

Dec. 28, 1943.

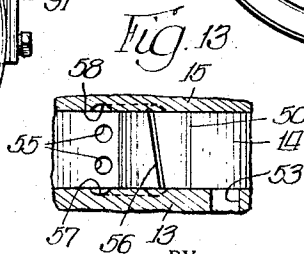
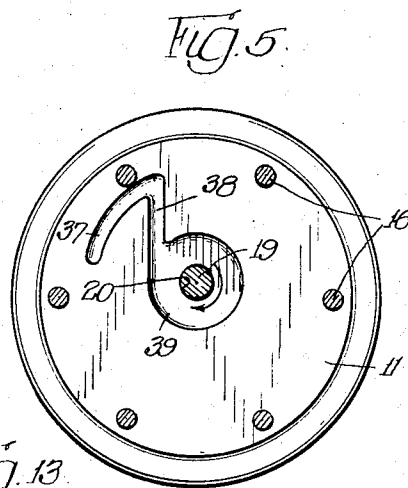
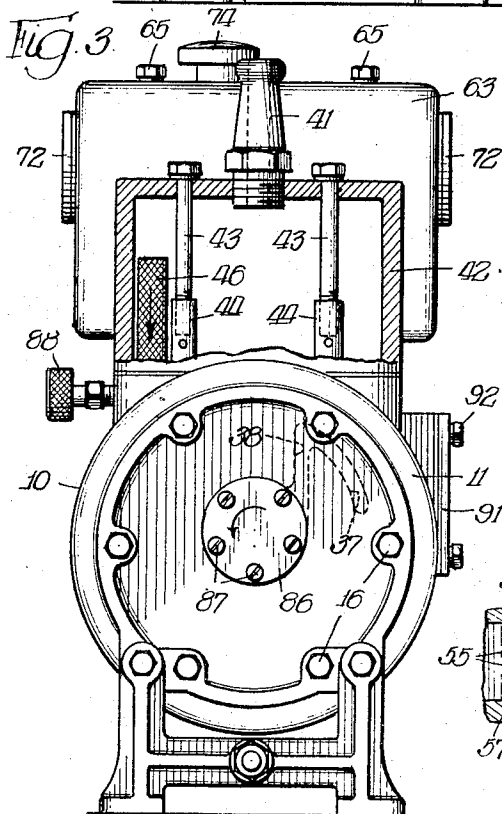
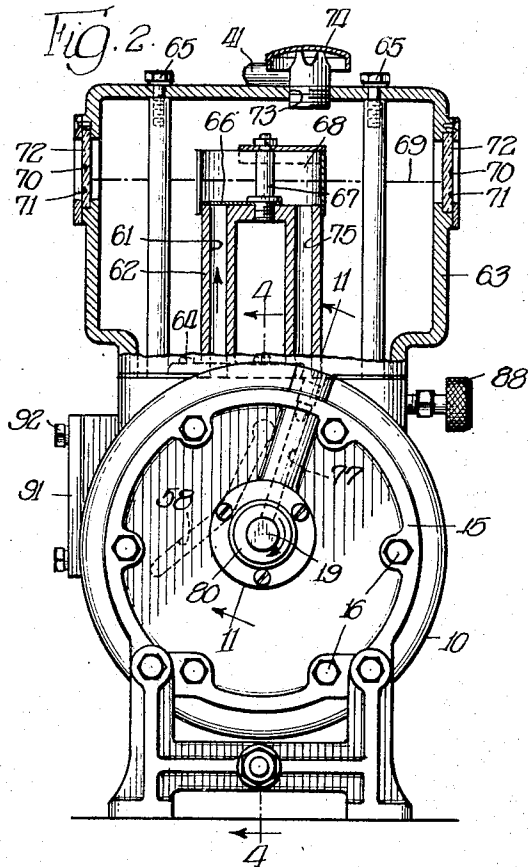
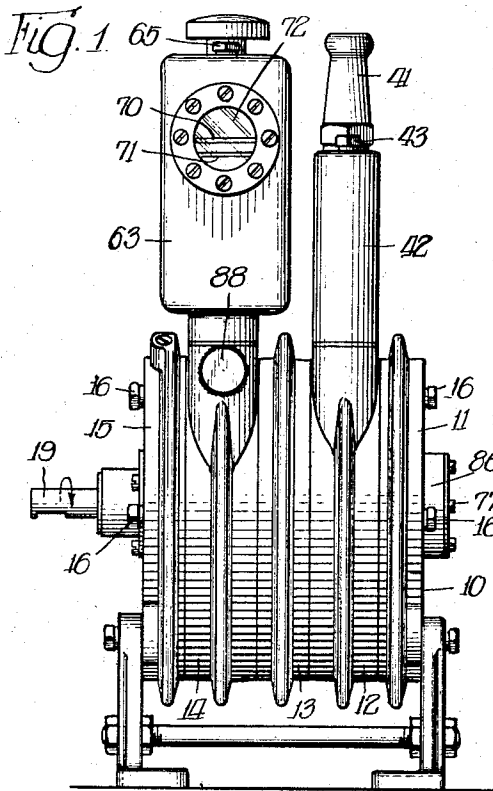
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2,337,849

