane 19 by edgewise angular movement through one of the slots of the piston. As will be seen from Figs. 3 and 4 the vane 19 is in the shape of a quadrangular ring and the vane 20 has a modified H or I shape.

To permit the edgewise angular movement of the vane 20 as well as the above-mentioned relative axial shifting between the vanes 19 and 20, I provide the piston 18 with a radial clearance opening or slot 38 which may be cored or otherwise formed in the end portion thereof substantially in alignment with the slots 33 and 34. This opening or slot 38 may extend through the end wall 18a of the piston, as shown in Fig. 1, and may or may not extend part-way into the shaft projection 26.

In assembling the vanes 19 and 20 in the piston 18, the vane 19 is first inserted so as to extend through the pair of slots 31 and 32. The open end of the vane 20 is then partially inserted into the piston by passing the side 20a edgewise through the slot 33 thereby bringing the vane to the tilted or angular position 20c shown in dotted lines in Fig. 6. When the vane occupies this position it will be noted that the left end of the side 20a extends into or through the slot 33 and that the corner 37a of the recess 37 lies near the end of the slot 33. Now by swinging or further tilting the vane 20 and using the end of the side 20a as a fulcrum or pivot, the vane can be moved farther into the piston so as to assume the second position 20d shown in dotted lines in Fig. 6 and in full lines in Fig. 5 in which the sides 20a and 20b are substantially parallel with the piston axis but the vane is not centered axially or radially of the piston. The next step is to shift the vane 20 axially toward the right as seen in Fig. 6 and thereby withdraw the end of the side 20a from the slot 33, after which the vane is lowered or shifted radially thereby moving the side 20a into or through the slot 34 and bringing the vane to its assembled position such as the full line position 20e shown in Fig. 6. While I have described the insertion of the vane 20 as being a step-by-step movement, it will be understood, of course, that in actual practice this insertion of the vane 20 may be a more or less continuous movement.

While I have described the insertion of the vane 20 by calling for movement of the side 20a through the slot 33, this can be carried out by inserting the side 20b through the slot 34. To permit this to be done I provide the end wall 18a of the piston with another slot 38 located diametrically opposite the one referred to above. This duplication of the slot 38 also improves the balance of the piston.

In removing the vanes 19 and 20 from the piston 18, the reverse of the above-described procedure is followed, that is to say, the vane 20 is first partly withdrawn from the piston by radial movement in the slots 33 and 34 thereof. This vane is then shifted axially of the piston toward the left, as shown in Fig. 6, thereby bringing the end of the side 20a of the vane into the clearance slot or opening 38. The vane is then tilted or swung edgewise to the dotted-line position 20c, after which it can be freely withdrawn from the slot of the rotor through which it projects.

Referring further to the construction of the vanes 19 and 20 I wish to point out that they may have the opposite sides or tips thereof in direct contact with the cylinder liner 22, or if desired, they may have grooves therein in which axially extending packing elements 40 may be mounted. To reduce the weight of the vane 20 it may be

desirable to provide an opening 41 therein and a recess 42 in its opposite end. It will be understood, of course, that the shape of the vanes 19 and 20 and of the openings or recesses therein can be varied considerably but that the axial length of the openings 36 and 37 should be sufficient to permit the above-explained edgewise movement of the vane 20 to or from its assembled position in the piston.

In Figs. 7 and 8 I show another rotary pump constructed according to my invention and embodying the above-explained objects and features. This rotary pump comprises an outer casing or housing 45 having a cylinder liner 46 therein, and a piston 47 rotatable in the liner and carrying a pair of vanes 48 and 49 which extend diametrically through the piston at substantially right angles to each other. The piston 47 is eccentrically mounted in the liner 46 and is tangent thereto along an axial line, as shown in Figs. 7 and 8. For mounting the piston in this relation I may provide the housing sections or bearing members 50 and 51, which are supported in the outer housing 45, and in which the axially aligned projections or shaft portions 52 and 53 of the piston are journaled. The housing sections or bearing members 50 and 51 also form end walls for the cylinder chamber or working space 54 of the pump.

