Jan. 28, 1969 R. K. TURNER 3,424,091

FUEL PUMP FOR CHARGE FORMING APPARATUS

Filed Oct. 3, 1966 Sheet 1 of 2

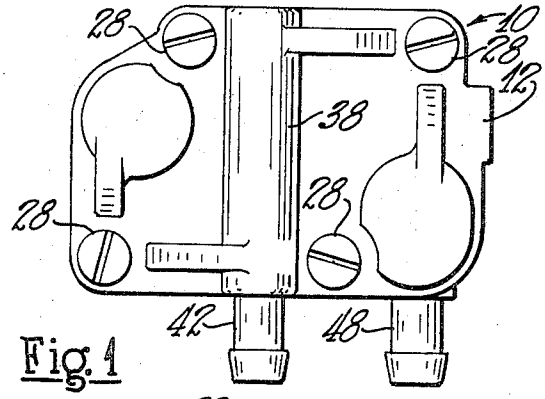


Fig. 1

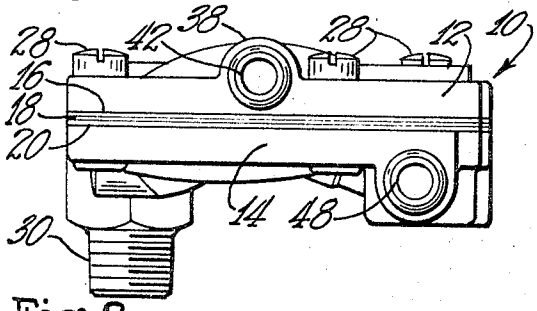


Fig. 2

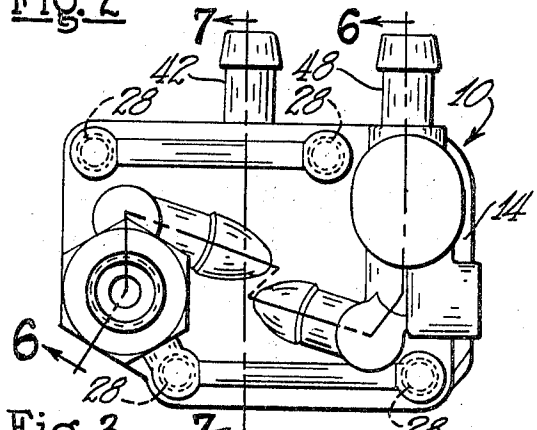


Fig. 3

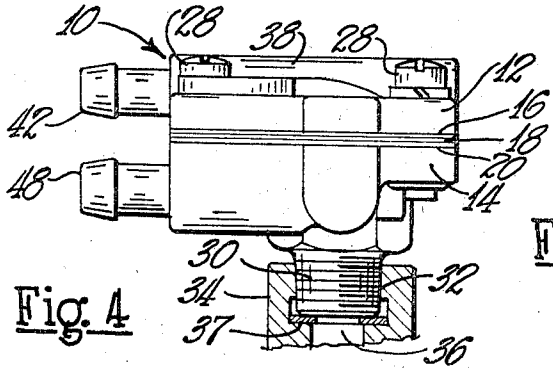


Fig. 4

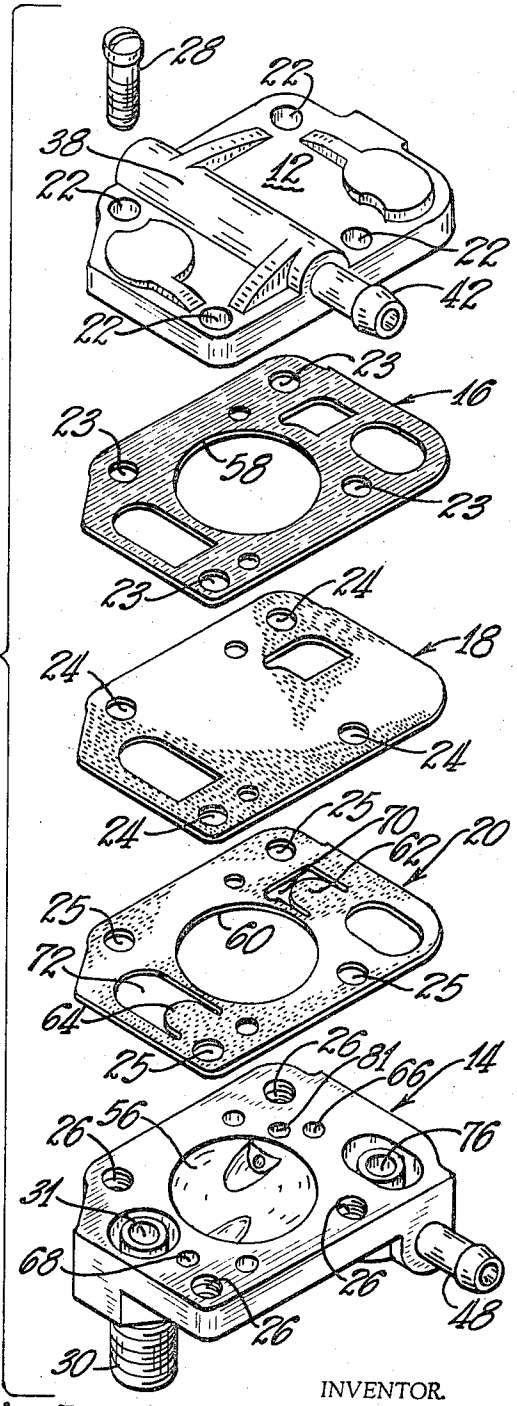


Fig. 5

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Sheet 2 of 2

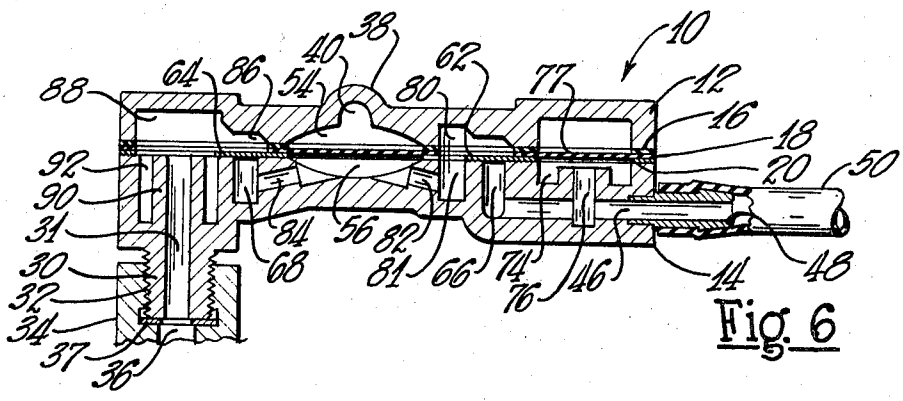


Fig. 6

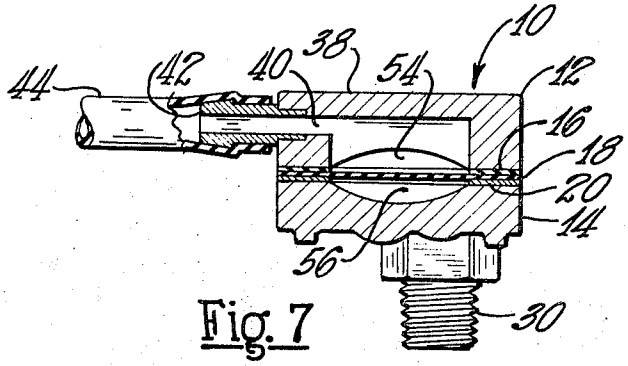


Fig. 7

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FUEL PUMP FOR CHARGE FORMING APPARATUS

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U.S. Cl. 103—44 12 Claims
Int. Cl. F04b 9/12, 43/06, 21/02

ABSTRACT OF THE DISCLOSURE

The disclosure embraces a diaphragm fuel pump for use with two cycle engines wherein the flexible pumping diaphragm is actuated by varying fluid pressures in the crankcase of the engine, the pump including a flexible member contiguous with the pumping diaphragm, the flexible members having inlet and outlet valves integral therewith for controlling flow of liquid fuel through inlet and outlet ports of the pump.

This invention relates to apparatus for pumping fuel from a supply for delivery to a charging forming device or apparatus and more especially to a fuel pumping means of the diaphragm type actuated by varying fluid pressures, such as the varying pressures in the crankcase of a two cycle engine with which the pump may be used.

Diaphragm fuel pumps having a fluid-pressure actuated diaphragm have come into extensive use with two cycle engines for pumping fuel from a tank for delivery to a carburetor wherein the pumping diaphragm is actuated or vibrated by fluid pressure pulses or varying pressures in the engine crankcase. Diaphragm pumps of this character have incorporated flap-type valves formed integrally with the pumping diaphragm for controlling inlet and outlet ports in the fuel pump in order to deliver fuel from a fuel supply or tank to the region of the fuel inlet valve in the carburetor.

