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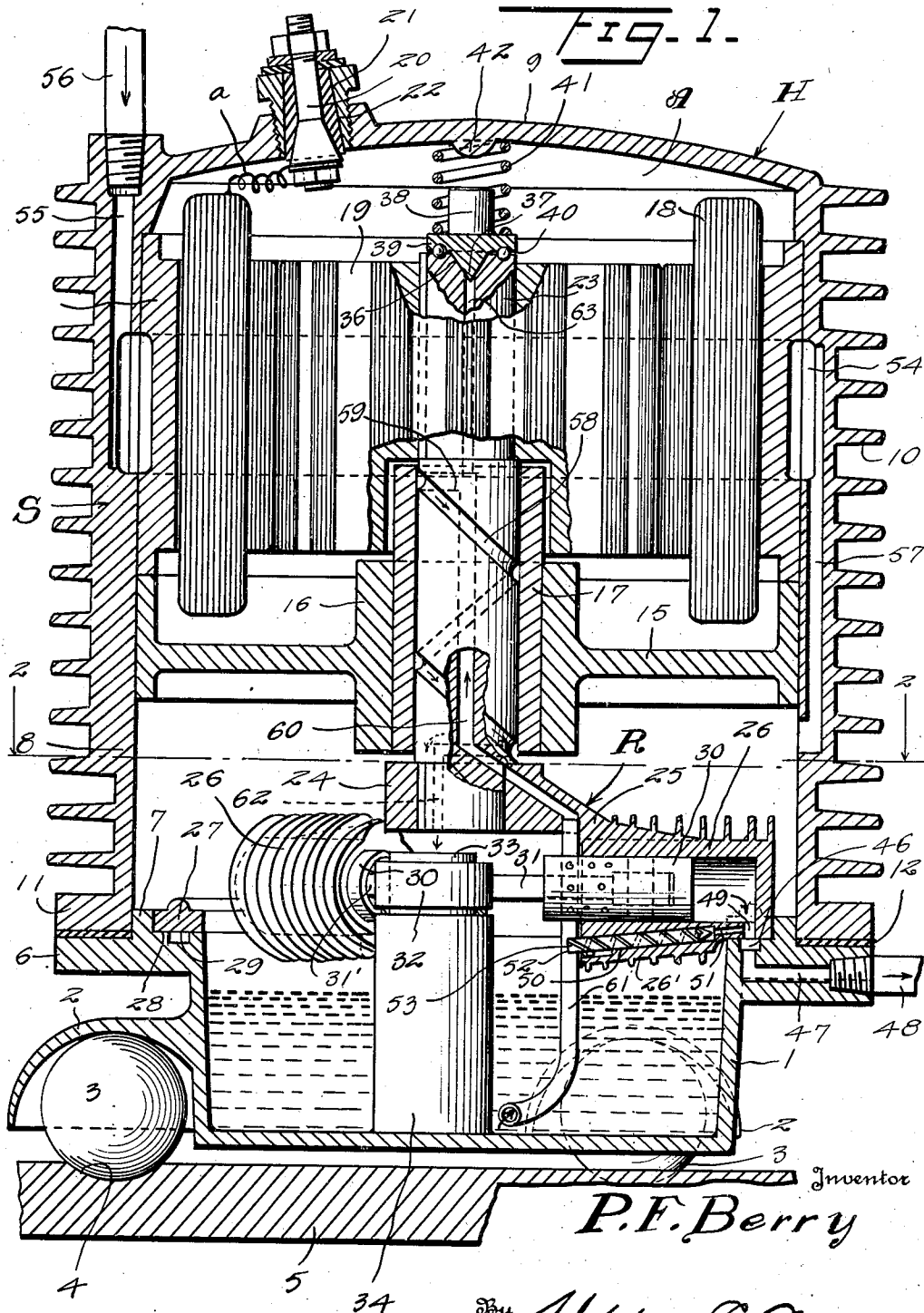
P. F. BERRY

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Filed Aug. 6, 1935

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March 9, 1937.

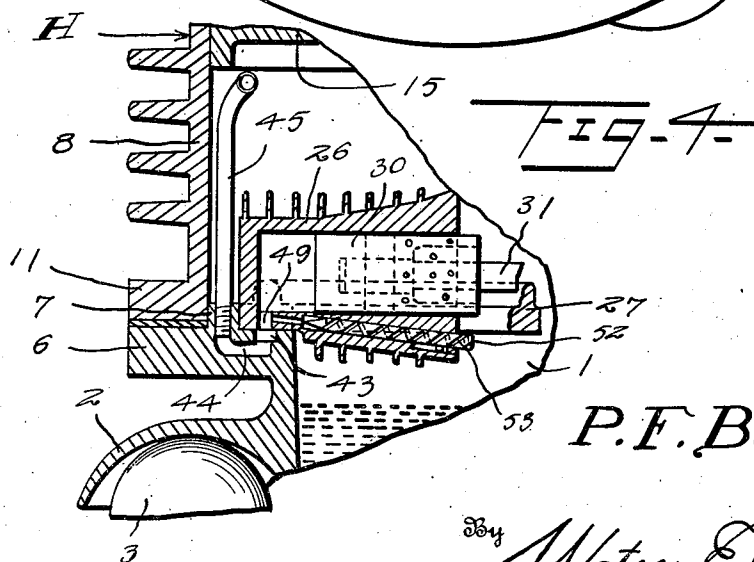
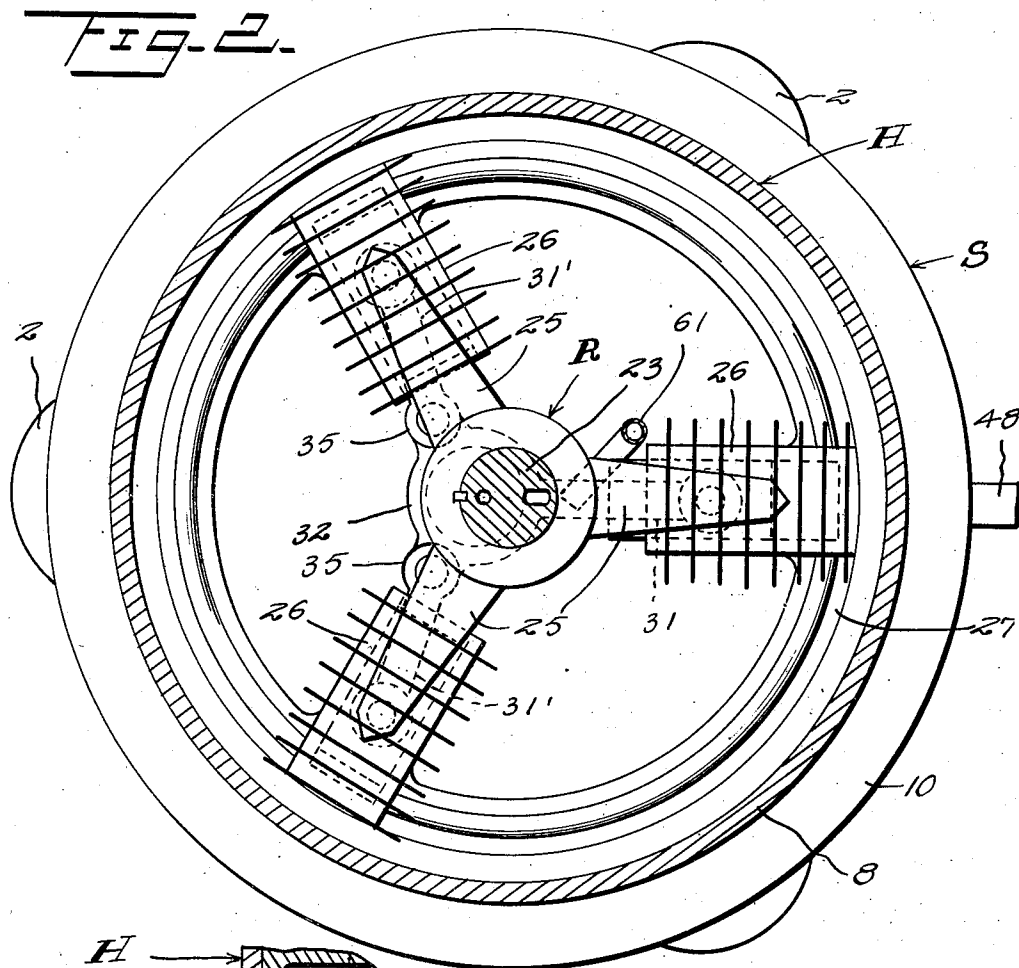
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FIG. 3.