VACUUM PUMP

Filed March 14, 1939

2 Sheets-Sheet 1



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VACUUM PUMP

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2 Sheets-Sheet 2

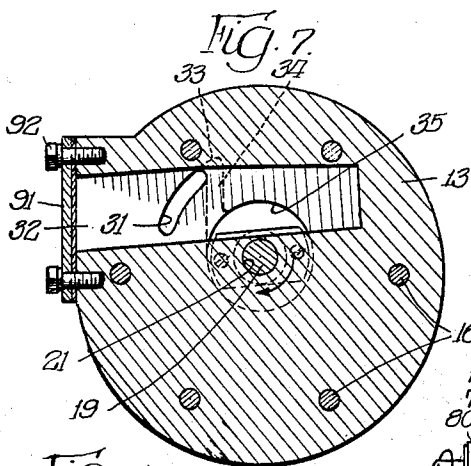
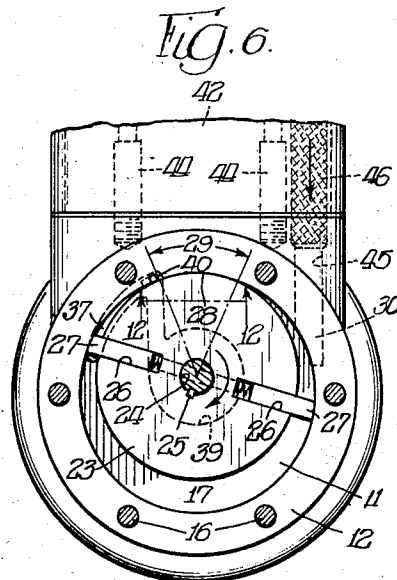
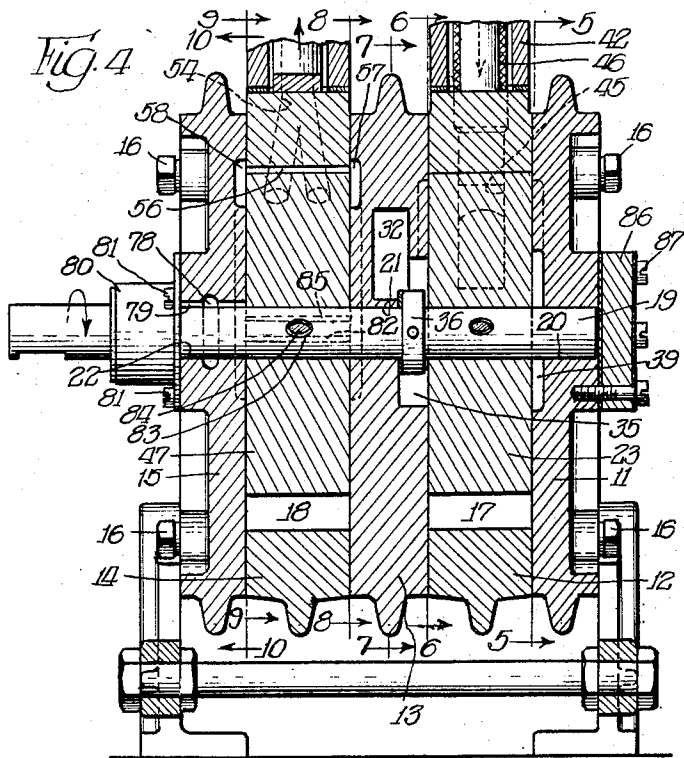


Fig. 11.

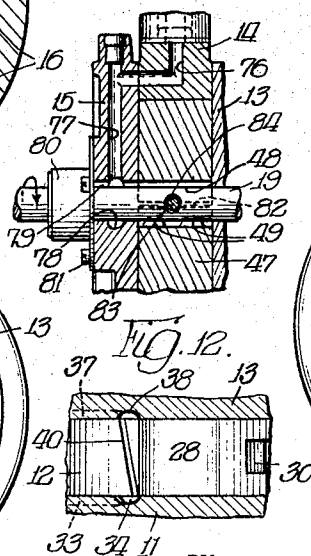


Fig. 12.

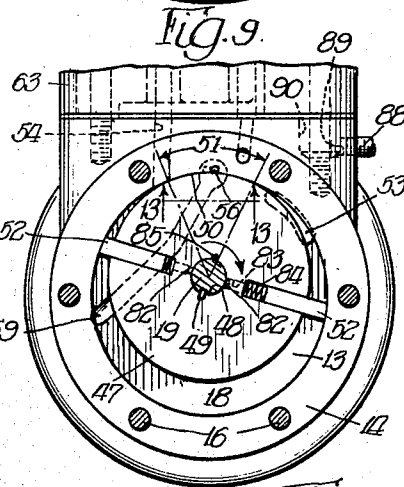
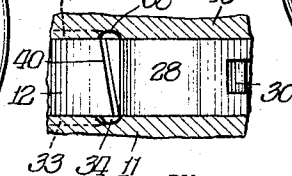
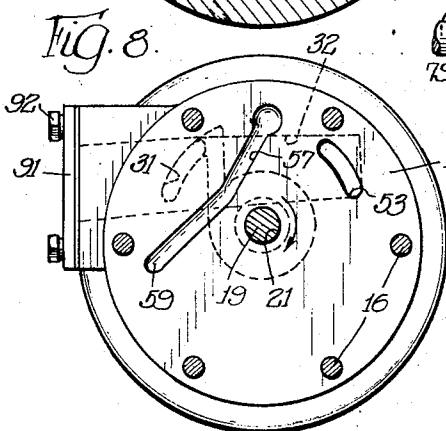
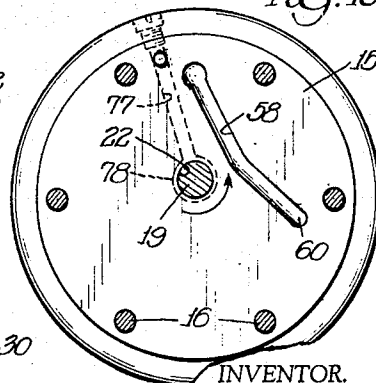


