Oct. 10, 1950 J. M. ROTH ET AL 2,525,619

PUMP

Filed Feb. 13, 1947 2 Sheets-Sheet 1

Fig. 1.

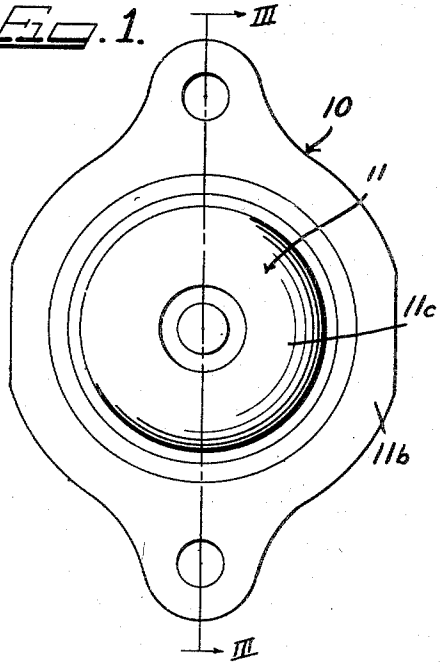


Fig. 2.

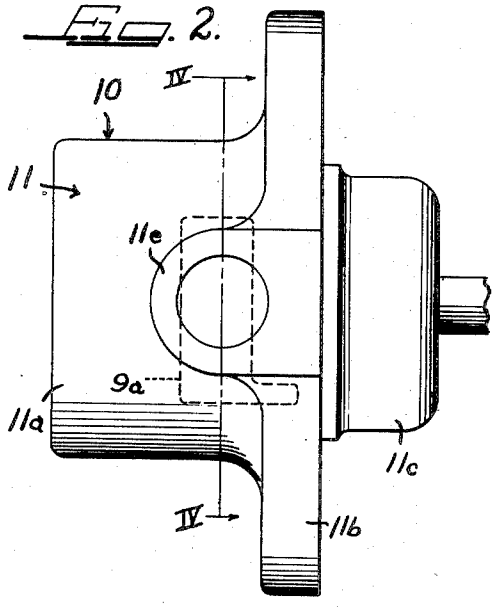


Fig. 3.

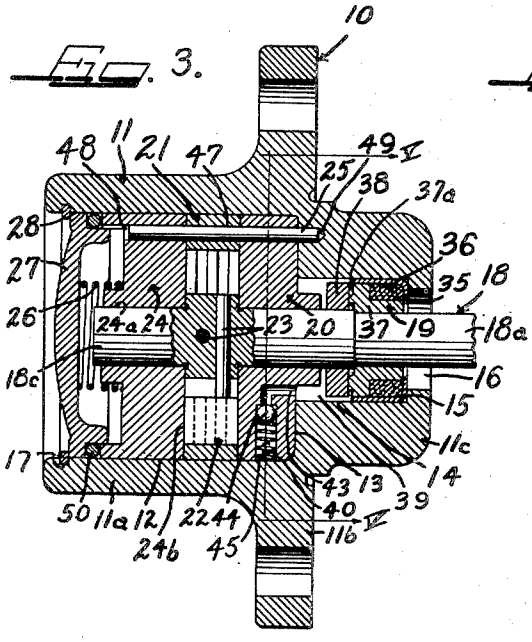
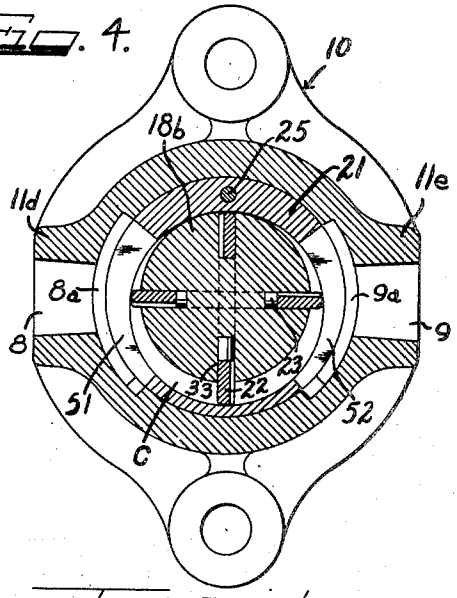


Fig. 4.



