July 25, 1933. E. C. HORTON ET AL 1,920,014

MULTIPLE DIAPHRAGM PUMP

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Fig. 2

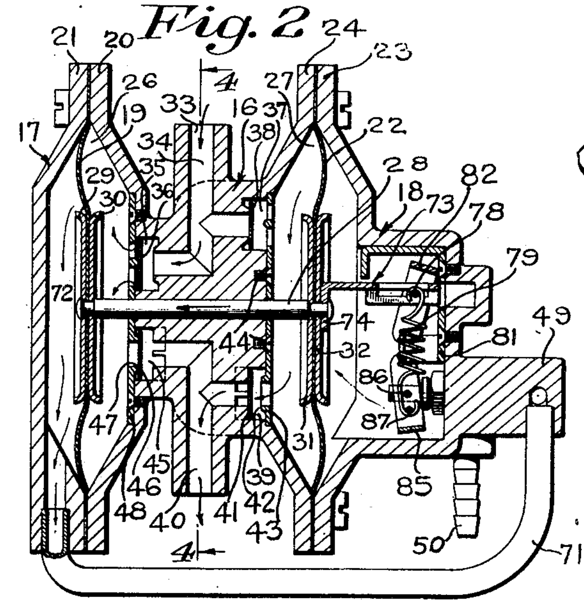

Fig. 3

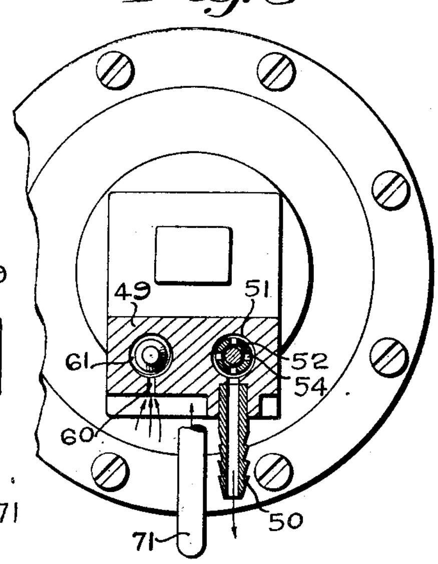

Fig. 1

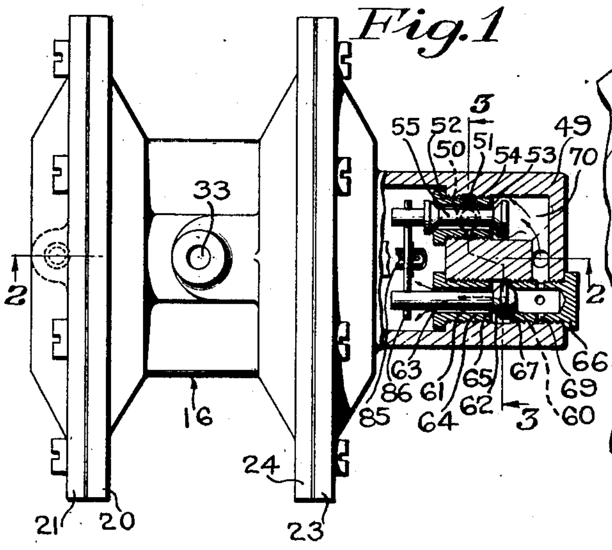

Fig. 4

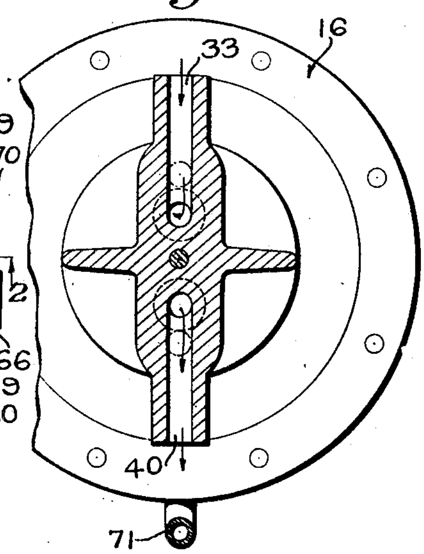

Fig. 5

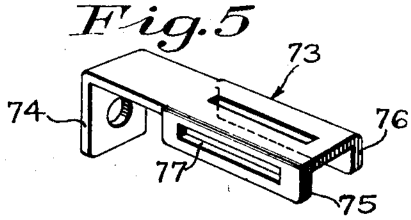

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Fig. 6

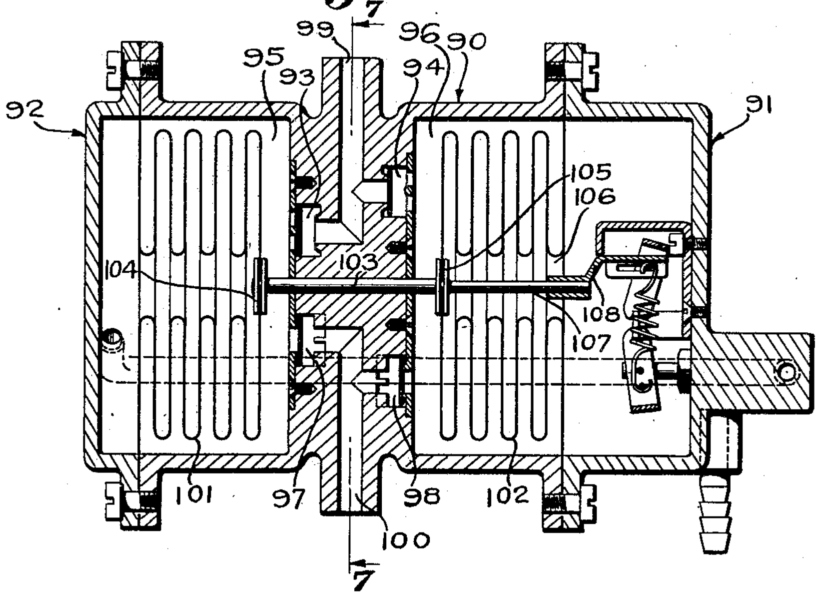

Fig. 7

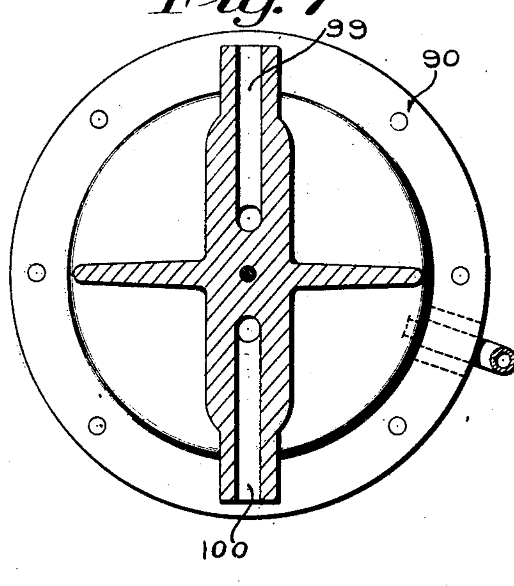

Fig. 8

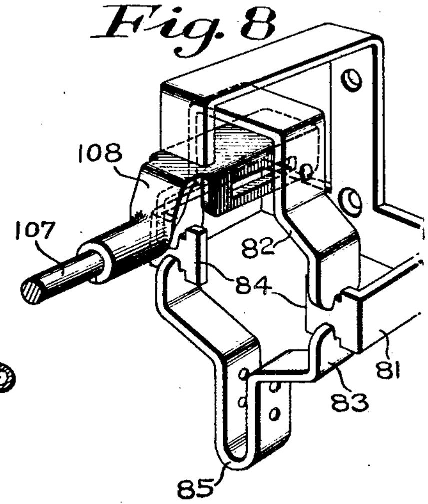

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Fig. 9

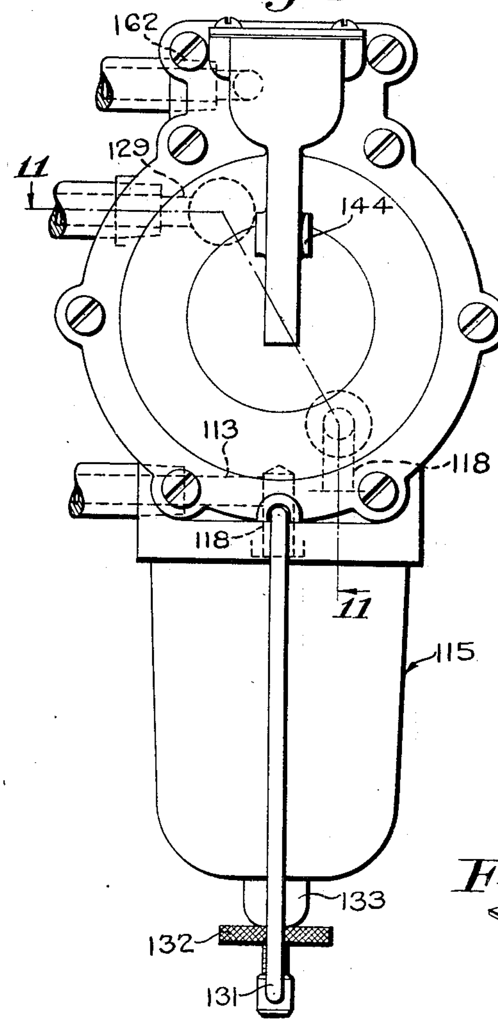


Fig. 10

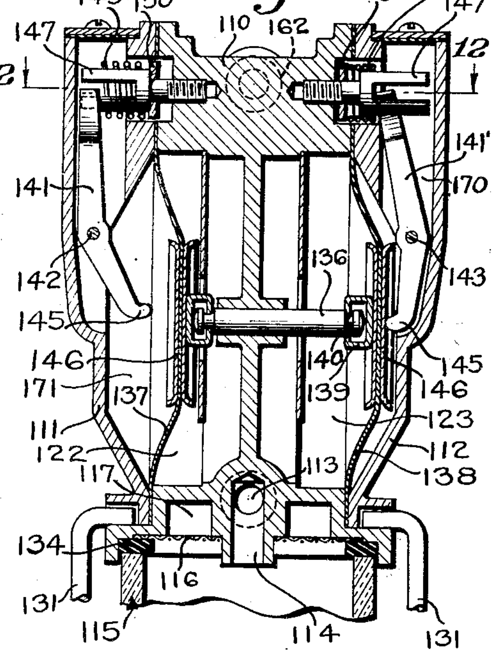


Fig. 11

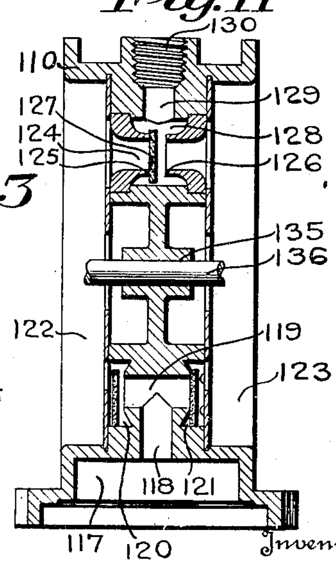


Fig. 13

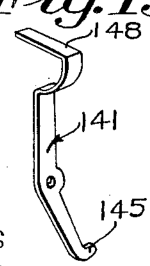
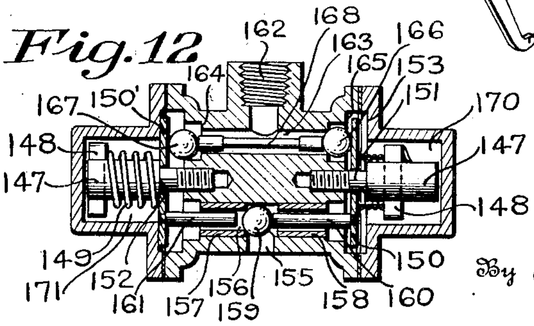


Fig. 12



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Patented July 25, 1933 **1,920,014**

UNITED STATES PATENT OFFICE

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MULTIPLE DIAPHRAGM PUMP

Application filed June 26, 1931. Serial No. 547,132.

The present invention relates to differential pressure fluid pumps and more particularly to multiple diaphragm pumps which possess propulsive action upon movement of the piston connecting rod in any permitted direction of movement.