Fig. 10.



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UNITED STATES PATENT OFFICE

2,337,849

VACUUM PUMP

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Application March 14, 1939, Serial No. 261,803

12 Claims. (Cl. 230-205)

This invention has to do with rotary oil sealed vacuum pumps, such as are used in the production of extremely high vacuums, and is particularly concerned with pumps of the type wherein the rotor is provided with two or more outwardly spring-pressed vanes for sliding engagement with the surrounding wall of the stator and wherein the rotor is eccentrically mounted in the stator and turns in an arcuate seat in the latter which has the same radius of curvature as the rotor.

The purpose of the invention is to provide an improved pump of the type described which is capable of producing a higher vacuum than has heretofore been possible with other pumps of the same general type.

The improved pump is characterized, among other features, by a novel construction and arrangement of the exhaust port in the finishing stage, which insures rapid and complete evacuation of all the oil in front of the vanes as the latter approach the seat; the provision of a chamber between the finishing and roughing stages, which receives oil from the finishing stage and feeds it back to that stage for recurrent circulation; and a novel construction and arrangement of the seat in the roughing stage, which allows free flow of all excess oil back to the pumping chamber, reduces the flow of oil across the seat to the intake side of the latter, and allows the volatiles pushed into the seat to free themselves from the oil before the latter reaches the intake side. This last mentioned feature is applicable to single as well as two-stage pumps.

While the foregoing statements are indicative in a general way of the nature of the invention, other more specific objects and advantages will be apparent to those skilled in the art upon a full understanding of the novel features which form the subject matter of the invention.

A preferred embodiment of the invention is presented herein for the purpose of exemplification, but it will of course be appreciated that the invention is susceptible of incorporation in other structurally modified forms coming equally within the scope of the appended claims.

In the accompanying drawings:

Fig. 1 is a side view of a two-stage vacuum pump constructed in accordance with the invention;

Fig. 2 is a view of one end of the pump, with the main oil reservoir and the exhaust port for the roughing stage shown in section;

Fig. 3 is a view of the other end of the pump, with the housing about the inlet port for the finishing stage shown in section;

Fig. 4 is a vertical longitudinal section through the pump, taken on the line 4-4 of Fig. 2;

Figs. 5, 6, 7, 8, 9 and 10 are vertical transverse sections through the pump, taken respectively on the lines 5-5, 6-6, 7-7, 8-8, 9-9 and 10-10 of Fig. 4;

Fig. 11 is a fragmentary radial section through one end of the pump, taken on the line 11-11 of Fig. 2;

Fig. 12 is a fragmentary section, taken on the line 12-12 of Fig. 6, showing the arcuate seat for the rotor in the finishing stage; and

Fig. 13 is a fragmentary section, taken on the line 13-13 of Fig. 9, showing the arcuate seat for the rotor in the roughing stage.

The two-stage pump shown in the drawings includes a casing 10 which is composed of an end plate 11, a stator ring 12, a center plate 13, a second stator ring 14 and a second end plate 15. These parts are all tightly clamped together, in the order named, by a plurality of bolts 16, which bolts are screwed from opposite sides of the casing into the center plate 13. The stator ring 12, with the end plate 11 and center plate 13, forms the pumping chamber 17 of the finishing stage of the pump, while the stator ring 14, with the center plate 13 and end plate 15, forms the pumping chamber 18 of the roughing stage of the pump. The pump is adapted to be operated by an electric motor (not shown), through a shaft 19 which is journaled in bearing apertures 20, 21 and 22 formed respectively in the end plate 11, center plate 13 and end plate 15. The pumping chambers 17 and 18 are circular in shape, and the shaft 19 passes through both chambers at points a little above their centers.

