Oct. 16, 1962 W. GEMEINHARDT 3,058,428

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Filed July 20, 1960 3 Sheets-Sheet 1

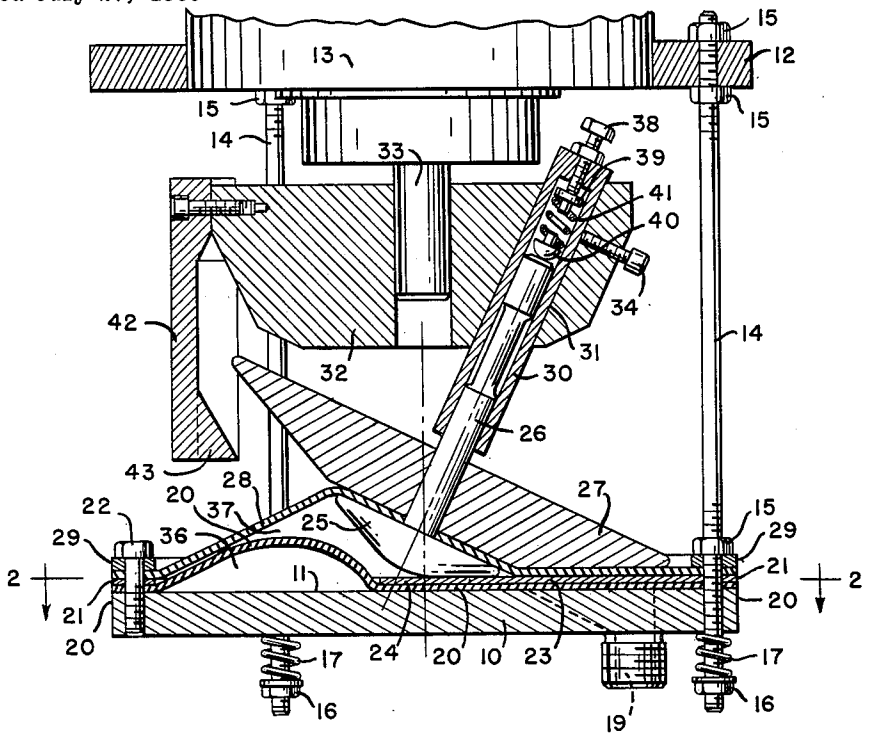


FIG. 1

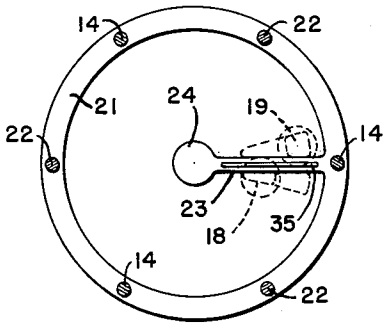


FIG. 2

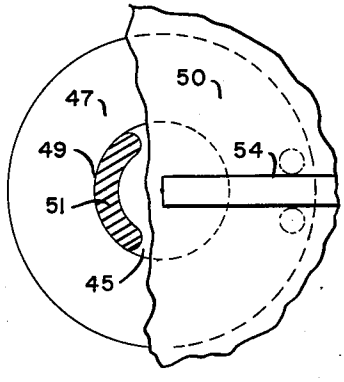


FIG. 4

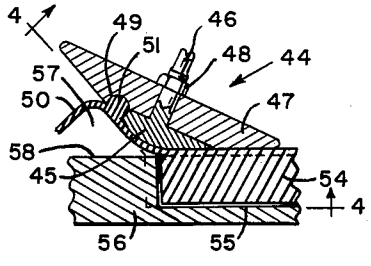


FIG. 3

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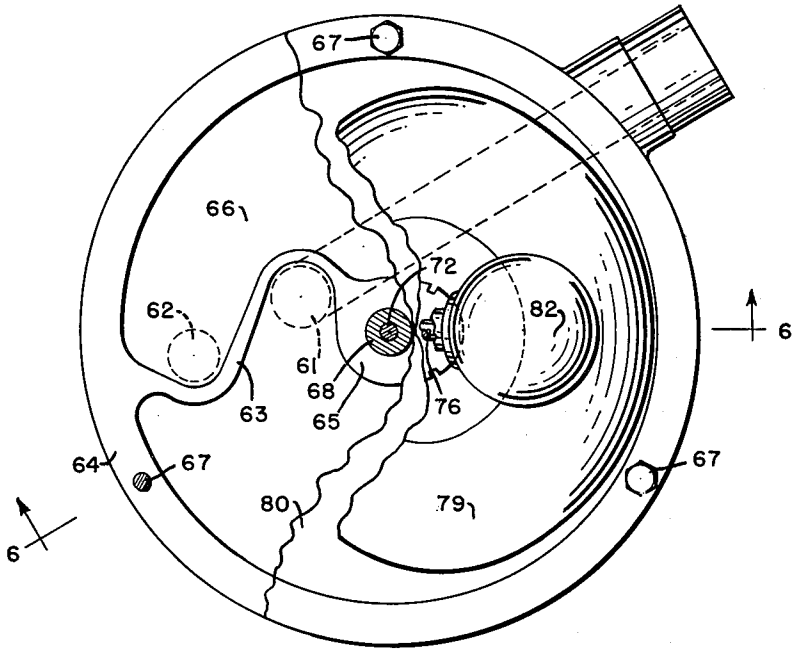