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PUMP

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Fig. 5.

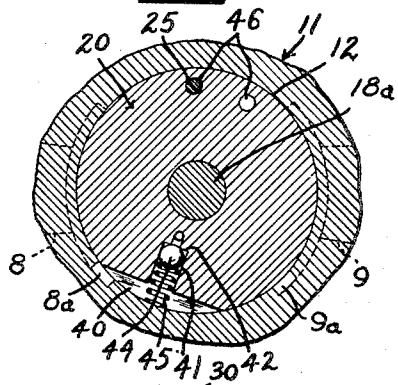


Fig. 6.

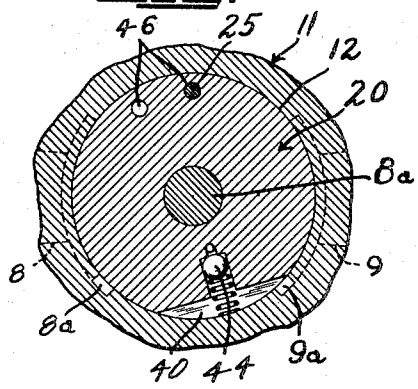


Fig. 7.

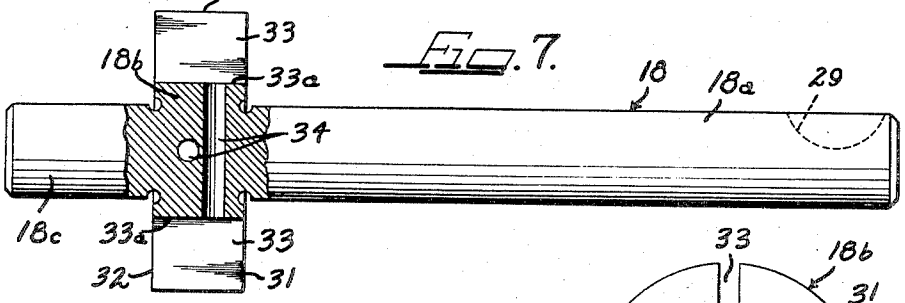


Fig. 8.

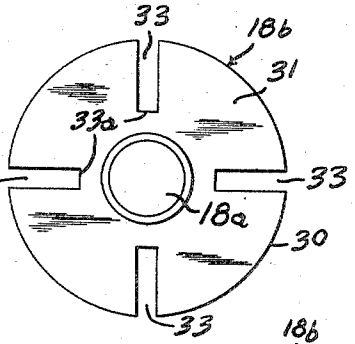


Fig. 9.

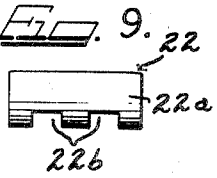
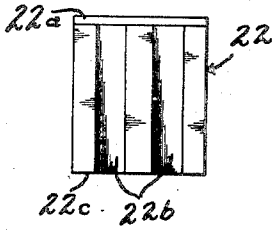


Fig. 10.



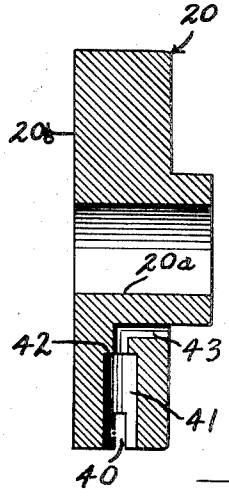
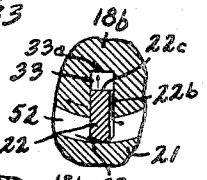


Fig. 11.

Fig. 13.



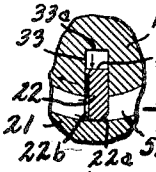


Fig. 12.