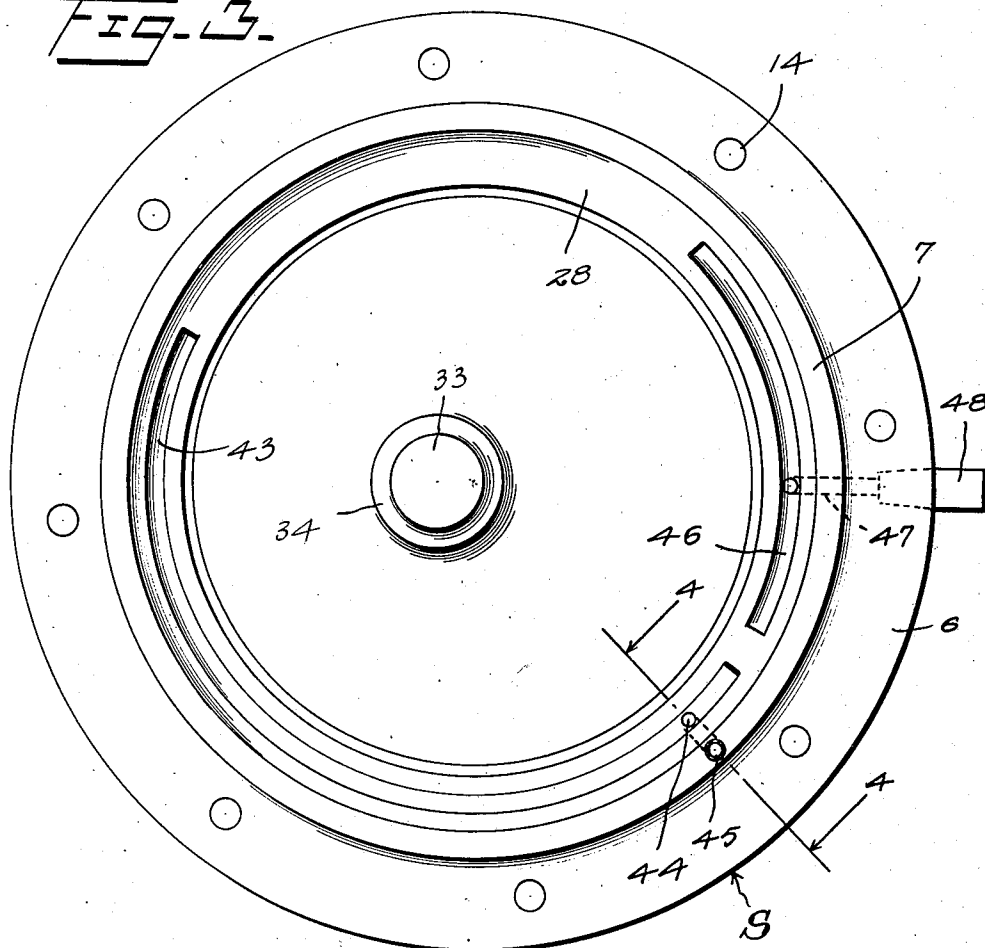
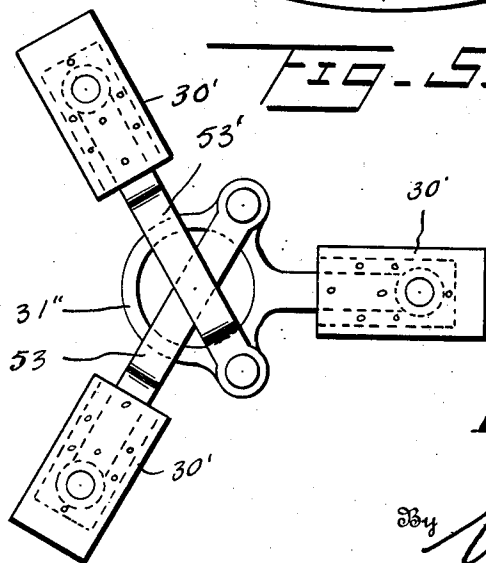


FIG. 5.



