

May 15, 1962

C. W. KRUCKEBERG

3,034,450

HAND OPERATED DIAPHRAGM PUMP

Filed May 9, 1956

3 Sheets-Sheet 1

FIG. 2

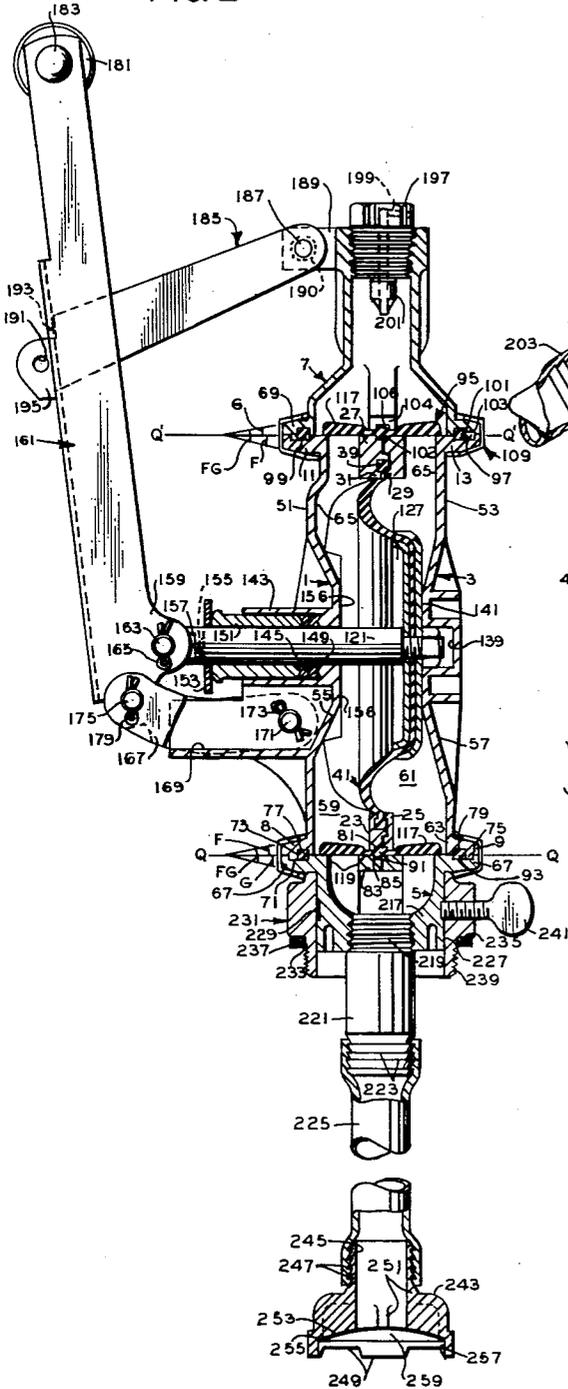
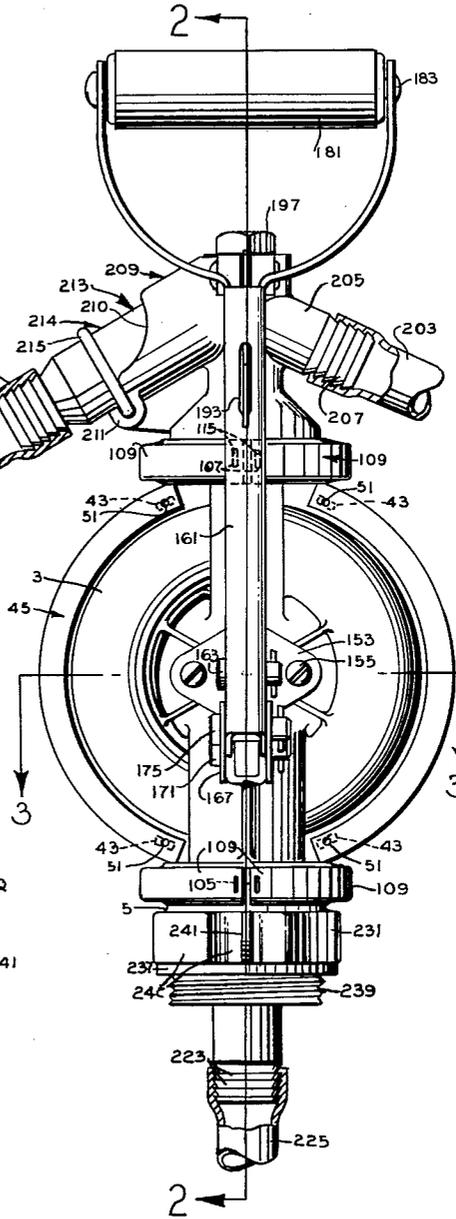


