

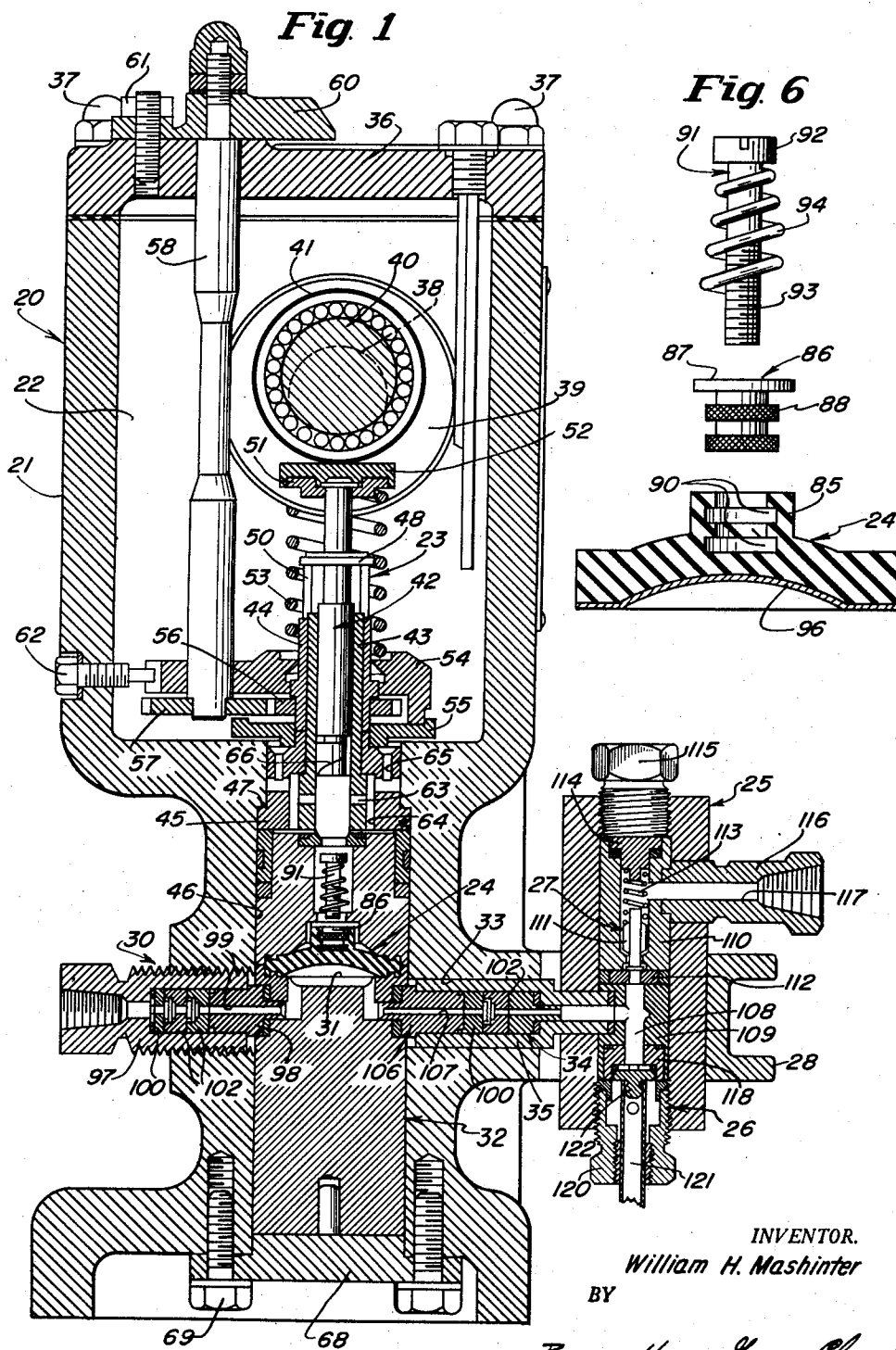
Aug. 9, 1960

W. H. MASHINTER
DIAPHRAGM TYPE PUMP

2,948,223

Filed Jan. 21, 1958

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig 2

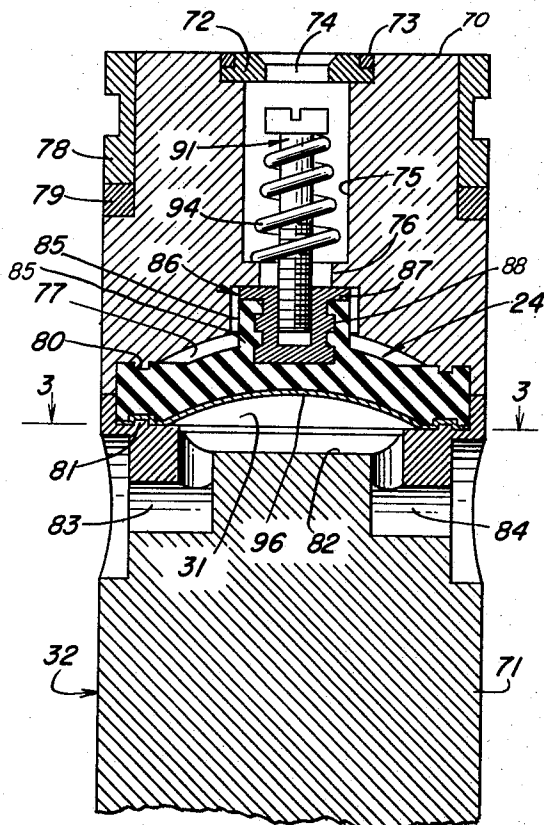


Fig 4

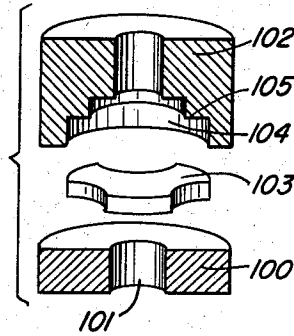


Fig 5

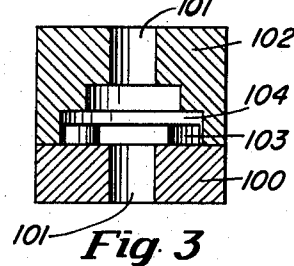


Fig 3

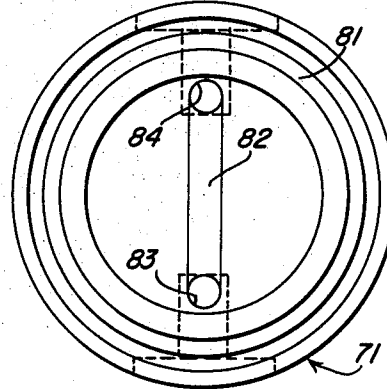
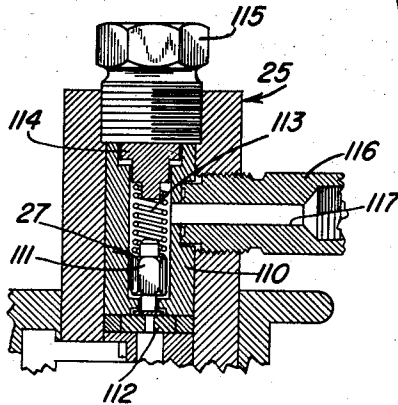


Fig 7



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DIAPHRAGM TYPE PUMP

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6 Claims. (Cl. 103—44)

The invention relates to pumps and in particular to diaphragm pumps of packless construction especially designed for pumping fluids of a chemical or corrosive nature and which will pump said fluids and other difficult to handle materials as well as ordinary liquids in measured quantities at high pressures and in an accurate and precise manner for discharge over a wide output flow range.

The improvements of the invention have been incorporated in pumping apparatus of the diaphragm type and accordingly a flexible diaphragm element is provided for pumping the various liquids supplied to the pump, the said diaphragm element being so constructed and arranged with other elements of the pumping unit as to be particularly effective in handling the noncondensable gases which are generally entrained in the liquids being pumped and which, if not properly discharged along with the liquids, might otherwise accumulate within the pumping chamber to the extent where the metering accuracy of the pump is either destroyed or the pump becomes entirely inoperative as a pumping instrumentality.

