W. E. SHORE.

ROTARY VACUUM MACHINE.

APPLICATION FILED NOV. 13, 1912.

**1,149,961.**

Patented Aug. 10, 1915.

4 SHEETS—SHEET 1.

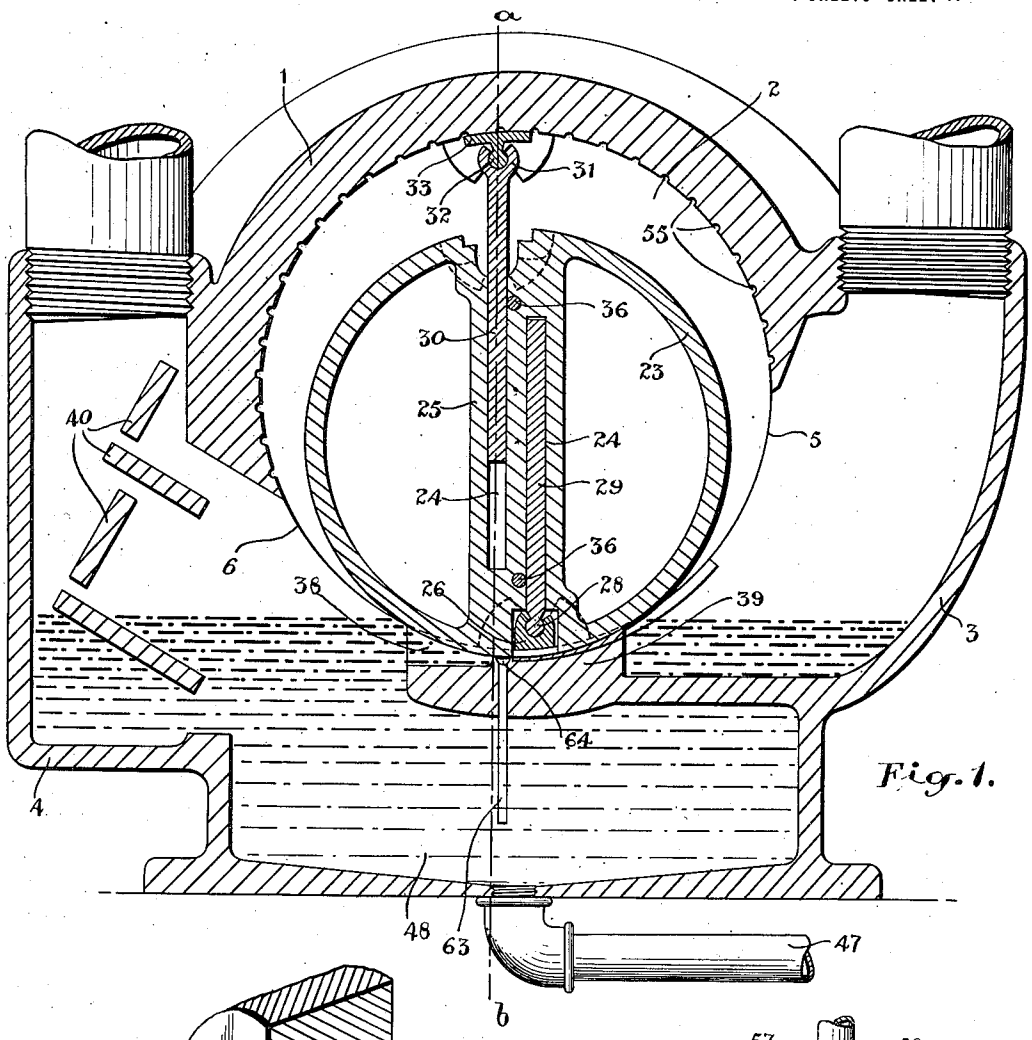



Fig. 1.

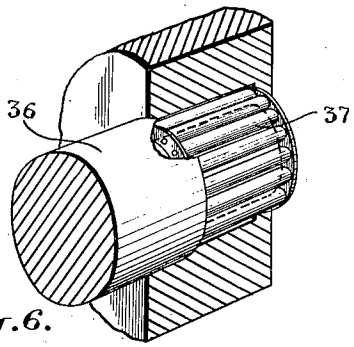



Fig. 6.

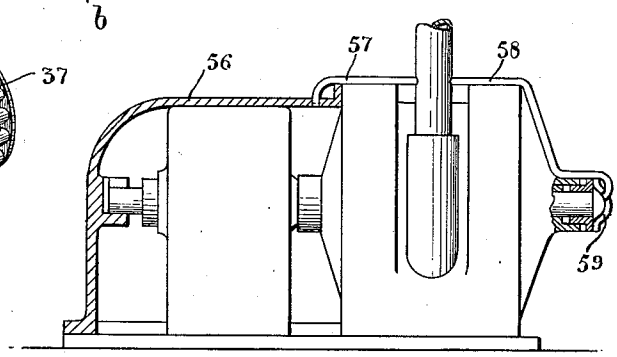



Fig. 8.

