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MECHANICAL FUEL PUMP

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This invention relates to pumps, and more particularly to a diaphragm pump of a type especially suitable for pumping fuel to the carburetor for an internal combustion engine, the diaphragm of the pump being operable by a drive from the engine.

In the manufacture of diaphragm fuel pumps of the class described, it is economically desirable to use for the diaphragm a normally flat relatively thin disk of flexible diaphragm material, as distinguished from a diaphragm molded to have an initial conformation other than flat. In the usual fuel pump design, such a disk has its central portion held between a pair of backing plates and its periphery clamped flatwise between parts of the pump, with the annular portion of the diaphragm between the backing plates and its clamped periphery in a slack condition to allow for flexing of the diaphragm without any substantial stretching of the diaphragm. A problem arises in the manufacture of such pumps due to the fact that the disposition of the diaphragm to obtain the slack tends in some measure undesirably to stress and distort the diaphragm, thereby weakening it and increasing the difficulty of obtaining a proper seal around its periphery.

In a pump of the class described, with the stated slack in the diaphragm, the volumetric efficiency and compression ratio of the pump are reduced if the slack is subject to a reversing action as the diaphragm flexes. While this tendency may be reduced by making the span between the backing plates and the clamped margin of the diaphragm relatively small, this decreases the pump capacity.

Pumps of the class described are usually made with a spring for driving the diaphragm through its discharge stroke, the diaphragm being returned through its suction stroke by the drive from the engine. As the spring drives the diaphragm through its discharge stroke, the force of the spring decreases. Without compensation for this decrease in the force exerted by the spring, the pressure developed by the diaphragm materially decreases during its discharge stroke.

Pumps of the class described have an intake check valve and a discharge check valve, the intake valve opening and the discharge valve closing on a suction stroke of the diaphragm to prime the pumping chamber, the intake valve closing and the discharge valve opening on a discharge stroke of the diaphragm for discharge of fuel from the chamber. It is desirable that the valve arrangement be such as to allow for constructing the pump to have minimum space remaining in the pumping chamber of the pump at the end of a discharge stroke of the diaphragm, so as not to reduce the compression ratio of the pump. It is also desirable that the valve arrangement be such as to avoid undue disturbance of the fuel in the pumping chamber, particularly in the case where the ratio of vapor to fuel may be relatively high.

In a fuel pump of the class described, the diaphragm is under control of a mechanism including a rocker arm

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actuated by an engine-driven cam means in such manner that during part of a cycle of the cam means, the rocker arm is free to allow the diaphragm to be flexed by its operating spring through a discharge stroke, and during another part of the cycle the arm is adapted positively to move the diaphragm through a suction stroke. Here- tofore, the mechanism has been such as to cause un- desirably noisy slapping, and to require relatively ex- pensive construction for the rocker arm pivot.

Accordingly, it is an object of this invention to pro- vide a diaphragm pump construction of the class de- scribed which enables manufacture of pumps using a normally flat disk of flexible material for the diaphragm, without severe bending, stressing and distortion of the diaphragm arising from the provision of slack in the diaphragm. In conjunction with this object are the fur- ther objects of providing a construction which, while having a substantial span between the central portion and the clamped margin of the diaphragm, has little tendency to be subject to reverse action of the slack, so as to obtain a relatively high volumetric efficiency and compression ratio, and also providing a construction which inherently compensates for the decrease in spring force on the diaphragm as it flexes through a discharge stroke so as to tend to maintain the unit pressure devel- oped by the pump more constant throughout the dis- charge stroke of the diaphragm.

Another object of the invention is the provision of an intake and discharge check valve construction which tends to minimize disturbance of fuel in the pumping chamber, and which, while being compact so that it does not seriously reduce the compression ratio, is reliable in operation for a relatively long period of time.