FIG. 1



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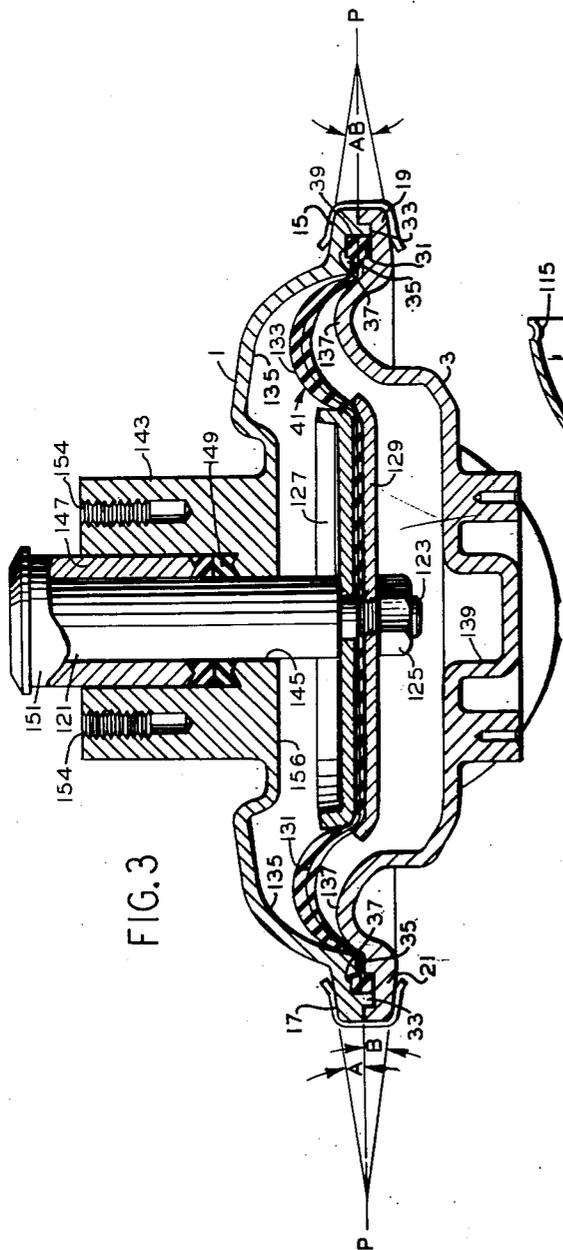