The instant pump provides a plurality of pumping diaphragms which coordinate in their action to deliver substantially continuous and uniform flow of fluid. Preferably the propelling action of the pump is obtained efficaciously from a source of diminished pressure or suction, such as that obtaining within the intake manifold of an internal combustion engine, or from other suitable source of suction, whereby the difference in pressure existing between atmospheric pressure and that obtaining at the suction source is used to actuate the pistons and diaphragms of the pump and produce work thereupon.

The instant invention is further provided with means for alternately permitting the admission and withdrawal of propelling fluid to the diaphragms of the pump whereby suitable pressure is maintained thereupon for moving the pumping diaphragm thereof to and fro.

Several embodiments of the instant invention are illustrated in the appended drawings, wherein:

Fig. 1 is a plan view of the device partly in section.

Fig. 2 is a vertical section on line 2—2 of Fig. 1.

Fig. 3 is an irregular cross-section on the line 3—3 of Fig. 1.

Fig. 4 is a cross-section on the line 4—4 of Fig. 2.

Fig. 5 is an enlarged perspective view of the valve actuating member.

Fig. 6 is a vertical section of a modification of the device.

Fig. 7 is a transverse section along the line 7—7 of Fig. 6.

Fig. 8 is an enlarged view in perspective of the actuating stirrup and rocker arms.

Fig. 9 is a side elevation of a further modification of the device.

Fig. 10 is a fragmentary vertical section along line 10—10 of Fig. 9.

Fig. 11 is an irregular cross-section along line 11—11 of Fig. 9.

Fig. 12 is a horizontal section along line 12—12 of Fig. 10 showing the valve mechanism.

Fig. 13 is a view in perspective of the valve actuating link.

Referring more particularly to the drawings the improved pump, an embodiment of which is shown in Fig. 1, comprises a body member 16, a pump housing member 17, and a valve housing member 18. A flexible pumping diaphragm 19 is provided between the pump housing 17 and the body member 16 and is assembled therewith in fluid tight relation in any desired manner, as for instance by clamping the periphery thereof between flanged portions 20 of the body member and cooperating flange members 21 of the pump housing member 17 by suitable bolts 25. A similar pumping diaphragm 22 is included in fluid tight assembly between the valve housing member 18 and the body member 16 as by clamping the diaphragm between flanges 23 and 24. The diaphragms are preferably of a liquid proof, non-resilient fabric.