Still another object of the invention is the provision of a construction such as to minimize noisy slapping of the rocker arm mechanism and to enable use of a simple, economical construction for mounting the rocker arm pivot. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

Fig. 1 is a vertical section of a pump constructed in accordance with this invention, as it appears apart from an engine with which it may be associated, parts being shown in their position at the end of a discharge stroke;

Fig. 2 is a section corresponding to Fig. 1, showing the pump as it appears when installed with the engine, parts being shown in their position at the end of a suc- tion stroke;

Fig. 3 is a plan view of a cup-shaped body and valve assembly per se of the pump, parts being broken away;

Fig. 4 is a section taken on line 4—4 of Fig. 3;

Fig. 5 is a plan view of a discharge valve spring re- tainer per se;

Fig. 6 is a view in elevation of Fig. 5; and,

Fig. 7 is a right end view of Fig. 1.

Corresponding reference characters indicate correspond- ing parts throughout the several view of the drawings.

Referring to the drawings, a pump of this invention is shown generally to comprise a cup-shaped sheet metal receptacle 1, a cast cup-shaped body 3 which serves the dual purpose of closing the receptacle 1 and providing a pumping chamber 5, a diaphragm 7 closing the cup-shaped body 3, a coil compression spring 9 for biasing the diaphragm in discharge direction, and a cast casing 11. The space within the receptacle 1 is divided by an annular partition 13 constituted by a tubular projection extending from body 3 into a central intake chamber 15 and a surrounding discharge chamber 17. The base 19

of receptacle 1 has a central inlet port 21 in which is secured an inlet nipple 23. The peripheral wall 25 of the receptacle has a discharge port 27 in which is fixed a discharge nipple 29. Adjacent the discharge port, the base of the receptacle has a depressed portion providing a sump 31. Body 3 is formed with a circular series of slots 33 constituting intake valve ports providing for communication from intake chamber 15 to the pumping chamber 5 under control of an intake check valve 35. The body is also formed with a circular series of slots 37 surrounding slots 33 and constituting discharge valve ports providing for communication from pumping chamber 5 to discharge chamber 17 under control of a discharge check valve 39.

The casing 11 comprises a conical portion 40 constituting a housing for the diaphragm 7 and spring 9, and a flaring portion 41 extending laterally from the small end of spring housing 40 constituting a housing for a rocker arm 43. The diaphragm 7 is fixed on the lower end of a stem 45 which extends slidably through a packing member 47 held in the upper end of spring housing 40. Spring 9 surrounds stem 45, reacting from a gland 48 bearing against packing member 47. Stem 45 extends up into the inner end of rocker arm housing 41 through an opening 49.

The rocker arm 43 has longitudinal ribs 51 receiving a pivot pin 52. The ends of this pin are mounted in grooves 53 cast in the sides of the rocker arm housing 41. These grooves are initially of uniform width throughout their length, as indicated by the dotted lines 53a in Fig. 2, extending inward from the open outer end of housing 41. After the pin 52 with the rocker arm thereon has been inserted in the grooves, portions of the sides of housing 41 are peened inward toward the grooves and against the pin as indicated at 54 to hold the pin in place. The rocker arm has a slot 55 extending outward from its inner end receiving the stem 45. The latter has a head 57 at its upper end engageable by the rocker arm.

The outer end of the rocker arm is downwardly curved as indicated at 58. A leaf spring 59 has one end secured as by a rivet 60 to the rocker arm 43 at a point spaced from the curved outer end 58 of the arm, preferably at a point between pin 52 and the inner end of the arm. The spring 59 extends toward the outer end of the rocker arm. It has a downwardly curved free end portion 62 which is normally spaced from the outer end portion 58 of the arm. When the pump is installed on an engine, the free end portion 62 of the spring is engaged by an engine driven push rod 61 which is angled downward in the direction toward the pump. It will be understood that this push rod is actuated by an engine driven cam (not shown). The action of the cam and push rod are such that during a part of the cycle of the cam, the push rod is movable back to a retracted position in which the rocker arm 43 is freed to rock counterclockwise from the retracted position in which it is shown in Fig. 2 to the advanced position in which it is shown in Fig. 1. With the rocker arm freed for such movement, the stem 45 is freed to enable spring 9 to drive the diaphragm 7 down through a discharge stroke if fuel is free to flow out of pumping chamber 5 and discharge chamber 17 (as determined by the requirements of a carburetor supplied by the pump).