FIG. 3

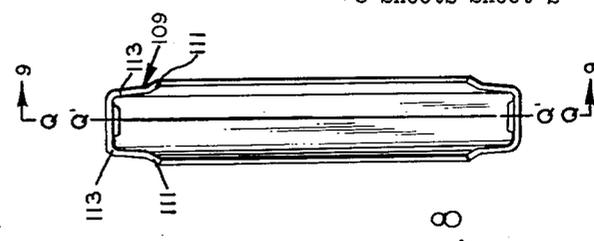


FIG. 8

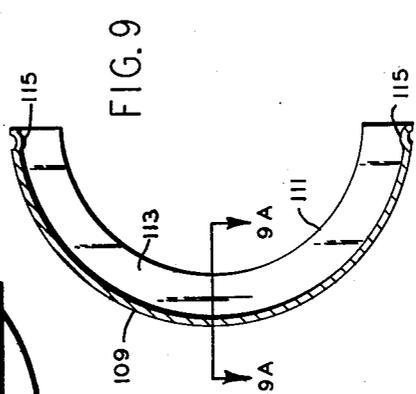


FIG. 9

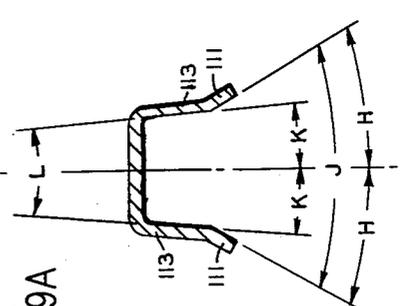


FIG. 9A

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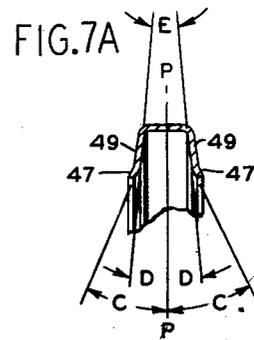
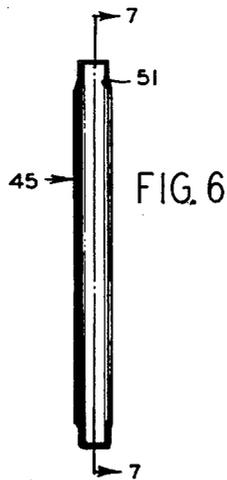
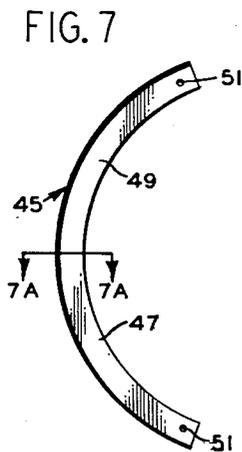
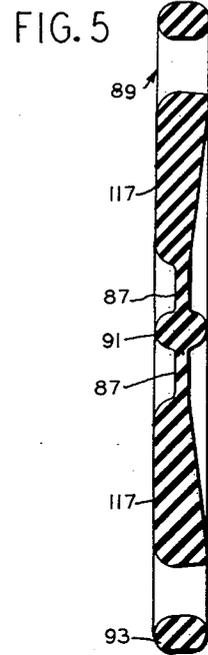
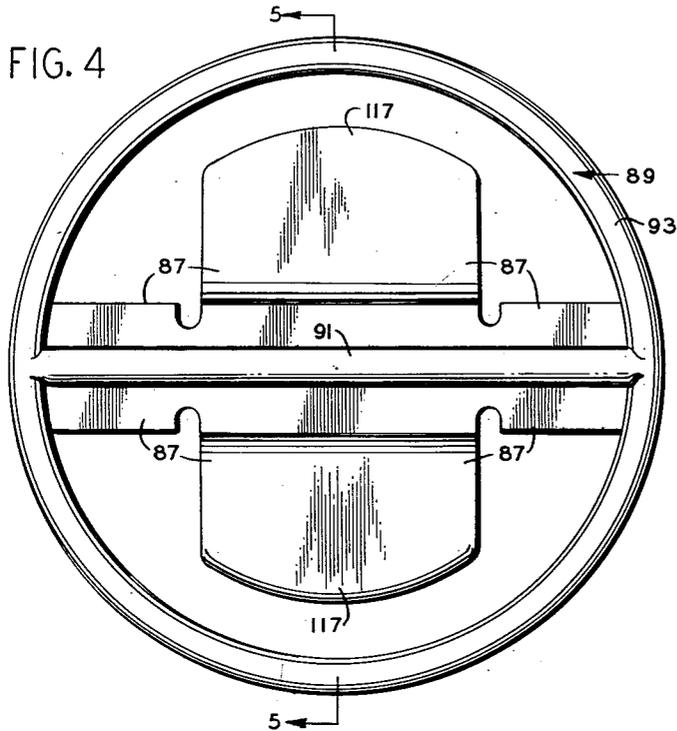
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HAND OPERATED DIAPHRAGM PUMP

Filed May 9, 1956

3 Sheets-Sheet 3



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3,034,450

HAND OPERATED DIAPHRAGM PUMP

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Filed May 9, 1956, Ser. No. 583,750
16 Claims. (Cl. 103—150)

This invention relates to a hand operated diaphragm pump. More specifically it relates to pump of the type indicated which is especially constructed so that it can be manufactured at low cost without sacrificing either efficiency of operation or durability of the unit.

Another object of the invention is to provide an apparatus of the type described which can be readily constructed of die cast or molded plastic parts with a minimum of secondary finishing operations.

A further object of the invention is to construct the unit so that many of the usual bolts and screws used to hold the parts assembled are eliminated by the use of friction clamps.

Yet another object of the invention is to provide integral valves, valve supports and joint seals out of yieldable material so that all three parts may be molded in a single piece.

Still another object of the invention is to provide a flexible suction conduit instead of the usual rigid pipe.

A further object of the invention is to provide a simple bung adapter.

It is another object of the invention to eliminate the usual screwed hose connectors.

Still a further object of the invention is to provide a diaphragm pump which has a high efficiency.

It is yet another object of the invention to provide a pump of the kind described which is capable of producing a high vacuum.

These and other objects will become apparent from a study of this specification and the drawings which are attached hereto, made a part hereof and in which:

FIGURE 1 is a vertical elevation showing the general arrangement of the parts, particularly the outlet, nozzle and nozzle support.

FIGURE 2 is a vertical sectional view of the pump taken substantially on the line 2—2 of FIGURE 1.

FIGURE 3 is a cross-sectional view of the pump taken substantially on the line 3—3 of FIGURE 1.

FIGURE 4 is a plan view of the integral valve, support and gasket.

FIGURE 5 is a sectional view taken substantially on the line 5—5 of FIGURE 4.

FIGURE 6 is an interior elevation of the body clamps.

FIGURE 7 is a sectional view taken substantially on line 7—7 of FIGURE 6.

FIGURE 7A is a sectional view taken substantially on the line 7A—7A of FIGURE 6.

FIGURE 8 is an interior elevation of a fitting clamp.

FIGURE 9 is a sectional view taken substantially on the line 9—9 of FIGURE 8.

FIGURE 9A is a sectional view taken substantially on the line 9A—9A of FIGURE 8.

Referring first to FIGURES 1 and 2, the numerals 1 and 3 represent the front and rear body members while 5 and 7 represent the intake and discharge fittings.

Members 1 and 3 are provided with semi-annular inlet flanges 8, 9 and outlet flanges 11, 13 respectively. They are also provided with peripheral flanges 15, 17 and 19, 21 respectively, which extend internally through the body cavities as bridges 23, 25 and 27, 29 in the region of the inlet and outlet.

As is clearly shown in FIGURES 2 and 3, the flanges 19, 21 and bridges 25, 29 are formed with a circular

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groove 31 of rectangular cross-section while the flanges 15, 17 and bridges 23, 27 are formed with a circular pilot flange 33 of substantially square cross-section which has such a diameter that it interfits with the large diameter of the groove 31 so as to accurately align and support the body members, one on the other.