The chamber 17 of the finishing stage contains a circular rotor 23 which is somewhat smaller in diameter than the chamber and is located in the upper portion of the latter. The shaft 19 passes through an aperture 24 in the center of the rotor 23 and is secured to the latter by one or more keys 25. The rotor 23 is provided with diametrically opposed radial slots 26 in which two outwardly spring-pressed vanes 27 are slidably mounted with their outer ends in sliding engagement at all times with the peripheral wall of the chamber 17. The upper part of the rotor 23 slidably contacts with the wall of the chamber 17 at the top of the latter, in a closely fitting arcuate seat 28 which has the same radius of curvature as the rotor and is in continuous contact therewith throughout the angle indicated by the arrow 29. The rotor 23 and the vanes 27 are of the same width as the chamber 17 and

slidingly engage at their sides with the opposed faces of the end plate 11 and center plate 13. The rotor 23, by reason of its eccentric mounting within the upper portion of the chamber 17, renders the available pumping space within the chamber crescent-shaped. This crescent-shaped pumping cavity extends from one side of the seat 28 around the rotor 23 to the other side of the seat.

An inlet port 30 is located at that side of the seat 28 from which the vanes 27 leave the seat, and an exhaust port 31 is located at that side of the seat at which the vanes enter the seat. The inlet port 30 is formed in the peripheral wall of the chamber 17, while the exhaust port 31 is formed in the face of the center plate 13 at one side of the chamber. The exhaust port 31 leads from the chamber 17 into a small center chamber 32 which is located inside of the center plate 13 at a point above the bearing aperture 21 for the shaft 19. The exhaust port also communicates, within the pumping chamber 17, with a shallow arcuate groove 33 in the face of the center plate 13, which groove extends to a point at one side of the front or high pressure edge of the seat 28 and there connects with a downwardly extending groove 34 in the face of the center plate 13, which latter groove in turn connects at its lower end with a circular cavity 35 which surrounds the shaft 19. The cavity 35 opens into the center chamber 32 and, incidentally, is made sufficiently deep to accommodate a collar 36 which is pinned to the shaft 19 to prevent endwise movement of the latter. An arcuate groove 37, similar in both size and shape to the groove 33, is located in the face of the end plate 11, directly opposite the groove 33, and connects, like the groove 33, with a downwardly extending groove 38 which terminates at its lower end in a circular cavity 39 formed in the face of the end plate 11 about the shaft 19. A narrow cross groove 40 is provided in the peripheral wall of the chamber 17, at the front edge of the sealing seat 28. This groove 40, which is set at a slight angle in order to prevent the outer edges of the vanes 27 from catching against the same, extends across the chamber from one side to the other and connects at its ends with the arcuate grooves 33 and 37, at points substantially in line with the downwardly extending grooves 34 and 38.

The vessel or other piece of equipment which is to be exhausted is connected by a suitable conduit (not shown) to a nipple 41 which is screwed into the top of a small rectangular housing 42 mounted on top of the stator ring 12. The housing 42, which is clamped tightly in place by bolts 43 which screw into studs 44 carried by the ring, provides a sealed enclosure for a passage 45 which leads downwardly and terminates in the inlet port 30. The entrance to this passage is protected by a fine wire screen 46 of tubular form.

The chamber 18 of the roughing stage of the pump contains a rotor 47 which—like the rotor 23—is provided at its center with an aperture 48 for the shaft 19, is secured to the shaft by keys 49, contacts with an arcuate seat 50 in the top of the peripheral wall of the chamber 18 through a wide angle 51, and is provided with outwardly spring-pressed vanes 52 which slidingly engage at their outer ends with the peripheral wall of the chamber and along their side edges with the side walls of the chamber.

The pumping space within the chamber 18—

like the pumping space within the chamber 17—is crescent-shaped, and extends from one side of the seat 50 around the rotor 47 to the other side of the seat. An inlet port 53 is located near the low pressure edge of the seat 50—which is the end of the seat from which the vanes leave the seat. This inlet port is formed in the face of the center plate 13 at one side of the chamber 18 and is in open communication with the center chamber 32 in that plate. An outlet port 54 is located near the high pressure edge of the seat 50—which is the end of the seat through which the vanes enter the seat. This outlet port extends upwardly through the peripheral wall of the chamber 18, at a point immediately in advance of the edge of the seat 50, and is characterized by two relatively small branch openings 55 which are arranged side by side in the wall.

A narrow cross groove 56 is formed in the arcuately extended seat 50 about midway between the high and low pressure edges of the seat. This groove, which is set at a slight angle, extends entirely across the seat from one side of the chamber to the other and connects at its ends with the upper ends of two downwardly inclined grooves 57 and 58, which latter grooves are formed opposite each other in the faces of the center plate 13 and end plate 15. The grooves 57 and 58 pass to one side of the bearing apertures 21 and 22 in the plates and terminate at points 59 and 60 within the effective pumping space of the chamber 18, which points are more than 180° removed from the inlet port 53 measured in the direction of rotation of the rotor 47, whereby one or the other of the vanes 52 will always provide a sealed partition in the chamber 18 between the inlet port 53 and the lower ends of the grooves 57 and 58 regardless of the position of the rotor.

The outlet port 54 extends upwardly from the top of the stator ring 14 into a vertically extending tube 61 formed in a fitting 62 which is located within an oil reservoir 63. The fitting 62 is secured to the top of the ring by screws 64, and the reservoir 63 is secured to the top of the ring about the fitting by bolts 65. A downwardly spring-pressed flap valve 66, in the form of a thin leaf spring, is positioned over the top of the outlet tube 61, and is held down at one end by a screw stud 67, which stud also serves to support an open-work baffle 68 in a position about the top of the fitting.