This particular disposition of the diaphragms provides a plurality of fuel pumping compartments 26 and 27, as defined by the respective diaphragm and the body member, whereby fuel is expelled from one compartment while the other compartment is intaking fuel; that is to say, propulsion of fuel to the fuel supply line is effected upon movement of the diaphragms in either direction. A continuance of propulsion of the fuel is insured by the provision of the rod 28 connecting the diaphragm 19, as through the cup plates 29 and 30, to the diaphragm 22, as through the cup plates 31 and 32.

Passage of fuel through the device is effected by means of a fuel inlet 33 which is connected by means of the passage 34 to a valve port 35 which has contained therein a suitable valving mechanism 36 permitting uni-directional flow from the inlet 33 to the fuel chamber 26. The companion fuel chamber 27 is also connected to the fuel inlet passage 33 by means of the valve port 37 regulated by the valve 38. Thus, upon movement of the piston rod in the direction of the arrow, fuel is caused to enter the fuel chamber 26 while upon movement in the opposite direction fuel enters the companion fuel chamber 27.

Fuel is caused to flow from the pumping chamber 27 upon movement of the rod and diaphragm 28 and 22 respectively, in the direction of the arrow, through the valve port 39 communicating with the fuel reservoir or chamber 27 into the fuel outlet 40. The fluid flow is regulated through the valve port 39 by means of the valve 41 contained therein which valve is adapted to close upon its seat 42 suitably formed in a plate 43 attached to the inner wall of the fuel chamber as by means of screws 44. In like manner the fluid outlet passage 40 is connected to a valve port 45 communicating with the companion fuel reservoir or chamber 26. This valve port is similarly provided with valving means, as indicated at 46, adapted to close upon a seat 47 similarly provided, as for instance, in the plate 48 attached to the inner wall of the body member 16.

It is thus seen that upon movement of the rod 28 in the direction of the arrow, fluid is caused to enter the inlet port 33 and flow into the fluid reservoir 26 through the valve port 35, since the valve 38 is closed upon its seat, thus preventing entrance of fuel therethrough. During this movement any fluid contained within the fluid reservoir 27 is caused to pass through the valve port 39 into the outlet passage 40, and is prevented from passing into the companion fuel reservoir 26 since the valving means 46 is closed upon its seat 47. When the piston rod is moved in the direction adverse to the arrow fluid in the fuel reservoir 26, now filled, escapes through the port 45 and into the outlet 40, while the companion fuel reservoir 27 is being filled by fluid which enters the fluid intake port 37 through the passage 34.

The differential pressures are so directed upon the sides of the diaphragms that these pressures possess relatively the same ratio and there is no reversal or buckling of the diaphragm thereby insuring a longer life to the pumping portion of the device. The valve housing 18 is provided with an extension 49 having an attaching nipple 50 adapted to be connected to a source of suction such as that provided within the intake manifold of an internal combustion engine. This attachment or nipple is in fluid communication with an annular ring 51, within the extenson member 49, which surrounds an internal sleeve 52 and has communication with the passage 53 therethrough, by means of the ports 54, thus providing means through which fluid may be removed through the passage 53, the port 54 and the nipple 50. The internal sleeve 52 is provided with a valving rod 55 carrying valving means 56 and 57 upon either end thereof capable of seating upon valve receiving portions 58 and 59 respectively formed in the ends of the internal sleeve 52.

An atmospheric port 60 provides fluid communication from the atmosphere to the passage 61 and from thence to the diaphragms 19 and 22 as hereinafter described. This passage is provided with a two-way communication which is governed by a valving means 62, the latter being provided with an extension 63 so placed within an internal sleeve 64 that the stem will move readily therein and permit seating of the valve 62 upon a valving seat 65 formed at one end of the internal sleeve 64. A second sleeve 66, substantially coaxial with the sleeve 64, is spaced therefrom and is provided with a valve seat 67 for cooperating with the valve 63 whereby the passageway 68 of the sleeve is closed. Ports 69 are provided in the sleeve 66 which communicate with a chamber 70, into which air and atmospheric pressure is permitted to flow when the valve 62 is closed upon its seat in the sleeve 64.

The chamber 70, further, is in fluid communication with a conduit 71 which extends therefrom to the pumping chamber 72, formed between the diaphragm 19 and the pump housing 17.

The operation of the pump will now be clearly apparent as the source of suction will cause fluid to flow out of the nipple 50 thus conveying fluid from the pumping chamber 72 through the conduit 71, thereby reducing the pressure within the pumping chamber 72, while at the same time the position of the valving member 62 permits air at atmospheric pressure to enter through the port 60, flow through the sleeve 64, and build up pressure upon the pumping side of the diaphragm 22 thus aiding in the movement of both diaphragms 22 and 19 (in the direction of the arrow shown upon the rod 28 in Fig. 2).