The housing 45 is provided with inlet and discharge passages 55 and 56 which communicate with the working chamber 54 through openings 57 provided in the liner 46 and from the arrangement above described, it will be seen that rotation of the piston 47 by power applied to the shaft extension 53 thereof, will cause fluid to be drawn in through the inlet passage and delivered through the discharge passage.

The piston 47 may comprise a one-piece hollow member having a body portion of substantially the same length as the cylinder liner 46 and provided with pairs or sets of diametrically opposed radial slots in which the vanes 48 and 49 are mounted, the slots 58 and 59 accommodating the vane 48 and the slots 60 and 61 accommodating the vane 49. The vanes are of a width to project from the piston for cooperation with the wall of the working chamber 54 and are of substantially the same length as the piston body so as to operate with running clearance between the housing sections or bearing members 50 and 51.

To eliminate the need for an added number of parts in making up the vanes and to obtain more efficient working cooperation between the vanes and the cylinder liner, I construct the vanes 48 and 49 with a one-piece body as in the case of the vanes 19 and 20 described above. To provide for easy assembly and removal of the vanes from the piston and also to permit one vane to extend through the other, I construct the vane 48 with an opening or recess 63 lying wholly within the edges thereof and I construct the vane 49 of H or I shape, that is to say with end recesses or openings 64 therein, so that it may extend through the vane 48 and can be inserted into or removed from the piston by edgewise movement in the slots 60 and 61 thereof.

In assembling the vanes 48 and 49 in the piston 47, the vane 48 is first inserted so as to extend diametrically thereof through the slots 58 and 59. The vane 48 is then shifted axially of the piston to the right, as seen in Fig. 12 to the full-line position 48a represented in this view. An open end of the vane 49 is then partially inserted through the slot 60 and the vane thereby brought

to the dotted-line position 49a shown in Fig. 12, in which the left end of the side portion 49b of the vane extends through the opening or recess 63 of the vane 48. The vane 49 is then swung or tilted downwardly and to the right and at the same time shifted axially of the piston, and is thereby brought to its full-line assembled position 49c. The vane 48 is then shifted axially toward the left so as to center the same with respect to the body of the piston.

To permit the vane 48 to be shifted axially of the piston and to permit the vane 49 to be inserted and tilted in the manner above explained, I may provide the piston 47 with certain clearance openings or slots which may be formed as extensions of the slots in which the vanes operate. Thus, clearance openings in the form of opposed radial slots 65 may be provided in the shaft projections 52 and 53 of the piston in alignment with, or as extensions of, the slots 58 and 59. Similarly, opposed radial clearance slots or openings 66 are formed in the shaft projections 52 and 53 of the piston substantially in alignment with, or as extensions of, the slots 60 and 61 in which the vane 49 is mounted. The slots extensions or clearance openings 65 permit the above-mentioned axial shifting of the vane 48 in the piston and the clearance openings or slot extensions 66 permit the H-shaped vane 49 to assume the tilted partially inserted dotted-line position 49a shown in Fig. 12 in which the left end of the side portion 49b of the vane extends into one of the clearance openings 66 and fulcrums therein as the vane is swung or tilted downwardly toward its position 49c. The relative axial displacement thus provided for the vanes 48 and 49 during assembly or removal thereof, makes it possible for the side portion 49b of the vane 49 to pass through the openings 63 of the vane 48.

The vanes 48 and 49 may have their side edges in direct running contact with the inner wall of the cylinder liner 46, or as shown in this instance, may be grooved to receive the axially extending bearing and packing elements 67.

The advantages of my invention can be realized to some extent in another manner, that is by increasing the width of the end openings 37 and 64 of the vanes 20 and 49 of the above-described rotary pumps so that the side elements of the vanes can straddle the shaft projection of the piston as the vane is inserted into or removed from the piston by edgewise tilting movement through one of the slots thereof. In a modified construction, such as that just mentioned, it would not be necessary for the radial slots 38 of the piston 18 to extend into the shaft projection 26 and the clearance openings or slot extensions 66 of the piston shown in Fig. 12 could then be omitted.

In Figs. 13 and 14, I show another rotary pump in which the body of the piston and the intersecting "through" vanes thereof are each of one-piece construction and are so formed that the vanes can be assembled into or removed from the piston by edgewise movement through the slots thereof. With the exception of the shape of the vanes, the pump illustrated in Figs. 13 and 14 is generally similar to that of Figs. 1 and 2 and, therefore, only a brief description of the general arrangement is deemed necessary.

