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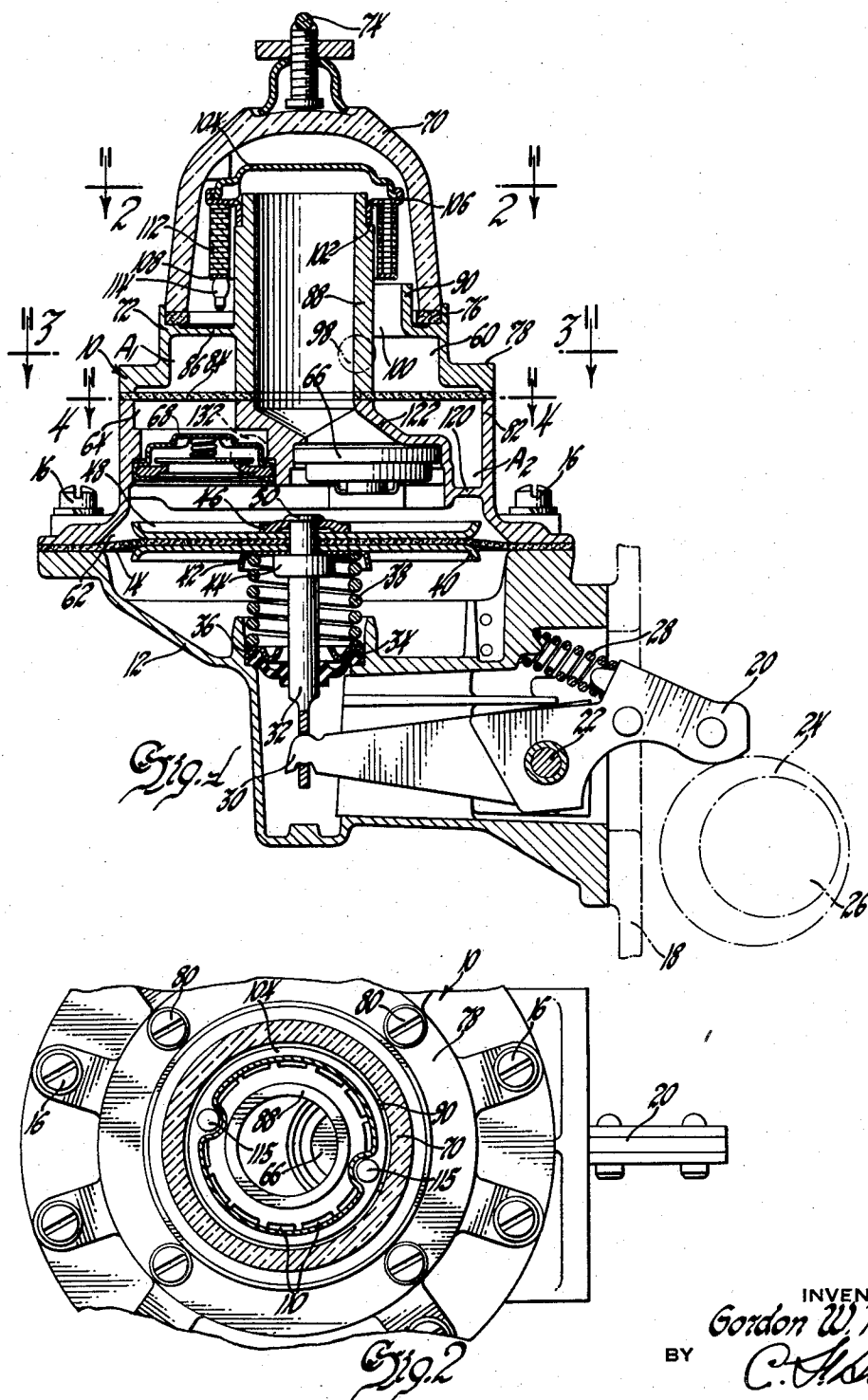
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OSCILLATABLE DIAPHRAGM PUMPS