FIG. 5

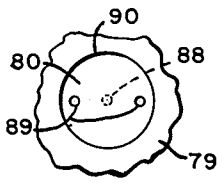


FIG. 7

FIG. 6

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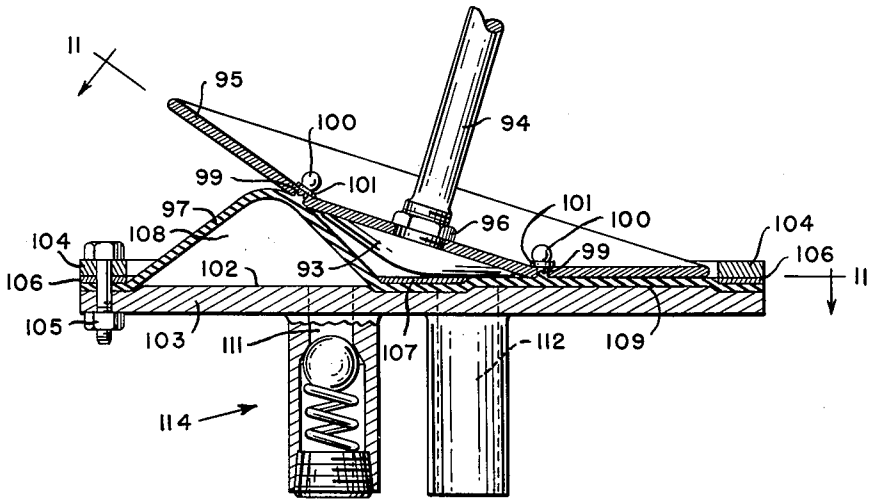


FIG. 10

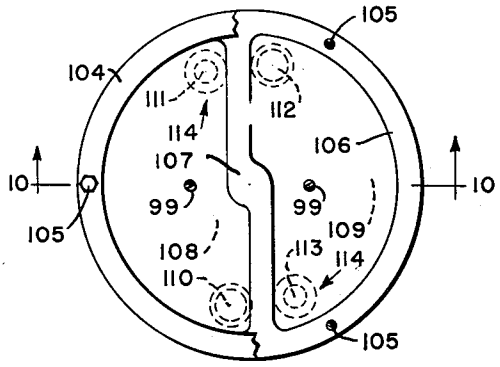


FIG. 11

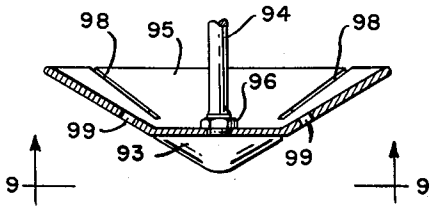


FIG. 8

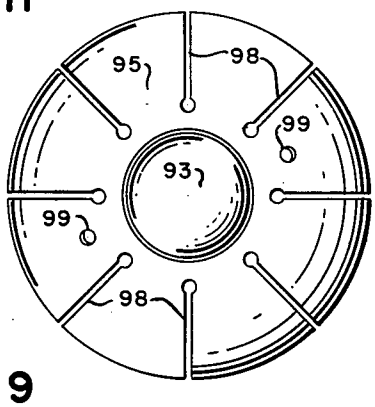


FIG. 9

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United States Patent Office 3,058,428
Patented Oct. 16, 1962

3,058,428

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Filed July 20, 1960, Ser. No. 44,177
19 Claims. (Cl. 103—150)

The present invention relates to pumps for moving liquids, gases and liquids containing corrosive and/or abrasive materials, and particularly to a new and improved reversible, positive displacement, self-priming pump employing a wobble cone principle. By "wobble cone" is meant a conical member, with an element thereof in contact with a reaction surface, is caused to move in such a path that its axis along the altitude of the conical member as well as all elements of the conical member move in a conical path such that every element of the conical member successively engages the reaction surface.

An object of the invention is to provide a reversible, positive displacement, self-priming pump in which only one moving element is involved.

Another object of the invention is to provide such a pump having few geometrically simple parts which are easily changeable and replaceable.

Another object of the invention is to provide such a pump in which the pumping chamber is completely isolated from the moving part so that no contamination of the fluid being pumped will be caused by the operation of the single moving part.

Another object of the invention is to provide such a pump having a nearly continuous flow.

Still another object of the invention is to provide such a pump in which diaphragm means may be caused to form a resilient chamber between an inlet and outlet port in a reaction surface, which ports are separated by divider means held in sealing relation with said surface, and in which the diaphragm means is progressively collapsed during each pumping cycle.