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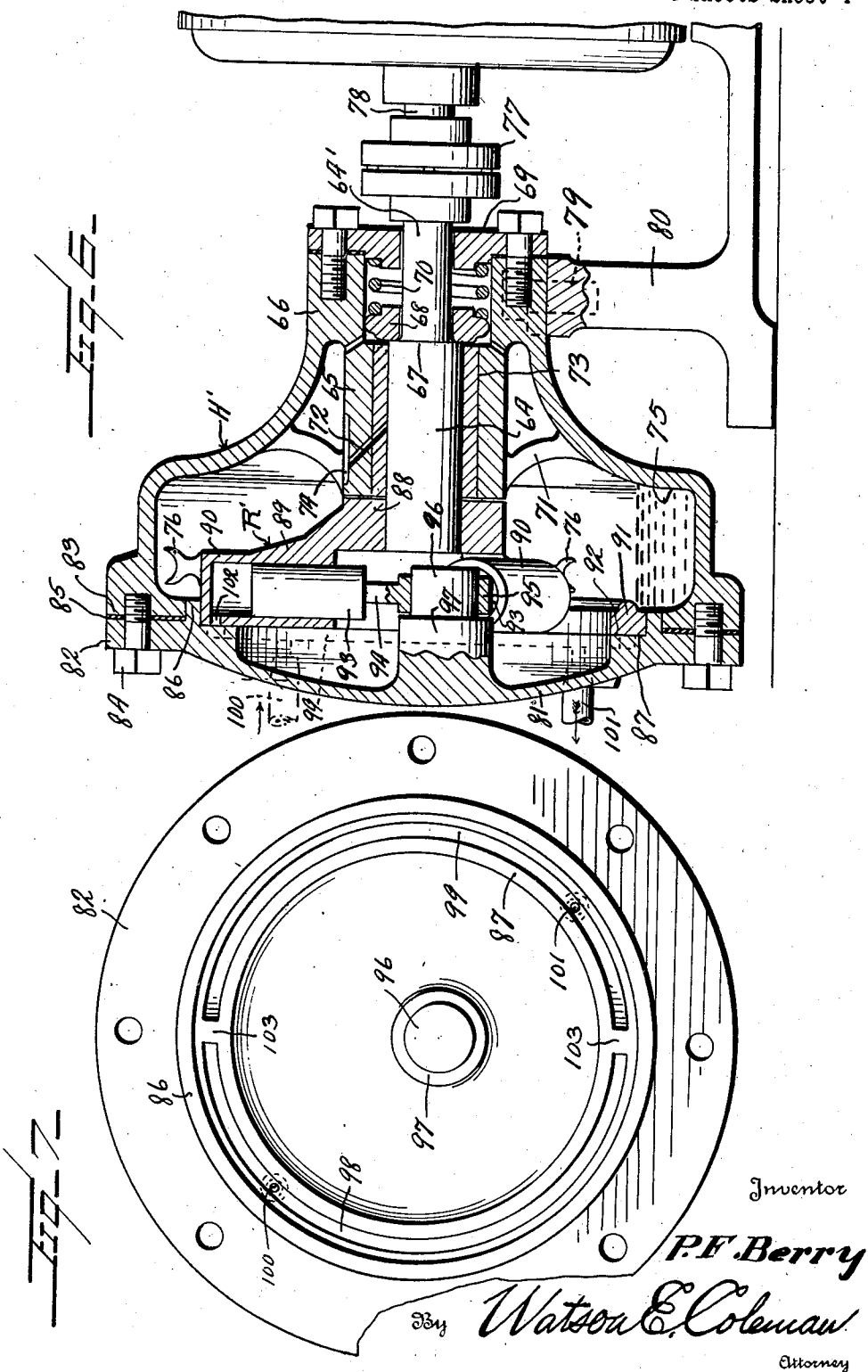
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UNITED STATES PATENT OFFICE

2,073,547

PUMP

Paul F. Berry, Columbus, Ohio

Application August 6, 1935, Serial No. 35,000

13 Claims. (Cl. 230—177)

This invention relates to a pump, and it is an object of the invention to provide an apparatus of this kind comprising a stator and rotor together with a plurality of pumping elements of a reciprocating type operating when the rotor is in motion and wherein the mounting of the rotor permits said rotor by its own weight maintaining an effective seal between the stator and rotor and more especially the coacting ports of such elements.

In the pumps now generally in service the biggest objection arises from the failure to provide said pumps with suitable means for maintaining a constant seal, the high friction wear on the seal or valve causing them to fail very rapidly in their essential function. It is an object of the present invention to provide suitable means for taking up such friction wear and thereby maintain a constant seal on the ports and which is obtained under the influence of the weight of the rotor.

A still further object of the invention is to provide an apparatus of this kind constructed and assembled in a manner to assure an uninterrupted pull or suction free of pulsation.

An additional object of the invention is to provide an apparatus of this kind wherein pumping units of a reciprocating type operate during the relative movement of a rotor with respect to a stator and wherein each of the units is provided with means to unload pressure when such unit is idle to facilitate starting and lessen motor torque, said unloading means operating automatically and preferably under control of centrifugal force.

A still further object of the invention is to provide a pump with means whereby the various parts thereof as required may be effectively lubricated while the apparatus is working.

The invention consists in the details of construction and in the combination and arrangement of the several parts of my improved pump whereby certain important advantages are attained and the device rendered simpler, less expensive and otherwise more convenient and advantageous for use, as will be hereinafter more fully set forth.

The novel features of my invention will hereinafter be definitely claimed.

In order that my invention may be the better understood, I will now proceed to describe the same with reference to the accompanying drawings, wherein:—

Figure 1 is a view in vertical section taken through a pump constructed in accordance with

an embodiment of my invention, certain of the parts being in elevation;

Figure 2 is a sectional view taken substantially on the line 2—2 of Figure 1 looking in the direction of the arrows;

Figure 3 is a view in top plan of the base member as herein disclosed;

Figure 4 is a fragmentary detailed sectional view taken substantially on the line 4—4 of Figure 3 and through an adjacent portion of the housing and rotor;

Figure 5 is a view in top plan and of a diagrammatic character illustrating a driving connection for the pistons of the pumping units arranged in accordance with a further embodiment of the invention;

Figure 6 is a vertical sectional view with portions in elevation illustrating a pump constructed in accordance with a further embodiment of my invention;

Figure 7 is a view in elevation of the inner face or side of the removable head or cap as comprised in this embodiment of the invention.

