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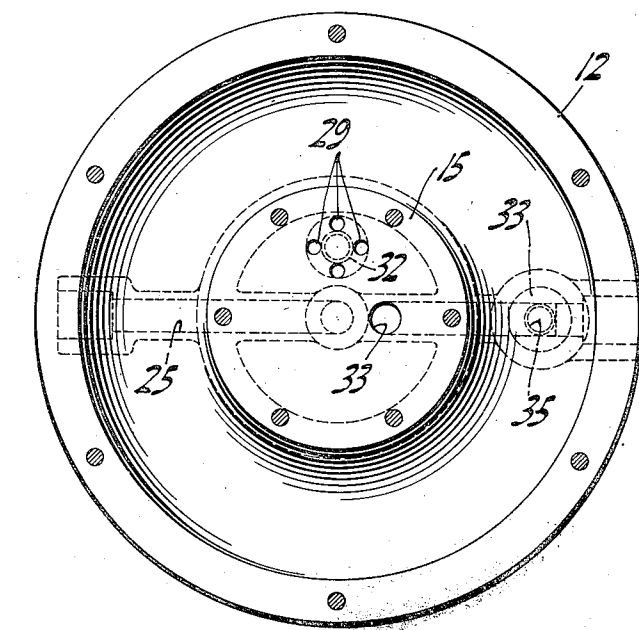
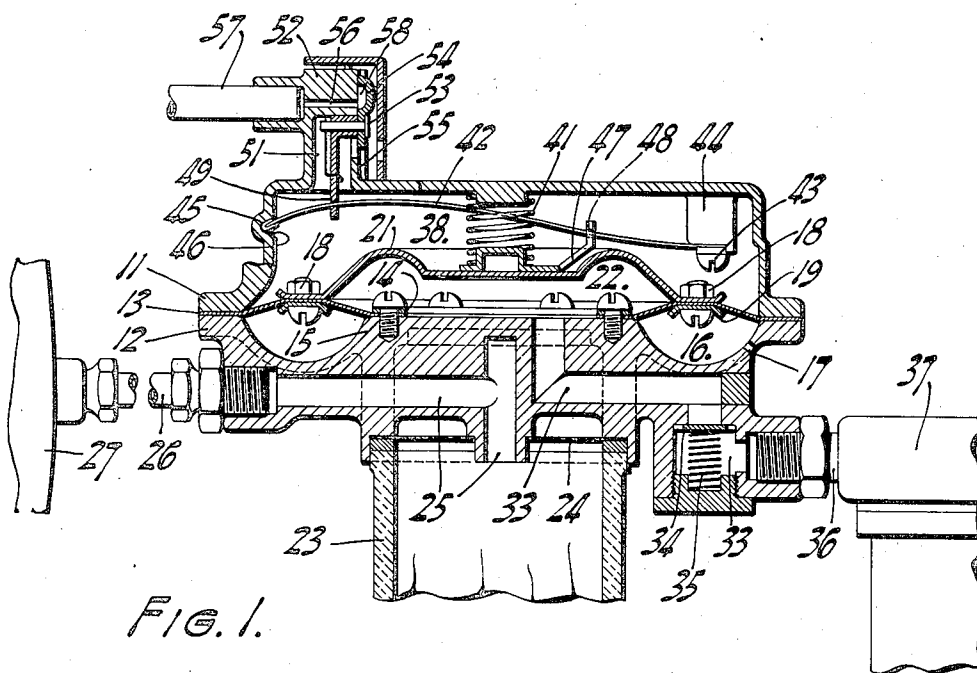
E. C. HORTON ET AL