Still another object of the invention is to provide such a pump in which no sliding or rubbing occurs between parts within the pump chamber.

Still another object of the invention is to provide such a pump in which plural diaphragms are arranged relative to a reaction surface such that the progressive movement of one away from the reaction surface during a cycle of operation causes the other to follow it, thereby forming a resilient, collapsible chamber between two ports in said reaction surface.

Another object of the invention is to provide such a pump in which a wobble plate having a conical surface acts on diaphragm means between said surface and a reaction surface to progressively collapse a resilient chamber between inlet and outlet ports in said reaction surface.

In one aspect of the invention, a member having a reaction surface, which in the embodiments disclosed is shown as a plane surface, may be provided with inlet and outlet ports extending through said member and located in spaced relation. A first resilient, circular diaphragm may have its peripheral edge sealingly fixed to said plane surface about a circle of less diameter than the diaphragm so that it bulges and forms a resilient chamber between the plane surface and the diaphragm.

In another aspect of the invention, a divider member may be held aganst the diaphragm between the inlet and outlet ports in a manner to hold said diaphragm along a radial line between said ports at all times in sealing engagement with said plane surface.

In still another aspect of the invention, a conical member may be supported such that an element of the conical surface thereof is parallel with, and slightly spaced from,

the plane surface. A second resilient diaphragm having substantially the same area as the first may be fixedly attached to the conical member at a point slightly spaced from its apex, and the peripheral edge of said diaphragm may be held in sealing contact with the plane surface. The spacing of the element of the conical surface of the conical member from the plane surface may be such that both diaphragms are forced into sealing engagement with the plane surface along a radial line.

In still another aspect of the invention, the altitude axis of the conical member may be caused to move along a path that defines a cone, causing said conical member to have imparted to it a "wobble" action.

In another aspect of the invention, the space between the two diaphragms may be filled with liquid. This liquid may include self-healing ingredients so that should a leak develop in either diaphragm, it will be sealed by the self-healing liquid.

In still another aspect of the invention, a single diaphragm may be employed between the conical member and the plane surface, and in which case the diaphragm may be sealingly held against the plane surface along a radial line between the inlet and outlet ports, while a substantial arcuate portion of the diaphragm may be fixed to the surface of the conical member at a location spaced from the apex thereof.

The above, other objects and novel features of the invention will become apparent from the following specification and accompanying drawings which are merely exemplary.

In the drawings:

FIG. 1 is a sectional elevational view of a pump to which the principles of the invention have been applied;

FIG. 2 is a sectional view of a reduced size, taken substantially along line 2—2 of FIG. 1;

FIGS. 3 and 4 are views of a modified form of the invention;

FIGS. 5, 6 and 7 are views of another modified form of the invention; and

FIGS. 8, 9, 10 and 11 are views of still another modified form of the invention.

Referring to the drawings, and particularly to FIG. 1, the principles of the invention are shown as applied to a pump including a base member 10 having a plane surface 11. The member 10 may be attached to a frame 12 of a prime mover 13 by bolts 14 and spacing nuts 15, as well as nuts 16 and spring means 17 for a purpose to be described later.

Inlet and outlet ports 18 and 19 (FIG. 2) may extend through the member 10 and may terminate in the plane surface 11. A circular diaphragm 20 may be confined within a circular area of surface 11 of less diameter than the diaphragm 20 by annular ring 21 and bolts 22. It may be made of soft rubber or plastic with or without reinforcement since, as will appear hereinafter, the diaphragm 20 is operated under balanced pressure, thereby substantially relieving it of stress and strain. The annular ring 21 may include a radial divider strip 23 terminating in a circular plate portion 24 at the center of the annular member 21. The strip 23 may lie between the inlet and outlet ports 18 and 19. A conical member 25 may be fixed to a shaft 26 extending along the altitude axis of the conical member 25. A frustoconical member 27 may be fixed to shaft 26 holding between it and cone member 25, a resilient diaphragm 28. The diaphragm 28 may be of reinforced flexible rubber, plastic, metal or the like, and its diameter may also be greater than the outer diameter of the annular ring 21 within which diameter it is confined by an annular locking ring 29 held to member 10 by bolts 22.

The shaft 26 may be journaled in a sleeve 30 that is slidingly received within a hole 31 in a member 32 fixed

to the output shaft 33 of the prime mover 13. The hole 31 is angularly disposed relative to the axis of shaft 33, and the sleeve 30 is adjustably fixed within this hole by a set screw 34. The angularity of hole 31 and the axial position of sleeve 30 therein are such that an element of the conical surface of the conical member made up of members 25 and 27 forces the diaphagms 28 and 20 into sealing engagement with the plane surface 11 along a radial line. With such cooperation, the conical member 25 engages the plate portion 24 of the divider 23 and ensures that the strip 23 is rigidly held against the diaphragm 20 at all times, forcing it into sealing engagement along a radial line between the ports 18 and 19. To increase the unit pressure ensuring this sealing action, a wire or ridge 35 may be fixed to the surface of strip 23 in contact with diaphragm 20.