A second flange 35 having a large diameter substantially equal to the small diameter of groove 31 and having a width somewhat greater than that of flange 33 is disposed on body member 1 and extends substantially parallel to flange 33. The two flanges and the body member define a groove 37 in the body 1 which is comparable in size and disposed in complementary location with respect to that portion of the groove 31 which is not occupied by the flange 33. The grooves 31 and 37 are adapted to receive and compress the peripheral seal ring or bead 39 which has a substantially elliptical cross-section and is formed as an integral part of the diaphragm 41.

The body members 1 and 3 are thus supported on each other, the diaphragm is supported and clamped in place by and between the members and also seals the joint between them.

Flanges 15, 17, 19 and 21 are externally bevelled to a frusto-conical shape so that the angles A and B (FIG. 3) made by such bevel with the central plane P—P are each preferably between 7 and 7½ degrees. The included angle AB will thus be between 14 and 15 degrees. The flanges 19 and 21 have elongated indentations 43 (FIG. 1) formed therein near their extremities and flanges 15, 17 are preferably similarly provided with indentations (not shown).

FIGURES 6 and 7 show an arcuate clamp 45 which is preferably made of strip metal and which is adapted to be applied to the pairs of flanges to hold the body members together. It will be seen from the cross-section shown in FIGURE 7A, that the peripheral edges 47 of the clamp are preferably bent so as to diverge outwardly at an angle C of about 30 degrees from the central plane P—P of the clamp which is coincident with the similarly identified plane of the body members. The clamping surfaces 49, which engage the frusto-conical surfaces of the body members just described, are each preferably inclined so as to diverge outwardly from the central plane P—P at an angle D of between 4½ and 5 degrees thus making the included angle E between 9 and 10 degrees.

Each clamp is preferably provided with a projection 51 in one wall 49 near each extremity which is formed by indenting the exterior of the wall. Such projections are adapted for engagement with the corresponding depressions 43 in the flanges of either member. While only two projections are formed in the clamp, four may of course be used if desired or two may be used, one in each wall, preferably at opposite ends of the clamp.

The clamp is applied by merely pressing it over the corresponding flanges of the assembled body members, the diaphragm bead being compressed into sealing relation in the process and the walls 49 being sprung or strained due to the difference in the included angles AB and E, until the walls 49 conform substantially to the surfaces of the flanges, but not beyond the elastic limit of the clamp material so that the frictional engagement between the clamp and the flanges will be high enough to hold the clamp in position. The projections 51 and depressions 43 are provided as a precaution to prevent material displacement of the clamp in a flange disengaging direction in the event the clamp or flanges are improperly formed or the clamp is improperly applied.

It should be noted that while specific angles A, B, AB, C, D and E have been cited in order to illustrate the embodiment of this feature of the invention, the sizes of the angles may be varied within the critical angles of fric-

tion for the materials from which the body members and the clamp are manufactured so that the clamps are "self held" by friction in the position to which they are forced on the flanges in the assembly process.

The body members 1 and 3 include walls 51, 53 and 55, 57 respectively which with the diaphragm 41 define pumping chambers 59, 61 and with the bridges 23, 25, and 27, 29 define inlet ports 63 and outlet ports 65 respectively which are exteriorly encircled by the respective complementary pair of flanges 8, 9 and 11, 13.

The inlet fitting 5 has a flange 67 which mates with flanges 8 and 9 while the outlet fitting 7 has a flange 69 which mates with the flanges 11, 13.

Flange 67 defines a relatively wide groove 71 which is adapted to receive pilot flanges 73, 75 formed on the body members for aligning the inlet fitting with and supporting it against shifting on the body members. The flanges 8 and 9 are also provided with semi-circular grooves 77, 79 which are arranged in complementary relation with respect to that portion of the groove 71 not occupied by the pilot flanges.

The bridge members 23, 25 of the body members are complementarily grooved at 81 while a central bridge member 83 in the fitting 5 is provided with a complementary groove 85. The surfaces of these bridge members are spaced to receive the web portions 87 of the intake valve and seal unit indicated generally by 89 (FIG. 4). The diametrically extending bead 91 of this unit is received in the grooves 81, 85 while the peripheral circular bead 93 thereof is received in the grooves 71, 77, 79. The beads are substantially elliptical in cross-section and are compressed substantially along their major axes when the fitting is drawn down on the body as will be described.

The outlet valve unit 95 is of the same construction as the inlet valve unit and need not be further described.

The outlet fitting is provided with a pilot flange 97 which is adapted to enter grooves 99, 101 in the flanges 11, 13 and the portions of the latter which are not occupied by flange 97 cooperate with groove 103 of the fitting to retain and compress the peripheral bead 93 of the outlet valve unit.

It will be seen from FIGURE 2 that the bridge members 27, 29 are provided with complementary grooves 102 to receive the lower side of the bead 91 of the outlet valve unit. A bridge 104 is integral with the outlet fitting and is disposed in closely spaced relation above said first mentioned bridge members. It is provided with a groove 106 which receives the other side of the bead 91. When the fitting is drawn down on the body members as described below, the bead will be compressed between the bridges.

The flanges 8, 9 and 67 and 11, 13 and 69 (FIG. 2) are tapered to a frusto-conical shape having angles F and G of 7 to 7½ degrees each with respect to the plane Q—Q or Q'—Q' or an included angle FG of from 14 to 15 degrees and are provided with axially directed notches 105, 107 which are disposed in diametrically opposite positions substantially 90 degrees from the plane P—P.