As illustrated in the accompanying drawings, my improved pump comprises a stator S and a rotor R. The stator S as disclosed consists of a base member 1 which is constructed in a manner to constitute a well or reservoir and extending outwardly from the side wall of this base member or reservoir 1 is a plurality of bosses 2 preferably three in number and equidistantly spaced around said base member or reservoir 1. These bosses are in the form of inverted cups and are adapted to directly contact from above with the spherical members 3 of rubber or other desired yielding or deformable material. Each of these balls or members 3 is seated in a suitably positioned pocket or cavity 4 provided in a desired supporting member 5. These members or balls 3 with the associated bosses 2 provide a mounting for the pump in its entirety which effectively damp vibration and substantially eliminates sound or noise transfer.

It is to be particularly noted in Figure 1 that each of the bosses 2 has its under or concave face disposed on a radius greater than that of the associated ball or member 3, thus permitting the pump as a unit to move or shimmy without losing its position and at the same time effectively cushioning said pump to absorb vibration.

The supporting member 5, when the pump is employed in connection with electrical refrigeration, preferably constitutes the floor of the cabinet.

The top face of the base member or reservoir 1 is open and the upper marginal portion thereof is defined by a surrounding and continuous flange 6 and at a relatively slight distance outwardly from the side wall of the base member or reservoir 1 this flange 6 is provided with an upstanding continuous annular flange 7. Resting from above upon the flange 6 outwardly of the flange 7 is the lower end of the side wall 8 of a housing H. The top of the housing H is closed by a head 9 preferably integral with the side wall 8 while the opposite or lower end of the housing H is open. The wall 8 is also provided therearound with the integrally formed cooling fins 10. The lower end portion of the wall 8 of the housing H is also provided with an outstanding surrounding flange 11 to facilitate the mounting of the housing H upon the flange 6 and interposed between the flanges 6 and 11 is a suitable gasket 12 in order to assure a hermetic connection.

The housing H may be bolted or otherwise secured to the base member or reservoir 1. In Figure 3 the flange 6 is shown provided at spaced points therearound with the openings 14 through which the anchoring bolts are inserted. It is believed to be obvious that the flange 11 will be provided with openings for register with these openings 14 of the flange 6.

Pressed into the housing H or otherwise effectively mounted therein is a plate 15 which intersects the interior of the housing H to provide within the housing an upper motor compartment A. The mounting of the plate 15 is such to seal off the compartment A against the refrigerant vapor and oil within the lower portion of the stator S or below the plate 15 and particularly when the pump is in action. At the axial center of the housing H, or more particularly the compartment A, the plate 15 is formed with a vertically disposed bearing sleeve 16 through which is snugly engaged a hardened bushing 17. This bushing is pressed or otherwise engaged within the bearing sleeve 16 in a manner to prevent passage of refrigerant vapor and oil between the applied bushing 17 and sleeve 16 into the motor compartment A.

Pressed or otherwise effectively engaged within the motor compartment A is the field 18 of an electric motor, said field coacting in a well known manner with the armature 19 of the motor. The motor may be connected with the desired suitable source of current in any preferred manner but, as indicated in Figure 1 of the drawings, the field 18 is in electrical connection through the conductor α with a connector rod 20 disposed through an insulating sleeve 21 arranged within a plug 22 which threads through the head 9 of the housing H. This connector rod 20 is adapted to have direct communication with a source of electrical energy.

The armature 19 is fixed to the upper end portion of the shaft 23 of the rotor R, said shaft however being free for endwise movement independently of the armature 19. This shaft 23 is snugly disposed through the bushing 17 hereinbefore referred to and extends below the bearing sleeve 16. This lower or extended portion of the shaft 23 has keyed thereto for rotation therewith the hub 24 from which substantially radiate the arms 25. The outer portions of the arms are integrally formed as herein disclosed with the upper and inner portions of the finned cylinders 26. As herein disclosed, these cylinders 26 are three in number and are equidistantly spaced and have their longitudinal axes radial to the shaft

23. The outer or closed ends of the cylinders 26 are formed with or otherwise suitably secured to a continuous annular member 27 resting from above on the annular face 28 provided by the upper portion of the flange 6 inwardly of the flange 7 and continued over the upper margin of the side wall of the base member or reservoir 1. This face 28 and the opposed under face 29 of the annular member 27 are flat and suitably machined or treated to assure a close sealing contact of said faces.

Operating within each of the cylinders 26 is a reciprocating piston 30 of desired construction and in the embodiment of the invention as illustrated in Figures 1 to 4 inclusive the coacting rod 31 of one of the pistons 30 is rigidly connected to an annular strap 32 which snugly engages and rotates around a bearing 33 provided at the upper portion of an upstanding post 34 mounted upon the bottom wall of the base member or reservoir 1. The location of this post 34 is such as to position the bearing 33 to one side of the axial center of the shaft 23 so that the strap 32 is in eccentric relation with respect to the shaft 23. The rods 31' of the remaining pistons are pivotally engaged, as at 35, with the strap 32. It is also to be stated that the rods 31 and 31' are also in desired pivotal connection with the pistons.

As a result of the connections of the rods 31 and 31' with the strap 32 it is believed to be obvious that upon operation of the rotor R when the motor field 18 is energized, the pistons 30 will be caused to have desired reciprocation within their cylinders 26. It is also to be noted that the mounting of the shaft 23 is such whereby the weight of the rotor assures the desired effective close contact between the opposed faces 28 and 29 of the flange 6 and the member 27.

As illustrated in Figure 1, the upper end of the shaft 23 at its axial center is provided with a conical center or recess 36 in which is engaged a conoidal center lug or point 37 carried by a flanged thrust bearing plug 38. Interposed between the flange 39 of the plug 38 and the adjacent upper end of the shaft 23 are suitable antifricition members 40 herein disclosed as ball bearings, the opposed faces of the flange 39 and the shaft 23 being provided with suitable raceways for such bearings. Contacting from above with the flange 39 and surrounding the body portion proper of the plug 38 is a coil spring 41, said spring having its opposite end portion bearing against the head 9 of the housing H and surrounding an inwardly disposed positioning lug 42 formed with said head 9. This spring 41 when applied is of a tension to constantly urge the rotor R downwardly or in a direction to further assure the desired effective contact between the opposed faces 28 and 29 of the flange 6 and member 27 respectively.