The fact that the diaphragm 20 is greater in diameter than the circle within which it is confined causes it to form an arcuate pocket 36 extending arcuately from the one side of strip 23 to the other. The chamber 37 may be filled with a liquid which may include ingredients that seal any leaks that may develop in the diaphragms 20 and 28. Additionally, the liquid within chamber 37 acts to provide with the fluid being pumped a balanced pressure condition on each side of diaphragm 20, thereby substantially relieving it of stress and strain.

It is to be noted that the axis of shaft 26 does not intersect the axis of shaft 33 at the point of contact between cone 25 and plate 24, but rather at a point substantially above this point of contact. Practically, the shaft 26 is adjusted for optimum conditions of movement about a conical path. This adjustment may be effected roughly by manually setting the sleeve 30 within hole 31 and locking it with screw 34. Fine adjustment may be effected by turning a screw 38 which acts on plungers 39 and 40 through a spring 41. The plunger 40 contacts the end of shaft 26 opposite that which is connected to cone 25. Counterweight means 42 may be fixed to member 32 in order to balance the additional mass attached to it, i.e., the cone made up of members 25, 27 and sleeve 30. A rib 43 may be fixed to the internal surface of the counterweight 42 and it will act to cool and clean the wobble cone 27 and diaphragm 28 during a pumping operation.

Rotation of the member 32 by energizing the prime mover 13 causes the axis of shaft 26 to move along a conical path, thereby imparting a wobbling action to the conical members 25, 27. This wobbling action causes each of the infinite number of elements of the conical surface of conical members 25, 27 to successively come into contact and force the diaphragms 20, 28 into progressively sealing relation with the plane surface 11 throughout 360°. Since the divider strip will prevent any communication between the inlet and outlet ports 18 and 19, except when the elements of the conical members 25, 27 move from the trailing side of port 19 to the leading side of port 18, the fluid entering pocket 36 from the inlet 18 is positively forced ahead of the successive elements of conical members 25, 27 as its axis moves in a conical path. This action forces the fluid out of the outlet 19. The springs 17 act to permit member 10 to move away from the conical members 25, 27 should an obstruction be lodged between them and member 10.

Inasmuch as each element of the conical surface of the conical members 25, 27 repeatedly contacts the diaphragms 20, 28 at the identical spot, a groove may be provided along the element of the conical member that falls along the divider strip 23, or a groove may be provided within the surface 11 of plate 10 in order to accommodate the thickness of said divider strip, if such is desired.

Referring to FIGS. 3 and 4, the principles of the invention are shown as applied to a modified form of the invention, including a cone member 44 composed of a conical element 45 that is fixed to a shaft 46. A frusto-conical member 47 may be attached to shaft 46 by a nut 48. The conical member 47 may be provided with a kidney-shaped recess 49 of substantially circular cross section. A single diaphragm 50 may be provided with an arcuate rib 51 thereon adapted to be received within the recess 49. A rib 54, integral with the diaphragm 50, may extend radially from the center thereof and outwardly from the acruate rib 51. The rib 54 may have a dovetail cross section for reception within a dovetail groove 55 formed in a base member 56 similar to member 10 of FIG. 2. The groove 55 may pass between inlet and outlet ports similar to the ports 18 and 19 of FIG. 1 (not shown in FIG. 5). The rib 54 serves as a divider strip in the same way that rib 23 of FIG. 1 functions. Movement of shaft 46 about a conical path causes the diaphragm 50 to form an arcuate chamber 57 between it and a plane surface 58 on member 56. The chamber 57 extends from one side of the rib 54 to the other side, and as the elements of the conical member 44 progressively move into contact with the diaphragm 50, the portion of chamber 57 on one side of a contacting element is in communication with the inlet to the pump, while the portion of chamber 57 on the other side of said element is in communication with the outlet of the pump.

The pump constructions disclosed on FIGS. 1 to 4, inclusive, are reversible. Thus, when rotating the altitude axes along a conical path in a clockwise direction (FIG. 2), port 18 is the inlet and port 19 the outlet; and during counter-clockwise rotation of such axes, port 19 is the inlet and port 18 the outlet.

Referring to FIGS. 5, 6 and 7, the principles of the invention are shown as applied to a hand-operated, unidirectional pump including a base plate 59 having a plane surface 60. Inlet and outlet ports 61 and 62 may extend through the plate 59 and terminate in the plane surface 60. The ports 61 and 62 may be spaced radially relative to each other and closely spaced arcuately, so that both ports preferably are substantially tangent to a common radial line between them. A divider strip 63 may extend from an annular member 64 and may encircle opposite side portions of each port 61, 62, terminating in a circular plate 65 at the center of the annular member 64. A first diaphragm 66, similar to diaphragm 20, may be mounted between the annular member 64 and the plane surface 60 of plate 59, and the two may have their peripheral edges sealingly fixed to plate 59 by bolts 67.