**Witnesses.**

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ROTARY VACUUM MACHINE.

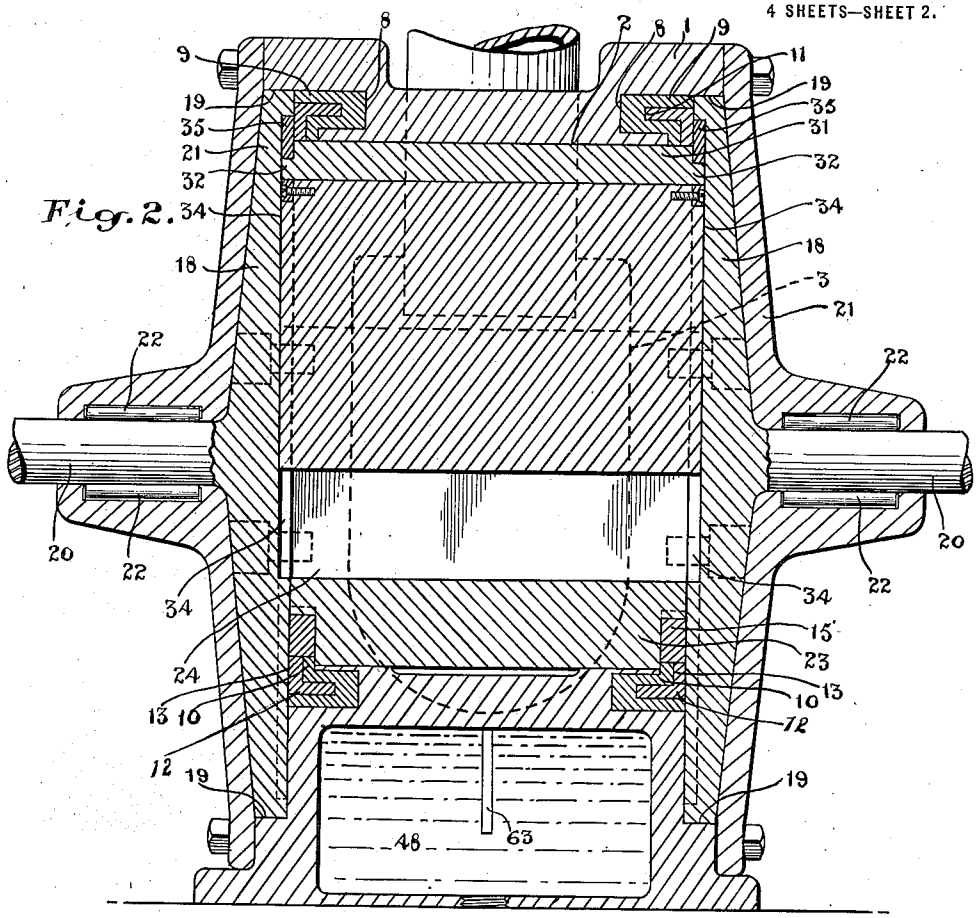
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4 SHEETS—SHEET 2.

Fig. 2.



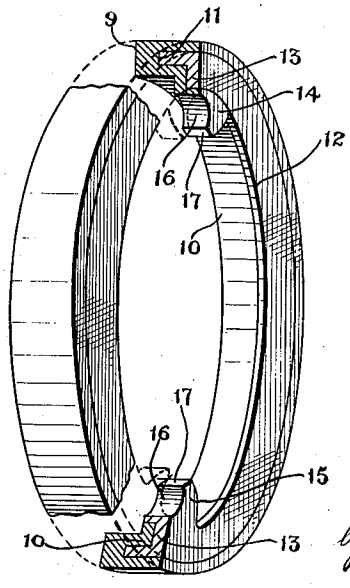




Fig. 3.

**Witnesses.**

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4 SHEETS—SHEET 3.