The face 28 hereinbefore referred to is provided therearound for a desired distance with an elongated groove 43 which in connection with the applied annular member 27, or disc ring as it may be called, provides an intake port. An end portion of this groove or port 43 has in communication therewith from below a passageway 44 which extends outwardly through the flange 6 and up through the flange 7. This passageway 44 is continued by an upstanding suction tube 45 herein disclosed as having its upper or entrance end terminating in relatively close proximity to the applied plate 15.

Adjacent to an end of the groove 43 is a second groove 46 provided in the flat face 28 hereinbefore referred to and which in connection with the

applied member or disc ring 27 provides an exhaust port from an intermediate portion of which there leads from below a passageway 47 formed in the flange 6 and which delivers to the line 48 leading to the evaporator of a mechanical refrigerating apparatus. The face 28 between the outer ends of the grooves 43 and 46 is unobstructed and serves to maintain the entrance port 49 of each of the cylinders 26 sealed during the compression stroke of the associated piston 30. This port 49 is positioned adjacent the outer or closed end of the cylinder 26 and is disposed through the lower portion thereof.

It is believed clearly apparent from the foregoing that with the rotor in action the several pistons 30 will be reciprocated and while the port 49 of a cylinder 26 is in register with the groove 43, the associated piston will operate to suck or draw into the cylinder the desired gas within the lower portion of the housing H and as the port 49 passes from the grooves 43 said port will be closed and maintained closed during the compression stroke of the piston and as the port 49 communicates with the groove 46 the refrigerant, preferably volatile, will flow out through the passageway 47 and pipe line 48 to the evaporator. This operation occurs in succession by the various pistons and their cylinders thus assuring substantially continued flow of the refrigerant.

As before stated, the contact between the faces 28 and 29 assures the desired effective closing of the grooves 43 and 46 and such contact is maintained by the weight of the rotor plus the action of the spring 41. This contact also serves to take up any frictional wear which may occur on such faces 28 and 29.

The lower portion of the wall of each of the cylinders 26 is thickened, as at 26', and disposed through such thickened portion is a passageway 50 disposed on an inward and downward incline. The inner portion of this passageway 50 is restricted to provide a port 51 in communication with the port 49 of the cylinder 26. Slidably mounted in the passageway 50 is a needle valve 52, the periphery of which being grooved, as at 53, for a purpose to be hereinafter referred to. When the rotor is at rest the needle valve 52 by gravity will move inwardly into an open position with respect to the port 51, as illustrated in Figure 1, so that any pressure within said cylinder 26 will be relieved or unloaded. This is of advantage as the starting of the idle pump is materially facilitated together with a material lessening of motor torque. When the rotor becomes active the needle valve 52 by centrifugal force will be moved outwardly and thereby automatically move into a position to close the port 51.

Diagrammatically illustrated in Figure 5 is an operating assembly for the pistons 30' when comprised in a structure materially larger than that hereinbefore described. In this embodiment certain of the rods 31' have their outer portions offset, as at 53', so that said rods will not interfere in any way with each other when the pump is in operation.

As is illustrated in Figure 1, the opposed faces of the mounting ring for the motor field 18 and the side wall of the housing H are provided with registering grooves providing a channel 54 surrounding said field 18. In communication with this channel 54 at one side of the housing H is a port 55 formed in said wall and leading from the top of the housing H and communicating from above with the channel 54. This port 55 has in communication therewith the low or re-

turn pipe line 56 leading from the evaporator of the refrigerating apparatus. At a point preferably diametrically opposed to the communication of the port 55 with the channel 54, said channel 54 also has in communication therewith a channel 57 formed in the side wall of the housing H and leading from below from the channel 54 and delivering within the housing H at a point closely adjacent to but below the plate 15 so that said returned refrigerant may be again circulated through the refrigerating system. By providing this course of return the relatively cold returning gas provides a medium for cooling the motor. It is also to be noted that the cylinders 26 extend above the base member or reservoir 1 so that they may have the benefit of the cooling action of the vapor within the lower portion of the housing H before being carried out through the line 45 under the action of the several pumping units. This lower portion of the housing H or that part below the plate 15 may be termed a refrigerant chamber.

The peripheral portion of the shaft 23 within the bushing 17 is provided therearound with a spiral groove 58, the upper end of which being in communication with an inwardly and radially disposed port 59 indicated by broken lines in Figure 1 which leads to an axially disposed port 60 extending through the shaft 23. The lower portion of this port 60 is directed through the hub 24 and partially through one of the arms 25. The lower end portion of this port 60 is continued by a depending tube 61 having its lower end portion open. When the rotor is in action the oil within the base member or reservoir 1 will pass up through the tube 61 in the port 60 and down through the spiral groove 59 to assure effective lubrication of that portion of the shaft within the sleeve 17.

The lower portion of the spiral groove 58 has in communication therewith a passageway 62 which discharges through the lower end portion of the shaft 23 and upon the bearing 33 or as it may be called eccentric pin. By this means this pin together with the associated strap 32 are effectively lubricated while the centrifugal force created by the rods 31 will cause the oil to flow along the rods to the interior of the pistons to assure an effective lubrication of the connections between the pistons and their rods. If desired the piston skirts may be provided with openings so that the oil may pass therethrough to lubricate the internal walls of the cylinders.

The upper end of the passageway 62 is continued by a further channel 63 disposed axially of the shaft 23 and which communicates with the conical center or recess 36 to assure effective lubrication at that point.

It is also to be stated that when the rotor R is active the depending tube 61 will serve to effect a sufficient splashing of the oil in the base member or reservoir 1 to further lubricate adjacent portions of the mechanism.

It is also believed to be apparent that with the structure as hereinbefore described there is a continuous pull or suction upon the low or return line free of pulsation. While the embodiment of the invention as hereinbefore described has been particularly disclosed for use as a compressor for a refrigerating system this continuous suction free of pulsation permits my improved pump with but slight modification to be employed as a vacuum pump for general use. In the embodiment of my invention as illustrated in Figures 6

and 7 is disclosed a vacuum pump of this character.

