Aug. 13, 1940. C. BLOM ET AL 2,211,316

WET TYPE GAS PUMP

Filed Feb. 21, 1936 3 Sheets-Sheet 1

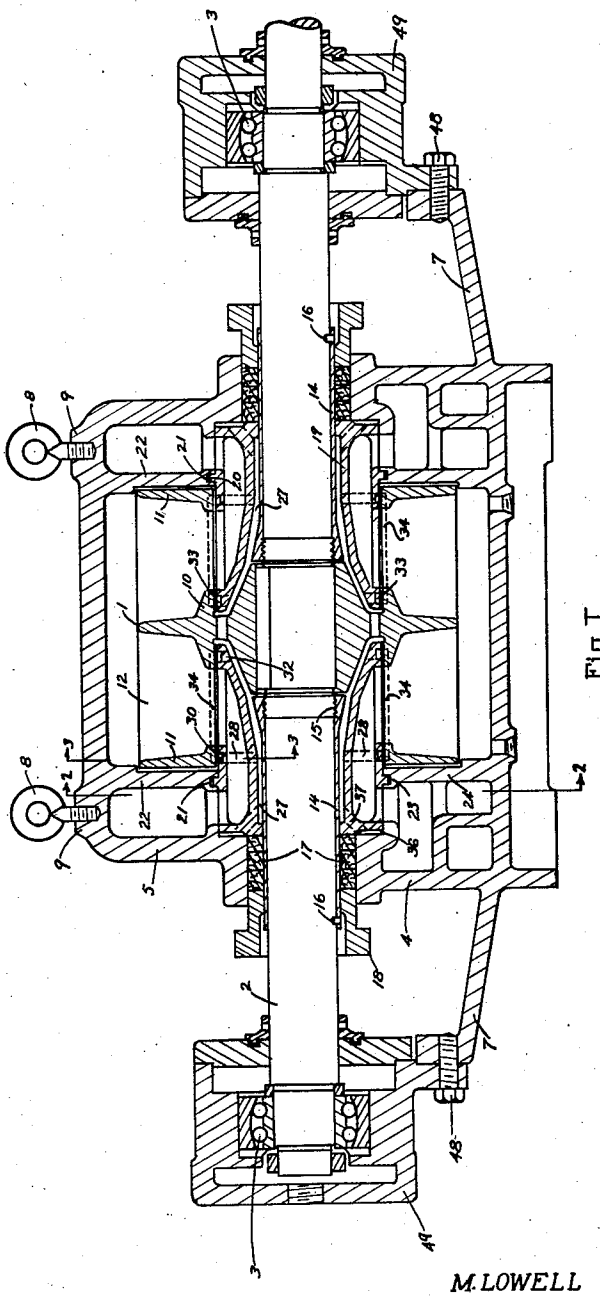


Fig. I

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WET TYPE GAS PUMP

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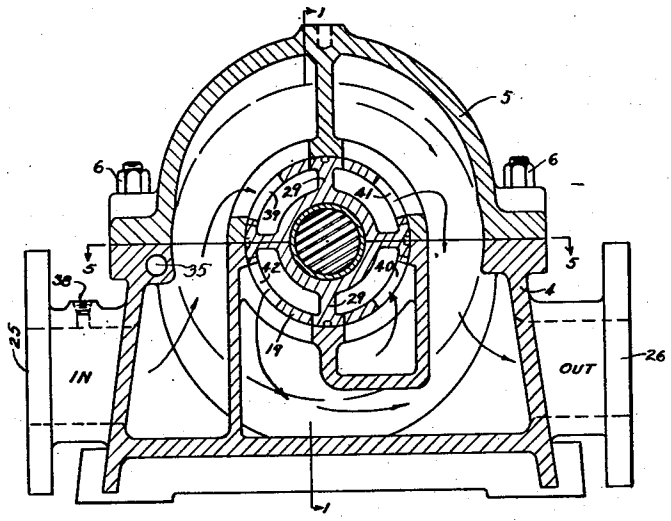