When the rocker arm rocks counterclockwise from its retracted position of Fig. 2, leaf spring 59 remains in engagement with the end of the push rod 61, flexing in the direction toward the rocker arm. During another part of the cycle, the push rod 61 is moved in the direction toward the rocker arm. If, prior to such movement, the rocker arm has been moved by stem 45 to the Fig. 1 advanced position, the push rod acts through the leaf spring 59 to drive the rocker arm back to the Fig. 2 retracted position, thereby pulling up the stem 45 and driving the diaphragm up through a suction stroke. With the leaf spring interposed between the push rod 61 and the

rocker arm, noisy slapping is eliminated. Also, with the push rod acting on the rocker arm via leaf spring 59 at an angle as shown, the arm is constantly biased in inward direction as regards rocker arm housing 41, whereby pivot pin 52 is constantly biased against the inner ends of grooves 53. This makes possible the use of the relatively simple and inexpensive mode of holding the pin 52 in place in the pre-cast grooves 53 by peening at 54.

The peripheral wall 25 of receptacle 1 is formed with a conical flaring shoulder 63, and, above that, with a cylindrical portion 65 having an inside diameter slightly larger than the diameter of the rim of cup-shaped body 3. The base of body 3 is designated 67 and its peripheral wall is designated 69. The interior surface 71 of the latter is of conical form, flaring outward away from base 67, the angle of flare being 45°, for example. The wall 69 has an external annular rib 73 which seats on the conical shoulder 63 of the receptacle. Above the rib 73 there is a packing ring 77 compressed between wall 69 and shoulder 63 for sealing the receptacle. The base 67 of body 3 has a shallow circular recess 79 on the inside away from the receptacle, and a central cup-shaped offset 81 projecting outward from base 67 and down into the receptacle providing a recess 83 constituting an intake valve chamber. The annular partition or projection 13 is constituted by an integral extension of offset 81 which is of smaller diameter than offset 81 to provide an annular shoulder constituting a discharge valve seat 85 surrounding the inner end of partition 13. The latter extends down to the base 19 of the receptacle 1, a gasket 87 being interposed between the end of partition 13 and base 19 surrounding the inner end of intake nipple 23. Base 89 of offset 81 has a central conical boss 91 projecting down within partition 13. The intake valve ports 33 extend through the base 89 of offset 81 around the axis of partition 13 outward of boss 91 and inward of partition 13. The discharge valve ports 37 surround the intake ports, being located outward of partition 13 and extending through base 89 from seat 85 to the intake valve chamber 83. Body 3 also has an annular rib 93 projecting down into the receptacle 1 surrounding partition 13 providing air domes 95 and 97.

The inside face 99 of the base 89 of cup-shaped offset 81 constitutes a valve seat for the intake check valve 35. Preferably, this face or seat 99 is slightly concave, being formed with a slight taper (a 1° taper, for example) flaring up toward intake valve chamber 83. This taper is exaggerated in Fig. 4. At the center of base 89 of offset 81 is a socket 101 extending down into boss 91. The discharge valve seat 85 is preferably of arcuate contour, being formed so that the surface defined thereby is a portion of a cylindrical surface of relatively long radius, generated about an axis lying a considerable distance below the seat 85 and extending at right angles to the axis of body 3. The arcuate contour of seat 85 is exaggerated in Fig. 4.

The diaphragm 5 consists of a relatively thin disk of flexible fuel-resistant material, such as a suitable synthetic rubber with a fabric insert which, in its initial unstressed condition, is flat (or at least substantially flat). The diaphragm is mounted at the end of stem 45 between a pair of circular backing plates 105 and 107. Plate 105 engages the face of the diaphragm toward the base 67 of body 3, and plate 107 engages the other face of the diaphragm. Plate 105 is relatively thick as compared with plate 107 and is of somewhat smaller diameter than recess 79 to fit therein as shown in Fig. 1. The edge of plate 105 at its face which engages the diaphragm is rounded as indicated at 109. Plate 107, which may be formed of sheet metal, has an annular corrugation or rib 111 projecting away from the diaphragm and forming a seat for confining the lower end of spring 9. Plate 107 is of larger diameter than plate 105, and the margin of plate 107 which overhangs plate 105 is flared outward in downward direction to provide a rim 113 on plate 107 constraining the dia-

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phragm to have a portion originally flaring outward in downward direction from the plates 105 and 107 toward the base of the body 3.