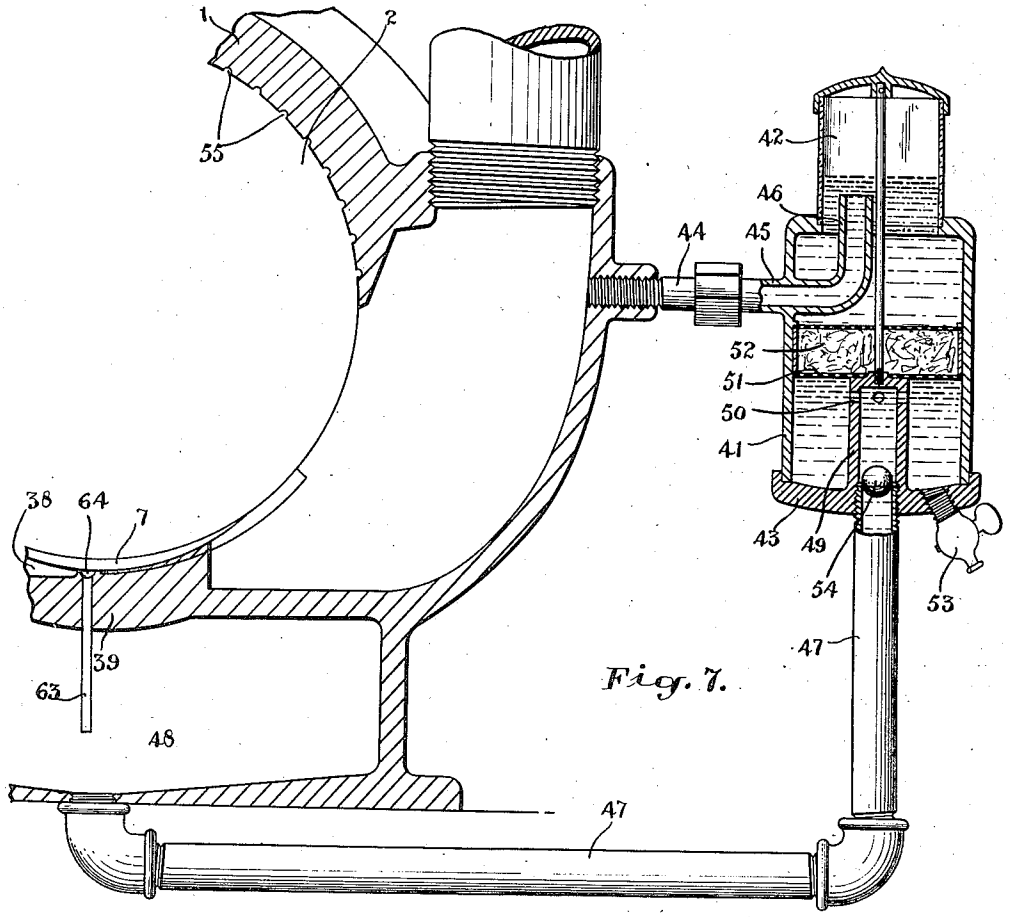



Fig. 7.

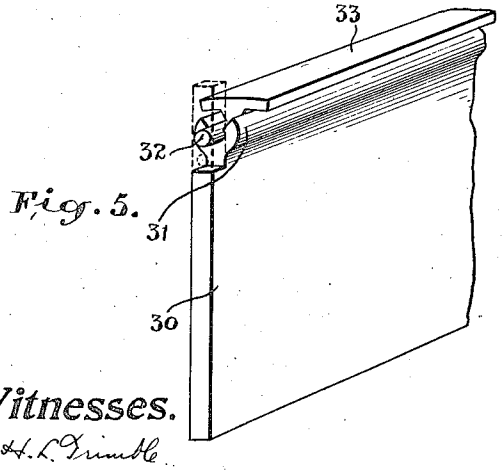



Fig. 5.

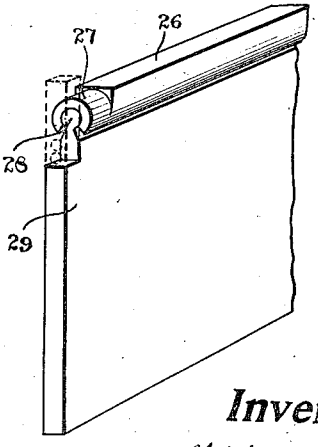



Fig. 4.

Witnesses.

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W. E. SHORE.

ROTARY VACUUM MACHINE.

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4 SHEETS—SHEET 4.