2,297,653

FUEL PUMP

Filed May 27, 1940

2 Sheets-Sheet 1



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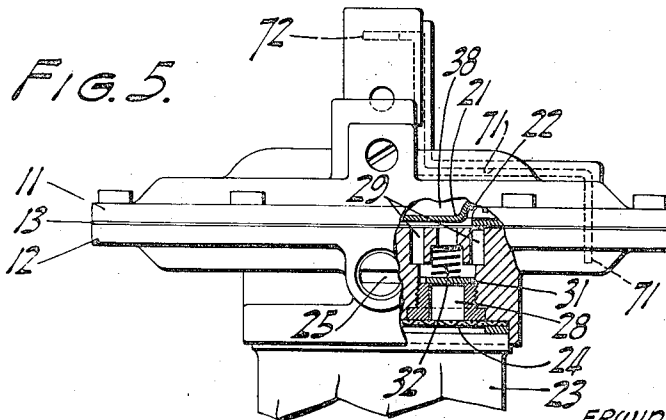
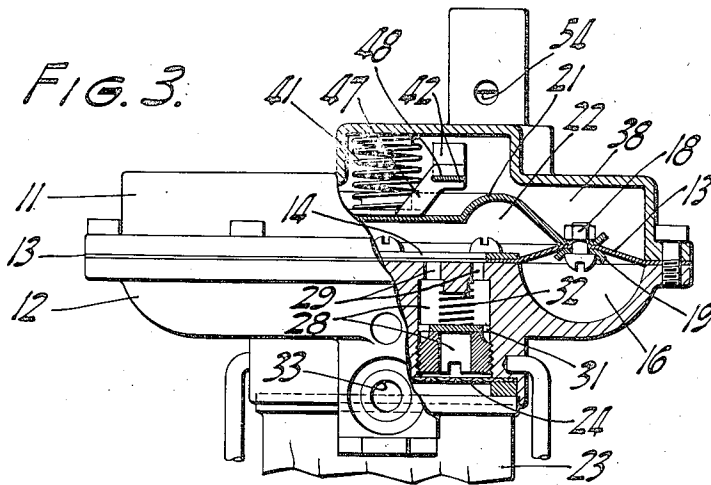
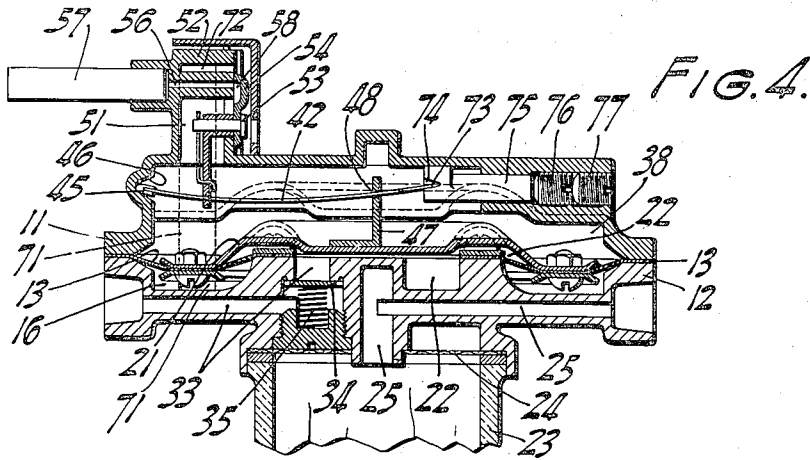
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UNITED STATES PATENT OFFICE

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FUEL PUMP

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Application May 27, 1940, Serial No. 337,334

10 Claims. (Cl. 193—152)

The present invention relates to pumps and has particular relation to pumps adapted to lift fuel from a reservoir to the carburetor of a motor vehicle engine, and for similar uses.

According to the invention flexible diaphragm means are employed to lift the fuel, the diaphragm means being moved by the application of differential pressures to the opposite faces thereof. The invention contemplates a novel arrangement of the diaphragm means whereby relatively small differential pressures may produce a relatively high pressure for lifting fuel, whereby, for example, a relatively low degree of suction produced at the intake manifold of a vehicle engine may be utilized effectively to transfer fuel from the tank or reservoir to the engine carburetor.

The invention further contemplates such a pump wherein both the fuel intake stroke and the fuel exhaust stroke are effected by differential fluid pressures upon the diaphragm means, and also, such a pump wherein one of said strokes is effected by fluid pressure and the other stroke is produced by other means.

A novel valve arrangement is provided whereby the application of differential fluid pressures is accurately controlled and may be adjusted to vary the pumping capacity of the device.