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2 Sheets-Sheet 1



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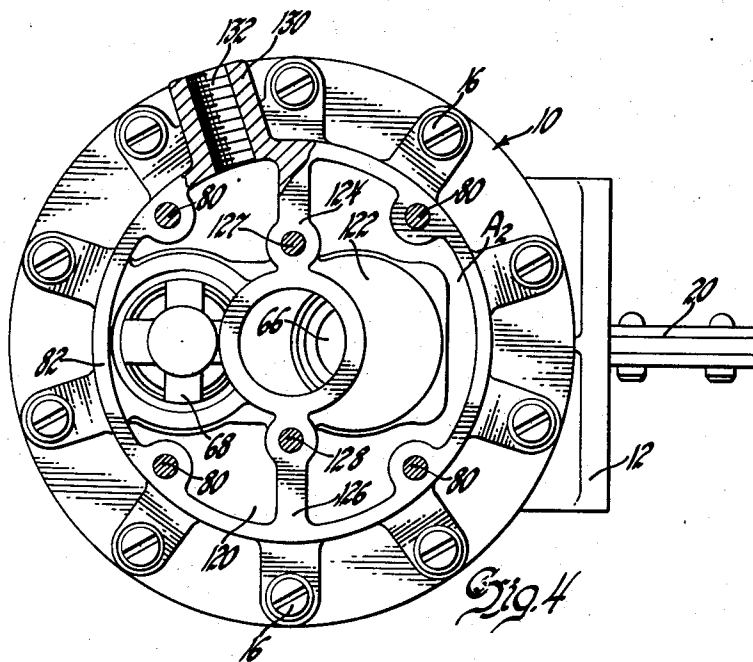
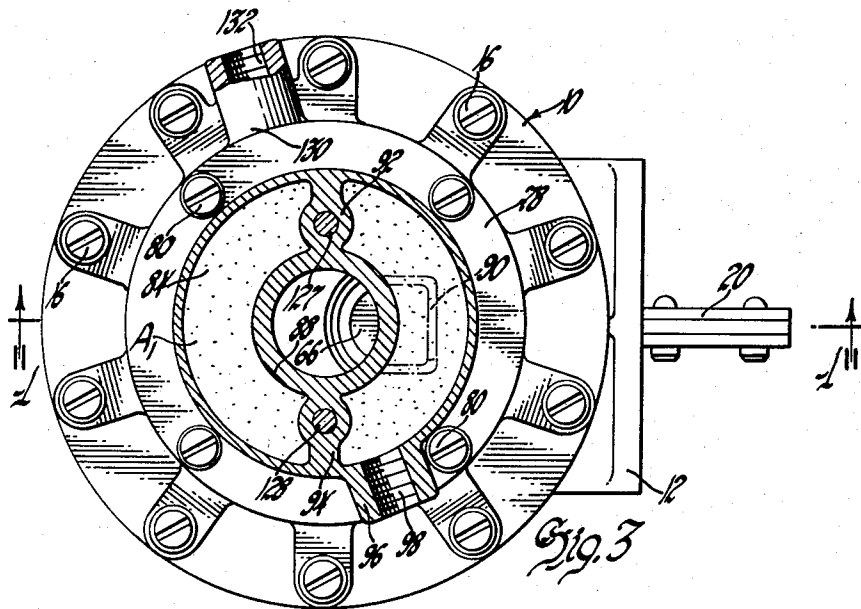
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1

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OSCILLATABLE DIAPHRAGM PUMPS

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11 Claims. (Cl. 103—150)

This invention relates to pumps for liquid fluids and more particularly to fuel pumps of the oscillating diaphragm type.