The valves 55 and 62 are actuated by valve actuating means attached to a movable portion of the pump. An embodiment of the valve actuating means is shown in Fig. 5 and comprises a stirrup 73 which is provided with a flanged end 74 for attachment to a portion of the moving piston mechanism, such as the end of the piston rod 28. Depending lateral flanges 75 and 76 are slotted as at 77 to receive a pin member 78 slidable in the slot for carrying a spring 79. The upper portion of the stirrup is slotted as at 80 to provide a receiving and guiding portion for the clip member of the spring 79.

A bracket member 81 is attached to the valve housing and is provided, at a distance spaced from the housing, with angular portions 84 having bearing edge surfaces, for receiving the rocker arm 82 to which the pin 78 is attached for providing a snap valve action upon movement of the piston and actuator arm. A second rocker arm 83 is provided which bears against the lower edge of the angular piece 84 as illustrated in an enlarged view in Fig. 8. The lower U-shape member 85 (Fig. 2) of the rocker arm is attached to a rod 86 connecting the stems 86 and 63 of the valving members 55 and 62, respectively. A pin 87, placed somewhat below the attachment of the rod 86, has attached thereto the other end of the spring 79 and provides the snap mechanism for actuating the valve members 55 and 62.

It will be seen that as the piston and actuator move in the direction of the arrow upon the piston rod 38 that the upper rocker is pulled in the direction of the arrow until the pin 78 is just over the center line connecting that pin with the pin 86, whereupon the spring mechanism 79 causes the lower end 85 of the rocker arm 83 to move to the outward position whereby the valves 55 and 62 are caused to close upon their seats. This position of the valve permits air at atmospheric pressure to flow through the conduit 71 into the pumping chamber 72 and at the same time air is drawn through the suction port 51 thus reducing the pressure in the companion pumping chamber, thereby causing a reversal of the pressure upon the respective diaphragms and hence a reversal in the movements thereof.

A variation of the invention is shown in Fig. 6 wherein the device comprises a body member 90, a valve housing member at 91, and a piston housing member at 92. The body member is provided with valved inlet ports 93 and 94 communicating with the fluid pumping chambers 95 and 96 and with the inlet passage 99. The pumping chambers are provided with fluid outlet ports 97 and 98, respectively, which permit fluid flow from the respective fluid pumping chambers into the outlet conduit 100. The pumping diaphragms comprise longitudinally compressible bellows or accordian diaphragms 101, 102 of suitable composition, such as metal sheets. These diaphragms are connected for coordinate movement by means of a piston rod 103 which is connected to the diaphragms in any suitable manner. In the modification shown in Fig. 6, this connection is made by means of the clips 104 and 105 whereby a fluid tight connection is insured between the clips and the diaphragms. The diaphragm 102 is provided with a passageway 106, which in the modification shown herein is located substantially axially thereof for receiving an extension 107 of the piston rod 103. The extension rod 107 is connected to the actuating member 108 which has actuating connection with a snap valve actuating mechanism of a suitable type such as that described hereinabove.

In the position of the valves and diaphragms shown in Fig. 6, fuel is entering the chamber 95 while it is being expelled from chamber 96 as a pressure less-than-atmospheric exists upon the working side of the diaphragm 101 and atmospheric pressure upon the working side of the diaphragm 102. Upon movement of the piston rod 103 to the left, the snap valve actuator moves the valving mechanism and causes a reversal of the atmospheric air and a reversal in movement of the diaphragms, compressing the diaphragm 102 longitudinally while the diaphragm 101 expands longitudinally.

Another modification of the invention is shown in Figs. 9, 10, 11, 12 and 13. The pump in this modification comprises a body member 110 and housing members 111 and 112. The body member is provided with a fuel inlet port 113 which connects with a passageway 114 in fluid communication with a fuel reservoir 115. The fuel thereafter passes through the screen 116 into the passage 117 and then through the conduit 118 into the valve connecting passage 119 which terminates in valve ports 120 and 121 whereby fluid may be directed in either of two directions into the fluid pumping chamber 122 or the fluid pumping chamber 123. The member 110 is further provided with a passageway 124 which has interrupted fluid communication with the fluid pumping chambers 122 and 123 and which has connected therein the valve seats 125 and 126 and is provided with valving means 127. An annular passageway 128 surrounds the valve seats 125 and 126 whereby the fluid flowing through either of said valves may be transferred from said annular passage through the passageway 129 to the fluid outlet 130.

It is thus seen that fluid from a source such as the fuel reservoir attached to an automotive vehicle, or other source, enters the inlet passage 113, flows therethrough and into the fuel reservoir 115.

The fuel reservoir 115 is attached to the pump in any suitable manner, as for instance to the body member 110, by the clip 131 and screw 132 bearing against the nipple 133 upon the lower portion of the reservoir 115 whereby the same is caused to bear against a gasket 134, thus forming a fluid tight connection between the fuel reservoir and the surfaces of the body member 110. The straining member or screen 116 is placed between the body member 110 and the reservoir 115 whereby fluid from the reservoir is caused to flow therethrough into the passageway 117 which is formed between the flanges of the body member and the screen 116.