Two substantially semi-circular clamps 109 are applied to each set of flanges. The clamps are of the form shown in FIGURES 8 and 9 and comprise peripheral edges 111 which diverge outwardly from the plane Q—Q or Q'—Q' preferably at an angle H of 30 degrees making the included angle J substantially 60 degrees, as shown in FIG. 9A, to facilitate the assembly of the clamp on the associated parts. The walls 113 of the clamp diverge outwardly from the medial plane at an angle K of from 4½ to 5 degrees making the included angle L 9 to 10 degrees. The clamp is provided with transversely directed, internal projections 115 near each end which are adapted to engage the notches 105 and 107 described above, again as a precautionary measure. It will thus be seen that the clamps span the joints in the flanges 8 and 9, 11 and 13 and assist in holding these joints closed.

As in the case of the clamps 45, the clamps 109 are

pressed into place so that the beads 91, 93 of the valve units are compressed into their respective grooves and so that the fittings and body members establish pressure contact between their adjacent surfaces along the beads 93. The clamps spring sufficiently to cause the walls 113 to conform substantially with the walls of the flanges but without exceeding the elastic limit of the clamp material, and are frictionally held in place.

Again while specific angles are recited for purposes of illustration, it should be understood that any suitable angles within the limits of the limiting angle of friction for the materials used in the manufacture of the clamps, fittings and body members may be used.

It will be seen from FIGURES 2 and 4 that the valves 117 extend outwardly in opposite directions and substantially perpendicular to the axis of the bead 91 and that they bend about the edges of the bridge members 23, 25, 106 (FIGURE 2). The inlet valves cover the ports 119 which are defined by the walls and bridge 83 of fitting 5 while the discharge valves cover the ports 65 defined by the walls and bridges 27, 29 of the body members 1 and 3.

It should be noted from FIGURE 5 that the bottom surface of each of the valves 117 diverges outwardly and downwardly at an angle of about 6 degrees with respect to the top surface of the valve which occupies a plane which is tangent to the tops of the beads 91, 93 in the free, molded unit. However, when the valve unit is installed in the pump as described above, the valves are rotated to the position shown in FIGURE 2 and are thus provided with an initial bias toward their respective seats which insures that they will seat rapidly when the valve opening differential pressure dissipates. The angle may of course be made greater or smaller to secure the amount of seating pressure desired.

The diaphragm 41 mentioned briefly above, has its central portions fixed to a piston rod 121 by means of a threaded projection 123, nut 125, a cupped washer 127 which rests on the shoulder at the juncture of the projection with the rod and the dished washer 129. The diaphragm is thus clamped between the washers. This portion of the apparatus is hereinafter referred to as a "piston."

Further, the diaphragm is preferably of molded synthetic rubber which is reinforced with a fabric 131 such as cotton. The section 133 of the diaphragm disposed between the piston and the bead is molded in a bowed condition with a gradually decreasing wall thickness from the center to the edges of the section in accordance with the disclosure contained in Patent Number 2,685,304 issued August 3, 1954, to G. W. Wright for Self-Sustaining Arched Diaphragm Structure so that the diaphragm will not invert as the direction of the piston movement changes.

As will be seen from FIGURE 3, the body members 1 and 3 are contoured at 135 and 137, except in the region of the inlet and discharge passages, to conform to the contour of the diaphragm at the ends of the stroke so that nearly all of the liquid will be displaced from the respective pump chambers on each stroke. This results in a high efficiency. Actual tests have established an efficiency of approximately 99.7% determined by the ratio of actual to theoretical displacement at zero head.

A recess 139 is provided in the body member 3 to provide clearance for the nut 125, and with a projecting boss 141 (FIG. 2) around the recess to serve as a stop to limit the stroke of the piston in one direction.

The body member 1 is provided with an outwardly extending boss 143 which is bored at 145 to provide a guide bearing for the rod 121. The boss is counterbored at 147 to receive packing material 149 and a packing gland 151 which is held compressed in place by a follower plate 153. The latter is held in place and adjusted by screws 155 which enter threaded openings 154 in the boss 143.

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The inner face of 156 of the boss serves as a stop for the piston. The outer end of the rod 121 is provided with vertical flat surfaces 157 which are held in place between the ears 159 which project from the side portions of a channel shaped operating lever 161. A pivot pin 163 is inserted through the ears 159 and the rod 121 and is held in place by cotter pins 165.

A pair of curved links 167 are mounted at one end adjacent and outside of the side walls of a drain trough 169 by means of a pivot pin 171 which passes through said walls and is held in place by cotter pins 173. The trough conducts any leakage from the packing box away from the pump and over the edge of the barrel in which the pump is mounted so that it may be absorbed by the sawdust or other material usually placed on the floor adjacent the barrel rather than accumulating in a pool on the head of the barrel.

The opposite ends of links 167 are mounted on a pivot pin 175 which is mounted in the ears 177 which project downwardly from the side walls of the lever. The pin is held in place by cotter pins 179.