The top of the fitting 62 and the flap valve 66 at the upper end of the outlet tube 61 are adapted to be submerged in a body of oil contained within the reservoir 63. The reservoir is adapted to be filled with the oil to approximately the level indicated by the line 69 in Fig. 2, the top and bottom limits recommended for the level of the oil being indicated respectively by the marks 70 and 71 provided on glassed-in observation windows 72 mounted in the end walls of the reservoir. The reservoir is adapted to be filled with the oil through an opening 73 in the top thereof. The opening 73 is normally closed by a vented screw cap 74. The air or other gas exhausted from the vessel being operated on is forced upwardly through the outlet tube 61, raises the flap valve 66, bubbles up through the body of oil in the reservoir, and passes off into the atmosphere through the vents in the cap 74.

The oil in the reservoir, in entering the pump to lubricate the same, passes downwardly through a tube 75 in the fitting 62. The tube 75 has its

open upper end submerged in the body of oil to substantially the same depth as the flap 88, with the result that the oil used for lubricating the pump is taken from the body of oil at a point near the surface of the latter. The oil after passing downwardly through the tube 75 enters an L-shaped duct 76 formed in the upper part of the stator ring 14. From the duct 76 the oil is directed laterally and enters a downwardly inclined duct 77 in the end plate 15. The duct 77 connects at its lower end with an annular channel 78 provided in the bearing aperture 22 in the end plate 15. This channel 78 is intersected by a groove 79 which extends from the channel to the inner face of the end plate. The oil used in lubricating both stages of the pump flows along the shaft 19 through the groove 79 to the near face of the rotor 47. Escape of oil in the opposite direction along the shaft is prevented by an oil sealing unit 80 of any suitable construction which fits about the shaft on the outside of the end plate 15 and is secured to the plate by screws 81.

From the face of the rotor 47 the oil enters the roughing stage of the pump through two diametrically opposed grooves 82 in the rotor 47, which grooves momentarily register with the groove 79 in the end plate 15 during every revolution of the rotor. The grooves 82 extend from one face of the rotor to the other along the shaft and intermediate their ends intersect with radially disposed holes 83 in the rotor and shaft, which holes contain the spring means 84 employed for pressing the vanes 52 outwardly in the slots in the rotor. The holes 83 open into the bottoms of the slots and the oil upon entering these slots from the holes 83 lubricates the vanes 52, the faces of the rotor 47, and all other surfaces within the chamber 18 of the roughing stage.

The oil for the finishing stage of the pump travels from the groove 79 in the end plate 15 through a third groove 85 in the rotor 47, which latter groove, like the grooves 82 in the rotor, registers with the groove 79 during every revolution of the rotor. The groove 85 continues without interruption to the far face of the rotor 47 and there feeds its oil directly to the bearing aperture 21 in the center plate 13. This oil travels along the shaft 19, in a thin film between the shaft and the bearing aperture, enters the cavity 35 in the far face of the center plate 13, and finds its way from there to all of the working surfaces of the rotor 23 and vanes 27. The far end of the shaft 19 and the bearing aperture 20 surrounding the same in the end plate 11 are sealed off from the atmosphere by a small plate 86 which is secured to the outer face of the end plate 11 by screws 87.

The oil contained in the reservoir 63 may be drained from the same by removing a knurled screw plug 88 which is located just below the bottom of the reservoir in a threaded duct 89 which communicates with a small sump 90 in the upper portion of the stator ring 14. The oil which has accumulated in the center chamber 32 in the center plate 13 may be drained from that chamber by removing a small plate 91 at one end of the same, which plate is held in place by screws 92.

Before starting the pump the reservoir 63 is filled with a good quality of oil, to approximately the level 69. As soon as the pump is started a certain amount of this oil will immediately find its way into all the cavities of the pump, where

it will both seal and lubricate the contacting surfaces of all of the relatively movable working parts. After the pump has been run but a short time some of the oil will accumulate in the bottom of the center chamber 32, between the finishing and roughing stages, and will re-circulate from there back into the finishing stage, the only additional oil entering the finishing stage from then on being raw oil which passes directly into the same from the reservoir 63 through the enclosed duct provided by the special groove 85 in the rotor 47, without first passing through the pumping chamber of the roughing stage.

In this pump a substantial improvement resides in the provision of means for effecting quick removal of all the oil with its gaseous volatiles at the exhaust port of the finishing stage, which means acts to reduce the amount of gaseous molecules carried into and through the rotor seat in the stage. Instead of the usual circular exhaust port heretofore employed in pumps of this type the additional groove 40 is incorporated, which groove extends the full width of the stator ring 12 so that more complete exhaustion of all oil in front of the vanes is effected and not merely that portion passing directly across the path of the exhaust port, thus reducing the amount of oil and volatiles compressed into and through the seat.

This high vacuum or finishing stage of the pump, it will be noted, is in direct series with the low vacuum or roughing stage of the pump, and all oil which is discharged from the exhaust port of the finishing stage flows freely under the reduced pressures of the roughing stage to the center cavity 32. The gaseous content of the gaseous space above the oil in this center cavity is at a lower pressure than that of the atmosphere by virtue of the pumping effect of the roughing stage.