Fig. II

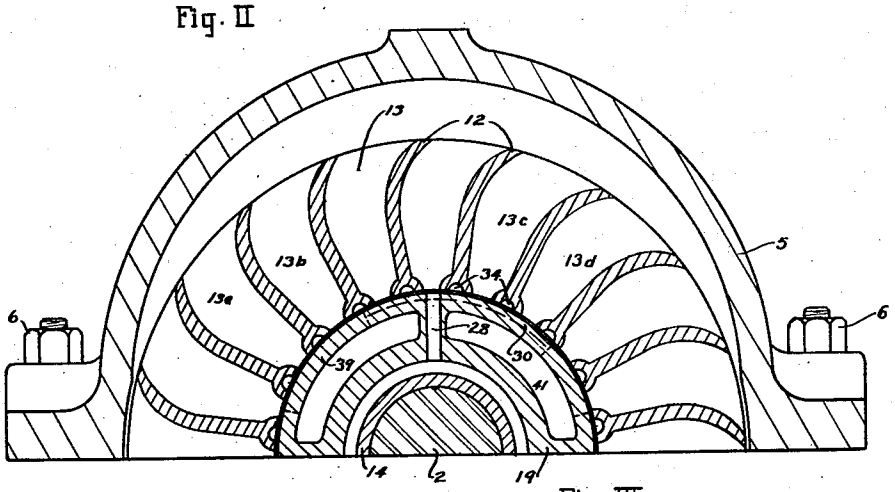


Fig. III

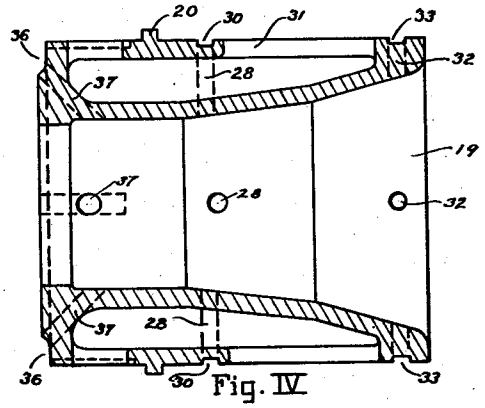


Fig. IV

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WET TYPE GAS PUMP

Filed Feb. 21, 1936 3 Sheets-Sheet 3

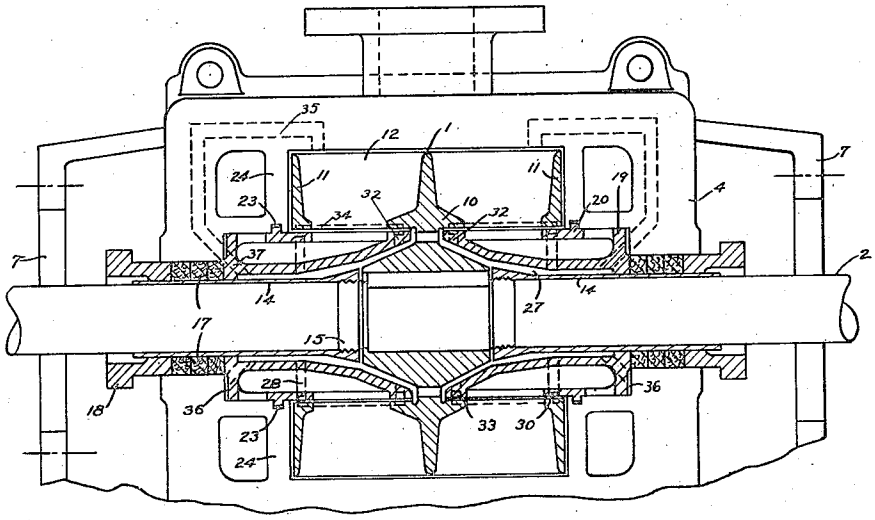


Fig. V

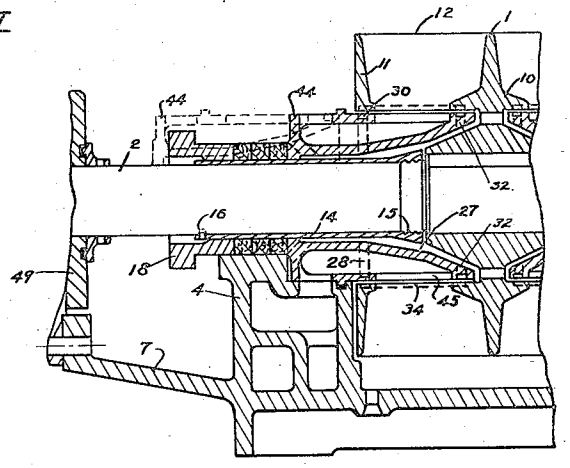


Fig. VII

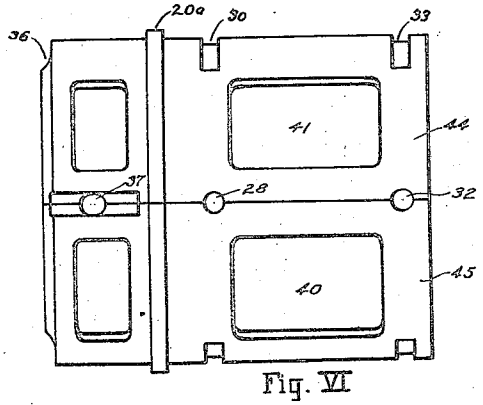


Fig. VI

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UNITED STATES PATENT OFFICE

2,211,316

WET TYPE GAS PUMP

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Application February 21, 1936, Serial No. 65,087

14 Claims. (Cl. 230—79)

This invention relates to pumps of the rotary liquid piston type, and particularly to vacuum pumps and gas compressors which employ a rotor in combination with an endless revolving liquid body, and in which the liquid alternately enters and recedes from a series of displacement chambers in the rotor due to the influence of the elliptical shape of the pump casing.

Pumps of this character, employing a construction wherein the rotor is journaled on a port member or port members, the rotor being provided with openings in the bottom of the displacement chambers which cooperate with ports in the port members, are old in the art. However, for the purpose of illustrating the manifold benefits of the invention herein disclosed, it may be said that one of the chief difficulties now encountered in the use of such pumps is the necessity for completely dismantling the pump to inspect its interior or to repair or replace any of its working parts. The dismantling of the pump requires an appreciable amount of space at one end of the unit, which may be had either by removal of the pump motor or the provision of suitable space adjacent the end of the pump opposite the motor. This space is required for the reason that after the casing heads are removed the working parts of the pump must be moved axially until they are clear of the casing before they can be lifted away. This procedure also involves the objectionable feature of dismantling the supporting bearings and exposing them to dirt and foreign matter, as well as impairing the machined fit between the bearing and the shaft resulting from repeated removal and replacement of the bearing. The dismantling of a pump is a tedious and time consuming task, and not only requires the services of a number of workmen, but also involves costly interruptions of manufacturing processes.