A more specific object of the invention is to provide a pump wherein the pumping chamber thereof has an ejection groove or hydraulic ejection passage in its bottom wall and which connects the inlet and outlet openings of the chamber, whereby the flow path for the liquid being pumped is approximately confined to the said passage so that the entrained gases and vapors are caused to travel along with the liquid and are thus prevented from accumulating within the said pumping chamber.

Another object resides in the provision of a pump having a pumping chamber incorporating an elastomeric diaphragm hermetically sealed around its edges and having an ejector groove or hydraulic ejection passage formed in its bottom wall and connecting the inlet and outlet openings of said chamber. On downward movement of the flexible diaphragm as it rolls inwardly from its outer peripheral edges, the diaphragm acts with a squeezing action to displace liquid, thereby forcing the same through the groove or ejection passage into the discharge outlet of the pump. The downward movement of the diaphragm augmented by the above squeezing action results in imparting progressively increased fluid velocity to more rapidly force the fluid from the pump chamber. The downward movement of the diaphragm results in imparting kinetic energy to the liquid of such magnitude as to force the liquid from the chamber with almost explosive force. Thus the passageway functions to keep the entrained gas, air bubbles or vapors in rapid motion and to cause them to be swept along to the discharge outlet.

Another object of the invention is to provide a pump having a flexible diaphragm hermetically sealed to a body reagent head with inlet and outlet openings therein so as to form a unitary pumping device. For pumping chemicals or corrosive fluids the invention contemplates that the diaphragm on its pumping chamber side will be surfaced with a chemically resistant resin polymer sheet or

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a flexible metallic covering and which may be bonded to the diaphragm or employed as a separate element having flexing movement therewith.

Another and more specific object of the invention is to provide an elastomeric diaphragm with a molded-in top piece of metal or the like, and wherein said metal top piece functions as a protective valve member in coaction with a protective integral valve seat assembly provided by the housing of the pump to form a protective integral valve assembly whereby damage to the diaphragm, which otherwise might occur, due to extremely high supply pressure, is prevented.

A further object is to provide a diaphragm type of pump wherein the flexible diaphragm thereof has a coil spring operatively associated therewith for positively returning the diaphragm on its suction stroke to its starting position, in which position the capacity of the pumping chamber is approximately a maximum.

A further object is to provide a diaphragm type of pump wherein the flexible diaphragm is conveniently and hermetically sealed around its periphery by structural elements formed integral with coating members and which may be removed from the pump housing as a unit easily and quickly to facilitate repair and replacement of the pumping instrumentality.

A still further object is to provide a pump such as described wherein the inlet and outlet valve assemblies will incorporate valve members of the flat, light-weight type and which are adapted to contact flat seating surfaces whereby the valves are quick-acting, positive in seating, and wherein they operate in a self-cleaning manner which renders the valves especially suited for high pressure pumping and for handling liquids containing particles in suspension.

With these and other objects in view, the invention may consist of certain novel features of construction and operation as will be more fully described and particularly pointed out in the specification, drawings and claims appended thereto.

In the drawings, which illustrate an embodiment of the invention, and wherein like reference characters are used to designate like parts—

Figure 1 is a vertical sectional view taken substantially through the center of the diaphragm type pump embodying the improved features of the present invention;

Figure 2 is a vertical sectional view taken through the pumping unit and showing said unit on a slightly enlarged scale to better illustrate the flexible diaphragm and the protective valve assembly associated therewith;

Figure 3 is a top plan view taken substantially along line 3—3 of Figure 2, the same showing the ejection groove or hydraulic ejection passage as formed in the body reagent head of the present pump;

Figure 4 is an exploded view illustrating the several elements comprising the valve assembly for the inlet and outlet openings of the present pump;

Figure 5 is a sectional view of the parts when the valve elements are assembled with the flat valve member in closed position on its seat;

Figure 6 is an exploded view showing the various parts comprising the diaphragm pumping element and the protective valve member; and

Figure 7 is a fragmentary view showing the spring-loaded discharge valve.