In any mechanical device of this general type there is the possibility of the higher pressures achieved in the roughing stage finding some channel of entry by which they may increase the internal pressures of the finishing stage and thereby impair the efficiency of the finishing stage. The center cavity 32 insures against any such impairment in the present pump by providing in effect an oil seal between the finishing stage and the roughing stage so that any gaseous content within the roughing stage which by virtue of its higher pressure might find access to the finishing stage will first be liberated in this center cavity. Thus this same gaseous content is exposed to the intake of the roughing stage, and instead of such leak forming a direct path into the finishing stage this reservoir of oil in the center cavity will provide a direct path for such gaseous pressure to return directly to the roughing stage without interference with the performance of the finishing stage.

Another noteworthy feature of the improved pump is the effect of the groove 56 and connecting grooves 57 and 58 in dividing both the seat and the pumping chamber of the roughing stage into two areas of oil circulation, the area in advance of the seat being what might be termed a wet area and the area beyond the seat being a dry area. This groove 56 midway of the seat, by communicating with the side grooves 57 and 58, provides a free path for the flow of oil and volatiles therefrom along the sides of the rotor to a point in the roughing stage chamber removed a little more than 180° from the intake port 53. Such point in the stator cavity is far

enough removed from the exhaust port 55 so that extreme compression will not have been achieved within the pumping chamber at that point. Thus it will be seen that the groove 56 serves two purposes—it allows a free flow of all of the excess amount of oil back to the stator cavity of the roughing stage at a point removed 180° from the intake port 53, and it also allows those volatiles which are pushed into the seat 50 by the preceding vane 52 to free themselves from the oil in the seat by again taking on their gaseous form, to return quickly to the stator cavity at the point described. Being led into the stator cavity at a point removed 180° from the seat, this excess of oil and the volatiles which free themselves from the oil within the seat are placed directly ahead of the next vane and again forced against the exhaust port 55 under the compression of that vane.

The result of this construction is that two areas are provided within the roughing stage of the pump, which might be described as a wet side, and a dry side. The wet side includes the last portion of the stator cavity, which is removed 180° from the intake port 53, and the first half of the seat 50. To this area all excess of oil within the roughing stage is confined and the liquid or gaseous density from volatiles liberated or compressed within the oil at low pressures is kept high. This is in contrast to the relatively dry side of the roughing stage, which is located at the intake side and includes all the area of the stator cavity up to a point 180° from the intake and in the other direction up to a point just short of the center of the seat 50. In this area it is desirable to have extreme freedom from an excess of oil and extreme freedom from the gaseous volatiles which to whatever extent they are present impede the flow of gaseous molecules being pumped away from the finishing stage. The groove 56 in the stator ring and the connecting path from said groove to the points 59 and 60 in the stator cavity produce this condition and represent a fundamental advance in pumps of this general type. It will be appreciated that the improvements embraced within this invention relate to the definite control of the areas within the pump to which the high gaseous content and excess of oil are confined. By keeping the areas of excess oil and high gaseous content within a cycle which recurrently leads back to the exhaust port and never reaches a free path to the intake port efficiency and effectiveness have been greatly augmented.

The device of the preceding paragraph effectively increases the ability of the pump to discharge gas molecules and thereby lower the order of the pressure which is the effective limit the pump can achieve. Pumps of very similar design without this feature of single cavity showed a practical limit of not less than .02 mm. of mercury pressure while pumps including this feature (single cavity) attain a limit .001 mm. and with two cavities as described herein .00005 mm.

I claim:

1. In a rotary oil sealed vacuum pump for producing extremely high vacuums, a hollow generally cylindrical stator, a circular rotor which is eccentrically positioned in the stator and is provided with two or more outwardly spring-pressed vanes for sliding engagement with the surrounding cylindrical wall of the stator, an arcuate seat in said wall of the same radius of curvature as the rotor, in which seat the rotor turns, means for supplying oil to the crescent-

shaped pumping chamber present between the stator and rotor, inlet and outlet ports in the pumping chamber at opposite sides of the arcuate seat, and a cross groove in the surrounding cylindrical wall of the stator at the edge of the high pressure side of the seat in communication with the outlet port, which groove is set at an angle to the outer edges of the vanes crossing the same.

2. In a rotary oil sealed vacuum pump for producing extremely high vacuums, the combination with a roughing stage, of a finishing stage alongside the roughing stage having a hollow generally cylindrical stator, a circular rotor which is eccentrically positioned in the stator and is provided with two or more outwardly spring-pressed vanes for sliding engagement with the surrounding cylindrical wall of the stator, an arcuate seat in said wall of the same radius of curvature as the rotor, in which seat the rotor turns, means for supplying oil to the crescent-shaped chamber present between the stator and rotor, an inlet port in the surrounding cylindrical wall of the stator at one side of the arcuate seat, an outlet port in one of the side walls of the stator at the opposite side of the seat in communication with the roughing stage, and a cross groove in the surrounding cylindrical wall of the stator at the edge of the high pressure side of the seat in communication with the outlet port, which groove is set at an angle to the outer edges of the vanes crossing the same.