In assembling the pump, after the check valves have been assembled with body 3 in a manner to be described, the body 3 is dropped into the receptacle 1, the upper cylindric portion 65 of the receptacle 1 being completely open at this stage of operations, with packing ring 77 interposed between wall 69 of body 3 and the flaring shoulder 63 of the receptacle. Then, the diaphragm is assembled with the body 3 simply by inserting it in the body in the manner apparent from Fig. 1, in which the flaring portion of the diaphragm lying outward of the rim 113 of plate 107 engages the conical internal surface 71 of wall 69 of body 3, flaring upward and outward to the rim of the body. Laying the diaphragm in body 3 in this manner is readily accomplished without undue bending, distortion or wrinkling of the diaphragm. Then the lower end of the housing 40 is entered in the upper cylindric portion 65 of the receptacle, with rim 115 on housing 40 engaging the marginal portion 116 of the diaphragm. Rim 115 is preferably formed with a beveled edge 117 conforming to the taper of surface 71 for engaging the marginal portion 116 of the diaphragm, and projects outward to provide an annular shoulder 119. After housing 40 is in place, the upper part of cylindric portion 65 of the receptacle is crimped over on shoulder 119 to form an inwardly directed rim 121 holding the parts in assembly, with sufficient pressure on the marginal portion 116 of the diaphragm and on packing ring 77 to seal the receptacle 1 and the pumping chamber 5. Portion 116 being of conical form rather than flat, pressure is applied over a relatively extensive area adjacent the periphery of the diaphragm for a good seal.

Rim 113 of plate 107 constitutes means constraining the diaphragm to have a portion flaring outward in the direction toward the base of body 3. This portion of the diaphragm merges into the clamped marginal portion 116 of the diaphragm in the form of a single annular free non-reversing loop 120 convex toward the base of body 3 (the bottom of the pumping chamber 5). The clamped marginal portion 116 of the diaphragm flares outward away from the base of body 3 in facewise engagement with an outer portion of the flaring internal surface 71 of body 3 and conforms in shape to surface 71. When the diaphragm is in its retracted position of Fig. 2, spaced from the bottom of pumping chamber 5, the effective diameter and area of the diaphragm are a maximum. As the diaphragm flexes down through a discharge stroke, the loop 120 rolls into engagement with the flaring internal surface 71 of body 3, whereby the effective diameter and area of the diaphragm decrease to a minimum (compare Fig. 2 and Fig. 1). At the end of the discharge stroke of the diaphragm, the loop is in effect flattened out completely against the internal surface 71 of wall 69 of body 3, and plate 105 engages the bottom of body 3 in recess 79 so that there is practically no space remaining in chamber 5.

The angle of flare of surface 71 is so related to the rate of the spring 9 that, as the diaphragm advances through a discharge stroke, its effective area diminishes substantially proportionally to the decrease in the force exerted by the spring 9, thereby maintaining the unit pressure developed by the diaphragm substantially constant throughout its discharge stroke. For example, in a typical embodiment of the invention, when the diaphragm is in retracted position, its effective diameter is 3.230 inches, its effective area is 8.19 square inches, and spring 9 is compressed to a length of 1.000 inch and exerts a total force of 45.5 lbs. on the diaphragm. Accordingly, at the start of a discharge stroke, the diaphragm develops 5.5 p.s.i. unit pressure (45.5 divided by 8.19). Spring 9 expands to a length of 1.350 inches in driving the diaphragm to the end of a discharge stroke. With

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the 45° flare for surface 71, the effective diameter of the diaphragm decreases to 2.835 inches, its effective area thereby decreases to 6.31 square inches. The force exerted by the spring decreases to 32.2 lbs. Accordingly, the unit pressure developed by the diaphragm at the end of its discharge stroke is 5.1 p.s.i. (32.2 divided by 6.31).

