

June 28, 1960

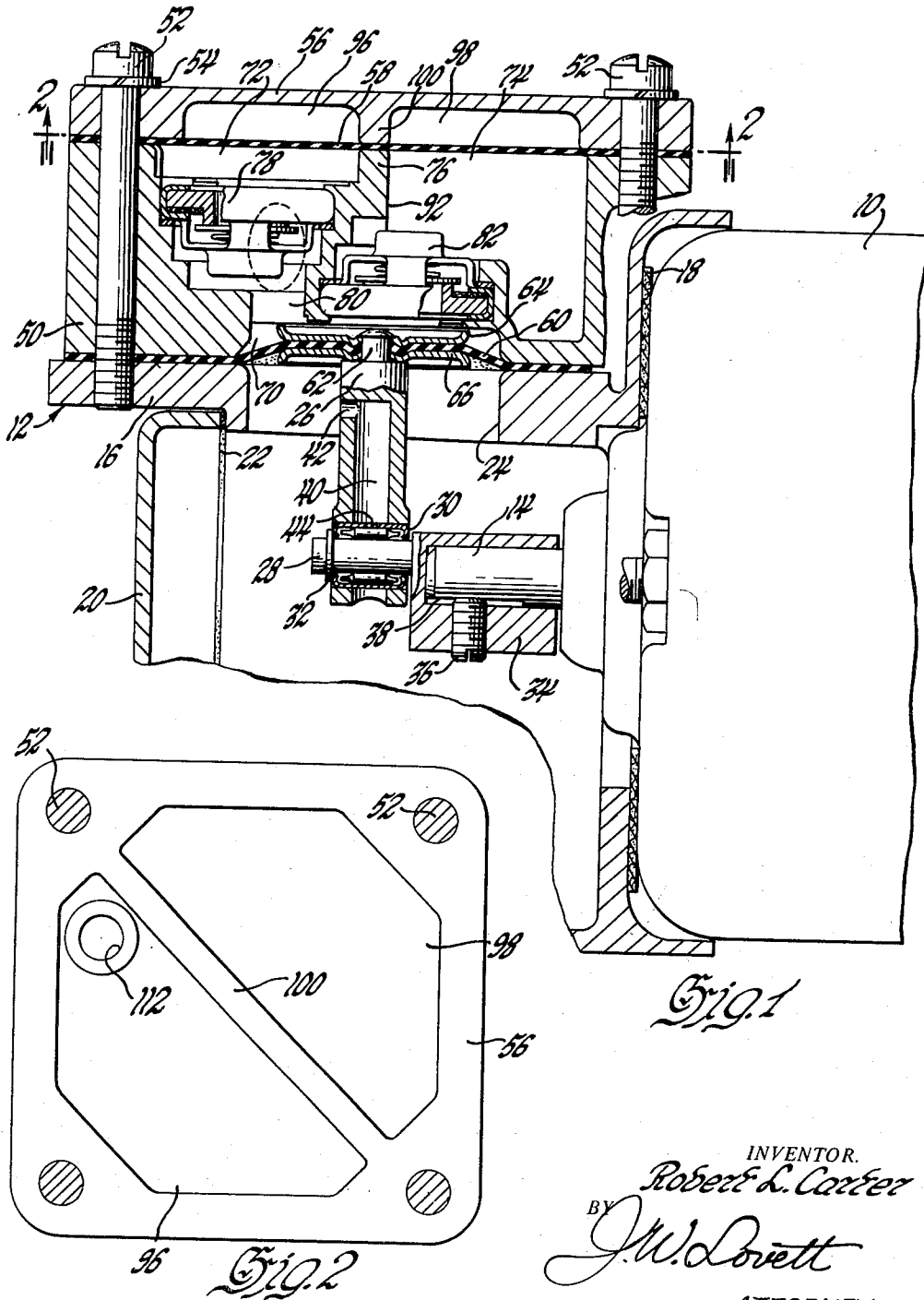
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DIAPHRAGM PUMP WITH PULSATOR BY-PASS VALVE