Pumps which rely upon the oscillation of diaphragms for their operation are inherently deficient in that fluid delivery by such pumps is not as constant, smooth, or uniform as would be desirable. Also, it is customary, in the use of such pumps, to employ an extraneous or separate accessory for filtering the fluid being pumped. The provision of a separate accessory for filtering is inimical to desired compactness and neatness as well as cost of installation as applied for numerous uses but particularly in the case of an automobile engine fuel system as an example.

An object of the present invention is to provide an improved oscillatable diaphragm pump characterized by uniformity in fluid delivery.

Another object is to provide an improved pump in combination with a filter in the form of a compact unit.

In pursuance of the above objectives a feature of the invention comprises a diaphragm pump having three chambers arranged on one side of the diaphragm, two of these chambers being separated from each other by a yielding member or flexible sheet and at least one of these chambers being partitioned to form a dead-air space. Another feature comprises a diaphragm pump having a valve controlled fluid passage leading through three chambers of the pump with means provided to minimize fluctuations in the fluid pressure conditions existent at both the inlet and outlet portions of the pump. One other feature comprises a unitary device which includes an improved arrangement or combination of a diaphragm pump, a means for making the fluid discharge of the pump more uniform, and a filter for the fluid.

These and other important characteristics and features of the invention will now be described in detail in the specification and then pointed out more particularly in the appended claims.

In the drawings,

Figure 1 is an elevational view of a fuel pump in which the present invention is embodied and is a section taken along the line 1—1 of Figure 3;

Figure 2 is a partial and horizontal view in section and taken along the line 2—2 of Figure 1;

Figure 3 is a horizontal view in section taken along the line 3—3 of Figure 1 with an inlet lip portion at a higher level being shown in dash lines; and

Figure 4 is a view in section like that of Figure 3 but taken for the most part along the line 4—4 of Figure 1.

Referring to Figures 1 to 4 inclusive, the numeral 10 refers generally to the body of a pump and the body consists of a lower body portion 12 and an upper portion between which the margin of an oscillatable pump diaphragm 14 is clamped with the aid of cap screws 16.

The lower body portion 12 is flanged and adapted to be fastened to the casing 18 of an engine by means not shown. When so mounted, a lever 20 pivoted at 22

2

within the body portion 12 is adapted to be rocked by the action of a cam 24 actuated by an engine cam shaft 26. Yielding engagement of one end of the lever with the cam 24 is assured by the action of a compression spring 28 mounted within the lower body portion 12. The lever 20 is actually composed of several parts but as all parts within the body portion 12 are conventional and the nature of the lever 20 is of no moment insofar as the present invention is concerned, that lever is considered herein as a unit. The other end of the lever 20 is connected as at 30 to the lower end of a vertical stem 32 which is secured to the central portion of the pump diaphragm 14. The stem 32 passes through a sealing member 34, a curved washer 36 and coaxial with a coil spring 38 which is mounted between the washer 36 and the diaphragm 14. Flanged plates 40 and 42 are interposed between the diaphragm 14 and the spring 38, and a shoulder portion 44 of the stem 32 is held tightly in engagement with the under side of the plate 42 by means of the clamping effect of a washer 46, a flanged upper plate 48, and a head 50, the latter forming the top of the stem 32. As is conventional, the rotary movement of the cam 24, accompanied by cooperative action of the spring 38, serves to oscillate the diaphragm 14 and this action creates a variable volume of a chamber within the pump body 10 just above and adjacent to the diaphragm 14.

The upper body portion of the pump contains three coaxial chambers 60, 62, and 64, portions of which communicate in series by means of one-way valves 66 and 68. The chamber 60 is defined by an inverted cup 70 and an annular section 72 which is interiorly partitioned. The cup 70 is held in fluid tight relation with the section 72 by a conventional bail 74 and an interposed washer 76. The section 72 is provided with an annular exterior shoulder 78 through which four cap screws 80 (Figures 2, 3, and 4) are passed firmly to attach the section 72 to an intermediate body portion 82.