The bearing surface 135 is formed in the body member 110 for receiving the piston rod 136 which connects the diaphragms 137 and 138 in such manner that they move synchronously. The piston rod is connected in any suitable manner to the diaphragms, and in the modification shown in Fig. 10, the collar or clip members 139 on the diaphragms are detachably engaged in the grooves 140 beneath the heads of the rod 136.

The action of this device is substantially similar to the action of the device illustrated in Fig. 2 and described hereinabove. Thus, in the showing in Fig. 10 the diaphragms 137 and 138 are in a position which represents substantially their limit of movement and the fuel pumping chamber 123 is filled with liquid fluid while the pumping chamber 122 is substantially depleted thereof. Upon movement, therefore, of the piston rod and diaphragm in the direction of the arrow upon the rod 136, fluid is caused to flow through the outlet port 124 from the fuel containing chamber 123 into the annular passageway 128 and from thence to the outlet 130. Upon the same stroke of the diaphragm the inlet port 121 is closed by the valving means contained therein, while the valving means in the port 120 are open so that fuel may flow into the fuel containing chamber 122.

The valving mechanism, a modification of which is shown in Figs. 10 and 12, is controlled by the levers 141, Fig. 13, and 141′ which are pivoted upon the pins 142 and 143, respectively, the pins being secured to a convenient portion of the housing as for instance at 144. The levers are provided at one end with convenient fingers 145 for contact with the cup plates 146, or other convenient portion of the movable diaphragm, whereby the levers may be pivoted upon the pins when moved by the diaphragms.

Bifurcated guiding or supporting members 147 are attached to the body member 110 and act to guide the upper stirrup portions 148 of the levers upon movement thereof. Resilient means 149 surround the guiding members 147 and bear against the stirrup end 148 of the lever while the other end bears against a valving mechanism 150, supported by members 147, for controlling the action thereof upon movement of the lever. This valving mechanism is guided by the reduced end portions 151 of the stud 147 and is adapted to seat upon the shoulder 152 thereof and upon a flanged portion 153 of the lever housing, Fig. 12. A similar valving mechanism 150′ and resilient means 149′ are disposed in similar relation to the lever 140′.

The body member 110 is provided with a port 155 one end opening to the atmosphere and the other end communicating with a passageway 156 provided with internal sleeve 157 and 158 disposed axially with respect to one another and provided with valving seats thereon to accommodate the ball valve 159 whereby atmospheric air may be caused to flow through the one or the other of the sleeves. A pin 160 is provided within the internal sleeve 158 of sufficient length to make propulsive contact with the ball valve 159 and the valve plate 150, so that when the lever mechanism is moved by the diaphragm 138 tension is put upon the resilient means 149 sufficient to overcome the fluid resistance offered by the seated valves, whereby the valve plate 150 is moved from its seat upon the shoulder 152 of the stud 147 and the flanges 153 of the valve housing 112, thereby moving the ball valve 159 from its seat upon the internal sleeve 158 to the seat upon the companion internal sleeve 175. A corresponding valve actuating member 161 is provided between the ball valve 159 and the plate valve 150′ for moving the ball in the opposite direction upon movement of the valve plate 150′ from its seat.

A suitable port 162 is provided for withdrawal of actuating fluid, which withdrawal may be effected by making communication with a source of reduced pressure or suction, such as has been specified hereinabove. This passageway is provided in the body member 110 at a convenient point, as for instance adjacent the top thereof and is in fluid communication with a transverse passage 163 provided with valving seats 164 and 165 at either end thereof. Valving means, such as the ball valve 166, is provided between the valve seat 165 and the plate valve 150, and a similar valve 167 is provided in a companion compartment between the valve seat 164 and the plate 150′. A valve actuating member, such as the floating pin member 168 is provided in the passage 163 and bears against the ball valves 166 and 167 for movement thereof to and from their valve seats in synchrony with the movements of the valve plates 150.

The operation of the valving mechanism is clearly seen as atmospheric air enters the atmopsheric port 155, passes through the passage 156 downwardly therefrom past the lever 141 into the pumping chamber 170 between the housing member 112 and the body member 110 and bears against the diaphragm 138.

Since the ball valves 159 and 166 are seated, atmospheric air at normal atmospheric pressure is constrained to pass to the compartment 170 and may not pass out through the passage 163 to the source of suction since the ball valve 166 is seated. The source of suction will draw fluid from the pumping compartment 171 confined between the valve housing member 111 and the body member 110 through the passageway 163 since the ball valve 167 is unseated as the floating pin member is pushed by the ball valve 166 against the ball valve 167 thereby unseating the same.

It will be noted that in this modification the diaphragms do not buckle or reverse themselves since the relative pressure upon the two sides of the diaphragm is regulated to retain the same relative degree.