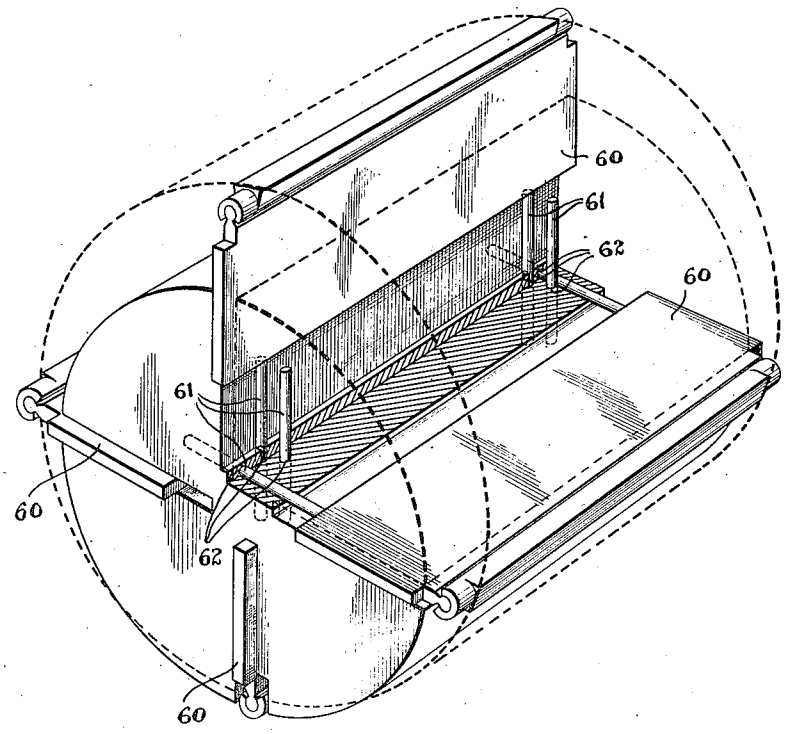



Fig. 9.

*Witnesses.*

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A. G. Kelly.

*Inventor.*

William E. Shore

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Atty.

# UNITED STATES PATENT OFFICE.

WILLIAM E. SHORE, OF TORONTO, ONTARIO, CANADA, ASSIGNOR OF FORTY ONE-HUNDREDTHS TO JOHN FRANEY AND TWENTY ONE-HUNDREDTHS TO JANE C. FRANEY, OF TORONTO, CANADA.

## ROTARY VACUUM-MACHINE.

1,149,961. Specification of Letters Patent. Patented Aug. 10, 1915.

Application filed November 13, 1912. Serial No. 731,143.

*To all whom it may concern:*

Be it known that I, WILLIAM EDWARD SHORE, a subject of the King of Great Britain, and resident of the city of Toronto, county of York, Province of Ontario, in the Dominion of Canada, have invented certain new and useful Improvements in Rotary Vacuum-Machines, as described in the following specification and illustrated in the accompanying drawings, that form part of the same.

The principal features of this invention consist in the novel construction and arrangement of parts; whereby the piston vanes and their contact shoes are held in constant positive relation to the inner wall of the cylinder and whereby the contact of the shoes and vanes with the inclosing walls is rendered air tight, and whereby the sealing and lubricating fluid is constantly circulated.

The principal objects of the invention are, to devise a rotary machine which may be utilized as a vacuum machine or a high pressure blower producing a high vacuum and also displacing a considerable volume of air, the construction being such as to allow the attainment of very high speed, thereby producing a machine applicable for all classes of work requiring high capacity both as to suction and flow of air.

Reference is made herein to the applicant's copending application No. 727,558, filed October 24, 1912 for rotary compressors.

In the drawings, Figure 1 is a vertical cross sectional view through the center of the machine. Fig. 2 is a vertical longitudinal sectional view through the line *a*—*b* Fig. 1. Fig. 3 is a perspective detail of a pair of the piston supporting rings shown partly broken away and in section. Fig. 4 is a perspective detail of a portion of one of the piston vanes and packing shoes. Fig. 5 is a perspective detail of a portion of a slightly modified form of piston vane and packing shoe. Fig. 6 is an enlarged perspective detail showing the method of journaling the side roller bearings for the piston vanes. Fig. 7 is a cross sectional view of a portion of the machine showing the oil distributing and separating device in longitudinal section. Fig. 8 is an elevational view showing the application of a direct connected motor to the machine, the inclosing casing being shown in longitudinal section. Fig. 9 is a sectional perspective view of the piston core showing a modification in the arrangement and number of the piston vanes.

Like numerals of reference indicate corresponding parts in each figure.

Referring to the drawings, 1 is the main casing of the machine formed with a cylindrical chamber 2 in the center thereof and having the lateral hollow extensions 3 and 4 centrally arranged in the length thereof and comprising the intake and outlet passages respectively.

5 and 6 are the inlet and outlet ports opening through the wall of the cylinder and communicating with the extensions 3 and 4 respectively. The upper side of the port 6 is arranged on a lower level than the upper side of the inlet port 5 the purpose of which will be hereafter fully explained.

7 is a recess in the bed of the cylindrical chamber 2, extending longitudinally from end to end thereof, said recess being of arc-shape in transverse section and of a lesser radius than the radius of the cylinder.

8 are annular recesses formed in the end walls of the main casing at the end of the cylinder 2 and concentric therewith.