The upper portion of the web of the lever 161 is cut away, the side walls are spread and a hand grip 181 is mounted therebetween on a pin 183 which is riveted in place.

A locking link 185 is pivotally mounted by means of a rivet 187 between a pair of projections 189 on outlet fitting 7 which extends toward the lever 161. A helical spring 190 frictionally restrains the link in any of its pivoted positions. The free end of the link is perforated at 191 and is adapted to extend through a slot 193 formed in the web of the lever. When the parts occupy the positions shown in FIGURE 2, a padlock may be inserted in the hole 191 to lock the lever against unauthorized operation. The free end of the link is also provided with a hook 195 which engages the web of the lever below the slot so as to hold the handle in its innermost position when the pump is not being operated.

Referring to FIGURES 1 and 2, the outlet fitting 7 is provided with a vertical threaded outlet into which is screwed a plug 197 which is provided with a vent channel 199. A rubber, slit valve 201 is mounted in the lower end of the duct. The valve acts to admit air from the atmosphere to facilitate draining of the hose 203 which may be attached to the pump as described below but prevents the escape of fluid from the fitting.

The fitting is also provided with a downwardly and outwardly extending tube 205 which is provided with a number of circumferential, annular ridges 207 which have sharp crests so as to bite into the hose 203 which is attached by being stretched and forced over the tube.

A nozzle support 209 is disposed on the fitting 7 substantially diametrically opposite to the tube 205. The support is tubular but has a closed inner end and is cut away as at 210 to facilitate the insertion of a nozzle. It extends downwardly and outwardly from the fitting and its lower free edge is provided with a cradle portion 211. The spout 213 of the nozzle 214 enters the tubular portion of the support and a circumferential flange 215 of the nozzle is fitted in the cradle. The nozzle has the end opposite from the nozzle inserted in the hose and it is held in the hose by means of ridges 207' which are similar to ridges 207. The nozzle and attached hose are thereby supported within easy reach of the operator. The nozzle performs all of the functions usually performed by a nozzle. The flange 215 assists in holding the nozzle in the container being filled.

The inlet or suction fitting 5 is provided with a bottom wall 217 which is centrally threaded at 219 to receive a nipple 221. The nipple is provided with a number of circumferentially ridges 223 which have sharp crests and serve to retain the suction hose 225 on the nipple.

The fitting has a cylindrical outer surface 227 which is provided centrally with a peripheral groove 229.

An annular nut or bung adaptor 231 is rotatably

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mounted on the surface 227 and is provided at its lower end with a reduced portion 233 which forms a shoulder 235 which serves to compress a gasket 237 mounted on 233 against the bead surrounding the bung hole of the barrel when the threaded end 239 of the nut is screw therein. The exterior surface of the nut may be provided with the usual wrench flats 240 (FIG. 1).

A thumb screw 241 is threadedly mounted radially in the nut in a position so that it may engage the groove 229. After the nut has been fastened in the barrel, the pump may be rotated to the desired position and clamped by the screw.

The lower end of the suction hose is provided with a bell shaped strainer body 243 having a tubular portion 245 which is provided with annular ridges 247 adapted to enter the suction hose. The rim portion of the body is serrated at 249 to permit the entrance of liquid in the event the body should come to rest upright on the bottom of the barrel.

The interior of the body is provided with a number of radial webs 251 which terminate in concave, arcuate lower surfaces 253 which merge at their outer ends with an annular shoulder 255 formed by a counter bore 257 from the bell end of the body.

A perforated metal strainer disc 259, having a slightly larger diameter than the counterbore, is pressed into the counter bore and into contact with the faces of said ribs. The disc is thus distorted to a dished shape and is frictionally held in place.

It is to be noted that numerous parts of the pump may be made of plastic material either reinforced or plain molded parts. Specifically, the inlet and discharge fittings 5, 7, the body members 1, 3 and the strainer body 243 lend themselves to manufacture by molding processes. Other parts such as the nozzle 214 and adapter 231 may also be made of plastic material if desired.

Assembly

The time required to assemble the pump is greatly reduced by the use of the clamps described above. The diaphragm and piston are manufactured as a sub-assembly and after the piston rod has been inserted in the bearing 145, the two body members 1 and 3 are fitted together with the pilot flange 33 entered in groove 31. Thereafter the clamps 45 may be pressed home either separately or simultaneously by the use of proper tools. This compresses the bead 39 of the diaphragm in the corresponding grooves to seal the joint. The time required for drilling the usual bolt holes is entirely eliminated as are the bolts and nuts and the time required to insert and tighten them. Material cost and labor cost is thus substantially reduced.

The valve units 89 are located in the grooves 77, 79, 99 and 101, the intake and discharge fittings are placed in position, clamps 109 are positioned over the tapered flanges and compressed thereon to assemble these parts, again without the usual bolts and nuts and without the machine work, material and labor required to assemble pumps as they are usually constructed. The packing and packing gland may then be inserted, and plate 153 installed. Thereafter the handle and link 185 may be assembled. The plug and valve assembly 197—201 is inserted and the bung adaptor 231 is mounted. The discharge hose 203 has its nozzle 214 pressed into one end and the other end of the hose is pushed onto the tube 205. The sharp ridges hold these parts together.