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2 Sheets-Sheet 1



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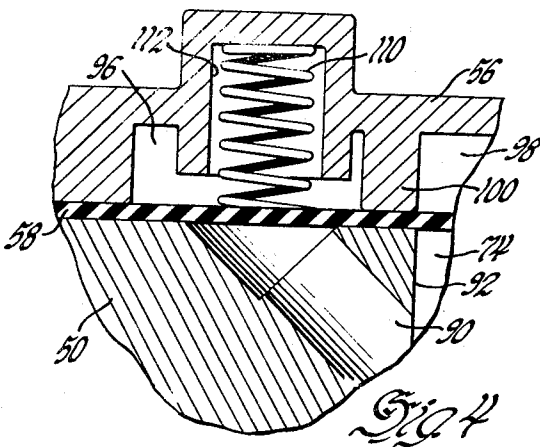
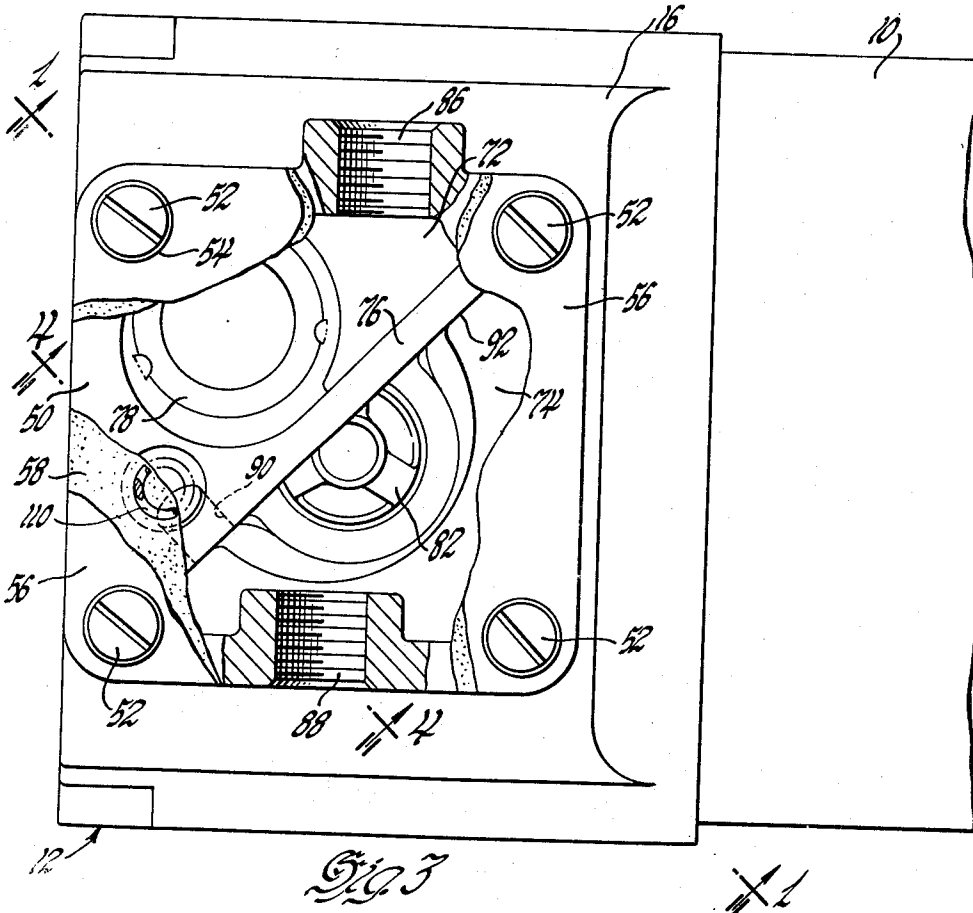
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DIAPHRAGM PUMP WITH PULSATOR BY-PASS VALVE

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8 Claims. (Cl. 103—42)

This invention relates to pumps and more particularly to fuel pumps of the diaphragm type.