9 are ring members fitted into the annular recesses 8 and rotatable therein, said rings being formed with an inturned annular flange 10 extending completely therearound and an annular recess 11 of L-shape in cross section in the outer edges.

12 are ring members of L-shape in cross section fitted into the annular recesses 11 in the rings 9 and rotatable therein. The inner edges of the flange 10 of the rings 9 and the flange 13 of the rings 12 are arranged flush with the interior wall of the cylinder chamber 2 and form a continuation thereof.

14 is a lug projecting radially inward from the flange 10 of each of the ring members 9 and extending outwardly and overlapping the flange 13 of the rings 12.

15 is a lug extending radially inward from the flange 13 of each of the rings 12 and overlapping the flange 10 of the ring members 9.

The lugs 14 and 15 are arranged in the same rotating plane and each is formed with a circular transverse opening 16, the axis of which is parallel to the axis of the rings.

17 are openings cut through the inner radial side of the lugs and opening to the circular opening 16.

18 are a pair of flanged heads of circular form rotatably supported within the circular recesses 19 in the outer ends of the main casing 1, said recesses being eccentric to the cylinder chamber 2.

20 are shafts secured to or forming part with the heads 18 and extending outwardly from the center thereof.

21 are circular caps rigidly secured to the end faces of the main casing 1 and having the journal bearings 22 supporting the shafts 20.

23 is the piston core of cylindrical form rigidly secured at the ends to the heads 18 and concentric therewith, the peripheral surface of said core fitting into the recess 7 in the bed of the cylinder chamber. The ends of the core 23 are recessed to receive the inwardly extending lug members 14 and 15 of the rotatable rings 9 and 12.

24 are slots formed in the central web 25 of the core and extending longitudinally thereof from end to end, said slots being arranged in parallel relation the one to the other and formed with parallel side faces.

26 is a shoe having its outer edge face adapted to fit the inner peripheral face of the cylinder chamber 2.

27 are journal ends formed on the extremities of the shoe 26 extending into the circular openings 16 in the pair of lugs 14 carried by the ring members 9. As the ring members 9 are rotatably supported concentric with the cylinder chamber 2, the shoe 26 will be held in positive relationship to the inner wall of said cylinder. The back or inner edge of the shoe 26 is slotted longitudinally to fit around a cylindrical shaped edge portion 28 of the piston vane 29, said piston vane being slidably arranged in one of the slots 24.

30 is the other piston vane slidably arranged in the adjacent slot 24 and a shoe similar to the shoe 26 may be carried on its outer edge but I have shown herein a slightly modified form of shoe and piston vane, though it will be understood that in all probability only one kind of shoe will be used in one machine.

In the modified form of shoe the piston vane is formed with an enlarged outer end 31 which is slotted longitudinally and formed around the cylindrical portion 32 of the shoe 33. In this form, the partial cylindrical shaped end of the vane is journaled in the orifices 16 in the lugs 15 of the rings 12. Both vanes are thus pivotally supported in relation to the shoes and may swing freely to accommodate themselves to the change of centers as the eccentrically arranged core rotates within the cylinder. The shoes, however, remain in constant fixed relation to the center of the cylinder.

The heads 18 are formed with transverse slots 34 in their inner faces to receive the extending ends of the piston vanes and in order that the end portions of the vanes may be packed securely I provide the short extension pieces 35 which extend outward past the outer faces of the shoes and engage the end faces of the rings 12, thus forming a gate valve.

36 are rollers journaled upon suitable roller bearings 37 at the ends and arranged within the core 23 and engaging one of the side faces of the piston vanes, providing a roller bearing thereacross to reduce the frictional contact as said vanes slide in and out in the slots in said core.

38 is a recess formed in the cylinder wall extending below the arc-shaped recess 39 into which the core extends, said recess 38 extending from a point close to the center outwardly on the outlet side and opening to the outlet port and of the same width as said port. This recess is provided so that as the vanes rotate the oil carried in front of the shoe, at the end portions of the cylinder to the side of the outlet port, will be able to escape and will therefore not resist the rotation of the shoe.

40 are baffle plates arranged in the outlet extension 4 extending transversely thereof and adapted to prevent the carrying off of the oil which is churned up by the operation of the machine.

In Fig. 7 I show an oil separating casing 41. This casing is cylindrical in form and provided with a glass dome 42 at the top and a cap 43 closing the bottom.

44 is a pipe connected into the side of the inlet extension 3 and communicating with a pipe member 45 having an upturned end 46 extending within the glass dome 42 of the oil separator.

47 is a pipe connected to the bottom of the oil chamber 48 in the base of the casing 1 and to the cap 43.

49 is a hollow extension within the cap 43 forming a continuation of the pipe 47 and having laterally arranged holes 50 at the inner end.