3. In a rotary oil sealed vacuum pump for producing extremely high vacuums, roughing and finishing stages having crescent shaped pumping chambers arranged alongside each other, an exteriorly accessible oil reservoir vented to the atmosphere, means for supplying oil from the reservoir to each stage of the pump without requiring the oil for the finishing stage to first pass through the pumping chamber of the roughing stage, an inlet port for the finishing stage, an outlet port for the roughing stage opening into the reservoir, a double partition between the pumping chambers of the two stages containing a center chamber for receiving oil from the finishing stage and returning it to the same, an outlet port from the finishing stage opening directly through one of the walls of the double partition into the center chamber, an inlet port for the roughing stage opening directly into the roughing stage from the center chamber through the other wall of the double partition, whereby gases passing from the finishing stage to the roughing stage are required to travel through the center chamber, and means isolated from direct communication with the inlet port of the finishing stage for conducting oil from the center chamber back to the finishing stage.

4. In a rotary oil sealed vacuum pump for producing extremely high vacuums, a casing containing roughing and finishing stages, said casing being composed of a center plate, two stator rings at opposite sides of the center plate, and two end plates at the far sides of the stator rings, one of the stator rings with the center plate and one of the end plates forming the pumping chamber of the roughing stage of the pump, and the other stator ring with the center plate and the other end plate forming the pumping chamber of the finishing stage, an oil reservoir mounted on the stator ring of the roughing stage, a drive shaft journaled in bearing apertures in the center plate and end plates eccentrically of the stator rings, rotors on the shaft in the pumping chambers of both stages turning

in arcuate seats formed in the peripheral walls of the stator rings, said rotors being provided with outwardly movable vanes for sliding engagement with said peripheral walls and the arcuate seats therein connecting ducts in the stator ring of the roughing stage below the reservoir, in the adjacent one of said end plates and in the rotor in the roughing stage for supplying oil from the reservoir to each stage with the oil for the finishing stage passing through a separate enclosed duct in the rotor in the roughing stage, an inlet port for the finishing stage, an outlet port for the roughing stage discharging into the oil reservoir below the oil level therein, a center chamber in the center plate above the bearing aperture therein for receiving oil from the finishing stage and returning it to the same, an outlet port for the finishing stage opening into the center chamber, an inlet port for the roughing stage opening into the roughing stage from the center chamber, and means for conducting oil from the center chamber back to the finishing stage.

5. In a rotary oil sealed vacuum pump for producing extremely high vacuums, a hollow stator, a circular rotor which is eccentrically positioned in the stator and is provided with two or more outwardly spring-pressed vanes for sliding engagement with the surrounding wall of the stator, an arcuate seat in said wall of the same radius of curvature as the rotor in closely fitted association therewith throughout a substantial arc whereby to produce an arcuate seal between the stator and rotor and allow only the passage of a thin film of lubricating oil from one side of the seat to the other, said stator forming with the rotor a crescent-shaped pumping chamber which extends from one side of the seat about the rotor to the other side of the seat, a low pressure inlet port in the chamber at one side of the seat, a high pressure outlet port in the chamber at the other side of the seat, means for supplying oil to the chamber, and a by-pass between a portion of the seat and the chamber at a point in the latter which is more than 180° from the inlet port and is sealed off from the inlet port at all times by at least one of the vanes, which by-pass permits any volatiles from the oil within the seat to return directly to the high pressure side of the chamber and permits any excess of oil within the seat to also return to the high pressure side, whereby to leave the portion of the seat beyond the by-pass and the low pressure side of the chamber relatively free of volatiles and excess oil.

6. In a rotary oil sealed vacuum pump for producing extremely high vacuums, a hollow stator, a circular rotor which is eccentrically positioned in the stator and is provided with two outwardly spring-pressed vanes for sliding engagement with the surrounding wall of the stator, an arcuate seat in said wall of the same radius of curvature as the rotor in closely fitted association therewith throughout a substantial arc whereby to produce an arcuate seal between the stator and rotor and allow only the passage of a thin film of lubricating oil from one side of the seat to the other, said stator forming with the rotor a crescent-shaped pumping chamber which extends from one side of the seat about the rotor to the other side of the seat, a low pressure inlet port in the chamber at one side of the seat, a high pressure outlet port in the chamber at the other side of the seat, means for supplying oil to the chamber, and a by-pass between a portion

of the seat and the chamber at a point in the latter which is more than 180° from the inlet port and is sealed off from the inlet port at all times by at least one of the vanes, which by-pass communicates also with the side faces of the rotor at oppositely disposed points adjacent the seat, said by-pass permitting any volatiles from the oil within the seat to return directly to the high pressure side of the chamber and permitting any excess of oil within the seat to also return to the high pressure side, whereby to leave the portion of the seat beyond the by-pass and the low pressure side of the chamber relatively free of volatiles and excess oil.