A flexible sheet or a yielding member 84 is interposed between the annular section 72 and the intermediate body portion 82. The sheet or member 84, as illustrated, is in the form of a fabricated diaphragm impregnated with oil to make it resistant against the undesirable effects of gasoline or other liquid fuels which enable it to retain desired characteristics of flexibility and impermeability despite repeated flexures and subjection to high and low temperature conditions. Such a sheet is disclosed in the United States Letters Patent No. 1,847,445 granted March 1, 1932, in the names of Messrs. Donald W. Randolph and Jay T. Ford. Other forms of such sheet material or yielding member may be employed without departing from the spirit of the present invention.

The annular section 72 is provided with a horizontal thin wall 86 and integral with the wall 86 is provided a central cylindrical tube portion 88, a three-sided upwardly directed lip portion 90, and two partitions 92 and 94 (Figure 3). A boss 96 (Figure 3) is formed integral with the vertical wall of the section 72 to provide a fuel inlet 98. The lip 90 forms an upwardly directed passage 100 (Figure 1). The diaphragm or sheet 84 cooperates with the partitions 92 and 94 to form a dead-air space A1 within the section 72.

An annular shoulder 102 is formed on the top portion of the tube portion 88 and serves as a seat for a filtering element which is composed of a top imperforate cover member 104, a two-flanged plate 106 and a metal annulus 108. The inner and downwardly directed edge of the flanged plate 106 is adapted to rest upon the shoulder 102 and the outer flanged portion of the plate 106 is crimped over the margin of the cover plate 104. The flanged plate 106 has formed therein an annular series of arcuate slots 110 (Figure 2). Tightly confined be-

3

tween the flanged plate 106 and the annulus 108 is a stack 112 of discs or washers of filter material such as impregnated paper or equivalent porous filter material. Each of the discs is formed with a series of arcuate slots to conform with the slots 110 in the plate 106. Two pins 114 are utilized to hold the stack 112 in its assembled condition. Each pin 114 passes down through the flanged plate 106, down through the stack 112 and through the annulus 108. The top end of each pin 114 is provided with a head 115 (Figure 2) and the bottom end is upset (Figure 1). Vertical passages aligned with the slots 110 are therefore provided leading through the stack 112 and these passages terminate at their lower ends at the upper side of the annulus 108.

The intermediate body portion 82 incloses the lower chamber 62 and the upper partitioned chamber 64 and integral with that portion is a thin horizontal wall 120, through which two ports and corresponding valves 66 and 68 lead. The body portion 82 also has a portion 122 which forms a passage leading to the chamber 62 by way of the valve 66. This passage extends from the interior of the cylindrical portion 88 as clearly may be seen in Figure 1. Two vertical partitions 124 and 126 (Figure 4) are formed integral with the horizontal wall 120, portion 122, and the outside wall of the intermediate body portion 82 to form a dead air space A2 from the chamber 64. The flexible sheet 84 is apertured and the inner margin thereof is clamped between the bottom of the cylindrical portion 88 and the upper annular surface of portion 122 with the aid of two bolts 127 and 128. These bolts supplement the action of the four cap screws 80 in holding body portions 72 and 82 for rigid confinement of the sheet 84 margins.

Integral with the body portion 82 is a boss 130 (Figures 2, 3 and 4) which is interiorly threaded at 132 as an outlet connection for the pump. The threaded outlet 132 is shown by a dotted circle in Figure 1.