Diaphragm pumps as commonly used in the fuel systems of automotive vehicles are not positively driven insofar as their pumping strokes are concerned. The pump delivery may otherwise tend to exceed the fuel consumption requirements and such tendency is conventionally prevented by employing the back-up pressure of the fuel to reduce the length of stroke and displacement of the diaphragm during pumping action. Such reduction is possible because the diaphragm, during its working stroke, is commonly actuated by a yieldable spring and not by any positively driving element. In order to stabilize the flow of fuel from such pumps it has often been the practice to provide a second diaphragm partially defining at least one dead air chamber and separating that chamber from the inlet or outlet passage of the pump. In such installations, an inlet or outlet passage is considered to be a "pulsator chamber" and each dead air chamber permits the second diaphragm to yield at fuel pressure peaks and thereby contribute to the flow stabilization. A dead air chamber for each of the pulsator or inlet and outlet pump chambers is disclosed in the United States Patent 2,308,041 granted January 12, 1943, in the names of A. M. Babitch and G. W. Harry.

It has now been found that a diaphragm pump with one or two pulsator chambers may be positively driven on the pumping stroke and that a pulsator diaphragm may be employed in such a way that the discharge from the pump proper is stabilized and need not exceed discharge demand despite the positive drive.

An object of the present invention is to provide a pump of the diaphragm type which is characterized by a fluid flow stabilized by pulsator action and adapted to be driven either positively or impositively during its pumping stroke. Another object is to provide an improved diaphragm pump in which a pressure relief arrangement or by-pass is incorporated to form a compact structure.

To these ends, a feature of the invention is a diaphragm pump having a pulsator diaphragm which is resiliently actuated to control a by-pass from the discharge side of the pump to the inlet side thereof. Another feature is a positively driven diaphragm pump with a pulsator diaphragm arranged to limit the pump discharge pressure.

These and other important 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:

Fig. 1 is a partial view of a pump and motor, the pump being in section partly as seen along the line 1—1 in Fig. 3 to illustrate structural details;

Fig. 2 is a view looking in the direction of the arrows 2—2 in Fig. 1;

Fig. 3 is a plan view of the parts shown in Fig. 1 with parts broken away better to depict details of the pump; and

Fig. 4 is an enlarged sectional view looking in the direction of the arrows 4—4 in Fig. 3.

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Figs. 1 and 3 disclose one end of an electric motor 10 as illustrative of one form of a driving mechanism for a fuel pump attached thereto and generally indicated at 12. The motor is provided with a conventional shaft 14 which extends within a housing 16 supported adjacent to the motor 10. A gasket 18 is shown interposed between one end of the housing 16 and the motor forming a tight seal. A vertical cover 20 is arranged to close off one side of the housing 16 with the aid of a second gasket 22 at the peripheral margin of the cover. The top wall of the housing 16 is apertured as at 24 to accommodate a pump driving mechanism composed of a depending hollow rod 26, the lower end of which is joined to an eccentric pin 28 with a roller bearing arrangement 30 eliminating the friction between the pin and the rod. The bearing is in tight fit within the lower end of the rod and is retained on the pin by means of a spring washer 32 received in an annular groove on the pin. The latter is an integral part of a block 34 which is recessed to receive the end of the motor drive shaft 14. A set screw 36 passes through one wall of the block 34 to bear against a flat surface 38 on one side of the shaft 14. The arrangement is such that the pin 28 is eccentric with respect to the shaft 14 so that operation of the motor 10 will cause reciprocation of the rod or plunger 26 in a vertical direction and the driving effect being a positive value during both up and down strokes. The rod 26 is hollow as at 40 with a horizontal aperture 42 communicating with its interior, the purpose in mind being to insure lubrication of the bearing 30 by virtue of an aperture 44 in the bearing. It will be understood that the housing 16 is provided with lubricant by splash action or otherwise. Preferably, the hollow rod 26 is filled with lubricant prior to assembly of the bearing 30.