The suction hose 225 is similarly applied to the nipple 221 and the screen body is likewise pushed into the section end of this hose. The use of a suction hose instead of the usual suction pipe is not only cheaper but entirely eliminates telescopic joints and other mechanisms employed to fit the pump to the container. A suction hose is supplied in a length sufficient to reach the bottom of the largest container usually handled and the hose merely bends if it is inserted in a smaller container.

It should also be noted that in the event it is desired to connect the pump to an outlet pipe as in the case where a meter is used with the pump, the plug 197 may be entirely removed and the pipe connected to the fitting in its stead. The outlet tube 205 may be plugged in such case.

As described above, the screen 253 is assembled in the body 243 merely by being pressed into it.

It will thus be seen that since very little machine work is required to form the parts, particularly the body members, inlet and outlet fittings, strainer, valves and seals, bung adapter, etc. all of which are used substantially in the "as molded" state and since a great many bolts and screws, hose couplings and threaded receptacles, as well as the complicated suction stub have been eliminated, the cost of material and labor to manufacture and assemble the pump has been greatly reduced but without sacrificing efficiency, strength, operability or the durability of the product. A substantial reduction of weight has also been achieved which reduces shipping costs as well as the labor required to install or remove the pump from a barrel.

Operation

The operation of the device is relatively simple. The screen body and suction hose are inserted in the tank or barrel and the adapter 231 is tightened on the bung hole. The pump is then rotated to the desired position which is usually with the lever 161 overhanging the rim of the barrel and movable in a diametral plane of the barrel. The thumbscrew 241 is then tightened.

Assuming that the pump is locked up, the padlock is first removed, the hook 195 is disengaged from the lever 161 and swung to an out of the way position where it is held by spring 190 and the nozzle 214 is disengaged from the support 209 and is inserted in the vessel to be filled. The handle 181 is then grasped and lever 161 is reciprocated. This action is transmitted to the piston rod, piston and diaphragm so that on the right hand motion of the lever, the right hand suction and discharge valves will be closed and opened respectively upon reduction of the volume of chamber 61 while the left hand suction and discharge valves 117 will be opened and closed respectively, permitting liquid to enter the expanding chamber 59. The valves reverse upon reversal of the direction of the handle movement. Thus the chambers are alternately filled through the suction hose and discharge liquid to the delivery hose.

Stops 141 and 156 serve to limit the strokes of the piston and as stated above, the diaphragm does not distort under ordinary conditions of operation so that it sweeps both chambers 59 and 61 substantially completely and the pump is accordingly very efficient.

When the delivery has been completed, the locking link 185 is recentered in the slot 193 and hook 195 is engaged with the lever and the spring 190 will hold the link in place to keep the lever from striking out from the tank into the path of passers by. The padlock may be installed if desired.

The hose is drained, air being admitted through the slit valve 201 and the nozzle is restored to the support 209. The hose is usually of such length that when the nozzle is on the support, the hose will be supported in a relatively well rounded bight, off the floor and out of contact with the rim edges of the barrel so as to minimize damage to the hose and the danger of tripping passers by.

The pump described is capable of producing a relatively high vacuum on the order of 21 inches of mercury as against a maximum of about 15 inches for currently available pumps of the same general type.

It is obvious that various changes may be made in the form, structure and arrangement of parts of the specific embodiments of the invention disclosed herein for purposes of illustration, without departing from the spirit of the invention. Accordingly, applicant does not desire

to be limited to such specific embodiments but desires protection falling fairly within the scope of the appended claims.

I claim:

1. A casing for a fluid handling device comprising body member having mating flanges disposed in face to face contact with each other and having interfitting pilot means for preventing relative displacement of said members parallel to said flanges, said members defining an internal cavity, corresponding portions of the exterior lateral surfaces of said flanges being bevelled to provide outwardly converging surfaces, a channel shaped clamp having side walls adapted to engage said converging surfaces and serving to force said flanges into and hold them in pressure contact when said clamp is forcibly engaged with said converging surfaces, the angle of bevel of each flange being less than the angle of repose for the materials of said flange and clamp so that said clamp will be frictionally retained on said flanges.

3. The structure defined by claim 1 which includes detent means on opposite ends of said clamp and on at least one of said flanges for interlocking said clamp and flange.

3. The structure defined by claim 1 which includes complementary grooves in the mating faces of said flanges, a gasket disposed in said grooves, said gasket having a thickness greater than the combined depths of said grooves so that it will be compressed to seal the joint between the flanges when said clamp is installed.

4. The structure defined by claim 1 in which the angle formed by the side walls of the clamp is less than the included angle of said bevels so that said clamp walls will be displaced as the clamp is installed.

5. The structure defined by claim 1 wherein said body members are of molded plastic material and said clamp is of metal.

6. The structure defined by claim 1 wherein said pilot means includes interfitting pilot flanges and groove means provided on said flanges for aligning said flanges with respect to each other.