A headed fastener 68 may extend through openings in plate 65, plate 59 and diaphragm 66. A handle 69 may be threaded onto fastener 68, and it may include a gripping surface having finger-receiving grooves 70 thereon. A shaft 71 may include a portion 72 that is journaled within a cylindrical passage extending axially through the fastener 68 and a bearing 73 within the handle 69. A spring 74, acting between the one end of fastener 68 and a pin 75 in shaft portion 72, resiliently urges the shaft portion 72 into bearing 73. The shaft 71 may also include a portion 76 that is angularly disposed relative to portion 72.

A frusto-conical disk 77 may be journaled on the portion 76 and it may include a sleeve portion 78 integral therewith. Another frusto-conical member 79 may be clamped to sleeve 78 by a nut 81 threaded on the sleeve 78, with a second diaphragm 80 between the two frusto-conical members. The outer peripheral edge of the second diaphragm may also be held in sealing relation with the peripheral edge of the diaphragm 66 by the bolts 67.

The angularity of the portion 76 of shaft 71 relative to the portion 72 is such that he conical members 77 and 79 contact the diaphragm 80 along an element of the conical members and force the two diaphragms, along this element, into sealing contact with the plane surface 60 of base member 59.

A handle 82 may be attached to the outer end of sleeve 78, and a spring 83 may act between the end of sleeve 78 and a pin 84 in shaft portion 76, forcing the conical members 77, 79 into contact with the diaphragm 80. The described construction resiliently supports the conical members 77, 79 in contact with the diaphragm 80, forcing it and diaphragm 66 into contact with the plane surface 60 of member 59. The outlet 62 may be provided with a check valve 85 including a ball 86 and a spring 87 of predetermined strength.

The frusto-conical member 77 may be provided with an air passage 88, and the diaphragm 80 may include air passages 89 in spaced relation relative to passage 88. The frusto-conical member 79 may include a hole 90 circumscribing the spaced air passages 89.

For the foregoing it is evident that movement of the portion 76 of shaft 71 about a conical path will cause the diaphragms 80 and 66 to be progressively forced into contact with the plane surface 60. Depending upon the predetermining strength of spring 87, pressure within the chamber 91 will be substantially above atmosphere, hence exhausting the air in chamber 92 between the diaphragms 80 and 66 through the air passages 88 and 89. This will create a partial vacuum within the chamber 92 so that in succeeding movements of shaft portion 76 in a conical path, the diaphragm 66 will be sucked toward diaphragm 80, maintaining the chamber 91 in the form shown in FIG. 6.

The embodiment shown in FIGS. 5 and 6 may be operated by holding handle 69 in one hand or by any other suitable means, and using the other hand to grip handle 82 and move the shaft portion 76 about a conical path.

Referring to FIGS. 8, 9, 10 and 11, a still further modified form of the invention is shown as embodied in another type of uni-directional pump. It may include a conical element 93 fixed to a shaft 94. A sheet metal frusto-conical member 95 may be attached to shaft 94 by a nut 96 with a single diaphragm 97 (FIG. 10) held rigidly to the elements 93 and 95. The sheet metal member 95 may be provided with radial slots 98 which provide resiliency to the frusto-conical member 95. Diametrically-disposed apertures 99 may be provided in the member 95, and knob-like protuberances 100 on diaphragm 97 may extend through the apertures 99. C-shaped connectors 101 may partially encircle the necks formed by the knob-like protuberances 100 to rigidly hold the diaphragm 97 to the conical member 95.

The peripheral edge of diaphragm 97 may be sealingly held in contact with a plane surface 102 of a base plate 103 similar to plate 10 of FIG. 1, by annular member 104 and bolts 105. Another annular member 106 may also be held between member 104 and the peripheral edge of diaphragm 97 by bolts 105. The member 106 may include a diametrically-disposed divider bar 107 (FIG. 11) which divides the space between diaphragm 97 and surface 102 into two chambers 108 and 109. Although the divider bar 107 is disclosed in a form to provide two chambers 108 and 109, it is evident that it may comprise more than two arms extending from the center thereof, in which case a plurality of chambers will be formed. Referring to FIG. 11, inlet and outlet ports 110 and 111 may be provided within plate 103 in communication with chamber 108; and, inlet and outlet ports 112 and 113 may be provided in plate 103 in communication with chamber 109. Check valves 114 similar to check vale 85 may be included within outlet ports 111 and 113.

From the foregoing it is evident that a plurality of separate pumps are provided in the single structure shown in FIGS. 8 to 11, inclusive.

Although the various features of the new and improved pump have been shown in detal to fully disclose several embodiments of the invention, it will be evident that changes may be made in such details and certain features may be used without others without departing from the principles of the invention.