A main pump body 50 is fixed to the upper wall of the housing 16 by means of four bolts 52. Each bolt is provided with a washer 54 and passes down through a cap 56, a pulsator diaphragm 58, the body 50 and into the top wall of the housing 16. Interposed between the housing 16 and the body 50 is a pump diaphragm 60 the center of which is fixed to the driving rod 26 by means of a peened over portion 62 on the rod and two diaphragm plates 64 and 66 between which the diaphragm is held as is conventional in diaphragm pumps. The bottom portion of the pump body 50 is recessed and co-operates with the pumping diaphragm 60 to form a pumping chamber 70. Above the pumping chamber the body 50 defines an inlet or pulsator chamber 72 and an outlet or second pulsator chamber 74. A transverse partition 76 is integral with the body 50 and separates the two pulsator chambers. A conventional spring biased one-way pump valve 78 controls a communicating passage 80 which leads from the pulsator chamber 72 to the pumping chamber 70. A similar valve 82 serves as an outlet valve controlling the flow from the fuel pump chamber 70 to the outlet or pulsator chamber 74. One side of the body 50 is provided with a threaded inlet 86 for the admission of fuel to the chamber 72. The opposite side of the body 50 has a threaded outlet port 88 leading from the pulsator chamber 74.

Fig. 4 depicts an inclined by-pass 90 which leads upwardly from the pulsator chamber 74 to a portion of the pulsator diaphragm 58 lying over that portion of the pump body 50 which defines the inlet chamber 72. As seen in Fig. 3, the by-pass 90 is inclined upwardly and in a direction through an extended wall 92 of the partition 76.

The cap 56 has two recesses or spaces 96 and 98 separated by a ridge 100. These spaces register at least partially with the inlet and outlet chambers 72 and 74, respectively. The ridge 100 is such that a portion thereof registers with the partition 76. The space 96 extends

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over a portion of the pulsator diaphragm 58 which lies over the upper end of the by-pass 90. A coiled spring 119 bears down against the diaphragm and is retained in a recess 112 formed in the underside of the cover or cap 56.

With the rotation of the motor shaft 14, it will be seen that the diaphragm 60 will be oscillated to produce a pumping action through the pump 12, the pumping stroke being positive because of the eccentric drive arrangement. The dead air spaces 96 and 98 will serve to stabilize the flow as the diaphragm 58 will yield at any peaks or lows of pressure developed beneath that diaphragm. In the event that the discharge or fluid pressure in the pulsator chamber 74 becomes in excess of a predetermined value, the spring 119 will yield as the diaphragm 58 rises sufficiently to permit the by-passing of fluid from the chamber 74 to the inlet chamber 72. The valve action occurs between the horizontal top surface of the pump body 50 and that portion of the diaphragm 58 which may rise into the space 96 of the cap 56. The pump thereby ceases to be a positive displacement pump despite the fact that the pump diaphragm 60 is positively driven.

The diameter of the spring 119 is such that the diaphragm portion beneath it is not directly backed by the solid material of the pump body 50. This results in a more effective closure of the by-pass of the diaphragm. An operative arrangement would be had, however, by increasing the diameter of the spring beyond the periphery of the by-pass.

I claim:

1. A pump having a pump body and a pumping diaphragm cooperating to define a pumping chamber, inlet and outlet valves arranged to control flow through said pumping chamber, said body having a plurality of pulsator chambers in communication with the sides of said valves remote from the said pumping chamber, a cap secured to said pump body and partially defining dead air spaces, a yielding pulsator diaphragm closing said dead air spaces and interposed in sealing position between said body and cap, a return passage formed in said body and leading from one of said pulsator chambers to a portion of said pulsator diaphragm above the other pulsator chamber, a spring in said cap and urging said pulsator diaphragm portion into position closing said return passage, and means attached to said pumping diaphragm to actuate the latter.

2. A pump having a main body, said main body including two chambers overlying a pumping chamber, one-way valves arranged in said main body to control flow from one of said overlying chambers to the other by way of said pumping chamber, a cap fixed to said main body and partially defining a dead air space over said one chamber, a yielding pulsator diaphragm closing said dead air space and interposed in sealing relation between said main body and cap, a by-pass formed in said main body and leading from the said other overlying chamber to a portion of said pulsator diaphragm partially defining said dead air space, means in the latter space yieldingly urging said portion into position closing off said by-pass, and reciprocating means partially defining said pumping chamber and arranged intermittently to effect a pumping pressure in said pumping chamber.