51 is a filter casing of perforated sheet metal having a fiber packing of suitable filtering material 52 therebetween.

53 is a draw-off cock arranged in the cap 43.

54 is a ball valve resting in the end of the pipe 47 within the extension 49.

In the operation of this machine, the shaft is suitably connected to a suitable source of energy and is rotated thereby. The rotation

of the shaft rotates the heads 18 and piston core 23 and as said piston core rotates, the piston vanes are caused to rotate within the cylinder 2. The piston vanes and their contact shoes are held in positive relationship to the inner wall of the cylinder so that a suction is created through the inlet port and the exhaust discharges through the outlet at the opposite side. The upper side of the inlet port 5 is arranged at a higher level than the upper side of the outlet port so that as the core rotates the inlet will be cut off by one piston shoe before the opposite shoe clears the top of the outlet. This arrangement effectively prevents a break in the suction and a continuous flow is insured. The lower portion of the casing 1 is filled with oil to a point above the recess 7 so that the joint between the core and bed is oil packed and will prevent any leakage between the suction and outlet sides. The inner wall of the cylinder is preferably slotted from end to end with a plurality of narrow slots 55 arranged a short distance apart so that the oil which is carried by centrifugal action around the casing will fill said recesses and form an oil packing for the shoes in their travel around the cylinder. The oil casing 41 is connected by the pipe 44 to the suction inlet and the suction created draws the oil from said casing, thus drawing the oil from the bottom of the main casing upwardly through a suitable filter, thereby separating any solids which may be contained therein which would be injurious to the machine. The condition of the oil may be observed at any time through the glass dome and it may be drawn off through the cock 53. The oil bath provided flows in between all the contacting and moving portions of the device so that a perfect seal of all the operating contacting parts is maintained, with the result that a machine of very high efficiency is produced and a very high vacuum may be obtained. Owing to the peculiar ring support for the piston vanes and shoes all friction due to centrifugal force is eliminated and a very high speed of rotation may be attained.

The operation of the machine at high speed is not necessary for classes of work where it is merely necessary to obtain a vacuum but for vacuum cleaning purposes this feature is very valuable as a considerable displacement is necessary in such work and it is obvious that the greater speed that is attained will create a much greater displacement.

In Fig. 8 of the drawings I show a small view of my device directly connected with a motor of any suitable design. The motor is inclosed within a casing 56 which is connected to the casing of the machine in an air tight connection and pipes 57 and 58 are connected to the outlet of the rotary machine as shown to provide equalizing pressures at each end of the device, minimizing the tendency to leakage from the cylinder.

The machine herein shown is provided with two piston vanes but it must be understood that I may use more than the two vanes. In such construction the vanes 60 are shortened so that they will not cross the center of the core but each is provided with extension pins 61 sliding in holes 62 bored in the core. These pins may be arranged at varying distances in the width of the vanes as illustrated in the small perspective view in Fig. 8.

When the machine is used for a slow speed high vacuum service the oil chamber is filled to above the level of the core bed as shown in Fig. 1, but when it is desired to use the machine as a high speed blower or light suction work the oil level is lowered to a point below the core bed so that the pistons and shoes will not be continually splashing into the oil and therefore adding resistance. When a machine is used for this purpose I find it advisable to provide a special method of lubricating the core bed and I arrange a siphon tube 63 secured to the bed portion 39 and extending downwardly into the oil chamber in the hollow base. This tube communicates at the upper end with a longitudinal groove 64 cut in the core bed. The rotary movement of the core carries this oil upwardly toward the suction side thus providing a continuous film packing of oil sealing the intake from the outlet.

I have described herein a machine particularly adapted for vacuum or high pressure blower but it must be understood that with very little change in construction the machine may be adapted to operate as a power unit.

In Figs. 1 and 7 I show a removable block of arc shape in transverse section arranged in a recess in the bottom of the cylinder at one side of the center. This block is provided so as to allow for its removal and replacement in the event of wear in the cylinder bed through the constant engagement of the rotary piston vanes.

What I claim as my invention is:—

1. In a rotary vacuum machine, a cylinder having eccentrically arranged circular recesses at the ends, a pair of rotatable circular heads fitting in said recesses and closing the ends of said cylinder, a piston core extending between said heads and rigidly secured concentric thereto, said core being arranged eccentrically within the cylinder and engaging one side thereof, piston vanes slidably arranged in said core, shoe members pivotally connected to the outer edges of said piston vanes and adapted to engage the inner cylinder wall, and rotatable means for holding said contact shoes in fixed relation to the axis of the cylinder.