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UNITED STATES PATENT OFFICE

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PUMP

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Application February 13, 1947, Serial No. 728,258

4 Claims. (Cl. 103—137)

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This invention relates to pumps and particularly to rotary vane type pumps.

According to this invention an efficient, inexpensive rotary vane type pump is so constructed and arranged that it can operate in a clockwise direction or in a counter-clockwise direction, can be inexpensively formed without heretofore-necessary machining operations, has a suction drained seal chamber, is non-pulsating, and is relatively free from liner wear. The rotor for the pump has integral shaft portions projecting from opposite side faces thereof and has vane-receiving slots at spaced intervals around the periphery thereof and extending through the side faces thereof so that they are cheaply formed by a shaper, a grinder, or a milling cutter. These vane slots have solid bottoms and the bottoms of diametrically opposed slots are connected through drilled holes. Pins slidably ride in these holes and act on the inner ends of the vanes to maintain the vanes in contact with the pump liner.

The vanes preferably have rounded outer ends for riding on the pump liner and grooves on one side face thereof to vent the inner ends of the rotor slots to the pumping chamber between the rotor and liner. The vanes are reversible to have their grooved faces on either side. If the grooves are on the trailing sides of the vanes, the inner ends of the vanes are only subject to negative inlet pressures and the thrust on the vanes due to discharge pressure acting on their rounded outer ends is inward to subtract from the centrifugal force tending to hold the vanes tightly against the liner. If the grooves are on the leading sides of the vanes, the inner ends of the vanes are exposed to discharge pressure and the outer ends of the vanes will be forced against the pump liner to add to the centrifugal force. Pulsations due to vane retractions are eliminated because fluid trapped behind the vanes is released to occupy the space in the pumping chamber which was previously occupied by the extended ends of the vanes.

A feature of the invention resides in the provision of bearing blocks which rotatably mount the rotor shaft portions and also provide thrust bearings for the opposite side faces of the rotor to close the open ends of the rotor slots.

A further feature resides in the provision of a sealed chamber through which the pump rotor shaft projects and which is selectively drained into the port functioning as the inlet port of the pump as determined by the direction of operation of operation of the pump.

Another feature resides in the provision of a

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locking pin arrangement for the pump bearing blocks which permits shifting of one of the blocks to connect the sealed chamber selectively with ports on opposite sides of the pump.

It is, then, an object of this invention to provide a vane type pump with a peripherally slotted rotor wherein the slots have closed bottoms and open ends and wherein the closed bottoms of opposed slots are connected by holes for receiving pins.

A further object of the invention is to provide an inexpensive rotary vane pump with a rotor having integral shafts projecting from opposite faces thereof and equipped with peripheral slots extending through said faces whereby bearing blocks on the shaft portions afford thrust bearings for the opposite faces of the rotor as well as radial bearings for the shaft portions.

A further object of the invention is to provide a closed bottomed slotted rotor for pumps with pins connecting opposed rotor slots for acting on the inner ends of vanes therein.

A still further object of the invention is to provide a pump with a shiftable ported bearing block adapted to selectively connect a seal chamber of the pump with a port of the pump.

A still further object of the invention is to provide a rotory vane pump having closed bottom vane slots in the rotor thereof slidably receiving vanes with rounded outer ends riding on the bore of the pump liner wherein one side face of the vanes is grooved to vent the inner ends of the closed bottom slots with the pumping chamber on either the inlet or discharge side of the chamber to control the force of seating the vanes on the pump liner.

Another object of the invention is to block off opposed rotor slots in a rotary vane pump and balance the pressure on the blades of the pump by means of relief grooves for eliminating severe liner wear heretofore encountered on the inlet side of a pump by discharge pressure action on through-rotor vanes.

Other and further objects of the invention will be apparent to those skilled in the art from the following detailed description of the annexed sheets of drawings which, by way of a preferred example only, illustrate one embodiment of the invention.

On the drawings:

Figure 1 is a front end elevational view of the pump of this invention.

Figure 2 is a side elevational view of the pump.