The intake check valve 35 comprises a normally flat thin disk of flexible resilient fuel-resistant material, such as a suitable synthetic rubber with a fabric insert. This disk is of such diameter as to overlie the intake valve ports 33, but of smaller diameter than the circular series of discharge valve ports 37 so as not to obstruct the latter. Backing the valve 35 is a thin generally flat sheet metal spring 125 in the form of a spider having a central hub portion 127, radial spring arms 129, and arcuate fingers 131 at the ends of the arms (see Fig. 3). Spring 125 is backed by a retainer 133 constituted by a sheet metal stamping comprising a circular plate or head 135 and a stem 137 struck from the head. Stem 137 is pressed in the socket 101 and extends through central openings in the hub of the spring 125 and valve 35. Head 135 is spaced from seat 99, being located at the top of intake valve chamber 83. Tongues 139 are struck from the head 135 and engage the spring 125 at low points of the concavity of seat 99 to hold it down. The construction is preferably such that, after assembly, tongues 139 have little if any spring action, acting without appreciable yielding to hold the spring 125 in place.

The discharge check valve 39 comprises a thin normally flat ring of flexible fuel-resistant material, such as a suitable synthetic rubber with a fabric insert, surrounding the partition 13 and engaging the seat 85. Backing the ring-shaped valve 39 is a thin normally flat sheet metal ring 141 which constitutes a valve spring. This is backed by a retainer 143 comprising a flat sheet metal ring 145 having axially extending tongues 147 press-fitted in grooves 149 on the exterior of partition 13, and struck-out arcuate arms 151 engaging spring ring 141 at low points of the concavity of seat 85 to hold it against the valve 39. The construction is preferably such that arms 151 have little if any spring action, acting without appreciable yielding to hold spring 141 in place.

Operation is as follows:

With the pumping chamber 5 primed with fuel, and with fuel trapped in the discharge chamber 17 and the line (not shown) leading to the carburetor, the operation of push rod 61 simply results in relatively quiet flexure of leaf spring 59 without any action of rocker arm 43. The fuel trapped in chamber 5 maintains the diaphragm 7 in its retracted position of Fig. 2 against the bias of spring 9 during return (upward) strokes of rod 61. Upon a demand from the carburetor for fuel, fuel is free to flow out of receptacle 1 and spring 9 thereupon acts during a return stroke of rod 61 to drive the diaphragm down from the Fig. 2 position through a discharge stroke to the Fig. 1 position. Rocker arm 43 is freed to rock counterclockwise from its Fig. 2 position to permit stem 45 to move downward during the return stroke of rod 61. As the diaphragm moves down, the intake check valve 35 is held closed against its seat 99 and the discharge check valve 39 flexes open against the closing bias of spring ring 141.

As the diaphragm 7 is driven down, loop 120 rolls onto the flaring internal surface 71 of the cup-shaped pump body 3. As previously explained, this rolling action results in decrease of the effective working area of the diaphragm throughout the discharge stroke substantially in proportion to the decrease in the force exerted by spring 9 as it expands whereby the unit pressure developed by the diaphragm is maintained substantially constant, the pressure at the end of the discharge stroke being nearly that at the beginning of the discharge stroke. Since the outer margin 116 of loop 120 is clamped in such manner as to flare up and out and its inner margin

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is constrained by rim 113 of plate 107 to flare down and out, loop 120 is positively set or directed to remain convex toward the bottom of the pumping chamber without reversal as the diaphragm moves, even though the span between rim 113 and margin 116 is relatively large. In the advanced Fig. 1 position of the diaphragm, the loop 120 is in engagement with surface 71 to the base of body 3, and plate 105 substantially fills recess 79 so that there is little space left in chamber 5. Accordingly, the volumetric efficiency and compression ratio of the pump are relatively high.

Upon any forward (downward) stroke of rod 61 following a discharge stroke of the diaphragm, the rocker arm 43 is rocked clockwise from its Fig. 1 position back to its Fig. 2 position, and pulls up stem 45 to draw the diaphragm through a suction stroke against the bias of spring 9. The intake check valve 35 flexes open against the closing bias of spring 125 and fuel is drawn into the pumping chamber 5 through intake ports 33 from intake chamber 15. The discharge check valve 39 is held closed against its seat 85. With fuel entering the pumping chamber via ports 33 on a suction stroke of the diaphragm, and being discharged via ports 37 closely surrounding ports 33 on a discharge stroke, a flow of fuel laterally across the pumping chamber 5 is minimized, thereby minimizing fuel disturbance in the pumping chamber. It will also be observed that the valve arrangement is such that there is a minimum of clearance in the pumping chamber at the end of a discharge stroke of the diaphragm (see Fig. 1).