On the other hand, applicants' invention provides a novel construction and arrangement of parts, of which an essential feature is a pump casing employing a removable cover section. Such construction permits inspection of the working parts of the pump merely by removing the cover section; and the repair and replacement of parts without the necessity for more than the overhead space required to lift the parts out of the exposed casing. Also, in applicants' construction the shaft bearings are contained within bearing housings which are removably secured to supporting brackets. It is unnecessary, therefore, to dismantle the bearings or to unnecessarily expose them to dirt or foreign matter, or to destroy the machined bearing seat, to inspect the interior of the pump or remove any of the working parts from the casing, the bearing housings and rotating elements being movable as a unit.

A feature of the invention which makes possible the split casing referred to above is the novel construction of the separate port members. These may embody either a unitary or sectional construction, and port members embodying the latter construction may be removed from the pump without removing the rotating elements or disturbing the supporting bearings. The port members have a very slight running clearance relative to the rotor, and cooperate to supply sealing water directly to relatively moving parts of the pump in such manner that the water is supplied thereto when such parts present contiguous surfaces, and the supply of water ceases when the surfaces of such parts are not contiguous.

It is an object of the invention to provide a pump of the character described which embodies means to permit inspection of the working parts thereof without completely dismantling the pump.

A further object of the invention is to provide an improved construction in such pumps by means of which the pump may be opened up for inspection without removing the working parts from their operating positions.

A further object of the invention is to provide an improved construction in such pumps by means of which the interior of the pump may be inspected and the port members removed therefrom without removing the rotating elements or dismantling the supporting bearings.

A further object of the invention is to provide a pump of the character described employing a construction embodying a replaceable port member which may be renewed to restore clearances after wear has taken place.

A further object of the invention is to provide novel means for introducing sealing water between the relatively moving parts of the pump.

A further object of the invention is to provide a pump of the character described in which the centrifugal force exerted by rotation of the liquid piston may be utilized to supply water under sufficient pressure to seal the clearances between relatively moving parts of the pump.