Figure 3 is a longitudinal vertical cross-sec-

tional view taken along the line III—III of Figure 1.

Figure 4 is a transverse vertical cross-sectional view with parts in end elevation taken along the line IV—IV of Figure 2.

Figure 5 is a fragmentary transverse cross-sectional view taken along the line V—V of Figure 3 and illustrating the position of the bearing block for connecting the sealing chamber of the pump with an inlet port on one side of the pump.

Figure 6 is a view similar to Figure 5 but illustrating the position of the bearing block for connecting the sealing chamber with an inlet port on the other side of the pump.

Figure 7 is an enlarged side elevational view, with parts in vertical cross section, of the rotor and shaft unit for the pump of the invention.

Figure 8 is an end elevational view of the shaft and rotor unit of Figure 7.

Figure 9 is an outer end elevational view of a vane for the pump.

Figure 10 is a side elevational view of the grooved side of the vane.

Figure 11 is an enlarged vertical cross-sectional view of the shiftable bearing block for the pump.

Figure 12 is a diagrammatic fragmentary view illustrating forces on the vane when the grooved face thereof is on the leading side of the vane.

Figure 13 is a view similar to Figure 12 but illustrating the forces on the vane when the grooved face of the vane is on the trailing side.

As shown on the drawings:

The pump **10** shown in Figures 1 to 4 has a casing **11** with a generally cylindrical portion **11***a* extending to a radial flange **11***b* and a rounded cylindrical nose **11***c* projecting from the central portion of the opposite face of the flange. The casing **11** has a cylindrical bore **12** extending inwardly from the rear face thereof through the portion **11***a* to a shoulder **13**. A smaller diameter bore **14** extends from the inner end of the shoulder **13** through the portion **11***c* of the housing to a shoulder **15**. A still smaller diameter bore **16** extends from the shoulder **15** through the front end face of the housing portion **11***c*. A groove **17** is formed in the bore **12** adjacent the rear end face of the portion **11***a* of the casing.

The casing, as best shown in Figures 2 and 4, has bosses **11***d* and **11***e* extending radially outward from the casing portion **11***a* and terminating flush with the outer face of the flange **11***b*. These bosses **11***d* and **11***e* provide ports **8** and **9** which extend radially through the bosses and communicate at their inner ends with recesses **8***a* and **9***a* respectively formed in the bore **12** and having the configuration shown in Figure 2. As will be hereinafter more fully described, these recesses **8***a* and **9***a* communicate with the pumping chamber of the pump.

As best shown in Figure 3, the pump includes a unitary shaft and rotor **18**, a seal assembly **19**, a front end bearing block **20**, a liner **21**, vanes **22** in the rotor, pins **23** acting on the inner ends of the vanes, a rear end bearing block **24**, a locking pin **25**, a spring **26** acting on the bearing block **24**, a cover **27**, and a retainer **28**.

As best shown in Figure 7, the shaft and rotor unit **18** includes an elongated shaft portion **18***a*, a larger diameter circular block portion **18***b*, and a shorter shaft portion **18***c*. The shaft portions **18***a* and **18***c* are in axial alignment. The outer end of the shaft portion **18***a* has a key slot **29** therein for coupling with a driver (not shown).

The block portion **18***b* constitutes a rotor for the pump and has a circular outer periphery **30** of materially larger diameter than the shafts **18***a* and **18***c* together with flat side faces including a front side face **31** and a rear side face **32**. Radial slots **33** extend inwardly from the periphery **30** and are cut through the side faces **31** and **32**. As best shown in Figure 8, four slots **33** are provided and each of these slots terminates at a flat bottom **33***a* spaced radially outward from the shaft **18***a*. The slots **33** are easily cut since they extend through the faces **31** and **32** and the entire unit **18** can be formed by inexpensive machining operations. For example the slots **33** can be cut with a grinder, a milling cutter, or a shaper.

Small diameter holes **34** are formed through the body of the rotor **18***b* and connect the bottoms **33***a* of diametrically opposed slots **33**. These holes **34** slidably receive pins **23** mentioned hereinabove.