As shown in the drawings, the pump of Figs. 13 and 14 is provided with a housing 70 having a cylindrical liner 71 therein and a piston 72 which is mounted eccentrically for rotation in the liner

and carries a pair of intersecting through vanes 73 and 74. The vane 73 is slidably mounted in slots 75 and 76 of the piston, and similarly, the vane 74 is slidably mounted in slots 77 and 78 of the piston.

The piston 72 is of one-piece construction and comprises a hollow or recessed cylindrical body having substantially axially aligned shaft projections 79 and 80 at its ends by which it is mounted in suitable bearings provided in the housing 70. The radial slots in which the vanes 73 and 74 are mounted extend axially of the piston but terminate inwardly of the ends thereof as indicated in Fig. 13, the axial length of these slots being substantially equal to the axial length of the cylinder chamber 81 defined by the liner 71.

The vanes 73 and 74 each have a one-piece body of an axial length substantially equal to that of the radial slots of the piston in which they are operably mounted and have a width such that their opposite side edges are maintained in running contact with the inner face of the liner during rotation of the piston. The edges of the vanes may be shaped for direct contact with the liner or may have grooves therein in which the contact elements 82 are mounted.

To permit these one-piece vanes 73 and 74 to be assembled into or removed from the piston 72 through the slots thereof, and to permit them to operate in the piston in the intersecting relation above mentioned, I form the vanes with a recess or opening 83 therein which extends for a substantial distance axially of the vane and opens through an end thereof between the side or edge portions 83a and 83b. The vanes 73 and 74 may be identical in size and shape and from the illustration in Fig. 17, it will be seen that they are of recessed quadrangular form and may be conveniently referred to as being substantially C-shaped.

In assembling the vanes into the piston 72, one of the vanes, for example the vane 73, is first inserted through one of the pair of slots provided therefor. The remaining vane 74 is then assembled into position by edgewise movement through the slot 75 and in so doing, the side portion 83a thereof is inserted or hooked through the slot 75 and is passed through the recess or opening 83 of the previously inserted vane 73 thereby bringing the vane 74 to the tilted or inclined dotted-line position 74a, shown in Fig. 16. By a combined edgewise swinging or further tilting movement, the vane 74 can then be moved from the position 74a to the dotted-line position 74b and then from the latter position the vane can be shifted diametrically of the piston to bring the same to the full-line position shown in Fig. 16 in which the vanes 73 and 74 are fully assembled in the piston and extend in intersecting relation therethrough.

For the removal of the vanes from the piston, the reverse of the above-described operation is followed, that is to say, the vane 74 is first shifted diametrically of the piston to the dotted position 74b from which it is then withdrawn by a combined tilting and swinging movement during which it assumes or passes through the dotted-line position 74a preliminary to the passage of the side portion 83a through the recess 83 of the vane 73 and the complete withdrawal of the vane through the slot 75 of the piston. In thus assembling the vanes into or removing the same from the piston 72, the operation is begun by inserting either vane into the piston

first and following up the operation by the insertion of the other vane. This is made possible by the fact that the vanes 73 and 74 are of substantially identical shape and construction and are interchangeable.

To enable the above-described operation of assembling the vanes into or removing the same from the piston 72 to be readily carried out, I construct the hollow body of the piston so that the internal chamber or recess 85 thereof extends axially a short distance beyond or outwardly of the ends of the slots in which the vanes are mounted. In other words, the ends of the internal chamber or recess 85 are extended, by coring into the end walls of the piston or other suitable manner of construction, as indicated at 85a and 85b and these extensions accommodate and provide clearance for the corners 83c and 83d of the vane 74 during the edgewise angular swinging and tilting movement thereof. The end extensions 85a and 85b of the chamber or recess of the piston may be formed of the same size or diameter as the main intermediate portion of the chamber, although they can be in the form of radially extending slots or openings which are cored or otherwise formed in the end walls of the piston substantially in alignment with the slots in which the vanes are mounted, as in the case of the slots 38 shown in Fig. 1.