Referring first of all to Figure 1, the invention is embodied in a pump indicated in its entirety by numeral 20 and which includes a housing 21 generally rectangular in shape, having an oil reservoir chamber 22, a plunger pumping assembly 23 located within the upper portion of the housing, and having a flexible diaphragm pumping element 24 located in the lower portion of the

housing. A third assembly 25 provides a housing for the vapor and gas venting unit 26 in addition to a housing for the spring-loaded discharge valve assembly 27, the combined structural unit being releasably secured to the lower portion of the pump housing by the retaining member 28 which thereby permits removal of the unit for speedy servicing of the pump.

The lower portion of the housing approximately opposite the assembly 25 has an inlet valve assembly 30 threaded in the walls thereof and which functions to admit liquids to be pumped to the pumping compartment 31 of the unitary pumping assembly 32. The inlet valve assembly 30 is disposed on a horizontal plane and the same has connection with the pumping compartment 31 at its extreme right hand end, all of which will be explained in detail as the description proceeds. Diametrically opposite the inlet valve assembly 30 the lower portion of housing 21 is bored at 33 for receiving the outlet valve assembly 34 and which is likewise horizontally disposed, being positioned on the same plane as the inlet valve assembly. The projecting end of the tubular member 35 of the outlet valve assembly has interfitting relation with housing 25 and the parts communicate with each other through said projecting end. Also, the parts are clamped in position on the housing and maintained in assembled relation by the member 28.

The oil reservoir chamber 22 may contain a quantity of oil to the level as indicated in Figure 1, and said chamber is closed by the top plate 36 suitably secured to the housing by the cap screws such as 37. The drive shaft for the pump, indicated by numeral 38, extends through opposed side walls of the reservoir chamber, being suitably journaled in said side walls by the ball bearing assemblies 39 and between the said assemblies the shaft is provided with an eccentric lobe 40 on which is mounted a roller bearing assembly having an outer race 41. The plunger pumping assembly 23 is disposed vertically within the oil reservoir chamber 22 and the same essentially consists of the metering plunger 42, the plunger sleeve 43, the outer sleeve 44, and the sleeve retainer 45. The retainer is inserted within the central bore 46 formed in the base end of the housing and said retainer is positioned by contact thereof with shoulder 47. The sleeve 43 extends upwardly through the retainer, being in turn positioned and held thereby in vertical relation within the oil reservoir chamber. The metering plunger 42 is adapted to reciprocate within sleeve 43 and it will be observed that the plunger is provided with ears 48 disposed adjacent the upper end thereof and which are adapted to ride in slots 50 formed in the upper end of the outer sleeve 44. As a result thereof, any rotation imparted to sleeve 44 is directly transmitted to the plunger. The top terminal end of the plunger is provided with an upper spring seat 51 and with the tappet 52, said tappet being held in contact with race 41 on the eccentric lobe 40 by the coil spring 53, which is confined between the upper spring seat 51 and the lower spring seat 54. The action of the coil spring is to maintain the plunger in elevated position with the tappet 52 in contact with the eccentric lobe 40. The lower spring seat 54 is supported and positioned by the support 55, and within the space formed by these coacting elements there is located the pinion 56, which is fixed to the outer sleeve 44. The gearing 57 has meshing relation with pinion 56 and said gear is rotated by the quantity control shaft 58 journaled at its lower end by the lower spring seat 54 and at its upper end by the top plate 36, with the upper projecting end of shaft 58 having the indicator 60 suitably fixed thereto. The lock nut 61 can be used to lock the indicator and associated parts in adjusted metering position, whereas the lock screw 62 is associated with the lower spring seat 54 to prevent rotation of the spring seat.

The reciprocating movements of plunger 42 function

to apply hydraulic pulsations to the flexible diaphragm pumping element 24 and accordingly the sleeve 43 is provided with one or more ports such as 63 and which lead to a peripheral chamber 64 provided by the retainer 45 and which chamber surrounds the sleeve 43 and has a number of vertical passages 65 leading upwardly to connect with reservoir chamber 22. Accordingly, the oil from the reservoir chamber will flow downwardly through passages 65 into chamber 64 and through one or more of the ports 63 to within the sleeve 43 so that the end of the plunger 42 will have pumping action thereon. The plunger is provided with an inclined helical ramp 66 which makes it possible to vary the quantity of oil acted on by the plunger by adjusting its rotative position with respect to the port or ports 63. The ramp of the plunger need not necessarily have a helical inclination as other configurations may be resorted to, depending on the pumping characteristics desired. Also the ramp may be referred to as the scroll surface of the helix, since by rotation of the quantity control shaft 58 the sleeve 44, and thus the plunger 42, are rotated to secure any desired operative position of the said scroll surface for producing the hydraulic pulsations as described to effect pumping actions of the flexible diaphragm pumping element 24.