A further object of the invention is to provide a pump of the character described, which is easily assembled and disassembled, thus requiring a

minimum expenditure of time and labor for inspection and maintenance.

With these and other objects in view, the invention resides in the novel construction and combination of parts hereinafter described, illustrated in the accompanying drawings and set forth in the appended claims; it being understood that various changes in form, proportion, size and details of construction within the scope of the claims may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

In the drawings:

Figure I is a sectional side elevation of a wet type gas pump taken on the line 1—1 of Figure II which embodies the principles of the present invention.

Figure II is a sectional end elevation of the pump taken on the line 2—2 of Figure I.

Figure III is a fragmentary end elevation of the pump taken on the line 3—3 of Figure I.

Figure IV is an enlarged sectional elevation of one of the port members.

Figure V is a sectional plan view of the pump taken on the line 5—5 of Figure II, particularly illustrating the passages for conducting water from the piston chamber to the rotor vanes.

Figure VI is a side elevation illustrating an alternative form of construction of the port members.

Figure VII is a fragmentary side elevation of the pump, partly in section, illustrating the method of removing the sectional port members from the pump.

Referring to the drawings, the illustrated embodiment of the invention comprises a pump of the type employing water or other liquid as the pumping medium and in which the water alternately enters and recedes from a series of displacement chambers in a revolving rotor within an eccentric casing.

Referring more particularly to Figure I, the pump is illustrated as having a rotor 1 mounted upon a shaft 2 which is journaled in anti-friction bearings 3—3. The rotor 1 revolves within a casing of elliptical cross section which is made up of a bottom section 4 and a cover section 5, the casing being split in a plane intersecting the center of the rotating element, preferably horizontally, and the cover section 5 thereof being secured to the bottom section 4 by bolts or cap screws 6, as best seen in Figure II. Brackets 7 are formed integral with the bottom section 4 of the casing and support the anti-friction bearings 3—3. A pair of eye bolts 8—8 are threaded into bosses 9—9 of the cover section 5 to facilitate lifting and replacing the cover section.

The rotor 1 comprises a hub portion 10 keyed to the shaft 2. Shrouds or annular plates 11—11 extend outwardly from the hub portion, between which extend a plurality of blades or vanes 12 to form a series of displacement chambers 13. The rotor is positively driven by a motor or other suitable source of power through the medium of the shaft 2. The rotor 1 is preferably of a cylindrical shape and rotates within a compartment or chamber in the casing closely fitting the rotor at the two sides thereof, as shown in Figure II, and being spaced therefrom to form lobes above and below the rotor, as seen in Figure I. The pump casing is partly filled with liquid and the rotor is driven at high speed. The liquid in the casing will travel around with the rotor, and the centrifugal force and inertia of the liquid will cause it to follow the contour of the casing. By this arrangement, the liquid will enter and recede from each displacement chamber and act in effect as a liquid piston therein.

A pair of shaft sleeves 14—14 are disposed upon the shaft 2, one at each end of the hub 10 of the rotor. Each sleeve 14 is threaded onto the shaft 2 as at 15, whereby it may be threaded into abutting relation with a face of the hub 10, the opposite end of the sleeve being engageable by a wrench to turn the sleeve on the threaded portion of the shaft 2. By adjusting the shaft sleeves 14 with relation to the threaded portion of the shaft 2, the rotor 1 may be adjusted longitudinally of the shaft to cause it to assume a proper position with respect to the piston chamber. Set screws 16—16 prevent the sleeves from backing away from the rotor hub 10 during operation of the pump. Packing 17—17 and packing gland 18—18 form the usual stuffing boxes. The end of each shaft sleeve 14 extends through the stuffing box so that it may be engaged to adjust the position of the rotor without removing the cover section of the casing.

Cylindrical port members 19—19 are mounted within the casing concentrically with the shaft 2 and engage cylindrical recesses in the opposite faces of the rotor 1. Unlike constructions heretofore in use, applicants' separate port members are enclosed entirely within the pump casing. An annular tongue 20 encircles each of the port members 19 intermediate its length and engages a groove 21 milled in partitions 22—22 of the cover section 5 of the casing, and a groove 23 milled in partitions 24—24 of the bottom section 4 of the casing, to position the port member with respect to the rotor 1.