The intake check valve 35 may be cut out of the center of the same piece of material as the discharge check valve 39, and the spring 125 may be cut out of the same piece of sheet metal as the spring 141, thereby avoiding waste of material. Use of the flat check valve members 35 and 39 and flat springs 125 and 141 in conjunction with the spring retainers 133 and 143 provides a construction which is compact and reliable in operation for a relatively long period of time. In this respect, it will be noted that the springs 125 and 141 hold the valve members 35 and 39 in slightly arched condition against their concave seats, and this tends to maintain the valve members in condition to provide a good seal.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results obtained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

We claim:

1. In a diaphragm pump, a cup-shaped body having a base and a peripheral wall defining a pumping chamber, the internal surface of the peripheral wall of said body flaring outward away from the base, a flexible diaphragm, said diaphragm closing the pumping chamber and having a marginal portion flaring outward away from the base in facewise engagement with an outer portion of said flaring internal surface and conforming in shape thereto, a housing enclosing the diaphragm and engaging said flaring marginal portion of the diaphragm and clamping it in sealed relation against said outer portion of the flaring internal surface, means engaging a central portion of the diaphragm holding said central portion substantially flat, said means including a rim constraining the diaphragm to have a portion flaring outward in the direction toward the base of the body and merging into said marginal portion of the diaphragm in the form of a free loop, and a spring in said housing reacting from the housing against said constraining means and biasing the diaphragm in the direction toward the base of said body.

2. In a diaphragm pump, a cup-shaped body having

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a base and a peripheral wall defining a pumping chamber, the internal surface of the peripheral wall of said body flaring outward away from the base, a flexible diaphragm, said diaphragm closing the pumping chamber and having a marginal portion flaring outward away from the base in facewise engagement with an outer portion of said flaring internal surface and conforming in shape thereto, a housing enclosing the diaphragm and engaging said flaring marginal portion of the diaphragm and clamping it in sealed relation against said outer portion of the flaring internal surface, and a compression spring in said housing biasing the diaphragm in the direction toward the base of the body, means to move said diaphragm to a retracted position spaced from the base of the body to compress said spring, said spring acting with decreasing force to move said diaphragm to an advanced position at the base wherein the diaphragm engages said flaring internal surface from said clamped marginal portion of the diaphragm substantially to the base, the flare of said internal surface being so related to the rate of the spring that, as the diaphragm advances, its effective working area diminishes substantially proportionally to the decrease in the force exerted by the spring to thereby discharge fuel from the pumping chamber under substantially constant pressure.

3. In a diaphragm pump, a cup-shaped body having a base and a peripheral wall defining a pumping chamber, the internal surface of the peripheral wall of said body flaring outward away from the base, a flexible diaphragm, said diaphragm closing the pumping chamber and having a marginal portion flaring outward away from the base in facewise engagement with an outer portion of said flaring internal surface and conforming in shape thereto, a housing enclosing the diaphragm and engaging said flaring marginal portion of the diaphragm and clamping it in sealed relation against said outer portion of the flaring internal surface, means engaging a central portion of the diaphragm holding said central portion substantially flat and constraining the diaphragm to have a portion flaring outward in the direction toward the base of the body and merging into said marginal portion of the diaphragm in the form of a free loop, and a compression spring in said housing reacting from the housing against said constraining means and biasing the diaphragm in the direction toward the base of the body, means to move said diaphragm to a retracted position spaced from the base of the body to compress said spring, said spring acting with decreasing force to move said diaphragm to an advanced position at the base wherein said loop engages said flaring internal surface from said clamped marginal portion of the diaphragm substantially to the base, said loop rolling onto said flaring internal surface and thereby diminishing the effective working area of the diaphragm as the diaphragm advances, the flare of said internal surface being so related to the rate of the spring that, as the diaphragm advances, its effective working area diminishes substantially proportionally to the decrease in the force exerted by the spring.