The unitary pumping assembly 32 is located within the bore 46 formed in the lower portion of the pump housing and said assembly is conveniently maintained in place by the bottom closure plate 68 secured to the housing by the bolts such as 69. As best shown in Figure 2, the unitary pumping assembly essentially consists of a valve seat member 70, a body reagent head 71, and the flexible diaphragm pumping element 24. The top end of the valve seat member 70 is recessed to receive the retainer disc 72 which is provided with the seal 73. The opening 74 in the retainer disc 72 is in alignment with the passage extending from within the sleeve 43 and continuing through the central bore 75 formed in the valve seat member. Said bore intermediate its length has a reduced diameter to form the shoulder 76 and beyond the shoulder the bore connects with the diaphragm chamber 77 formed by coaction of the valve seat member 70 with the body reagent head 71. For sealing member 70 within bore 46 the member carries the sleeve 78 and which is associated with the pressure seal 79.

The flexible diaphragm pumping element 24 is confined between the valve seat member 70 and the body reagent head 71, being hermetically sealed around its peripheral edges by the said parts and for which purpose the same are formed with annular projections such as 80 and 81. The diaphragm 24 accordingly divides the chamber 77 into two compartments, the one above the diaphragm having communicating relation with bore 75, and with the interior of sleeve 43 so that the hydraulic pulsations developed therein are applied to the top surface of the said diaphragm. The other compartment 31 below the diaphragm functions as the pumping compartment for the pump and the same has its bottom surface formed by the body reagent head 71. In accordance with the invention, the head 71 is provided with a diametrically or circumferentially extending groove 82 and which is accordingly formed in the bottom wall of the pumping compartment, having connecting relation with the inlet and outlet openings 83 and 84, respectively. Referring to Figure 6, the top surface of the diaphragm 24 is formed to provide a central boss 85 which is cored centrally for receiving the valve member 86. Said member 86 has a flat top plate 87 and intermediate annular projections 88 which are knurled on their periphery. The cored opening in the boss 85 has annular recesses 90 formed therein whereby its shape is substantially complementary to that of the valve member, which is molded in place simultaneously with the molding of the diaphragm. The lock screw 91, having head 92 and threads

93, is threadedly secured to valve member 86 and thus to the diaphragm 24 so that the diaphragm, valve member and lock screw constitute a unit and which is caused to pulsate with the pulsating flows of the fluids as effected by reciprocating movement of the plunger 42. It will be observed from Figure 2 that the flat top plate 87 of the valve member is adapted to contact shoulder 76, the parts being resiliently held in contacting relation by coil spring 94. The coil spring has encircling relation with the lock screw 91 and is confined between the head 92 and the shoulder 76.

The diaphragm pumping element 24 may be formed of any suitable elastomeric material, as, for example, natural rubber, neoprene, "Hycar," butyl rubber, and other synthetic rubbers provided they have sufficient flexibility for such a diaphragm and adequate strength to withstand the constant pulsations to which such a diaphragm is subjected. Also, in accordance with the invention, the diaphragm, on the side adjacent the pumping compartment, is preferably surfaced with a covering 96 such as will resist the corrosive action of the fluids such as may be pumped by the present device. Said covering may comprise a thin film or layer securely bonded to the diaphragm, or the said covering may be entirely separate therefrom. Whether the said covering is bonded or unbonded, the same may comprise a chemically resistant polymer sheet such as polytetrafluoroethylene, polymonochlorotrifluoroethylene, or a polyterephthalate resin. The invention further contemplates that the covering may consist of a flexible metallic sheet and which may be gold, tantalum, silver, zirconium or titanium. Of course, clamping of the diaphragm together with its bonded or unbonded covering is important since localized stresses at the clamping point are not desired. The said diaphragm 24 is clamped around its peripheral edges and which constitute the starting points for the diaphragm on a pressure stroke, it being understood that the diaphragm will roll inwardly from its edges to compress the liquid within the pumping compartment and force the same through the valved outlet. The action of the diaphragm on a pumping stroke takes place against the tension exerted by the coil spring 94 and accordingly the spring implements the flexibility of the diaphragm in returning the same to its original inflated position, in which position of the diaphragm the capacity of the pumping compartment is substantially a maximum.