3. A diaphragm pump defining two flow chambers, a pumping chamber and a dead air space, said two flow chambers overlying said pumping chamber, one-way valves in said pump arranged to control flow through said chambers sequentially, a pulsator diaphragm separating one of said flow chambers from said dead air space, a portion of said pump defining a by-pass leading from the other of said flow chambers to a portion of said pulsator diaphragm above said one flow chamber, means yieldingly urging said portion of said pulsator diaphragm into position across said by-pass and against pressure existent in said other flow chamber, and a reciprocable diaphragm partially defining said pumping chamber.

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4. A diaphragm pump defining two flow chambers, a pumping chamber and a dead air space, said two flow chambers overlying said pumping chamber, one-way valves arranged to control flow through said pumping chamber from one flow chamber to the other, a pumping diaphragm partially defining said pumping chamber, positive driving means connected to said diaphragm for actuating the latter with a predetermined stroke, a pulsator diaphragm separating and sealing one of said flow chambers from said dead air space, a by-pass formed in said pump and leading from the other of said flow chambers to a portion of said pulsator diaphragm above said one flow chamber, and means yieldingly urging said portion of said pulsator diaphragm downwardly and toward a position transverse to said by-pass to close the latter.

5. A pump having a pump body and a reciprocable pumping diaphragm cooperating to define a pumping chamber, inlet and outlet valves arranged to control flow through said pumping chamber, said body having a plurality of pulsator chambers in communication with the sides of said valves remote from said pumping chamber, a cap secured to said pump body and partially defining dead air spaces, one of said dead air spaces corresponding with each of said pulsator chambers, a pulsator diaphragm closing said dead air spaces and interposed between said body and cap, a return by-pass formed in said pump body and leading from one of said pulsator chambers to a zone above the other, said pulsator diaphragm being resiliently urged into position closing said by-pass against the pressure of said one pulsator chamber, and means attached to said pumping diaphragm for actuating the latter.

6. A pump having a pump body and a pumping diaphragm cooperating to define a pumping chamber, one-way inlet and outlet valves arranged to control flow through said pumping chamber, said body having a plurality of said pulsator chambers in communication with the sides of said valves remote with the said pumping chamber, means arranged for actuating said pumping diaphragm to secure flow through said chambers, a cap secured to said pump body and partially defining dead air spaces, a pulsator diaphragm of yieldable material closing said dead air spaces and interposed between said body and cap, a return by-pass in said pump body and leading from one of said pulsator chambers to a portion of said pulsator diaphragm above the other pulsator chamber, and resilient means in said cap urging said pulsator diaphragm portion to yield into position closing said return by-pass.

7. A diaphragm pump having a main pump body and a reciprocable pumping diaphragm cooperating to define a pumping chamber, means fixed to said pumping diaphragm to actuate it with a positive and predetermined pumping stroke, two pulsator flow chambers formed within said pump and overlying said pumping chamber, one-way valves controlling the flow from one of said pulsator flow chambers to the other by way of said pumping chamber, a pulsator diaphragm of yielding material closing said pulsator flow chambers, a cap superimposed upon said pulsator diaphragm and partially defining two dead air spaces sealed by the latter, each of said dead air spaces corresponding with one of said pulsator flow chambers, and by-pass means yieldingly blocked by said pulsator diaphragm and leading from one of said pulsator flow chambers to the other.

8. A pump having a main body partially defining three chambers including a pumping chamber and two pulsator flow chambers, each of the said pulsator flow chambers having a port extending to the pump exterior and a second port extending to the said pumping chamber, a one-way valve controlling the second port of each pulsator flow chamber, a cap partially defining two dead air spaces substantially in registry with the said two pulsator flow chambers, a yieldable pulsator diaphragm interposed between said main body and cap to seal said air spaces and

pulsator flow chambers, a by-pass passage in said main body and leading from one of said pulsator flow chambers to a portion of said pulsator diaphragm determining the other pulsator flow chamber, means in one of said air spaces in said cap urging said pulsator diaphragm portion against said main body around one end of said by-pass passage, and reciprocable means in said pump for effecting intermittent pressure surges in said pumping chamber whereby a flow of fluid may be established through said pump with the said other pulsator flow chamber serving as a final discharge chamber.

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