What is claimed is:

1. In a pump, a base member having a reaction surface; spaced inlet and outlet ports extending through said base member; a conical member having an axis coincident with its altitude supported in position relatively to said reaction surface such that an element of the conical surface of said conical member lies substantially in contact with said reaction surface; diaphragm means between said conical member and reaction surface, connected to said conical member and having its periphery sealingly held in contact with said reaction surface; stationary divider means between said ports; means for holding said divider means in sealing contact with said reaction surface; and means for moving the altitude axis of said conical member in a conical path such that all elements of the conical surface of said conical member successively contact said diaphragm means and force it progressively into sealing engagement with said reaction surface during the movement of said altitude axis throughout said conical path.

2. In a pump, a base member having a reaction surface; spaced inlet and outlet ports extending through said base member; a conical member having an axis coincident with its altitude supported in position relatively to said reaction surface such that an element of the conical surface of said conical member lies substantially in contact with said reaction surface; diaphragm means between said conical member and reaction surface, connected to said conical member and having its periphery sealingly held in contact with said reaction surface; stationary divider means between said ports; means for holding said divider means in sealing contact with said reaction surface; means for moving the altitude axis of said conical member in a conical path such that all elements of the conical surface of said conical member successively contact said diaphragm means and force it progressively into sealing engagement with said reaction surface during the movement of said altitude axis throughout said conical path; and resilient means for urging said conical member into contact with said diaphragm means.

3. In a pump, a base member having a reaction surface; spaced inlet and outlet ports extending through said base member; a conical member having an axis coincident with its altitude supported in position relatively to said reaction surface such that an element of the conical surface of said conical member lies substantially in contact with said reaction surface; diaphragm means between said conical member and reaction surface, connected to said conical member and having its periphery sealingly held in contact with said reaction surface; means for causing said diaphragm means to form a chamber between said reaction surface and said diaphragm means; stationary divider means between said ports; means for holding said divider means in sealing contact with said reaction surface; and means for moving the altitude axis of said conical member in a conical path such that all elements of the conical surface of said conical member successively contact said diaphragm means and force it progressively into sealing engagement with said reaction surface during the movement of said altitude axis throughout said conical path.

4. In a pump, a base member having a reaction surface; spaced inlet and outlet ports extending through said base member; a conical member having an axis coincident with its altitude supported in position relatively to said reaction surface such that an element of the conical surface of said conical member lies substantially in contact with said reaction surface; diaphragm means between said conical member and reaction surface, connected to said conical member and having its periphery sealingly held in contact with said reaction surface; stationary divider means between said ports, said divider means having a bearing plate at the center of said diaphragm means; means for urging a portion of said conical member adjacent its apex in contact with said bearing plate; and means for moving the altitude axis of said conical member in a conical path such that all elements of the conical

surface of said conical member successively contact said diaphragm means and force it progressively into sealing engagement with said reaction surface during the movement of said altitude axis throughout said conical path.

5. In a pump, a member having a reaction surface; spaced inlet and outlet ports extending through said member; a conical member having an axis coincident with its altitude supported such that an element of the conical member lies substantially in contact with said reaction surface; a resilient diaphragm having its periphery held in sealing contact with said reaction surface within an area less than that of said diaphragm to thereby cause it to buckle forming a chamber between the reaction surface and the diaphragm; a divider strip on top of said diaphragm, between said ports and maintained in position to hold a strip of said diaphragm in sealing relation with said reaction surface between said ports; another diaphragm, fixed to said conical member and having its periphery held in sealing contact with said reaction surface in such manner to provide a chamber between said diaphragms; and means for moving the altitude axis of said conical member about a conical path to thereby progressively force both said diaphragms into sealing engagement with said reaction surface.

6. In a pump, a member having a reaction surface; spaced inlet and outlet ports extending through said member; a conical member having an axis coincident with its altitude supported such that an element of the conical member lies substantially in contact with said reaction surface; a resilient diaphragm having its peripheral edge held in sealing contact with said reaction surface within an area less than that of said diaphragm to thereby cause it to buckle forming a chamber between the reaction surface and the diaphragm; a divider strip on top of said diaphragm, between said ports and maintained in position to hold a strip of said diaphragm in sealing relation with said reaction surface between said ports; another diaphragm, fixed to said conical member and having its peripheral edge held in sealing contact with said reaction surface in such manner to provide a chamber between said diaphragms; means for moving the altitude axis of said conical member about a conical path to thereby progressively force both said diaphragms into sealing engagement with said reaction surface; and means for adjusting said conical member along its altitude axis to position it for optimum movement about said conical path.

7. In a pump, a member having a reaction surface; spaced inlet and outlet ports extending through said member; a conical member having an axis coincident with its altitude supported such that an element of the conical member lies substantially in contact with said reaction surface; a resilient diaphragm having its peripheral edge held in sealing contact with said reaction surface within an area less than that of said diaphragm to thereby cause it to buckle forming a chamber between the reaction surface and the diaphragm; a divider strip on top of said diaphragm, between said ports and maintained in position to hold a strip of said diaphragm in sealing relation with said reaction surface between said ports; another diaphragm, fixed to said conical member and having its peripheral edge held in sealing contact with said reaction surface in such manner to provide a chamber between said diaphragms; a liquid between said diaphragms filling the space therebetween; and means for moving the altitude axis of said conical member about a conical path to thereby progressively force both said diaphragms into sealing engagement with said reaction surface.