A vane or blade **22** is slidably mounted in each slot **33**. As best shown in Figures 9 and 10, these vanes **22** are of generally rectangular configuration for sliding fit in the grooves, and have end edges terminating flush with the faces **31** and **32** of the rotor **18***b*. The outer end **22***a* of each blade has a rounded, preferable fragmental cylindrical surface so that the blade will have line contact only with the liner and will have the major porton of its end face spaced from the liner even when in line contact therewith. One side face of the blade has grooves **22***b* connecting the rounded outer end face **22***a* with the flat inner end face **22***c*. These grooves **22***b* serve to vent the blind bottoms of the slots **33** with the pumping chamber of the pump as will more fully hereinafter be described. The pins **23** in the holes **34** thrust against the inner faces **22***c* of the blades.

The seal assembly **19** shown in Figure 3 includes a metal cup member **35** seated in the bore **14** of the casing **11** and having a flange bottomed on the shoulder **15**. A sealing washer **36** composed of felt, rubber, or the like fits in the cup **35** against the flange thereof and receives therein the reduced diameter portion of a sealing ring **37** which slides in the cup **35** and receives the shaft **18***a* freely therethrough. This seal ring **37** has a raised end face **37***a* urged by the resilient washer **36** against the face of a coacting seal ring **38** which is pressed on the shaft **18***a*. The seal assembly **19** seals a chamber **39** in the bore **14**.

The front end bearing block **20** is seated in the bore **12** against the shoulder **13** and rotatably supports the shaft **18***a*. This block **20** has a cylindrical bore **20***a* therethrough providing a radial bearing for the shaft **18***a* and a flat end face **20***b* providing a thrust bearing for the front side face **31** of the rotor **18***b*, as best shown in Figure 11.

A slot **40**, shown in Figures 3, 5, 6 and 11, is provided in the peripheral portion of the block **20** and extends circumferentially of the block as best illustrated in Figures 5 and 6. A bore **41** extends radially inward of the peripheral portion of the block **20** through the slot **40** to a shoulder **42**. A passageway **43** connects the bore **41** with the sealed chamber **39**. A ball **44** is bottomed by a spring **45** on the shoulder **42** to close the passageway **43**. The spring **45** is bottomed on the wall of the bore **12** of the casing and coacts with the ball **44** to provide a check valve preventing flow from the slot **40** to the chamber **39** but permitting flow from the chamber **39** to the slot **40** whenever the pressure differential between the

chamber 39 and slot 40 is sufficiently great to overcome the load of the spring.

As illustrated in Figures 5 and 6, the slot 40 is adapted to communicate with either the recess 8a or the recess 9a depending upon the position of the bearing block 20. This bearing block 20 has a pair of holes 46 drilled therethrough for receiving the locking pin 25. Since the slot 40 should communicate with the intake port to drain the seal chamber 39, the bearing block 20 is positioned either as shown in Figure 5 or in Figure 6, depending upon the direction in which the pump is to be rotated. If the pump is rotated in a direction so that the port 8 becomes the inlet port, the slot 40 will register with the recess 8a as shown in Figure 5. If, on the other hand, the port 9 is the inlet port, because of opposite rotation of the pump, the bearing block 20 will be shifted to receive the pin 25 in the other hole 46 thereof so that the slot 40 will communicate with the recess 9a. In this manner the sealed chamber 39 is always vented to the inlet port and fluid leaking into the chamber is fed back into the pump.

The pump liner 21 has a cylindrical outer periphery for snugly fitting the bore 12, and an inner periphery defining a pump bore. One face of the liner 21 is bottomed against the face 20b of the bearing block 20. The other face of the liner receives the bearing block 24 thereagainst. The liner has a single hole 47 for receiving the pin 25 therethrough.