The port members 19—19 are designed to have a very slight running clearance with respect to the rotor 1. A space is provided between the end of each port member and the rotor hub 10, and this space forms a continuation of an annular passage 27 extending between each port member and each shaft sleeve 14. Passages 28 are drilled through partitions 29 of each port member 19 and connect the passage 27 with a sectional annular groove 30 milled in the peripheral wall 31 of each port member. A like number of passages 32 are drilled through the inner end portion of each port member 19 to connect the passage 27 with a second sectional annular groove 33 milled in the peripheral wall 31. The sectional grooves 30 and 33 are parallel, and are spaced apart a little more than the length of the port openings which communicate with the displacement chambers of the rotor. These grooves 30 and 33 are interrupted where otherwise they would parallel the port openings, so that, in fact, each is made up of a series of disconnected grooves in the peripheral wall of each port member between the port openings. The passages 28 and 32, which connect the passage 27 with these sectional grooves 30 and 33, are plural in number, there being one passage 28 for each section of the groove 30, and one passage 32 for each section of the groove 33. These grooves 30 and 33 are designed to communicate with grooves 34 in the inner face of each of the rotor vanes 12. The groove 30 is so positioned that upon rotation of the rotor it will communicate with the outer end of the grooves 34 in the rotor vanes 12, and the groove 33 is so positioned that it communicates with the inner ends of the grooves 34 in the rotor vanes. Due to differences in pressure between adjacent displacement chambers, it will be appreciated that the gases contained in the

displacement chambers 13c and 13d will tend to leak back into oncoming displacement chambers through the clearances between the rotor vanes and the peripheral wall of the port member. It is to prevent this leakage between displacement chambers of the gases being pumped, which would materially reduce the efficiency of the pump, that sealing water is delivered to these clearances under pressure.

Water to seal the clearances between the rotor and the port members may be admitted to the pump through an intake port communicating with the usual water supply mains, or, as in the illustrated device, a portion of the water forming the liquid piston may be conducted to the annular passage 27 by means of passages communicating with the piston chamber of the pump. It has been found that the pressure exerted by the liquid piston is greater adjacent the discharge ports of the port members than the pressure adjacent the intake ports. For this reason, the passage 35, which conducts water from the piston chamber to the annular passage 27 connects with the piston chamber at a point opposite the outlet port in the port member in order to command the maximum available pressure for the sealing water. The passage 35 communicates with an annular recess 36 in the end face of the port member, to which water is delivered from the piston chamber, and which serves to distribute the water evenly to each of a series of channels 37 and into the annular passage 27.

From the annular passage 27 the water is forced through the passages 28 and 32 into the sectional annular grooves 30 and 33. As the rotor 1 is rotated, the vanes 12 revolve about the port members 19 in rapid succession, their travel being alternately over the surface of the peripheral wall 31 and over the port openings which register with the openings in the bottom of each displacement chamber 13. As each vane 12 passes over the surface of the port member between port openings, the ends of the groove 34 are brought into communication with the grooves 30 and 33, and sealing water is forced into the groove 34 under pressure sufficient to form a seal between the vanes and the peripheral wall of the port member. When the vanes 12 reach the port openings, the grooves 34 no longer communicate with the grooves 30 and 33 and the supply of sealing water to the groove 34 is shut off. During the time the vanes 12 are passing over the port openings of the port member, the grooves 34 retain the greater part of the sealing water therein because of the centrifugal force exerted by rotation of the rotor. It is reasonable to expect, however, that a small portion of the water may be lost therefrom through the port opening. The groove is compensated for this loss immediately as the vanes and the wall of the port member again present contiguous surfaces, at which point the groove 34 again comes into communication with the parallel grooves 30 and 33. Reference is made to Figure III, wherein is illustrated the several passages 28 through the partitions 29 of the port member, and the grooves 30 with which they communicate. The relative positions of the port openings is indicated in dotted lines, the port openings being positioned between adjacent ends of the annular grooves. Sealing water is also supplied from the groove 30 to the minute clearances between the shrouds 11 of the rotor and the port member, and from the groove 33 to the clearances between the port member and the rotor hub, in each of which places it acts as a seal between the relative moving parts.