2. In a rotary vacuum machine, a cylinder having eccentrically arranged circular recesses at the ends, a pair of rotatable circular heads fitting in said recesses and closing the ends of said cylinder, a piston core extending between said heads and rigidly secured concentric thereto, said core being arranged eccentrically within the cylinder and engaging one side thereof, piston vanes slidably arranged in said core, shoe members pivotally connected o the outer edges of said piston vanes and adapted to engage the inner cylinder wall, and means rotatably supported between the ends of the cylinder and said heads for supporting the contact shoes in fixed relation to the axis of the cylinder and pendently supporting said vanes.

3. In a rotary vacuum machine, a cylinder having concentrically arranged annular recesses in the ends, internested rings rotatably arranged in said annular recesses and having inwardly extending radial lugs arranged in the same transverse plane, shoe members pivotally supported from said lugs and held in positive running contact with the cylinder wall, piston vanes pivotally supported from said shoe members, heads closing the ends of said cylinder and eccentrically journaled, and a core rigidly connected concentrically to said heads and extending through said cylinder in eccentric relation thereto and operatively engaging said piston vanes.

4. In a rotary vacuum machine, a cylinder having concentrically arranged annular recesses in the ends, ring members rotatively arranged in said annular recesses formed with an inturned annular flange and an annular recess L-shaped in cross section in the outer edge, said rings each having a lug extending radially inward from the annular flange portion, ring members of L-shape in cross section rotatively arranged in the L-shaped recess in the aforesaid rings and each having a lug extending radially inward and arranged in the same plane as the lugs of the companion ring, shoe members pivotally supported from said lugs and held in positive running contact with the cylinder wall, piston vanes pivotally supported from said shoe members, heads closing the ends of said cylinder and eccentrically journaled, and a core rigidly connected concentrically to said heads and extending through said cylinder in eccentric relation thereto and operatively engaging said piston vanes.

5. In a rotary vacuum machine, a cylinder, a pair of circular heads eccentrically journaled and closing the ends of said cylinder and having transverse slots in the inner face thereof, a piston core rigidly connected concentrically to said heads and eccentrically arranged within said cylinder and having slots therein extending from end to end and registering with the slots in said heads, piston vanes slidably arranged in the slots in said core and extending into the slots in said heads, shoe members pivotally connected to the outer edges of said piston vanes and adapted to engage the cylinder wall, and rotatable means for holding said shoe members in fixed relation to the axis of the cylinder.

6. In a rotary vacuum machine, a cylinder, a pair of circular heads closing the ends of said cylinder and journaled eccentrically thereto and each having a pair of parallelly arranged slots extending across the inner face one at each side of the center, a cylindrical core rigidly secured concentrically between said heads and eccentric to the cylinder and having longitudinal slots parallelly arranged and extending from end to end thereof and registering with the slots in said heads, ring members rotatably journaled at the ends of the cylinder and having inwardly extending radial lugs, piston vanes slidably arranged in the slots in said core and extending into the slots in said heads, said vanes being pendently supported from the lugs of said rings, and contact shoes pivotally secured to the outer edges of said pendent vanes and engaging the cylinder wall.

7. In a rotary vacuum machine, a cylinder, a pair of circular heads eccentrically journaled and closing the ends of said cylinder and having transverse slots in the inner face thereof, a piston core rigidly connected concentrically to said heads and eccentrically arranged within said cylinder and having slots therein extending from end to end and registering with the slots in said heads, ring members rotatively arranged between the ends of said cylinder and said heads and having inwardly extending radial lugs forming journal bearings, shoe members adapted to engage the cylinder wall and having journal ends adapted to extend into the bearings in said lugs, piston vanes pendently supported from said shoes and sliding in the slots in said core and having the ends projecting beyond the shoes and ring lugs and extending into the slots in the heads, and extension pieces secured to the outer ends of said vanes adapted to slide in the slots in said heads to form gate valves at the ends of the shoe members.

8. In a rotary vacuum machine, a cylinder, heads closing the ends of said cylinder, a piston core rotatably supported eccentrically within said cylinder and having slots extending longitudinally thereof from end to end, piston vanes slidably arranged in the slots in said core and extending outwardly therefrom, shoe members rotatably supported in constant operating contact with the cylinder wall and pivotally connected to the outer edges of said piston vanes, and roller

bearing members journaled within said core adjacent to said longitudinal slots and extending longitudinally of said core and engaging said piston vanes and forming roller bearings for said vanes in their inward and outward movement.

9. In a rotary vacuum machine, a casing having a cylindrical chamber in the center thereof and formed with lateral hollow extensions comprising intake and outlet passages and a hollow base communicating with said outlet passage, the inlet port leading to said cylinder having its upper edge arranged above the level of the upper edge of the outlet port and the arc between said ports is less than that between the pistons, a piston core eccentrically journaled within said cylinder and engaging the bottom side thereof, heads closing the ends of said cylinder, piston vanes operatively engaging said core, and contact shoes held in positive operative contact with the wall of the cylinder and pivotally connected to the outer edges of said piston vanes.