From the above, operation of the pump may be understood but, in order to clarify the matter, it may be stated that actuation of the diaphragm 14 creates a variation in the pressure of fluid in the chamber 62. As a matter of convenience and for purposes of description, the inlet chamber 60 may be called a first chamber, the chamber 62 a second chamber, and the outlet chamber 64 may be called the third chamber. On a suction oscillation or a downward stroke of diaphragm 14, valve 66 is induced to open with the result that fluid is pulled into the second chamber 62 by suction. Because of this flow, fluid is drawn into the inlet 98 and passes from the inlet 98 up through the passage 100 of the first chamber 60 and upwardly to contact the inner and outer wall surface of the filter stack 112. A slight clearance is provided between the inner wall of the stack 112 and the outer wall of the cylindrical portion 88. As a consequence, fuel will flow from the exterior of the filter stack 112 and will enter the passages of the stack simultaneous with a filtering action. The fluid will then flow upwardly and through the slots 110, down through the interior of the cylindrical tube portion 88, the valve 66, and into the second chamber 62. From thence the fuel will pass upwardly through the valve 68 during an upward motion of a diaphragm 14 and as the valve 66 closes and into the third chamber 64 and then the fluid will pass through the outlet 132.

It will be noted that the inlet 98 and the outlet 132 are on opposite sides of the flexible sheet or yielding member 84 and that during the pumping action variations in pressure conditions within the first and third chambers 60 and 64 will be minimized by virtue of the yielding characteristic of the sheet 84 which separates these chambers from the dead-air spaces A2 and A1 respectively. The variations in suction during a given pump cycle within the first chamber 60 are minimized because the appropriate part of sheet 84 will yield upwardly when the suction is high and tend to become flat

4

when suction is low. When pressure is high in the third chamber 64, the portion of the sheet 84 above the valve 68 will yield upwardly to level off the momentary increase in pressure. By this simple and compact arrangement of the pump, delivery is made more uniform and filtering action is provided without departing from desired compactness.

I claim:

1. A pump having a body, an oscillatable pump diaphragm inclosed in said body, three chambers arranged in said body on one side of said pump diaphragm, a yielding member, the first and third of said chambers constituting inlet and outlet chambers respectively and being partitioned and separated from each other by said yielding member, the second of said chambers being partially defined by said pump diaphragm, a passage controlled by a pressure operated valve and connecting the said first and second chambers, a second passage controlled by a pressure operated valve and connecting the second and third of said chambers, and said body having an inlet and an outlet communicating with the interior of said body at opposite sides of said yielding member.

2. A pump having a body inclosing an oscillatable pump diaphragm, three chambers coaxially arranged in said body, a sheet of flexible material clamped in position with yieldable portions thereof separating two of said chambers, the said two chambers being partitioned, the other of said three chambers being adjacent to and partially defined by said pump diaphragm and communicating directly with each of the said two chambers, and a valve controlled one-way fluid passage leading into said body through said chambers in series and out from said body.

3. A pump having a body, an oscillatable pump diaphragm inclosed in said body, three chambers arranged in said body on one side of said pump diaphragm, a yielding member, the first and third of said chambers being inlet and outlet chambers each having a dead-air space separated from the other by said yielding member, the second of said chambers being arranged adjacent to and partially defined by said pump diaphragm, a passage controlled by a pressure operated valve and connecting the said first and second chambers, a filter in said passage, a second passage controlled by a pressure operated valve and connecting the second and third of said chambers, and said body having an inlet and an outlet communicating with the said inlet and outlet chambers at opposite sides of said yielding member.

4. A pump having a body, an oscillatable pump diaphragm inclosed in said body, three coaxial chambers arranged in said body, a sheet of flexible material separating the first and third of said chambers, a dead-air space partitioned off in said first chamber and partially defined by said sheet, the second of said chambers being adjacent to and partially defined by said pump diaphragm, a fluid passage leading through said body by way of said first, second, and third chambers in that order, a multiple disc filter arranged in said passage between said first and second chambers, and valve means arranged to control said passage and adapted to be operated by fluid pressures created in said second chamber by actuation of said diaphragm.

5. A pump having a body, an oscillatable pump diaphragm inclosed in said body, three chambers coaxially arranged with respect to said diaphragm in said body, a yielding member interposed between two of said chambers partially to define them and subject to the pressure therein, the other of said chambers constituting a pumping chamber connecting the said two chambers and being arranged adjacent to said pump diaphragm, a valve controlled one-way fluid passage leading through said body by way of said chambers in series, and an annular filter arranged in said passage coaxial with said chambers.