The valve elements for the inlet and outlet valve assemblies are shown in Figure 4 in somewhat enlarged form, and in Figure 5 the said elements have been illustrated in assembled relation with the flat valve member in closed position on its seat. For the inlet valve the threaded casing or housing 97 is suitably threaded into an opening provided therefor in the wall of the pump housing. Referring to Figures 1 and 2, the insert 98, having passage 99 therein, has inserted relation in the inlet opening 83 in the body reagent head 71 and the said insert functions to retain in assembled relation a plurality of elements which comprise the valve proper. Referring to Figures 4 and 5, said elements include a base 100 and a cage 102, both having a center opening 101, and a flat valve member 103. The said valve member is light in weight and the same has a shape formed by the scalloped edges, as shown in Figure 4. The flat valve member is supported on the flat surface of base 100 and the member is enclosed within the space 104, formed by the stepped surfaces of the cage 102. The stepped surfaces form the annular shoulder 105 and when the parts are assembled the said shoulder limits the upward movement of member 103 in an opening direction. For the inlet valve assembly one base 101 and a pair of cages 102 are employed, with a flat valve member for each case. Additional cages could be employed, with each one having a valve member, since, as the cages are repeated, the bottom one forms a base member for the cage supported thereby.

The discharge valve assembly 34 is similar in all basic

respects to that of the valve inlet assembly. However, the sleeve 35 has a sliding fit within bore 33 and said sleeve retains the insert 106. The insert has a central passage 107 extending therethrough and the same has inserted relation in the discharge opening 84 in the body reagent head 71. A base 100 and a cage 102 are retained in operative relation within the sleeve 35 to form the discharge valve.

The projecting end of the sleeve 35 communicates with passage 108 provided in member 109 retained by assembly 25. The assembly 25 also retains a member 110 comprising one element of a spring-loaded discharge valve 27. The said valve essentially consists of the valve element 111 having contact with a valve seat member 112 and which is resiliently retained in valve closing position on said seat member by the coil spring 113. The plug 114 provides the upper seat for the coil spring 113 and said plug is held in position by the threaded nut 115. The outlet connection 116 provides the discharge passage 117 through which the liquid discharged by the pump is caused to flow.

When the pump is initially started, or started after a long period of inactivity, the pumping compartment 31 and connecting passageways leading to the inlet and outlet valve assemblies must be completely vented of all gas, air and vapor. A venting device 26 is accordingly provided, the same including the tubular valve seat member 118 and the threaded retaining nut 120, which is suitably threaded to housing 25. The bleeder tube 121 is in turn threaded to the nut 120 and by means of a ball connection the bleeder valve member 122 is loosely fixed to the inner end of said tube. When the tube is retracted by rotating the same for a number of turns in a releasing direction, valve member 122 is accordingly released to thus open the venting passages whereby some of the gas, air and vapors within the pumping compartment 31 will escape on each pumping stroke of the diaphragm. However, on a suction stroke the valve member 122 will automatically close since it will be drawn shut by the suction effect. In order to permit this mode of operation and to assure proper seating of the valve member 122 some play or looseness is purposely provided by the ball connection of the member with its bleeder tube. Eventually all gas and vapor will be vented from the pumping compartment and thereafter a quantity of liquid will be discharged from the bleeder tube on each pumping stroke. This is an indication for the operator to close the venting valve member against its seat by reversing the rotation of bleeder tube 121.