Thus the diaphragm 138 retains the same bulge irrespective of the pressure within the pumping chamber 170. Should the pressure in the pumping chamber be atmospheric pressure, and should the diaphragms 137 and 138 be moving in the direction of the arrow, the diaphragm would consequently move against a fluid head created by the fuel contained in the fuel chamber 123 and hence maintain the bulge of the diaphragm. On the other hand, when the fuel pumping chamber 123 is being filled with fuel, the fluid head possessed by the fuel is relatively greater than the pressure obtaining within the chamber between the valve housing 112 and the diaphragm 138 which is less-than-atmospheric pressure and hence the bulge is maintained upon the diaphragm in the same direction at all times, both upon the working stroke and the filling stroke.

The diaphragms in the embodiments depicted in Figs. 2 and 10 are preferably non-resilient though readily flexible and, therefore, the sole driving power for the pumps will be fluid pressure controlled by the valve action.

What is claimed is:

1. A pump for motor vehicles, having a pair of end compartments separated by an intermediate body portion, the latter having a rod guide therein between the end compartments, a diaphragm in each compartment partitioning the same into an inner liquid fuel chamber and an outer fluid pressure motor chamber, a rod connecting the two diaphragms for movement in unison, said rod being supported in said rod guide and having free sliding contact therein with the opposite ends of the guide opening into the adjacent liquid fuel chambers, any leakage of fuel from one fuel chamber along the rod guide having free exit to the companion fuel chamber, said intermediate body portion having a common fuel inlet and a common fuel outlet opening directly into and out of the fuel chambers, and means for operatively admitting fluid pressure to the outer, motor chambers.

2. A fuel pump for motor vehicles, having a pair of end compartments with an intermediate body portion, a diaphragm in each compartment partitioning the same into inner and outer chambers, inlet and outlet ports for the outer pair of chambers, inlet and outlet ports for the inner pair of chambers, one pair of chambers constituting fuel chambers and the other pair of chambers constituting fluid pressure motor chambers, a member connecting the two diaphragms for movement in unison, said member being supported by the intermediate body portion, automatic valve mechanism for operatively admitting fluid pressure to the motor chambers through the inlet ports thereof, said automatic valve mechanism embodying resilient means acting during the greater part of each diaphragm movement to hold said automatic valve mechanism operative, and means operable by said moving diaphragms for actuating said automatic valve mechanism toward the end of each diaphragm movement, said means being independent of said mechanism.

3. A fuel pump for motor vehicles, having a pair of end compartments with an intermediate body portion, a diaphragm in each compartment partitioning the same into inner and outer chambers, inlet and outlet ports for the outer pair of chambers, inlet and outlet ports for the inner pair of chambers, one pair of chambers constituting fuel chambers and the other pair of chambers constituting fluid pressure motor chambers, a member connecting the two diaphragms for movement in unison, said member being supported by the intermediate body portion, automatic valve mechanism for operatively admitting fluid pressure to the motor chambers through the inlet ports thereof, and a play connection between said automatic valve mechanism and said moving diaphragms for actuating said valve mechanism toward the end of each diaphragm pumping movement.

4. A fuel pump for motor vehicles having the internal combustion engine with its carburetor and supply tank, comprising a central body casting having oppositely disposed chambered face portions each provided with a marginal diaphragm seat, said body casting having peripherally disposed inlet and outlet fuel passages opening through valved ports in the face portions, diaphragms closing the chambers of the body casting and having their peripheral portions engaged on the marginal seats, casing heads arranged over the diaphragms and clamping the same to said seats, said heads having intercommunicating chambers which are closed by said diaphragms, a power transmitting member connecting the two diaphragms, valve means for operatively connecting said head chambers to atmospheres of different pressures whereby the diaphragms will act to intake and expel fuel into; and from said first chambers, said valve means embodying a spring snap-action mechanism, and means operable by the diaphragm movement for engaging said

snap-action mechanism to actuate the same and operate the valve means for effecting the operative application of fluid pressure to the diaphragms.

5. In a fuel pump, a central casing section and end casing sections secured to the ends of the central section, a diaphragm between each end section and the central section, the diaphragms dividing the casing interior into a pair of fuel chambers and a pair of actuating chambers, means connecting the diaphragms for movement together, and means in said actuating chambers for reciprocating the diaphragm and connecting means, said central section having a continuous shouldered flange depending therefrom, a fuel container seated against the shoulder of said flange, a fuel inlet passage formed in said central casing section and discharging into the said fuel container, and screened passages in said casing between the fuel container and the fuel chambers, a fuel discharge passage in said casing and in communication with the fuel chambers, and valve means in said screened passages and the discharge passage for effecting a uni-directional flow of fluid through said fuel chambers.

6. In a fuel pump and casing section having recesses at the ends thereof, a diaphragm secured to each of said ends whereby a chamber is formed between each diaphragm and the casing section, substantially rigid means connecting said diaphragms for synchronous movement, an inlet and an exhaust passage in said casing communicating with each of said chambers, valves in said passages for effecting uni-directional fluid passage through said chambers and passages, and a plate secured in each of said recesses for retaining said valves.