Referring to Figure VI, there is illustrated an alternative form of construction of the port members. These port members comprise a top section 44 and a bottom section 45, the two sections being held in their respective positions by means of the peripheral tongue 20a which engages the grooves 21 and 23 of the cover section 5 and the bottom section 4 of the casing, in a manner hereinbefore described. The sectional port members are removable from the pump without dismantling the pump except to remove the cover section 5 of the casing. The removal of the cover section of the casing, which is accomplished in an obvious manner, disengages the tongue 20a from the groove 21, whereupon the top section 44 of the port member may be moved axially to disengage the rotor 1, as illustrated in Figure VII. When the inner end of the top section 44 of the port member disengages the rotor, the section 44 may be lifted away. Thereupon the bottom section 45 of the port member may be rotated about the shaft 2 until it has assumed the position formerly occupied by the top section 44, in which position it will have disengaged the bottom section 4 of the casing, and may then be moved axially to disengage the rotor and be lifted out of the pump. Thus the port members may be removed from the pump, to be renewed to restore clearances after wear has taken place, without removing the rotating elements from the pump or dismantling the supporting bearings. To replace the port members, the procedure outlined above is reversed. The bottom section 45 of the port member is moved axially of the shaft 2 until it engages the rotor 1, and is then rotated about the shaft 2 into its proper position; and the top section 44 of the port member is moved axially of the shaft to assume its working position relative to the rotor and to the bottom section 45 of the port member. Upon replacing the cover section 5 of the casing, the pump is again ready for operation.

The pump is equipped with intake and discharge openings 25 and 26, and intake and discharge passages communicate therewith and with openings in the port members. The drawings are lettered to indicate the respective passages, the arrows indicating the direction of flow of the gases therethrough. As has been indicated, the port members 19—19 are provided with passages and port openings communicating with openings in the bottoms of the displacement chambers 13. The pump is initially partly filled with liquid which, in operation, assumes a position concentric with the casing. This liquid constitutes the piston and forms a closure for each of the displacement chambers 13. A pipe connection 38 is tapped into the piston chamber by means of which water may be admitted to the pump as needed to make up for evaporation and to replace water which has been carried away by the flow of gas through the discharge ports.

The rotor 1 is driven by the shaft in the direction of the arrow, as shown in Figure II. As the liquid piston revolves with respect to the casing it will alternately approach and recede from the center or hub of the rotor, thus forming enlarging and contracting spaces in the displacement chambers 13. The gases to be pumped will enter the displacement chambers by way of the intake port 25 and communicating ports 39 and 40 of the port members, and are discharged from the displacement chambers by way of ports 41 and

42 of the port member which communicate with the discharge port 26. As the liquid piston begins to recede centrifugally from the displacement chambers 13a and 13b, the gases to be pumped are drawn into these chambers through the intake ports 38 and 40. After the openings in the bottom of the displacement chambers have passed out of communication with these ports, the casing wall begins to converge toward the rotor, causing the liquid piston to approach the center of the rotor to compress the gases in the displacement chambers. The displacement of the gases attains its maximum as the displacement chambers reach the horizontal center line of the casing, at which point the liquid piston completely fills the displacement chambers. As the displacement chambers pass over the ports 41 and 42 the gases therein are forced through these ports by the liquid piston until the displacement chambers are completely exhausted of the gases acted upon by the pump.

Inspection of the interior of the pump may be made by removing the bolts or cap screws 6 and lifting off the cover section 5 of the casing, without the necessity of breaking the intake or discharge pipe connections or dismantling any of the working parts of the pump. Should it be desired to remove the rotating elements from the pump, this may be accomplished by removing cap screws 48—48 which secure bearing housings 49—49 to the brackets 7 and lifting the shaft and rotating elements, complete with bearing housings, from the casing as a unit. These parts may then be conveyed to a place suitable for further dismantling operations and, if required, the bearing housings 49 may then be opened and the bearings removed therefrom.

Although there is shown and described herein a preferred embodiment of the invention, its application is not necessarily confined thereto, but may be used either in its entirety or in part, and either with or without modifications, without departing from the spirit of the invention. For example, it is not intended to limit the application of the present invention to a particular form of construction or arrangement of parts, these being considered as suggestive only, and we deem ourselves entitled to all such uses, modifications and variations thereof as may be included within the spirit and scope of the appended claims.

Having now described our invention and in what manner the same may be used, what we claim as new and desire to protect by Letters Patent is:

1. In a wet type gas pump, a casing having a peripheral groove on the interior thereof, a rotor mounted within said casing, port members having inlet and outlet ports communicating with said rotor, each port member having an annular tongue engaging said groove to position said port member relative to said rotor.