On the down stroke of the plunger 42 the pumping action thereof does not become effective until the scroll surface 66 has passed the ports 63. From there on the plunger will act on the oil below the same and within the passageway to produce a pumping action on the diaphragm 24. The extent to which the diaphragm will be flexed in a down direction will therefore depend on the rotative position of the plunger and thus the quantity of liquid acted on per stroke can be varied from zero to a maximum. Additional control of the pumping action is possible since the delivery rate of the pump can be varied by adjusting the speed of rotation of the drive shaft.

The hydraulic pulsations applied to the oil by the plunger 42 are in turn applied to the diaphragm 24 to produce a flexing movement of the diaphragm from its fully open position, as shown in Figures 1 and 2, to a fully or partially closed position. In said fully open position the fluid occupying the space under the diaphragm will be a maximum in quantity. As the said diaphragm is caused to move downwardly in a closing direction the diaphragm will roll inwardly from its clamped peripheral edges, and the fluid within the pumping compartment will be displaced to a progressively increasing extent so that eventually the fluid is forced through the discharge valves

and into the discharge outlet of the pump. The diaphragm acts with a squeezing action to displace the fluid in the pumping chamber so that the same is caused to flow from the compartment at an extremely rapid rate. This rapid flow of fluid is materially facilitated by the groove 82 which may be termed an hydraulic ejection passage since the fluid being pumped, and which may have non-condensable gases entrained therein, is swept along said passage and into the discharge outlet of the pump. Accordingly, the gases are prevented from accumulating within the pumping compartment. This is particularly so when the diaphragm is flexed to its full extent so as to eject all the fluid within the pumping compartment. In other words, substantially all the fluid taken in on a suction stroke is ejected on the next pumping stroke and as a result the gases and/or vapors entrained in the fluid are swept along the passage to the outlet. In fact, the velocity of flow is sufficiently great to sweep along any bubbles that may cling to the walls of the operating parts.

The valve assembly comprising the valve member 86 and the valve seat 76 in surrounding relation with the passageway communicating with the plunger 42, provides a protective type of valve for maintaining a balanced condition of the liquid pressures in the compartment above the diaphragm with respect to the fluid pressures in the pumping compartment below the diaphragm. The action of the coil spring 94 is to maintain the valve member 86 against its seat 76, in which position of the parts the valve is closed. Also in this position the diaphragm is fully open. Assuming that the plunger 42 is moving downwardly to displace the liquid within the passageway, it will be understood that eventually the liquid will reach a pressure sufficient to cause a downward flexing movement of the diaphragm, and, accordingly, the protective valve will be opened, thereby connecting the passageway with the chamber 77 above the diaphragm. The diaphragm will continue to flex in a downward direction as a progressively increasing pressure is applied to the diaphragm by continued downward movement of the plunger, and this pulsing action of the diaphragm will continue until the same is in flat contact with the bottom wall of the pumping chamber. Upon upward movement of the plunger on the suction stroke, the liquid pressure on the diaphragm is progressively reduced and the tension of the coil spring 94 is immediately effective to return the diaphragm to its fully open position.

The invention is not to be limited to or by details of construction of the particular embodiment thereof illustrated by the drawings, as various other forms of the device will of course be apparent to those skilled in the art without departing from the spirit of the invention or the scope of the claims.

What is claimed is:

1. In a pump, the combination with a housing providing a reservoir chamber, said housing having a central bore extending from the reservoir chamber to the opposite end of the housing, means including a diaphragm pumping assembly located within the bore, a plunger pumping assembly located in the reservoir chamber in alignment with the bore, said diaphragm pumping assembly including a valve seat member, a body reagent head and a flexible diaphragm sealed around its peripheral edge by being confined between the member and head, whereby the diaphragm forms a pumping compartment with said reagent head and which provides the end wall of the compartment, said head having spaced inlet and outlet openings formed therein and connecting with the pumping compartment, the said body reagent head also having a groove extending from the inlet opening to the outlet opening and which is located in the end wall of the pumping compartment, said groove forming an hydraulic ejection passage for facilitating flow of fluids having non-condensable gases entrained therein, and a

covering for the diaphragm for covering the surface thereof exposed to the fluids being pumped in the pumping compartment, said covering also being confined between the member and head to form a seal therewith and said covering consisting of a material having sufficient flexibility to pulsate with the diaphragm.