7. In a rotary oil sealed vacuum pump for producing extremely high vacuums, a hollow generally cylindrical stator, a circular rotor which is eccentrically positioned in the stator and is provided with two or more outwardly spring-pressed vanes for sliding engagement with the surrounding cylindrical wall of the stator, an arcuate seat in said wall of the same radius of curvature as the rotor, in which seat the rotor turns, means for supplying oil to the crescent-shaped pumping chamber present between the stator and rotor, an inlet port in the pumping chamber at the low pressure side of the seat, a circumferentially extending groove in one of the side walls of the pumping chamber at the high pressure side of the seat, which groove extends back away from the seat along the path of approach of the vanes, a cross groove in the cylindrical peripheral wall of the stator at the edge of the high pressure side of the seat in communication with that end of the circumferentially extending groove which is nearer the seat, and an outlet port in communication with the circumferentially extending groove.

8. In a rotary oil sealed vacuum pump for producing extremely high vacuums, a hollow generally cylindrical stator, a circular rotor which is eccentrically positioned in the stator and is provided with two or more outwardly spring-pressed vanes for sliding engagement with the surrounding cylindrical wall of the stator, an arcuate seat in said wall of the same radius of curvature as the rotor, in which seat the rotor turns, means for supplying oil to the crescent-shaped pumping chamber present between the stator and rotor, inwardly extending grooves in the opposed side walls of the pumping chamber at the high pressure side of the seat, a cross groove in the cylindrical peripheral wall of the stator at the edge of the high pressure side of the seat in communication at its ends with the outer ends of the inwardly extending grooves, and an outlet port in communication with the cross groove, said cross groove and inwardly extending grooves being disposed in the paths of travel respectively of the outer edge and side edges of each of the vanes.

9. In a rotary oil sealed vacuum pump for producing extremely high vacuums, a hollow generally cylindrical stator, a circular rotor which is eccentrically positioned in the stator and is provided with two or more outwardly spring-pressed vanes for sliding engagement with the surrounding cylindrical wall of the stator, an arcuate seat in said wall of the same radius of curvature as the rotor, in which seat the rotor turns, means for supplying oil to the crescent-shaped pumping chamber present between the stator and rotor, an inlet port in the pumping chamber at the low pressure side of the seat, circumferentially extending grooves in the op-

posed side walls of the pumping chamber at the high pressure side of the seat, which grooves extend back away from the seat along the path of approach of the vanes, inwardly extending grooves in the opposed side walls of the pumping chamber with their outer ends in communication with the ends of the circumferentially extending grooves which are nearer the seat, a cross groove in the cylindrical peripheral wall of the stator at the edge of the high pressure side of the seat in communication at its ends with the connecting ends of the circumferentially extending grooves and inwardly extending grooves, and an outlet port in communication with one of the circumferentially extending grooves, said cross groove and inwardly extending grooves being disposed in the paths of travel respectively of the outer edge and side edges of each of the vanes.

10. In a rotary oil sealed vacuum pump for producing extremely high vacuums, a hollow generally cylindrical stator, a circular rotor which is eccentrically positioned in the stator and is provided with two or more outwardly spring-pressed vanes for sliding engagement with the surrounding cylindrical wall of the stator, an arcuate seat in said wall of the same radius of curvature as the rotor, in which seat the rotor turns, means for supplying oil to the crescent-shaped pumping chamber present between the stator and rotor, an inlet port in the pumping chamber at the low pressure side of the seat, circumferentially extending grooves in the opposed side walls of the pumping chamber at the high pressure side of the seat, which grooves extend back away from the seat along the path of approach of the vanes, inwardly extending grooves in the opposed side walls of the pumping chamber with their outer ends in communication with the ends of the circumferentially extending grooves which are nearer the seat, a cross groove in the cylindrical peripheral wall of the stator at the edge of the high pressure side of the seat in communication at its ends with the connecting ends of the circumferentially extending grooves and inwardly extending grooves, and an outlet port in communication with one of the

circumferentially extending grooves, said cross groove being set at an angle to the outer edges of the vanes crossing the same, and said inwardly extending grooves being set at an angle to the side edges of the vanes, said cross groove and inwardly extending grooves being disposed in the paths of travel respectively of the outer edge and side edges of each of the vanes.

11. In a rotary oil sealed vacuum pump for producing extremely high vacuums, a casing containing roughing and finishing stages arranged alongside each other, said casing being characterized by a center plate between the stages and end plates at the far sides of the stages, a drive shaft journaled in aligning bearing apertures in the center plate and end plates, rotors on the shaft in both stages forming with the surrounding portions of the casing crescent shaped pumping chambers for the roughing and finishing stages, an exteriorly accessible oil reservoir on the casing vented to the atmosphere, means for supplying oil from the reservoir to both stages of the pump, an inlet port for the finishing stage, an outlet port for the roughing stage opening into the reservoir, said center plate being of double partition construction and containing a center chamber for receiving oil from the finishing stage and returning it to the same, an outlet port from the finishing stage opening directly through one of the double walls of the center plate into the center chamber, an inlet port for the roughing stage opening directly into the roughing stage from the center chamber through the other double wall of the center plate, and separate means isolated from direct communication with the inlet port of the finishing stage for conducting oil from the center chamber back to the finishing stage.

12. A vacuum pump of the construction described in claim 11, in which the casing is provided at one side with an opening in communication with the chamber in the center plate, and in which a cover plate is detachably secured to the casing over said opening in fluid-tight association with the same.

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