4. In a diaphragm pump, a cup-shaped receptacle having a base and a peripheral wall, a cup-shaped body having a base and a peripheral wall defining a pumping chamber, said body being mounted in position closing the receptacle with the base of the body toward the base of the receptacle, the internal surface of the peripheral wall of said body flaring outward away from the base, a flexible diaphragm which, when unstressed, is substantially flat, said diaphragm closing the pumping chamber and having a marginal portion flaring outward away from the base of the body in facewise engagement with an outer portion of said flaring internal surface and conforming in shape thereto, means holding said flaring marginal portion of the diaphragm against said outer portion of the flaring internal surface, said body having a tubular projection extending to the base of the

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receptacle constituting an annular partition dividing the receptacle into an intake chamber within the partition and a surrounding discharge chamber, the base of the receptacle having an inlet to the intake chamber and the receptacle having an outlet from the discharge chamber, the base of the body having an intake port providing for communication from the intake chamber to the pumping chamber and a discharge port providing for communication from the pumping chamber to the discharge chamber, an intake check valve mounted on the side of the base of the body remote from the base of the receptacle for closing the intake port on a discharge stroke of the diaphragm, and a discharge check valve on the receptacle side of the base of the body for closing the discharge port on a suction stroke of the diaphragm.

5. In a diaphragm pump, a cup-shaped sheet metal receptacle having a base and a peripheral wall provided with a shoulder, a cup-shaped body having a base and a peripheral wall defining a pumping chamber, said body being mounted in the receptacle on the shoulder with the base of the body toward the base of the receptacle, a flexible diaphragm closing the pumping chamber, means for clamping a marginal portion of the diaphragm against the body, said receptacle having an inwardly directed rim engaging over said clamping means, said body having an integral tubular projection extending to the base of the receptacle constituting an annular partition dividing the receptacle into an intake chamber and a discharge chamber, the receptacle having an inlet to the intake chamber and an outlet from the discharge chamber, the base of the body having an intake port providing for communication from the intake chamber to the pumping chamber and a discharge port providing for communication from the pumping chamber to the discharge chamber, an intake check valve on the pumping chamber side of the base of the body remote from the base of said receptacle for closing the intake port on a discharge stroke of the diaphragm, and a discharge check valve on the receptacle side of the base of the body for closing the discharge port on a suction stroke of the diaphragm.

6. In a diaphragm pump, a cup-shaped sheet metal receptacle having a base and a peripheral wall provided with a shoulder, a cup-shaped body having a base and a peripheral wall defining a pumping chamber, said body being mounted in the receptacle on the shoulder with the base of the body toward the base of the receptacle, a flexible diaphragm closing the pumping chamber, means for clamping a marginal portion of the diaphragm against the body, said receptacle having an inwardly directed rim engaging over said clamping means, a partition in said receptacle dividing the receptacle into an intake chamber and a discharge chamber, the receptacle having an inlet to the intake chamber and an outlet from the discharge chamber, the body having an intake port providing for communication from the intake chamber to the pumping chamber and a discharge port providing for communication from the pumping chamber to the discharge chamber, an intake check valve associated with the intake port for closing the intake port on a discharge stroke of the diaphragm, and a discharge check valve associated with the discharge port for closing the discharge port on a suction stroke of the diaphragm, said intake and discharge check valves being mounted on opposite sides of the base of said body, the base of said body having a recess in communication with said intake and discharge ports, and said intake check valve being mounted within said recess.

7. In a diaphragm pump, a cup-shaped receptacle having a base and a peripheral wall, a cup-shaped body having a base and a peripheral wall defining a pumping chamber, said body being mounted in position closing the receptacle with the base of the body toward the base of the receptacle, a flexible diaphragm closing the

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pumping chamber, means holding a marginal portion of the diaphragm against the body, an annular partition extending between the base of the body and the base of the receptacle dividing the receptacle into an intake chamber within the partition and a surrounding discharge chamber, the base of the receptacle having an inlet to the intake chamber and the receptacle having an outlet from the discharge chamber, the base of the body having a series of intake ports around the axis of the partition providing for communication from the intake chamber to the pumping chamber and a series of discharge ports surrounding the series of intake ports and located outward of the partition providing for communication from the pumping chamber to the discharge chamber, an intake check valve constituted by a generally flat flexible valve member engageable with the pumping chamber side of the base of the body remote from the base of the receptacle for closing the intake ports on a discharge stroke of the diaphragm, and a discharge check valve constituted by a substantially flat flexible ring valve member surrounding the partition and engageable with the receptacle side of the base of the body for closing the discharge ports on a suction stroke of the diaphragm.