2. In a pump of the character described, a pump housing providing a reservoir chamber for containing a fluid, a pumping chamber also provided by the housing, said housing having a passageway connecting the reservoir chamber with the pumping chamber, a flexible diaphragm pumping element in the pumping chamber and which divides the chamber into two compartments, one compartment connecting through the passageway with the reservoir chamber, the other comprising the pumping compartment and having a valved inlet and a valved outlet, means in associated relation with the passageway and with the reservoir chamber for pulsating the flexible diaphragm by producing pulsating flows of said liquid, whereby fluid to be pumped is drawn in through the valved inlet and discharged through the valved outlet, a groove formed in the end wall of the pumping compartment and connecting the valved inlet with the valved outlet, said groove comprising an hydraulic ejection passage to facilitate the flow of fluids from the pumping compartment on a pumping stroke of the diaphragm, a protective valve assembly for controlling the pulsating flows of fluid in the said passageway, said protective valve assembly including a valve seat provided by the housing in surrounding relation with the passageway and a protective valve member fixed to the diaphragm and adapted to have opening and closing action with respect to the seat, and a coil spring in associated relation with the diaphragm for yieldingly maintaining said diaphragm in a fully open position with the valve member in contact with its seat.

3. In a pump of the character described, a pump housing having an oil reservoir chamber and having a central bore extending from the reservoir chamber to the opposite end of the housing, a valve seat member in the bore and having a passageway connecting with the reservoir chamber, a body reagent head also located in the bore beyond the seat member, a flexible diaphragm between the seat member and reagent head and sealed around its periphery by being clamped between the parts, whereby the hydraulic space on one side of the diaphragm communicates with the reservoir chamber through the passageway and whereby the space on the other side of the diaphragm comprises a reagent pumping compartment, said body reagent head having spaced openings formed in the same and connecting with the pumping compartment to provide an inlet and an outlet opening in the end wall of said compartment, a protective valve assembly in associated relation with the diaphragm, said protective valve assembly including a protective valve member fixed to the diaphragm and located in the hydraulic space on one side of the diaphragm, and a valve seat provided by the valve seat member and comprising a shoulder extending inwardly of the passageway upstream of the valve member, and a resilient coil spring also having contact with the shoulder and operative to yieldingly maintain the valve member in contact with its valve seat.

4. A pump of the character as defined by claim 3, wherein the body reagent head has a groove therein connecting the inlet opening with the outlet opening and which is thereby located in the end wall of the pumping compartment to facilitate flow of fluids from the compartment on a pumping stroke of the diaphragm.

5. In a pump, in combination, a housing providing a reservoir chamber and said housing having a central bore extending from the reservoir chamber to adjacent the opposite end of the housing, a body reagent head located in the bore at the opposite end thereof and providing a relatively flat pumping compartment wall, a

valve seat member also located in the bore intermediate the length of the bore and said member forming a pumping chamber with the body reagent head, said valve seat member having a passage longitudinally thereof for connecting the pumping chamber with the said reservoir chamber, a flexible diaphragm located in the pumping chamber and being sealed around its peripheral edge by being confined between the body reagent head and the valve seat member, whereby the diaphragm divides the pumping chamber into two compartments, one compartment connecting through the passage with the reservoir chamber and the other comprising a pumping compartment, a valved inlet and a valved outlet for said pumping compartment and which provide diametrically spaced passages extending to the pumping compartment wall of the body reagent head for connecting with the pumping compartment, a plunger pumping assembly located in the reservoir chamber for pulsating the diaphragm by producing pulsating flows of said liquid within the passage in the valve seat member, whereby fluid to be pumped is drawn in through the valved inlet and discharged through the valved outlet, and said body reagent

head having a groove in the pumping compartment wall thereof and connecting the inlet passage with the outlet passage, said groove forming an hydraulic ejection passage for facilitating flow of fluids having non-condensable gases entrained therein.

6. A pump of the character as defined in claim 5, additionally including a covering for the diaphragm for covering that surface thereof exposed to the fluids being pumped in the pumping compartment, said covering being bonded to the diaphragm and consisting of a relatively thin layer of a chemically resistant material.

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