As illustrated in Figures 6 and 7 the rotor R' rotates about a horizontally disposed axis as comprised in the shaft 64. This shaft 64 is rotatably disposed through a bearing 65, the outer end of which being integrally formed with the reduced or neck-like portion 66 of the housing H' which forms a part of the stator structure. This restricted or neck-like portion 66 is open at its outer end and the portion 64' of the shaft passing therethrough is preferably reduced in diameter to provide an annular shoulder 67 with which engages a washer 68 freely mounted upon said reduced portion 64'. Interposed between this washer 68 and the cap 69 closing the outer end of the reduced or neck-like portion 66 is an expansible member 70 of desired tension and which operates to constantly urge the shaft 64 inwardly of the housing H'. This member 70, as herein disclosed, comprises a coil spring surrounding the portion 64' of the shaft 64.

The inner portion of the bearing 65 is supported by the spider arms 71 interposed between the inner portion of the bearing 65 and an adjacent portion of the wall of the housing H'. The outer portion of the bearing 65 has provided therethrough an oil passage 72 which is also continued through the lining 73 within the bearing 65, said passage 72 leading from a collecting channel 74 in the upper surface of the bearing 65. The lower portion of the housing H' constitutes a sump 75 for oil and which oil is effectively splashed within the housing H' by the splash fins 76 carried by the peripheral portion of the rotor R' at points spaced circumferentially therearound.

The reduced portion 64' of the shaft 64 extends exteriorly of the housing H' and is coupled, as at 77, in a conventional manner with the drive shaft 78 of a prime mover, such as an electric motor. The reduced or neck-like portion 66 of the housing H', as herein disclosed, is also suitably mounted and secured, as at 79, on a supporting structure 80.

The outer or larger end of the housing H' is closed by a head or cap 81. The peripheral portion of this head or cap 81 is provided with a surrounding flange 82 which overlies an edge face 83 defining the outer or larger end of the housing H', said flange being anchored to the housing H' by the bolts 84 or otherwise. Interposed between the flange 82 and the flat face 83 is a gasket 85 to assure a hermetic connection. The inner face of the head or cap 81 is also provided with an inwardly disposed annular flange 86 which snugly engages within the larger open end of the housing H' and said head or cap 81 inwardly of and immediately adjacent to the flange 86 is formed to provide an annular face 87 concentric to the shaft 64 when the head or cap 81 is in position.

The shaft 64 extends beyond the inner end of the bearing 65 and fixed to said extended portion of the shaft for rotation therewith is the hub 88 comprised in the construction of the rotor R'. Radiating from the hub 88 are the arms 89 preferably three in number or otherwise as may be desired. The outer end portions of the arms 89 are connected to the cylinders 90 having their longitudinal axes substantially radial to the shaft 64. The outer or closed end portions of these cylinders 90 are integrally or otherwise suitably secured to a continuous annular member 91 having direct contact with the annular face

87 hereinbefore referred to. This face 87 and also the opposed face 92 of the annular member 91 are flat and suitably machined or treated to assure a close sealing contact of said faces and which contact is maintained by the action of the member or spring 70 as transmitted through the shaft 64.

Operating within each of the cylinders 90 is a reciprocating piston 93 of desired construction and which cylinder is operatively connected by the coaxing rod 94 with an annular strap 95 which snugly engages and rotates around a bearing 96 provided at the outer portion of a post 97 carried by and extending inwardly from the head or cap 81 at a point to one side of the axial center of the shaft 64 so that the strap 95 is in eccentric relation with respect to the shaft 64.

It is believed to be clearly apparent that as the shaft 64 rotates the pistons 93 will have desired reciprocation within their cylinders 90.

The face 87 is provided practically half way therearound with an elongated groove 98 together with a second groove 99 also extending practically half way therearound, the groove 98 however being to one side of a radius of the face 87 and the second groove at the opposite side of such radius. These grooves 98 and 99 in connection with the applied annular member 91 provide ports, the port 98 being in communication, as at 100, with a suction line and the port 99 being in communication, at 101, with an exhaust line. Each of the cylinders 90 adjacent to its closed end and at a point at all times in advance of its piston 93 is provided with a port 102 which is continued through the annular member 91 and which port in proper sequence has communication with either the port 98 or the port 99.

The cylinders 90 are preferably three in number and equidistantly spaced and in the present embodiment of my invention when a cylinder 90 reaches a point farthest removed from the bearing 96 its piston 93 has reached its maximum suction or withdrawal stroke and which, as disclosed in the accompanying drawings, occurs when the cylinder 90 is at its uppermost position and, as illustrated in Figure 7, where the intake port 98 terminates. As the cylinder continues to advance in its rotary action its port 102 quickly passes over the short sealing surface 103 between the adjacent ends of the ports 98 and 99. The port 102 quickly has desired communication with the exhaust port 99 and the piston 93 starts its exhaust stroke or forward thrust emptying the cylinder 90 into the exhaust port 99 and which action continues until the cylinder 90 reaches its lowermost point of travel whereupon its port 102 will rapidly pass over the sealing surface 103 at the lower part of the surface 87 and the suction stroke or thrust of the piston begins as the port 102 again communicates with the suction port 98.

By having the cylinders equidistantly spaced and three in number it is believed to be apparent that there is at all times at least one piston on its suction stroke and another piston on its exhaust stroke thereby assuring a constant suction through the line 100 without any pulsation or lapsing occurring in the suction line during the operation of the pump.

This application is partly in continuation of my application Serial No. 671,194, filed May 15, 1933.

From the foregoing description it is thought

to be obvious that a pump constructed in accordance with my invention is particularly well adapted for use by reason of the convenience and facility with which it may be assembled and operated, and it will also be obvious that my invention is susceptible of some change and modification without departing from the principles and spirit thereof and for this reason I do not wish to be understood as limiting myself to the precise arrangement and formation of the several parts herein shown in carrying out my invention in practice except as hereinafter claimed.