I desire it to be understood that throughout the specification and claims where reference is made to the vanes as being of "one-piece" construction or as having a "single-piece" body, these or similar expressions are intended to mean a vane having a unitary body formed from a single-piece of material as distinguished from vanes having a body formed of separate parts which are assembled or connected with each other. It should also be understood that the above quoted or similar expressions are intended to include all vanes of the type shown in the accompanying drawings regardless of whether or not they are provided at their tips with separate bearing and packing elements, such as the elements 40, 67 and 82.

From the foregoing description and the accompanying drawings, it will now be readily seen that I have provided an improved construction for rotary pumps of the type having a pair of diametrically extending vanes, in which the vanes are of single-piece construction and are so formed that one vane can be assembled into or removed from the piston by edgewise movement through a slot of the piston and an opening or recess of the other vane. It will also be seen that by providing clearance slots or recesses in the piston a relative axial shifting of the vanes can take place so that edgewise swinging or angular movement of one vane causes the same to pass through the opening of the other vane.

While I have illustrated and described my improved construction for rotary pumps in a more or less detailed manner, it will be understood, of course, that the invention is not limited to the particular rotary pumps and details of construction herein disclosed, but may be embodied in various other similar devices and specific constructions coming within the scope of the appended claims.

Having thus described my invention, I claim:

1. In a rotary pump, a housing having therein a cylinder chamber and inlet and discharge passages communicating with the cylinder chamber, a piston rotatable in said chamber and having a one-piece body provided with two pairs of axially

extending diametrically opposed slots, the slots of each pair being in communication with each other through the interior of the piston and the slots of one pair being spaced substantially 90° from the slots of the other pair, and a pair of vanes extending diametrically through the respective pairs of slots for cooperation with the wall of the cylinder chamber, each vane having a one-piece body and one vane of the pair having an opening wholly within its edges and through which the other vane extends, said other vane having a section spaced inwardly from its side edges which is of shorter axial length than said side edges and of shorter axial length than the opening of said one vane, said piston having an opening substantially in alignment with one pair of slots and into which a portion of one of said vanes extends during assembling of said vanes into or removing the vanes from the piston, said other vane being capable of edgewise angular movement in one pair of the piston slots for movement to its assembled position in the piston and for movement of a portion of said other vane through said wholly inwardly lying opening.

2. In a rotary pump, a cylinder, a one-piece piston rotatable therein and having two sets of diametrically opposed radial slots terminating inwardly of its ends, and a pair of one-piece vanes extending diametrically of the piston through said slots at substantially right angles to each other, said piston having an opening adjacent one end thereof substantially in alignment with the slots of one of said sets, one of said vanes having an opening lying wholly inwardly of its edges and the other having a portion of reduced length spaced inwardly from its side edges and adapted to extend through such last-mentioned opening and one of the vanes being shiftable axially of the piston by movement of a portion thereof in said opening of the piston to thereby position the vanes relative to each other for passage of said other vane through said last mentioned vane opening.

3. In a rotary pump, a cylinder, a one-piece piston rotatable therein and having two sets of diametrically opposed radial slots terminating inwardly of its ends, and a pair of one-piece vanes extending diametrically of the piston through said slots at substantially right angles to each other, one of said vanes having a shape resembling a quadrangular ring and the other having an H-like shape adapting said other vane for passage of a portion thereof substantially radially of the piston through the opening of said one vane during assembly or removal of the vanes from the piston, said piston having an opening therein substantially in alignment with the slots of one of said sets permitting axial shifting of one of the vanes to thereby facilitate passage of said portion of the H-like vane through the opening of the ring-like vane.

4. In a rotary pump, a housing having a cylinder therein, a one-piece piston having axial projections mounting the same for rotation in said cylinder and also having two sets of diametrically opposed radial slots terminating inwardly of the ends of said projections, and a pair of one-piece vanes extending diametrically of the piston through said slots at substantially right-angles to each other, one of said vanes having an opening lying wholly inwardly of its edges and the other having a portion of reduced length spaced inwardly from its side edges and adapted to extend through such last-mentioned opening, said piston having an opening therein substantially in alignment with one set of said slots, one of the vanes being shiftable in its slot axially of the piston by movement of a portion of said vane into said opening of the piston to thereby position the vanes relative to each other for passage of the other vane through said wholly inwardly lying opening by edgewise angular movement.

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