These and other objects and advantages will become apparent from the following description of the typical embodiments of the invention shown in the accompanying drawings, wherein:

Fig. 1 is a vertical sectional view of the device;

Fig. 2 is a plan view of the lower section of the pump casing;

Fig. 3 is a side elevational view with parts broken away and appearing in section in a vertical plane transverse to that of Fig. 1; and,

Figs. 4 and 5 are views similar to Figs. 1 and 3, respectively, illustrating a modified pump construction.

As shown in Fig. 1, the pump may have a casing comprising upper and lower sections 11 and 12 between which is clamped the outer marginal portion of a flexible diaphragm 13. The latter may be of annular form with the central portion thereof clamped between a ring 14 and the central portion 15 of casing section 12. Beneath the diaphragm an annular chamber 16 is formed in the latter casing section, and the chamber is preferably vented to the atmosphere, as indicated at 17.

The intermediate, or flexible, portion of the diaphragm is clamped by fasteners 18 between a ring 19 and the marginal portion of a disc-like

member 21 which may be dished for strengthening and to provide the desired volumetric capacity to the chamber 22 which is between the disc and upper surface portion of diaphragm 13 and casing portion 15.

Carried by the lower casing section is a bowl 23 above which is a screen strainer 24. An inlet passage 25 for fuel is formed in the section 12 and connects the interior of the bowl with a fuel line 26 extending to a fuel tank 27. Fuel may pass from the bowl through strainer 24 and passages 28 and 29, shown in Fig. 3, into chamber 22. Passage 28 is normally closed by a check valve 31 backed by a spring 32, the check valve opening automatically by and upon flow of fuel into chamber 22. Fuel may pass from the chamber 22 through passage 33, which is normally closed by a check valve 34 backed by spring 35, and through fitting 36 into a carburetor 37, the check valve opening by and upon flow of fuel from the chamber.

Disposed in chamber 38 above the diaphragm and disc 21 is a coil spring 41 which normally urges depression of the disc. Also, within chamber 38 is a leaf spring 42 having one end secured by fastener 43 to a part 44 depending from the upper wall of casing section 11, and having the other end 45 thereof supported in a recess 46 in one end wall of the upper casing section. A finger 47 carried by disc 21 has an opening 48 receiving a portion of spring 42 near to the end thereof that is anchored by fastener 43.

Engaging the spring near end 45 thereof is a member 49 that extends through an opening 51 in a projection 52 formed on the upper casing section, the member 49 being connected by a pin 53 to a valve 54 slidable on face 55 of projection 52. Extending through the latter is a port 56 which may communicate, through a conduit 57, with the intake manifold of a vehicle engine, or other suitable source of less-than-atmospheric pressure. In the position of the valve 54 shown in Fig. 1 the port 56 is blocked, while air from the atmosphere may enter, past the lower edge of the valve, into opening 51 and chamber 38; but when the valve is lowered, the passage for atmospheric air is blocked and a recess 58 in the valve 54 opens the suction port 57 to the opening 51 and chamber 38.

In operation, with the parts in the position shown in Fig. 1, and air under atmospheric pressure in chambers 16 and 38, the spring 41 will depress disc 21, contracting chamber 22 and expelling fuel through passage 33, past check valve 34, into the carburetor. When the disc 21 has

been depressed to a predetermined degree the finger 47 will have so moved the portion of spring 42 near the right end thereof that the spring will snap to a reverse condition of bow, wherein member 49 and valve 54 will be lowered. Chamber 38 will accordingly be partially evacuated through suction conduit 57 while chamber 22 may be under somewhat less-than-atmospheric pressure (depending upon the level of chamber 22 in relation to the level of fuel in tank 27). Accordingly, the diaphragm will flex upwardly, compressing spring 41 and enlarging chamber 22 whereby fuel will be moved thereto through passages 28 and 29 past check valve 31.

When the plate 21 is so raised that finger 47 snaps the leaf spring 42 to the condition of bow shown in Fig. 1, chamber 38 will again be opened to the atmosphere, causing a contraction of chamber 22.