I claim:—

1. A pump comprising, in combination, a housing, an internal annular face within the housing, an annular member resting upon said face, means for supporting said annular member for rotary movement, means for rotating said member, a cylinder carried by said annular member and extending inwardly thereof, a piston mounted within the cylinder for reciprocating movement, non-rotatable means within the field defined by the annular member for reciprocating said piston when the annular member is in rotation, a wall of said cylinder having a port therethrough, a groove extending along the face within the housing, the coacting annular member closing said groove to provide an intake port, the wall of the housing having a passageway in communication with the groove and the interior of the housing, a second groove in the face of the housing with which the port of the cylinder is also adapted to communicate, the annular member closing said second groove to provide a port, the wall of the housing having a delivery passageway in connection with the second groove, a portion of the face of the housing between the grooves maintaining closed the port of the cylinder as said cylinder travels over said intermediate portion of the face.

2. A pump comprising, in combination, a housing, an internal annular face within the housing, an annular member resting upon said face, means for supporting said annular member for rotary movement, means for rotating said member, a cylinder carried by said annular member and extending inwardly thereof, a piston mounted within the cylinder for reciprocating movement, non-rotatable means within the field defined by the annular member for reciprocating said piston when the annular member is in rotation, a wall of said cylinder having a port therethrough, a groove extending along the face within the housing, the coacting annular member closing said groove to provide an intake port, the wall of the housing having a passageway in communication with the groove and the interior of the housing, a second groove in the face of the housing with which the port of the cylinder is also adapted to communicate, the annular member closing said second groove to provide a port, the wall of the housing having a delivery passageway in connection with the second groove, a portion of the face of the housing between the grooves maintaining closed the port of the cylinder as said cylinder travels over said intermediate portion of the face, and a mounting for the annular member, said mounting allowing said annular member to have movement toward the face of the housing to maintain said annular member and face in close contact and to compensate for wear of said face or annular member.

3. A pump comprising, in combination, a housing, an internal annular face within the housing, an annular member resting upon said face, means for supporting said annular member for rotary

movement, means for rotating said member, a cylinder carried by said annular member and extending inwardly thereof, a piston mounted within the cylinder for reciprocating movement, non-rotatable means within the field defined by the annular member for reciprocating said piston when the annular member is in rotation, a wall of said cylinder having a port therethrough, a groove extending along the face within the housing, the coacting annular member closing said groove to provide an intake port, the wall of the housing having a passageway in communication with the groove and the interior of the housing, a second groove in the face of the housing with which the port of the cylinder is also adapted to communicate, the annular member closing said second groove to provide a port, the wall of the housing having a delivery passageway in connection with the second groove, a portion of the face of the housing between the grooves maintaining closed the port of the cylinder as said cylinder travels over said intermediate portion of the face, said cylinder having an unloading port in communication therewith, and a valve member for closing said unloading port when the annular member is in rotation but moving into open position when said annular member is idle.

4. A pump comprising, in combination, a housing, an internal annular face within the housing, an annular member resting upon said face, means for supporting said annular member for rotary movement, means for rotating said member, a cylinder carried by said annular member and extending inwardly thereof, a piston mounted within the cylinder for reciprocating movement, a non-rotatable means within the field defined by the annular member for reciprocating said piston when the annular member is in rotation, a wall of said cylinder having a port therethrough, a groove extending along the face within the housing, the coacting annular member closing said groove to provide an intake port, the wall of the housing having a passageway in communication with the groove and the interior of the housing, a second groove in the face of the housing with which the port of the cylinder is also adapted to communicate the annular member closing said second groove to provide a port, the wall of the housing having a delivery passageway in connection with the second groove, a portion of the face of the housing between the grooves maintaining closed the port of the cylinder as said cylinder travels over said intermediate portion of the face, and means operatively engaged with the annular member for positively urging the same into contact with the internal face of the housing.

5. A pump comprising, in combination, a housing having an exhaust line and a suction line in communication therewith, a pump unit supported within the housing for travel in a circular path, said unit including a cylinder and a piston reciprocating therein, means for placing the cylinder of said unit in advance of the piston in proper sequence in communication with the exhaust line and the suction line, means to effect the desired reciprocation of the piston and operating only when the unit is travelling in a circular path, the wall of the cylinder having a downwardly inclined passageway in communication with the cylinder in advance of the piston therein, said passageway having an internal valve seat, and a needle valve for coaction with said valve seat slidably engaged within the passageway, the periphery of said needle valve being grooved to

afford communication with the housing, said needle valve when the pump unit is idle moving by gravity into open position to relieve the cylinder of pressure therein in advance of the piston, said needle valve moving by centrifugal force into closed position when the pump unit is in motion.

6. A pump comprising, in combination, a housing having an exhaust line and a suction line in communication therewith, a pump unit supported within the housing for travel in a circular path, said unit including a cylinder and a piston reciprocating therein, means for placing the cylinder of said unit in advance of the piston in proper sequence in communication with the exhaust line and the suction line, means to effect the desired reciprocation of the piston and operating only when the unit is travelling in a circular path, the wall of the cylinder having a downwardly inclined passageway in communication with the cylinder in advance of the piston therein, said passageway having an internal valve seat, a needle valve for coaction with said valve seat slidably engaged within the passageway, the periphery of said needle valve being grooved to afford communication with the housing, said needle valve when the pump unit is idle moving by gravity into open position to relieve the cylinder of pressure therein in advance of the piston, said needle valve moving by centrifugal force into closed position when the pump unit is in motion, and means for limiting the extent of movement by gravity of the needle valve.

7. A pump comprising, in combination, a housing having an internal annular face within the housing, an annular member resting upon said face, means for rotating said member, a cylinder carried by said annular member and extending inwardly thereof, a piston mounted within the cylinder for reciprocating movement, fixed means within the field defined by the annular member for reciprocating said piston when the annular member is in rotation, a wall of said cylinder having a port therethrough, a groove extending along the face within the housing, the coating annular member closing said groove to provide an intake port, the wall of the housing having a passageway in communication with the groove and the interior of the housing, a second groove in the face of the housing with which the port of the cylinder is also adapted to communicate, the annular member closing said second groove to provide a port, the wall of the housing having a delivery passageway in connection with the second groove, a portion of the face of the housing between the grooves maintaining closed the port of the cylinder as said cylinder travels over said intermediate portion of the face, a mounting for the annular member, said mounting allowing said annular member to have movement toward the face of the housing to maintain said annular member and face in close contact and to compensate for wear of said face or annular member, and means coating with the mounting of the annular member for positively urging the annular member into contact with the internal face of the housing.