10. In a rotary vacuum machine, a casing having a cylindrical chamber in the center thereof and formed with lateral hollow extensions comprising intake and outlet passages and a hollow base arranged below and communicating with said outlet passage and forming an oil well, said cylinder having a recess in the bottom thereof arc-shaped in cross section and extending from end to end and also having a recess extending below the arc-shaped recess at the outlet side and of the same width as the outlet port, the well formed by said base retaining the oil at a level above the arc shaped recess, a cylindrical piston core journaled in the cylinder and contacting with the bed formed by the arc shaped recess in the base and forming an air tight joint therewith, piston vanes slidably held in said core, contact shoes pivotally connected to the outer edges of said vanes and held in operative contact with the surface of the cylinder, and heads closing the ends of said cylinder.

11. In a rotary vacuum machine, a cylinder having inlet and outlet ports and a plurality of longitudinal slots formed in the inner wall between the inlet and outlet ports and spaced equidistantly therearound and each extending from end to end of the cylinder and forming oil receiving recesses, a piston core journaled concentrically in said cylinder and engaging one side thereof, piston vanes operating in said core, and shoe members pivotally connected to the outer edges of said vanes and rotatably supported in constant engagement with said cylinder wall and having contact faces adapted to cover each successive oil groove before uncovering the one to the rear and to thus maintain an oil packed face contact.

12. In a rotary vacuum machine, a cylinder having a recess in the bed thereof extending longitudinally from end to end at one side of the vertical center, a removable block fitting in said recess, said block and said bed having a longitudinal recess of arc-shape forming a depression in the bottom of the cylinder of a lesser radius than the cylinder, a piston core of smaller diameter than the cylinder rotatably supported eccentrically thereto and fitting in the recess in said bed and block, piston vanes carried by said piston core, contact shoes pivotally secured to the outer edges of said piston vanes and held in constant operative engagement with the cylinder wall, and heads closing the ends of the cylinder.

13. In a rotary vacuum machine, a casing having a centrally arranged cylinder and lateral hollow extensions forming inlet and outlet passages, said cylinder having inlet and outlet ports leading to said passages respectively, and a hollow base communicating with the outlet passage, a piston core operating in said cylinder, piston vanes operating with said core and rotating in said cylinder, a pipe communicating with said hollow base and extending upwardly on the suction side of the machine, a filter casing connected to said pipe, and a pipe connected to the top of said filter casing and communicating with the inlet passage, the suction being adapted to draw the oil upwardly through said pipe and filter from the base.

14. In a rotary vacuum machine, a casing having a centrally arranged cylinder and lateral hollow extensions forming inlet and outlet passages, said cylinder having inlet and outlet ports leading to said passages respectively and a hollow base communicating with the outlet passage, a piston core operating in said cylinder, piston vanes operating with said core and rotating in said cylinder, a pipe communicating with said hollow base and extending upwardly, a casing secured to the upper end of said pipe, a suitable filter casing arranged intermediately in said casing, and a pipe leading from the upper end of said casing above said filter and communicating with the inlet passage of said machine.

15. In a machine of the class described, a cylinder having a recess formed in the bed thereof extending longitudinally from end to end and arc-shaped in cross section, a groove arranged in the bed of said recess and extending longitudinally thereof, said groove having communication with an oil supply, a piston core of lesser diameter than the cylinder journaled eccentrically therein and fitting into the arc-shaped recess, and piston vanes operatively engaging said piston core and operating in said cylinder.

16. In a machine of the class described, a

cylinder, a piston core eccentrically journaled within said cylinder and having a plurality of longitudinal slots therein off-set from the axial center, piston vanes slidably arranged in said slots and having extension pin members extending into holes bored in the core at the base of said slots, the pins of one vane being adapted to extend past the pin of another vane to allow the use of more than two vanes in the cylinder.

17. In a rotary vacuum machine or pressure blower, the combination with the casing and shaft journals and a power unit for operating said shaft connected therewith, of an air tight casing extending around said power unit and connected to the casing of the machine in an air tight joint, a cap closing the outer bearing of the rotary machine, and pipes leading from the discharge and connected to said air tight casing and to said cap to effect an equalizing of pressure at the journal ends of the machine.

Signed at the city of Toronto, county of York, Province of Ontario, in the Dominion of Canada, this 25th day of October 1912.

WILLIAM E. SHORE.

Witnesses:
H. L. TRIMBLE,
E. HERON.