It will be observed that the area acted upon by the less-than-atmospheric pressure includes not only the upper surface of member 21 (excluding the upturned peripheral portion thereof) but also the portion of diaphragm 13 extending between the part thereof that is clamped by member 21 and the marginal portion thereof that is clamped between casing sections 11 and 12, whereas the area of fuel acted upon in chamber 22 is approximately that part of plate 21 within the peripheral portion thereof that engages the diaphragm. Accordingly, an advantage is obtained which enables a greater pressure per area to be exerted by the pump on the fuel than is represented by the difference of atmospheric pressure over suction at the source to which pipe 57 is connected. In instances where the fuel pump is disposed at the approximate level of the carburetor, the spring 41 may be relatively light, but when the carburetor is well above the level of the pump, the spring 41 can be relatively heavy, the diaphragm means of the present invention enabling the use of a heavier spring than would otherwise be feasible.

In the modified pump construction shown in Figs. 4 and 5, a number of the same principles are employed as in the device of Figs. 1 to 3, but the diaphragm is acted upon by differential pressures during both strokes, the spring 41 being omitted. This is accomplished by having a passage 71 extended through the casing from chamber 16 beneath the diaphragm 13 into a valve port 72 in the casing extension 52 above the suction port 56, the port 72 registering with recess 58 in valve 54 when the latter is raised. In operation, with the parts first in the position shown in Fig. 4, air will be withdrawn from chamber 38 via opening 51, recess 58 in valve 54, port 56 and suction conduit 57, while air under atmospheric pressure will enter chamber 16 through port 72 and passage 71, flexing upwardly diaphragm 13 and thereby elevating disc member 21. Accordingly, chamber 22 will be enlarged, intaking fuel via passage 25, jar 23, through screen 24 and past valve 31 through passages 28 and 29.

As plate 21 raises, member 47 carried thereby will reverse the direction of bow of spring 42, lifting the valve 54 so that air may flow past the lower edge thereof and through opening 51 into chamber 38, and so that port 56 is open through valve recess 58 into port 72, whereby air will be withdrawn from chamber 16. Accordingly, the diaphragm will be flexed downwardly, downward movement of plate 21 expelling fuel from chamber 22 past valve 34 through passages 33, until the left end of leaf spring 42 is snapped to the

position of bow shown in Fig. 4 whereupon another cycle of operation will commence.

In order to determine the stroke of the diaphragm and plate 21, the end 73 of the leaf spring 42 is received in a recess 74 in the end of a bolt 75 which is slidably mounted in casing section 11. A screw threaded member 76 is provided to adjust the bolt to increase or decrease the normal condition of bow of the leaf spring, while another screw threaded member, 77, may be provided to lock member 76 in the desired position of adjustment.

It will be understood that the pump constructions shown and described herein are merely illustrative embodiments of the inventive principles involved, and that these may be otherwise embodied without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. In a fuel pump, a flexible diaphragm having its central portion secured to a substantially rigid part and having its marginal portion secured to a substantially rigid part, and a plate overlying said central portion of the diaphragm and secured to the latter along a line extending between said inner central and marginal portions thereof, inlet and outlet ports for fuel communicating with the chamber formed between said plate and diaphragm, and means for subjecting the plate and said diaphragm to differential fluid pressures for effecting movement thereof to alternately expand and contract said chamber.

2. In a pump, a casing and a flexible diaphragm extending thereacross and having its margin anchored thereto, a relatively rigid imperforate plate secured to said diaphragm within said margin whereby the plate may have bodily movement upon flexure of the diaphragm, and a substantially rigid wall to which a central portion of the diaphragm is secured, providing independent working chambers having different effective diaphragm areas on the opposite sides of the plate.

3. In a pump, a casing having an annular recess, a flexible diaphragm forming an annular wall across said recess and secured to the inner and outer walls of said recess, and a substantially rigid and imperforate disc having a peripheral portion thereof secured to said diaphragm substantially along a line between said inner and outer walls of the recess, providing separate working chambers on opposite sides of the disc having different effective diaphragm areas.