8. A pump comprising, in combination, a housing having an internal annular face within the housing, an annular member resting upon said face, means for rotating said member, a cylinder carried by said annular member and extending inwardly thereof, a piston mounted within the cylinder for reciprocating movement, non-rotatable means within the field defined by the annular member for reciprocating said piston when the

annular member is in rotation, a wall of said cylinder having a port therethrough, a groove extending along the face within the housing, the coating annular member closing said groove to provide an intake port, the wall of the housing having a passageway in communication with the groove and the interior of the housing, a second groove in the face of the housing with which the port of the cylinder is also adapted to communicate, the annular member closing said second groove to provide a port, the wall of the housing having a delivery passageway in connection with the second groove, a portion of the face of the housing between the grooves maintaining closed the port of the cylinder as said cylinder travels over said intermediate portion of the face, a motor within the housing above the annular member, an upstanding shaft at the axial center of the annular member, a bearing for the shaft, said shaft having both rotary and endwise movement with respect to the bearing, an operative connection between the motor and the shaft, an operative connection between the shaft and the annular member, and means engaging the upper portion of the shaft for positively urging said shaft in a direction to maintain the annular member in close contact with the annular face of the housing.

9. A pump comprising, in combination, a housing having an internal annular face within the housing, an annular member resting upon said face, means for rotating said member, a cylinder carried by said annular member and extending inwardly thereof, a piston mounted within the cylinder for reciprocating movement, fixed means within the field defined by the annular member for reciprocating said piston when the annular member is in rotation, a wall of said cylinder having a port therethrough, a groove extending along the face within the housing, the coating annular member closing said groove to provide an intake port, the wall of the housing having a passageway in communication with the groove and the interior of the housing, a second groove in the face of the housing with which the port of the cylinder is also adapted to communicate, the annular member closing said second groove to provide a port, the wall of the housing having a delivery passageway in connection with the second groove, a portion of the face of the housing between the grooves maintaining closed the port of the cylinder as said cylinder travels over said intermediate portion of the face, a motor within the housing above the annular member, an upstanding shaft at the axial center of the annular member, a bearing for the shaft, said shaft having both rotary and endwise movement with respect to the bearing, an operative connection between the motor and the shaft, an operative connection between the shaft and the annular member, means engaging the upper portion of the shaft for positively urging said shaft in a direction to maintain the annular member in close contact with the annular face of the housing, the cylinder being comprised in the operative connection between the shaft and annular member.

10. A pump comprising, in combination, a housing, said housing having an internal annular face, an annular member resting upon said face, a shaft, means for rotating the shaft, arms radiating from the shaft and connected to the annular member, the outer portions of the arms being formed to provide inwardly facing cylinders, pistons working within the cylinders, means for reciprocating said pistons when the shaft and

annular member are in rotation, said last named means being within the field defined by the annular member and eccentric to the axial center thereof, a wall of each of the cylinders having a port therethrough, a groove extending along the face within the housing, the coacting annular member closing said groove to provide an intake port, the wall of the housing having a passageway in communication with the groove and the interior of the housing, a second groove in the face of the housing with which the port of the cylinder is also adapted to communicate, the annular member closing said second groove to provide a port, the wall of the housing having a delivery passageway in connection with the second groove, a portion of the face of the housing between the grooves maintaining closed the port of the cylinder as said cylinder travels over said intermediate portion of the face.

11. A pump comprising two members supported for relative rotation, one of said members constituting a shaft and the other a housing, said shaft having endwise movement, means for rotating one of said members, the housing having an internal annular face, an annular member contacting with said face, a plurality of cylinders interposed between and carried by the shaft and annular member, said cylinders being spaced apart circumferentially around the shaft with the bores thereof substantially radial to the center of the housing, pistons working within the cylinders, means for reciprocating said pistons upon relative rotation of the members, a wall of each cylinder having a port therethrough, the annular face within the housing being provided with arcuate grooves with which the port of each of the cylinders successively communicates, the annular member closing said grooves, the housing having an inlet in communication with one of said grooves and having an exhaust in communication with a second groove, each of said grooves being of a length to assure at all times during relative rotation of the members in communication therewith of the port of a cylinder to produce a suction free of pulsation, and means for urging the shaft in one direction to maintain the annular member in close contact with the internal annular face of the housing.

12. A pump comprising, in combination, a housing, said housing having an internal annular face, an annular member resting upon said face, a shaft, said shaft having endwise movement, means for rotating the shaft, arms radiating from the shaft and connected to the annular member, the outer portions of the arms being formed to provide inwardly facing cylinders, pistons working within the cylinders, means for reciprocating said pistons when the shaft and annular member are in rotation, said last named means being

within the field defined by the annular member and eccentric to the axial center thereof, a wall of each of the cylinders having a port therethrough, a groove extending along the face within the housing, the coacting annular member closing said groove to provide an intake port, the wall of the housing having a passageway in communication with the groove, a second groove in the face of the housing with which the port of the cylinder is also adapted to communicate, the annular member closing said second groove to provide a port, the wall of the housing having a delivery passageway in connection with the second groove, a portion of the face of the housing between the grooves maintaining closed the port of the cylinder as said cylinder travels over said intermediate portion of the face, said grooves being substantially of the same length and at opposite sides of a radial diameter of the annular member, and means for urging the shaft in one direction to maintain the annular member in close contact with the internal annular face of the housing.

13. A pump comprising, in combination, a housing, said housing having an internal annular face, an annular member resting upon said face, a shaft, said shaft having endwise movement, means for rotating the shaft, arms radiating from the shaft and connected to the annular member, the outer portions of the arms being formed to provide inwardly facing cylinders, pistons working within the cylinders, means for reciprocating said pistons when the shaft and annular member are in rotation, said last named means being within the field defined by the annular member and eccentric to the axial center thereof, a wall of each of the cylinders having a port therethrough, a groove extending along the face within the housing, the coacting annular member closing said groove to provide an intake port, the wall of the housing having a passageway in communication with the groove, a second groove in the face of the housing with which the port of the cylinder is also adapted to communicate, the annular member closing said second groove to provide a port, the wall of the housing having a delivery passageway in connection with the second groove, a portion of the face of the housing between the grooves maintaining closed the port of the cylinder as said cylinder travels over said intermediate portion of the face, each of said grooves extending substantially half way around the annular face and positioned at opposite sides of a radial diameter of said annular member, and means for urging the shaft in one direction to maintain the annular member in close contact with the internal annular face of the housing.

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