8. In a diaphragm pump as set forth in claim 7, said intake check valve comprising a generally flat spring member engaging the back side of said intake valve member, and a retainer having a portion fixed in the base of the body and extending through the intake check valve member and said spring member, said retainer engaging said spring member and having a portion overlying said spring member to limit movement of said spring member away from the base of said body.

9. In a diaphragm pump as set forth in claim 8, the base of the body having a recess defining an intake valve chamber, said intake check valve member, spring member, and retainer being located in said recess.

10. In a diaphragm pump as set forth in claim 7, said discharge check valve comprising a generally flat spring ring member engaging the back side of said discharge valve member, and a discharge valve retainer mounted on the annular partition and engaging said discharge spring ring member.

11. In a diaphragm pump as set forth in claim 7, the base of the body having a recess defining an intake valve chamber, the bottom of the recess constituting a seat for the intake check valve member, the intake check valve member being located in said recess engaging said seat, a generally flat spring member in the recess backing the intake check valve member, a retainer in the recess backing the spring member, said retainer having a stem extending through the spring member and intake check valve member fixed in the base of the body at the bottom of the recess, a head on the stem overlying the spring member, and fingers on the head engaging the spring member, a portion of the base of the body surrounding the partition constituting a seat for the discharge check valve member, a generally flat spring ring member surrounding the partition backing said discharge check valve member, and a retainer for said flat spring ring member comprising a ring fixed on the partition having fingers engaging the flat spring ring member.

12. In a diaphragm pump as set forth in claim 11, said seats being of concave form, and said fingers holding the spring members against low regions of the concavities.

13. In a diaphragm pump, means defining a pumping chamber, a diaphragm closing the pumping chamber, a stem connected to said diaphragm, a spring for moving the diaphragm through a discharge stroke, means comprising a rocker arm having one end thereof engageable with said stem for moving the diaphragm through a suction stroke, and a leaf spring secured at one end to the medial portion of the rocker arm and extending longitudinally toward the other end of the rocker arm and

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normally having its free end spaced from the rocker arm for engagement by an engine driven element.

14. In a diaphragm pump, means defining a pumping chamber, a diaphragm closing the pumping chamber, a housing enclosing the diaphragm, a rocker arm housing extending laterally from the diaphragm housing, a spring in the diaphragm housing biasing the diaphragm in discharge direction, a stem extending from the diaphragm into the inner end of the rocker arm housing having a head at its outer end, said rocker arm housing being open at its outer end, a rocker arm pivoted in and extending longitudinally of said rocker arm housing, said arm having a connection at its inner end with said stem, and a leaf spring secured at one end thereof to the rocker arm at a point spaced from its outer end and extending toward said outer end and normally having its free end spaced from the rocker arm for engagement by an engine driven element.

15. In a diaphragm pump, means defining a pumping chamber, a diaphragm closing the pumping chamber, a housing enclosing the diaphragm, a rocker arm housing extending laterally from the diaphragm housing, a spring in the diaphragm housing biasing the diaphragm in dis-

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charge direction, a stem extending from the diaphragm into the inner end of the rocker arm housing having a head at its outer end, said rocker arm housing being open at its outer end and having grooves and peened portions at the sides thereof on the interior, a pivot pin having its ends received in said grooves and held therein by said peened portions on the sides of the rocker arm housing, a rocker arm carried by the pin extending longitudinally in said housing, said arm having a slot extending outward from its inner end receiving said stem, and a leaf spring secured to the rocker arm at a point spaced from its outer end and extending toward the outer end of the rocker arm and normally having its free end spaced from the rocker arm.

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