4. In a fuel pump, a casing, a diaphragm having its marginal portion and its central portion secured to said casing with the portion thereof intermediate between the marginal and central portion adapted to flex, a substantially rigid member extending across the central portion of the diaphragm and secured to the flexible portion thereof, inlet and outlet ports for fuel communicating with the chamber formed between the member and the diaphragm, a spring for urging movement of the plate to flex the diaphragm in one direction, and means for applying differential fluid pressures to opposite face portions of the diaphragm and member to urge flexure of the diaphragm in the opposite direction.

5. In a pump, a casing, a diaphragm having its marginal portion and its central portion secured to said casing with the portions thereof between the marginal and central portions adapted to flex, a substantially rigid member extending across the central portion of the dia-

phragm and secured to the flexible portion thereof, whereby a first chamber is formed between the casing and said member, a second chamber is formed between the casing and the diaphragm and on the side of the latter opposite to that to which the member is secured, and a third chamber is formed between the central portion of the diaphragm and said member, means for conducting fluid to and from said third chamber, and means for alternately applying differential pressures to another of said chambers to effect reciprocation of the flexible portion of the diaphragm.

6. In a fuel pump, a casing, a diaphragm having its marginal portion and its central portion secured to said casing with the portions thereof between the marginal and central portions adapted to flex, a substantially rigid member extending across the central portion of the diaphragm and secured to the flexible portion thereof, whereby a first chamber is formed between the casing and said member, a second chamber is formed between the casing and the diaphragm and on the side of the latter opposite to that to which the member is secured, and a third chamber is formed between the central portion of the diaphragm and said member, means for conducting fuel to and from said third chamber, means for applying atmospheric pressure to the second chamber, means for alternately applying a differential pressure to the first chamber to alternately urge flexure of the diaphragm in one direction, and resilient means to urge flexure of the diaphragm in the opposite direction.

7. In a pump, a casing, a diaphragm having its marginal portion and its central portion secured to said casing with the portions thereof between the marginal and central portions adapted to flex, a substantially rigid member extending across the central portion of the diaphragm and secured to the flexible portion thereof, whereby a first chamber is formed between the casing and said member, a second chamber is formed between the casing and the diaphragm and on the side of the latter opposite to that to which the member is secured, and a third chamber is formed between the central portion of the diaphragm and said member, means for conducting fluid to and from said third chamber, and means for alternately reversing the application of differential pressures to the first and second chambers to effect reciprocation of the diaphragm and said member.

8. In a pump, a casing, a diaphragm having its marginal portion and its central portion secured to said casing with the portions thereof between the marginal and central portions adapted to flex, a substantially rigid member extending across the central portion of the diaphragm and secured to the flexible portion thereof, providing a first chamber between the casing and said member, a second chamber between the casing and the diaphragm and on the side of the latter opposite to that to which the member is secured, and a third chamber between the central portion of the diaphragm and said member, each of said chambers being separate and independent, and means for conducting fluid to and from each of said chambers independently of the other chambers.

9. In a pump, a casing, a diaphragm having its marginal portion and its central portion secured to said casing with the portions thereof between the marginal and central portions adapted to flex, a substantially rigid member extending across the central portion of the diaphragm and secured to the flexible portion thereof, providing a first chamber between the casing and said member, a second chamber between the casing and the diaphragm and on the side of the latter opposite to that to which the member is secured, and a third chamber between the central portion of the diaphragm and said member, each of said chambers being separate and independent, means for conducting fluid to and from the second chamber, and independent means for conducting fluid to and from at least one of the other chambers.

10. In a pump, a casing, a diaphragm having its marginal portion and its central portion secured to said casing, said diaphragm having the portion thereof intermediate between the marginal and central portions free to flex, and a substantially rigid member extending across said central portion of the diaphragm and secured to said intermediate portion, providing a pair of independent chambers on one side of said rigid member, and a chamber on the opposite side of the diaphragm, means for admitting and exhausting fluid from at least two of said chambers, said means for each chamber being independent of the other chambers.

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