2. In a wet type gas pump, a casing for said pump comprising a bottom section and a cover section, the cover section being removably secured to said bottom section, a rotor mounted within said casing, a sectional port member engaging said rotor and having inlet and outlet ports comunicating therewith, each section of said port member being movable axially to disengage said rotor whereby said section may be removed from said pump.

3. In a wet type gas pump, a casing for said pump comprising a bottom section and a cover section, the cover section being removably secured to said bottom section, a rotor mounted within said casing, a sectional port member engaging said rotor and having inlet and outlet ports communicating therewith, said port member having peripheral means releasably engaging said casing to position said port member in said pump, each section of said port member being movable axially to disengage said rotor upon removal of the cover section of said casing whereby said section may be removed from said pump.

4. In a wet type gas pump, a rotor, port members extending into the sides of said rotor and having inlet and outlet ports communicating with said rotor, and a split casing completely housing said rotor and port members, said port members freely engaging the component parts of said casing.

5. In a wet type gas pump, a casing for said pump comprising a bottom section and a cover section, the cover section being removably secured to said bottom section, a rotor mounted within said casing, and port members extending into the sides of said rotor and having inlet and outlet ports communicating with said rotor, said port members freely engaging said casing.

6. In a wet type gas pump, a casing for said pump comprising a bottom section and a cover section, the cover section being removably secured to said bottom section, a rotor, and port members extending into the sides of said rotor and having inlet and outlet ports communicting therewith, said rotor and port members being mounted entirely within said casing, said port members freely engaging said rotor and said casing.

7. In a wet type gas pump, a casing for said pump, a rotor mounted within said casing, and port members mounted within said casing and extending into the sides of said rotor and having inlet and outlet ports communicating therewith, said rotor and port members freely engaging said casing.

8. In a wet type gas pump, a casing, a rotor, and port members extending into the sides of said rotor and having inlet and outlet ports communicating therewith, said rotor and port members being mounted entirely within said casing, each port member having positioning means freely engaging said casing to position said port member relative to said rotor.

9. In a wet type gas pump, a casing for said pump, a rotor mounted within said casing, port members extending into the sides of said rotor and having inlet and outlet ports communicating therewith, each of said port members having peripheral means freely engaging said casing to position said port member relative to said rotor.

10. In a wet type gas pump, a rotor, port members extending into the sides of said rotor and having inlet and outlet ports communicating with said rotor, and a split casing completely housing said rotor and said port members, said casing being split in a plane parallel to the longitudinal axes of said rotor and port members.

11. In a wet type gas pump, a casing for said pump comprising a bottom section and a cover section, the cover section being removably secured to said bottom section, a rotor, and port members extending into the sides of said rotor and having inlet and outlet ports communicating therewith, said rotor and port members being mounted entirely within said casing.

12. In a wet type gas pump employing a liquid piston, a casing, a rotor mounted therein and having a multiplicity of vanes defining a plurality of displacement chambers, each of said

vanes having a groove in its inner face, the groove and face of each vane lying parallel to the axis of rotation, a cylindrical port member extending into the sides of said rotor and having inlet and outlet ports communicating with said rotor, means to conduct sealing water to a passage interiorly of said port member, and passages extending through the wall of said port member for directing sealing water from said first named passage directly into each extreme end portion of one of said grooves whereby equal pressure is maintained throughout the length of said groove.

13. In a wet type gas pump employing a liquid piston, a casing for said pump comprising a bottom section and a cover section, a rotor mounted therein and having a multiplicity of vanes defining a plurality of displacement chambers, each of said vanes having a groove in its inner face, the groove and face of each vane lying parallel to the axis of rotation, a sectional port member engaging said rotor and having inlet and outlet ports communicating therewith, means to conduct sealing water to a passage interiorly of said port member, and passages providing communication between said first named passages and the extreme ends of said grooves to deliver sealing water directly to each end of said grooves simultaneously.

14. In a wet type gas pump employing a liquid piston, a casing, a rotor mounted therein and having a multiplicity of vane defining a plurality of displacement chambers, each of said vanes having a groove in its inner face, the groove and face of each vane lying parallel to the axis of rotation, a port member having inlet and outlet ports communicating with said rotor, means to conduct sealing water to a passage interiorly of said port member, and means for directing sealing water from said first named passage directly to each extreme end portion of one of said grooves whereby equal pressure is maintained throughout the length of said groove.

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