8. In a pump, a member having a reaction surface; spaced inlet and outlet ports extending through said member; a conical member having an axis coincident with its altitude supported such that an element of the conical member lies substantially in contact with said reaction surface; a resilient diaphragm having its peripheral edge held in sealing contact with said reaction surface within an area less than that of said diaphragm to thereby cause it to buckle forming a chamber between the reaction surface and the diaphragm; a divider strip on top of said diaphragm, between said ports and maintained in position to hold a strip of said diaphragm in sealing relation with said reaction surface between said ports; another diaphragm, fixed to said conical member and having its peripheral edge held in sealing contact with said reaction surface in such manner to provide a chamber between said diaphragms; a motor having a driver connected to its output shaft; and means for connecting said conical member along its altitude axis to said driver along and axis angularly disposed relatively to the axis of said motor output shaft to thereby cause the movement of the altitude axis of said conical member about a conical path and to progressively force both diaphragms into sealing engagement with said reaction surface.

9. In a pump, a member having a reaction surface; spaced inlet and outlet ports extending through said member; a conical member having an axis coincident with its altitude supported in position relatively to said reaction surface such that an element of the conical surface of said conical member lies substantially in contact with said reaction surface; a single diaphragm between and contacting said conical member and reaction surface and having its periphery sealingly held in contact with said reaction surface; stationary divider means between said ports; means on said conical surface for causing a portion of said diaphragm to remain in contact therewith at all times; and means for moving the altitude axis of said conical member in a conical path such that all elements of the conical surface of said conical member successively contact said diaphragm and force it progressively into sealing engagement with said reaction surface during the movement of said altitude axis throughout said conical path.

10. In a pump, a member having a reaction surface; spaced inlet and outlet ports extending through said member; a conical member having an axis coincident with its altitude supported in position relatively to said reaction surface such that an element of the conical surface of said conical member lies substantially in contact with said reaction surface; a single diaphragm between and contacting said conical member and reaction surface and having its periphery sealingly held in contact with said reaction surface; a rib integral with said diaphragm on the side contacting said reaction surface; a groove in said reaction surface for receiving said rib; means on said conical surface for causing a portion of said diaphragm to remain in contact therewith at all times; and means for moving the altitude axis of said conical member in a conical path such that all elements of the conical surface of said conical member successively contact said diaphragm and force it progressively into sealing engagement with said reaction surface during the movement of said altitude axis throughout said conical path.

11. In a pump, a member having a reaction surface; spaced inlet and outlet ports extending through said member; a conical member having an axis coincident with its altitude supported in position relatively to said reaction surface such that an element of the conical surface of said conical member lies substantially in contact with said reaction surface; a single diaphragm between and contacting said conical member and reaction surface and having its periphery sealingly held in contact with said reaction surface; stationary divider means between said ports; an arcuate groove in the surface of said conical member on the opposite side thereof that cooperates with said divider means; a corresponding arcuate ridge on the exposed surface of said diaphragm adapted to be received within said arcuate groove; and means for moving the altitude axis of said conical member in a conical path such that all elements of the conical surface of said conical member successively contact said diaphragm and force it progressively into sealing engagement with said

reaction surface during the movement of said altitude axis throughout said conical path.

12. In a pump, a member having a reaction surface; spaced inlet and outlet ports extending through said member; a conical member having an axis coincident with its altitude supported in position relatively to said reaction surface such that an element of the conical surface of said conical member lies substantially in contact with said reaction surface; a single diaphragm between and contacting said conical member and reaction surface and having its periphery sealingly held in contact with said reaction surface; a rib integral with said diaphragm on the side contacting said reaction surface; a groove in said reaction surface for receiving said rib; an arcuate groove in the surface of said conical member on the opposite side thereof that cooperates with said rib; a corresponding arcuate ridge on the exposed surface of said diaphragm adapted to be received within said arcuate groove; and means for moving the altitude axis of said conical member in a conical path such that all elements of the conical surface of said conical member successively contact said diaphragm and force it progressively into sealing engagement with said reaction surface during the movement of said altitude axis through said conical path.

13. In a pump, a base member including a reaction surface; inlet and outlet ports extending through said base member, said ports being spaced radially, and arcuately located relatively to each other such that they are substantially tangent at opposite sides to a radial line extending between them; a conical member having an axis coincident with its altitude supported in position relatively to said reaction surface such that an element of the conical surface of said conical member lies substantially in contact with said reaction surface; diaphragm means between said conical member and reaction surface, connected to said conical member and having its periphery sealingly held in contact with said reaction surface; stationary divider means extending between said ports; means for holding said divider means in sealing contact with said reaction surface; and means for moving the altitude axis of said conical member in a conical path such that all elements of the conical surface of said conical member successively contact said diaphragm means and force it progressively into sealing engagement with said reaction surface during the movement of said altitude axis throughout said conical path.