The bearing block 24, like the block 20, snugly fits in the bore 12 and has a bore 24a therethrough affording a radial bearing for the shaft portion 18c together with an end face 24b affording a thrust bearing for the rotor face 32. A single hole 48 is drilled through the block 24 to register with the hole 47 for receiving the locking pin 25. As shown in Figure 3, this locking pin 25 extends into a well 49 communicating with the shoulder 13 of the casing.

The spring 26 acts on the bearing block 24 and is centered around a collar portion of this block. The spring is bottomed on the end cover 27 which snugly fits in the bore 12 of the casing and has a sealing gasket or ring 50 therearound for sealing engagement with the bearing block 24. The retainer ring 28 is seated in the groove 17 and can be sprung out of the groove to permit access to the interior of the housing. The pin 25 is retractable from the holes in which it is seated so that the bearing block 20 can be shifted in accordance with the desired direction of rotation of the rotor.

The liner 21, best shown in Figure 4, has passageways 51 and 52 therethrough aligned with the recesses 8a and 9a for joining the ports 8 and 9 with the pumping chamber C. The rotor 18b is eccentrically disposed in the bore of the liner as shown. The height or length of two blades 22 plus the length of one pin 23 plus the desired clearance is equal to the bore diameter of the liner. The pins 23 hold the blades 22 against the liner to produce the operating effect of through-rotor blades or vanes without the attendant disadvantages of such through blades or vanes.

As best illustrated in Figures 12 and 13 the grooves 22b on the side face of the blade 22 can either be on the leading or trailing side of the blades. In Figure 12, the grooves 22b are on the leading side of the blade and the closed end of the rotor slot 33 is thereby vented to the pressure side of the pump. Therefore pump pressure acts on the inner face 22c of the blade forcing the blade outwardly against the liner 21. This outward force is resisted by the component of inward force created by pump pressure acting on the rounded face 22a of the blade. One-half of this face is exposed to pump pressure since the blade rides on the liner along a line midway between its front and rear faces. Therefore when the blade is arranged as shown in Figure 12, the centrifugal force effect of holding the blade against the liner is assisted by pump pressure equivalent to the force exerted by the pump pressure on the full inner edge 22c of the blade minus the pump pressure exerted on one-half of the outer face 22a of the blade.

As illustrated in Figure 13, when the grooves 22b are on the trailing side of the blade, the blind end of the slot 33 is vented to inlet pressure, and, since this inlet pressure is usually a negative pressure, or suction, there is a tendency for the blade to be drawn into the blind end of the slot. This tendency, of course, is resisted by centrifugal force and also by the pin 23 whenever the blade engages the pin. The arrangement of Figure 13 reduces blade liner contact pressure, while the arrangement of Figure 12 increases this pressure. Since the rotor slots 33 have blind bottoms 33a, discharge pressure on the outer ends 22a of the blades is not transmitted to the inner ends of the opposite blades on the intake side of the pump. This eliminates heretofore-encountered severe liner wear around the intake side of the liner.

Since the blind inner ends of the slots 33 are vented through the grooves 22b with the pumping chamber, fluid trapped in the slots is fed to and from the pumping chamber C in accordance with the shifting movements of the blades to occupy the volume occupied in the pumping chamber by the extended ends of the blades. This feature eliminates pulsation, and is highly desirable.

From the above descriptions it should be understood that the invention provides an inexpensive vane-type pump adapted for clockwise or counterclockwise rotation and having a shiftable bearing block for selectively venting a sealing chamber to the intake port of the pump together with a peripherally slotted rotor carrying blade-actuating pins and equipped with grooved blades to vent the blind ends of the slots.