7. The structure defined by claim 1 wherein said body members include additional flange means defining a passage communicating with said cavity, a fitting having flange means adapted to mate with said additional flange means in face to face contact therewith and having interfitting pilot means for preventing relative displacement of said members and fitting parallel to said flange means, both said flange means being bevelled so that they comprise outwardly converging surfaces, additional channel shaped clamp means having side walls adapted to engage said last named converging surfaces and serving to force said flange means into and hold them in pressure contact when said clamp means are forcibly engaged with said last named surfaces, the angle of bevel of said flange means being less than the angle of repose for the materials of said flange and clamp means so that the latter will be frictionally retained in place.

8. The structure defined by claim 1 wherein said flanges have an arcuate periphery and the clamp is correspondingly arched to conform to the flanges.

9. The structure defined by claim 7 wherein the mating surfaces of said flanges include complementary grooves, a gasket disposed in said grooves, said gasket being thicker than the total depth of said grooves so that the gasket will be compressed to seal the joint between said flange means when said clamp means are installed.

10. In a pump, the combination of a pair of body members having mating radial flanges and cooperating to define an internal cavity, a piston mounted in one of said members for reciprocation within said cavity, a diaphragm attached to said piston, disposed so as to divide said cavity into two chambers and having a peripheral bead, said flanges defining grooves surrounding said cavity, one of said grooves being wider than the other and

having one edge aligned with the corresponding edge of said other groove, the other edge of said other groove being defined by an axially extending pilot flange which is disposed to fit into said one groove, said grooves being disposed to receive the bead, said bead having greater thickness than the combined depth of said grooves and means for clamping said members together to compress said bead in said grooves so as to seal the joint between the members, said mating flanges each having an exterior lateral surface bevelled to provide outwardly converging surfaces, a channel shaped clamp having side walls adapted to engage said converging surfaces to compress and hold the flanges in pressure contact with each other when said clamp is forcibly engaged with said surfaces, the angle of bevel of each flange being less than the angle of repose for the materials of the flanges and the clamp so that said clamp will be frictionally retained on the flanges.

11. In a pump, the combination of a body defining an internal cavity, a piston mounted for reciprocation in said cavity, a diaphragm connected to said piston and having its peripheral portion fixed to the body to divide the cavity into two displacement chambers, said body including flange and bridge means defining a pair of adjacent ports, one for each chamber, a fitting having flange and bridge means arranged opposite said first means, said flange and bridge means each defining opposed, communicating grooves, the groove of one of said flange means being wider than that of the other, a pilot flange on said other flange means adapted to fit into the groove of said one flange means, a unitary member of yieldable, resilient material, comprising gasket means for said flange and bridge means and also comprising a pair of valves one disposed to control each port, said gasket means being disposed in sealing relation between the flange and bridge means of both the body and fitting, and frictional clamping means coacting with said flange means to hold said unitary member in position.

12. The structure defined by claim 11 wherein said body is comprised of two body members having flanges defining a joint therebetween which intersects said body flange and bridge means lengthwise of the latter, wherein said body flanges and bridge means define a groove and said diaphragm is provided with a peripheral bead which is received in the groove.

13. The structure defined by claim 11 wherein said body and fitting flanges each have corresponding exterior lateral surfaces bevelled to provide outwardly converging surfaces, a channel shaped clamp element having side walls adapted to engage said converging surfaces to compress and hold the flanges in pressure contact with each other when said clamp element is forcibly engaged with said surfaces, the angle of bevel of each flange being less than the angle of repose for the materials of the flanges and clamp element so that the clamp element will be frictionally retained on the flanges.

14. In a diaphragm pump structure the combination of a pair of body members, means for connecting said members to define a central cavity, a piston mounted for reciprocation in the cavity, a diaphragm having its center portion attached to the piston and its peripheral edge clamped between said members, to form displacement chambers with the body, the portion of said diaphragm between the piston and the members having the contours of an arched, self sustaining annulus to prevent

reversal of such portion during reciprocation of the piston, said body members being provided with contours substantially matching the corresponding contour of that side of the diaphragm which is adjacent a particular member at the end of a stroke, so that the displacement efficiency is high, a suction fitting connected to said body members and having a seat defining inlet ports for said chambers, said members having co-planar surfaces forming a valve seat and defining discharge ports for said chambers, a discharge fitting connected to the body members adjacent said ports and defining a discharge passage which communicates with said ports, a combination gasket and valve member of compressible rubber mounted on each of said seats, with the valves thereof closing said ports and the gasket sealing the joint between the respective fitting and body members, said valves being initially disposed relatively to the gasket portion of said member so as to be lightly biased toward the valve closing position when said member is mounted on the seat, so that they will close quickly upon reversal of the direction of movement of the diaphragm, this action together with the high displacement efficiency of the diaphragm, serving to produce a pump having a high volumetric efficiency and a high vacuum.

15. The structure defined by claim 1 wherein the included angle between the walls of the clamp is less than the included angle of convergence of said lateral surfaces, said clamp side walls being constructed so as to yield after pressure contact of the flanges has been established and conform to the lateral surfaces of the flanges when said clamp is forcibly applied thereto.

16. The structure defined by claim 15 wherein the included angle defined by portions of the walls adjacent the free edges of the clamps is greater than that of the remainder of the walls of the clamp to facilitate the entry of the flanges into the clamp.

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