6. A pump having a body, an oscillatable pump

5

diaphragm inclosed in said body, three chambers arranged in said body, a sheet of flexible material separating two of said chambers partially to define inlet and outlet chambers, the other of said three chambers being an intermediate chamber and partially defined by said pump diaphragm, a valve controlled one-way fluid passage leading through said body by way of said chambers in series, and a cylindrical stack of annular discs of filter material positioned within said passage for clarifying fluid to be handled by said pump.

7. A pump having a body made in portions and an oscillatable pump diaphragm inclosed in said body, three chambers coaxially arranged with respect to said diaphragm in said body, a sheet of flexible material clamped between two of said portions of said body and interposed between the first and third of said chambers and yieldable to fluid pressures in said first and third chambers, said latter chambers being partitioned to have dead-air spaces partially defined by said sheet, the second of said chambers constituting a pumping chamber and being partially defined by said pump diaphragm, a fluid passage a portion of which is coaxial with said chambers, said passage leading through said body by way of said first, second, and third chambers in that order, valve means arranged to control said passage and adapted to be operated by fluid pressures created in said second chamber by activation of said diaphragm, and a cylindrical stack of discs of filter material arranged with respect to said passage to cause fluid in said passage to pass through the material of said stack.

8. A fuel pump having a body, an oscillatable pump diaphragm inclosed in said body, three communicating chambers arranged in said body coaxial with said diaphragm, a yielding member separating the first and third of said chambers to form inlet and outlet chambers, a dead-air space partitioned off in said first chamber, the second of said chambers being partially defined by said pump diaphragm, a fluid passage leading into said body and by way of said chambers in series and out from said body, valves and a filter arranged to control said passage, and said valves being adapted to be operated by fluid pressures created in said second chamber by actuation of said diaphragm.

9. A fuel pump having a lower body portion adapted for attachment to a support, an upper body portion having three coaxial chambers, an oscillatable pump diaphragm with its margin clamped in position between the said two body portions partially to define one of said chambers as a pumping chamber, a sheet of flexible and

6

impermeable material separating the other two of said chambers, a fluid passage formed in said upper body and communicating with said coaxial chambers in series, a filter comprising a stack of annular porous discs placed in coaxial relation with said chambers and with a wall of said stack impeding said fluid passage, one-way valve means arranged to control said passage and adapted to be operated by fluid pressures created in said pumping chamber by actuation of said diaphragm, and means within said lower body portion to actuate said diaphragm.

10. A fuel pump having a body formed in three parts comprising a supporting part, an intermediate part and a fluid inlet part, a pumping diaphragm clamped between said supporting part and said intermediate part partially to define a pumping chamber in the latter, an outlet chamber defined in said intermediate part and communicating with said pumping chamber by means of a pressure actuated valve, an inlet chamber in said inlet part and communicating with said pumping chamber by means of a suction operated valve, dead air spaces partitioned off in each of said inlet and outlet chambers, a yielding sheet of flexible material interposed between said intermediate part and said fluid inlet part partially to define dead air spaces in those parts, and means in said supporting part for operating said diaphragm.

11. A fuel pump having a body formed in three parts comprising a supporting part, an intermediate part and an inlet part, a pumping diaphragm clamped between said supporting part and said intermediate part partially to define a pumping chamber in the latter, an outlet chamber defined in said intermediate part and communicating with said pumping chamber by means of a pressure actuated valve, an inlet chamber in said inlet part and communicating with said pumping chamber by means of a suction operated valve, a filter element arranged in operative position in said inlet chamber, dead air spaces partitioned off in each of said inlet and outlet chambers, a yielding sheet of flexible material separating said inlet and outlet chambers and partially defining said dead air spaces, and means in said supporting part for operating said diaphragm.

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