It will, of course, be understood that various details of construction may be varied through a wide range without departing from the principles of this invention and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

We claim as our invention:

1. A rotary vane pump comprising a casing having a stepped bore therethrough with longitudinally spaced first and second shoulders between the bores, a seal assembly in one bore bottomed on the first shoulder, a rotor unit having a rotor block in another bore and a first shaft portion extending therefrom through the seal assembly together with a second shaft portion extending in the opposite direction, a seal on said shaft coacting with said seal assembly to form in said one bore a sealed chamber, a first bearing block bottomed on said second shoulder and rotatably supporting said first shaft portion, a second bearing block in said another bore rotatably supporting said second shaft portion, a

liner between said bearing blocks surrounding said rotor block and coacting therewith to define a pumping chamber, a removable end cap closing said another bore, a spring compressed between said end cap and said second bearing block urging the bearing block against the liner, said rotor having a plurality of open-sided vane slots having the open sides closed by the bearing blocks, vanes slidable in said slots, said casing having interchangeable inlet and outlet ports, means providing a passageway through the first bearing block communicating at one end with the sealed chamber, and means for locking the first bearing block in selected positions in said casing to join the other end of said passageway only with the port selected for the inlet port.

2. A rotary vane type pump comprising a casing having a first chamber extending inwardly from one face thereof and terminating in a shoulder together with a second chamber beyond said shoulder, a vane rotor in said first chamber having one shaft portion extending through said second chamber and another shaft portion extending in the oposite direction in said first chamber, a seal assembly in said second chamber surrounding said one shaft portion therein and coacting therewith for sealing the second chamber, opposed bearing blocks in said first chamber receiving said shaft portions and forming thrust faces for the sides of the rotor, one of said bearing blocks being bottomed on said shoulder, a liner between said bearing blocks, a cover for the open end of the first chamber, a spring interposed between the cover and the other of said bearing blocks and urging both said blocks and the interposed liner toward said shoulder, said casing having interchangeable inlet and outlet ports, said bearing block bottomed on the shoulder having a passageway connecting the sealed second chamber with a port, a spring-pressed check valve in said passageway for sealing the passageway whenever inlet port pressure is greater than the pressure in the sealed second chamber, and means for selectively angularly positioning said passaged bearing block relative to said casing to move said passageway into registration with whichever port is selected for the inlet port whereby said pump can be driven in either direction and still have the sealed chamber thereof drained into the inlet port.

3. A pump construction comprising a casing having an open end face, pump parts in said casing removable through said open end face, said parts including opposed bearing blocks and a rotor and shaft assembly rotatably mounted in said blocks with the rotor thereof between the blocks, said casing having a seal assembly therein coacting with the shaft to form a sealed chamber receiving the shaft therethrough, one of said bearing blocks having a passageway communicating with said chamber, inlet and outlet ports for said casing, said one bearing block being angularly positionable in the casing to selectively move the passageway thereof into registration with either one of said ports, and a removable pin locking both of said bearing blocks in the casing in either angular position of said one bearing block.

4. A rotary vane pump comprising an assembly composed of a rotor and shaft unit having a vaned circular block portion with shafts extending from opposite faces thereof, a liner surrounding the vaned portion of said unit, bearing blocks abutting the ends of the liner and forming radial bearings for the shafts together with thrust bearings for the rotor, and a locking pin extending through the bearing blocks and the liner, one of said bearing blocks having a pair of apertures for the locking pin to permit selective rotary displacement of said one bearing block relative to the liner and other bearing block, a casing receiving the assembly and having opposed ports, and a passageway through said one bearing block joining a chamber of the casing with one port of the casing whereby the shifting of said one bearing block as permitted by selective insertion of said locking pin into said pair of apertures will selectively connect said chamber with one or the other ports of the casing.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,002,023	Beach et al.	Aug. 29, 1911
1,245,691	Deyser	Nov. 6, 1917
1,730,145	Hildreth	Oct. 1, 1929
1,816,508	Wilsey	July 28, 1931
1,898,914	Vickers	Feb. 21, 1933
2,037,894	Grisell	Apr. 21, 1936
2,210,152	Sacha	Aug. 6, 1940
2,260,809	Johnson	Oct. 28, 1941
2,312,891	Ferris	Mar. 2, 1943
2,335,284	Kendrick	Nov. 30, 1943

FOREIGN PATENTS

Number	Country	Date
215,659	Great Britain	May 15, 1924
417,348	Great Britain	Oct. 3, 1934
433,488	Great Britain	Aug. 15, 1935
543,037	France	May 26, 1922