14. In a pump, a base member including a reaction surface; inlet and outlet ports extending through said base member, said ports being spaced radially, and arcuately located relatively to each other such that they are substantially tangent at opposite sides to a radial line extending between them; a conical member having an axis coincident with its altitude supported such that an element of the conical member lies substantially in contact with said reaction surface; a resilient diaphragm having its periphery held in sealing contact with said reaction surface within an area less than that of said diaphragm to thereby cause it to buckle forming a chamber between the reaction surface and the diaphrgam; a divider strip on top of said diaphragm, between said ports and maintained in position to hold a strip of said diaphragm in sealing relation with said reaction surface between said ports; another diaphragm; fixed to said conical member and having its periphery held in sealing contact with said reaction surface in such manner to provide a chamber between said diaphragms; and means for moving the altitude axis of said conical member about a conical path to thereby progressively force both said diaphragms into sealing engagement with said reaction surface.

15. In a pump, a base member including a reaction surface; inlet and outlet ports extending through said base member, said ports being spaced radially, and arcuately located relatively to each other such that they are substantially tangent at opposite sides to a radial line extending between them; a conical member having an axis coincident with its altitude supported such that an element of the conical member lies substantially in contact with said reaction surface; a resilient diaphragm having its periphery held in sealing contact with said reaction surface within an area less than that of said diaphragm to thereby cause it to buckle forming a chamber between the reaction surface and the diaphragm; a divider strip on top of said diaphragm, between said ports and maintained in position to hold a strip of said diaphragm in sealing relation with said reaction surface between said ports; another diaphragm, fixed to said conical member and having its periphery held in sealing contact with said reaction surface in such manner to provide a chamber between said diaphragms; a bent shaft for moving the altitude axis of said conical member about a conical path to thereby progressively force both said diaphragms into sealing engagement with said reaction surface; valve means for exhausting the chamber between said diaphragms; and a check valve within said outlet port.

16. In a pump, a base member including a reaction surface; inlet and outlet ports extending through said base member, said ports being spaced radially, and arcuately located relatively to each other such that they are substantially tangent at opposite sides to a radial line extending between them; a conical member having an axis coincident with its altitude supported such that an element of the conical member lies substantially in contact with said reaction surface; a resilient diaphragm having its periphery held in sealing contact with said reaction surface within an area less than that of said diaphragm to thereby cause it to buckle forming a chamber between the reaction surface and the diaphragm; a divider strip on top of said diaphragm, between said ports and maintained in position to hold a strip of said diaphragm in sealing relation with said reaction surface between said ports; another diaphragm, fixed to said conical member and having its periphery held in sealing contact with said reaction surface in such manner to provide a chamber between said diaphragms; a handle attached to said base member; and another handle attached to said conical member.

17. In a plural pump unit, a base member including a reaction surface; plural sets of inlet and outlet ports extending through said base member; a conical member having an axis coincident with its altitude supported in position relatively to said reaction surface such that an element of the conical surface of said conical member lies substantially in contact with said reaction surface; diaphragm means between said conical member and reaction surface, connected to said conical member and having its peripheral edge sealingly held in contact with said reaction surface; stationary divider means separating said plural sets of inlet and outlet ports; check valves in said outlet ports; and means for moving the altitude axis of said conical member in a conical path such that all elements of the conical surface of said conical member successively contact said diaphrgam means and force it progressively into sealing engagement with said reaction surface during the movement of said altitude axis throughout said conical path.

18. In a plural pump unit, a base member including a reaction surface; plural sets of inlet and outlet ports extending through said base member; a conical member having an axis coincident with its altitude supported in position relatively to said reaction surface such that an element of the conical surface of said conical member lies substantially in contact with said reaction surface; a single diaphragm between said conical member and reaction surface and having its peripheral edge sealingly held in contact with said reaction surface; stationary divider means separating said plural sets of inlet and outlet ports; check valves in said outlet ports; means between said diaphragm means and said conical member for holding a portion of said diaphragm means in contact with

said conical member at points cooperative with each set of ports; and means for moving the altitude axis of said conical member in a conical path such that all elements of the conical surface of said conical member successively contact said diaphragm means and force it progressively into sealing engagement with said reaction surface during the movement of said altitude axis throughout said conical path.

19. In a pump, a base member having a reaction surface; spaced inlet and outlet ports extending through said base member; a sheet metal conical member having an axis coincident with its altitude and having radial slots therein supported in position relatively to said reaction surface such that an element of the conical surface of said conical member lies substantially in contact with said reaction surface; diaphragm means between said conical member and reaction surface, connected to said conical member and having its periphery sealingly held in contact with said reaction surface; stationary divider means between said ports; means for holding said divider means in sealing contact with said reaction surface; and means for moving the altitude axis of said conical member in a conical path such that all elements of the conical surface of said conical member successively contact said diaphragm means and force it progressively into sealing engagement with said reaction surface during the movement of said altitude axis throughout said conical path.

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