7. In a fuel pump, a pair of casing sections and a diaphragm having peripheral portions clamped between said sections, each of the latter having a recess in the medial portions thereof whereby chambers are provided between the casing sections and the diaphragm, an inlet and an outlet passage in one of said sections extending into one of said chambers, valves in said passages for effecting a uni-directional flow of fluid through said passages upon reciprocation of said diaphragm, and a plate having apertures in registry with said passages, said plate being secured to the casing section in the recess thereof and over said passages to retain the valves therein.

8. In a fluid pressure operable fuel pump, a central casing section having a central wall, and an end section removably secured to each end of the central casing section, a diaphragm between the central section and each end section whereby inner fluid chambers are provided between said diaphragms and the central wall and outer fluid chambers are provided between said diaphragms and the end casing sections, valve means in one of said end casing sections detachably connected for operation to and by the adjacent diaphragm, and fluid passages controlled by said valve means for controlling the movement of fluid through said chambers.

9. In a fuel pump, a central casing section and an end section removably secured to each end of the central casing section, a diaphragm between each end section and the central section, said central casing having a heavy peripheral portion to which the end sections and the diaphragms are secured and a thin web-like central wall having a bearing portion slidably receiving said rod, means in said casing and without said chambers for reciprocating the rod and diaphragm assembly for alternately enlarging and contracting said chambers, fluid inlet and outlet passages in said peripheral portions of the central section and each opening into both chambers, and valve means in said passage for maintaining a uni-directional flow of fluid through said passages.

10. In a fluid pressure operable fuel pump, a hollow casing having end walls and a central wall dividing the interior of the casing into a pair of cavities, a piston in each cavity dividing it into a pair of chambers, means extending through the central wall and connecting the pistons for movement in synchronism, passages having valves therein for alternately applying fluid pressure to one and then to another of said chambers for actuating said pistons, and spring snap-action mechanism in one of said chambers for actuating said valves, and a mechanical connection in said last mentioned chamber between said mechanism and the piston and connecting means assembly for reversing said mechanism at the end of each stroke of the pistons.

11. In a fluid pressure operable fuel pump, a casing including a pair of sections, a flexible diaphragm between said sections, a member carried by said diaphragm and extending into the chamber between said diaphragm and a wall of one of said sections, valves in said wall for alternately admitting fluid under pressure to said chamber, and a spring snap-action valve mechanism within said chamber and connected to said member and said valves for reversing the positions of the valves when the diaphragm is moved to its limit position of flexure in either direction.

12. In a fluid pressure operable fuel pump, a casing having a pair of end walls and a diaphragm between said walls dividing the casing interior, said diaphragm being flexible toward and away from one of said walls, fluid inlet and outlet passages in said wall and valves for alternately opening and

closing said passages, a rock member pivoted to said wall and having its free end connected to said valves for reversing them, a second rock member pivoted to the wall and having its free end extending oppositely to the free end of said first rock member, means providing a play connection between the free end of said second rock member, and a spring connecting the free ends of said rock members, whereby upon continued movement of the diaphragm to its limit position in either direction the position of the valves will be reversed.

13. In a fluid pressure operable fuel pump, a casing comprising a central section and a pair of end sections, a diaphragm disposed between each end section and the central section, means extending through the central section connecting the diaphragms for movement in unison, said diaphragms and wall portions of the casing providing a pair of chambers therebetween which are alternately enlarged and contracted, passages for alternately opening said chambers to atmospheres of different pressures, said passages extending through said central casing section, valves for controlling said passages supported in said central casing section, and spring snap-action valve actuating means disposed in the interior of said casing and operably associated with the diaphragms and the valves to reverse the latter when the diaphragms reach the limits of their strokes in either direction.

14. A suction operated fuel pump for motor vehicles, comprising a casing structure consisting of end castings and an interposed body casting defining individualy separate end compartments, a diaphragm in each compartment partitioning the same into a pump chamber and a motor chamber, means connecting the diaphragms into a movable unit, valved fuel inlet and outlet passages in one of the castings and having communication with the pair of pump chambers, a suction passage opening through valve seat means on one of said castings, said valve seat means having communication with the atmosphere and with each motor chamber, valve means cooperating with said valve seat means and movable from one to the other of two operative positions first for connecting the suction passage to one motor chamber and the atmosphere to the companion motor chamber and then reversing the connections, spring means for moving and yieldably holding the valve means to its operative positions, and an actuator part within the casing structure and movable by said diaphragm unit into engagement with the spring means to operate the same.

15. A fuel pump for motor vehicles, comprising a central body having its opposite sides hollowed to form fuel chambers separated by a web, said web having a rod bearing and being provided with inflow and outflow passages opening into the fuel chambers, valves contained within the body for directing the flow of fuel into and out of said chambers, chambered heads mounted on the central body over its hollowed sides, pumping elements operating between and in the fuel chambers and the chambers of the heads, a rod supported in said bearing and connecting the pumping elements for movement in unison, said head chambers constituting motor chambers, fluid passages communicating with the motor chambers, and means arranged within one of the motor for operatively admitting fluid pressure to the motor chambers through said fluid passages to actuate the pumping elements.

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