A pump of this general character is shown in Phillips Patent 2,796,838. While the flap valve means fashioned as integral portions of the diaphragm provide an inexpensive valve means for controlling flow of liquid fuel through the pump, the pumping diaphragm is of highly flexible material and the valve flaps of the same material do not always seat properly and pumping efficiency impaired or reduced by reason of failure of the valves to close properly. At engine speeds of upwards of six thousand revolutions per minute or more, the flap valves, being of highly flexible material, are not effectively closed and hence high engine speeds cannot be maintained because of insufficient fuel due to reduced pumping efficiency.

The present invention embraces a fuel pump construction wherein the pumping diaphragm is fashioned of highly flexible material and the flap valves formed in an adjacent independent member of a character incorporating a degree of resiliency tending to effect a normal bias of the flap valves toward seating or closed position and thereby increase pumping efficiency.

Another object of the invention resides in the provision of valve means integral with a member disposed adjacent a pumping diaphragm of a fuel pump wherein the material of the member provided with valve flaps is of a character providing a resistance to flexure such that the valve flaps normally tend to remain in closed position between successive differential pressures established by a pumping movement or pumping stroke of the diaphragm whereby to provide for high fuel delivery capacity at all engine speeds.

Further objects and advantages are within the scope

of this invention such as relate to the arrangement, operation and function of the related elements of the structure, to various details of construction and to combinations of parts, elements per se, and to economies of manufacture and numerous other features as will be apparent from a consideration of the specification and drawing of a form of the invention, which may be preferred, in which:

FIGURE 1 is a top plan view of the fuel feed or pump construction of the invention;

FIGURE 2 is a front elevational view of a construction shown in FIGURE 1;

FIGURE 3 is a bottom plan view of the pump construction shown in FIGURE 1;

FIGURE 4 is a side elevational view of the pump construction illustrating the connection of the pump construction with a carburetor body;

FIGURE 5 is an isometric view illustrating components of the pump construction in disassembled relation;

FIGURE 6 is a sectional view taken substantially on the line 6—6 of FIGURE 3; and

FIGURE 7 is a fragmentary sectional view taken substantially on the line 7—7 of FIGURE 3.

The fuel feed or fuel pump construction illustrated is of a character adapted to be directly connected with a carburetor for pumping fuel into the carburetor. It is to be understood that the fuel feeding arrangement of the invention may be employed for pumping purposes generally and particularly for pumping liquids wherever high speed pumping action is desired and the pumping diaphragm is actuated by pulsating or varying fluid pressures.

Referring to the drawings in detail, the pump illustrated is fashioned as a unit construction adapted to be directly connected with a carburetor. The pump **10** is inclusive of a body or body construction comprising body components **12** and **14** which are of generally rectangular shape, the body components **12** and **14** being arranged in mating relation in assembly. Disposed between the body components **12** and **14** are the following components or elements viz a sealing gasket **16**, a pumping diaphragm **18** and a member **20** containing flap valves for controlling fuel inlet and outlet ports of the pump. The characteristics of these components will be hereinafter described.

The pump construction, in assembled relation, is illustrated in FIGURES 1 through 4. As shown in FIGURE 5, the body member **12** is fashioned with a plurality of openings **22** which, in assembly, register with openings **23** in the gasket **16**, openings **24** in the diaphragm **18**, openings **25** in the valve carrying member **20** and threaded openings **26** in the body member **14**. The aligned sets of openings receive securing screws **28** which are threaded into the openings **26** in the body member **14** to secure all of the components in assembled relation.

The body member **14** is fashioned with a threaded portion **30** which is tubular providing a fuel passage **31**, the portion **30** being adapted to be threaded into a threaded opening **32** in a boss **34** formed at the fuel inlet region of a carburetor body which is fashioned with a fuel inlet passage **36** for conveying fuel to the region of the fuel inlet control valve of the carburetor.

A sealing gasket **37** is disposed at the end of the threaded portion **30**. The carburetor may be of the float bowl type or an aspirated diaphragm type, both being of conventional construction.

As particularly shown in FIGURE 7, the body member **12** is fashioned with an elongated boss **38** provided with a passage **40** which snugly receives the tenon portion of a tubular nipple **42** adapted to be connected by a flexible tube **44** with the crankcase (not shown) of a two cycle engine or other source of varying fluid pressure for actuating or vibrating the pumping diaphragm. The body member **14** is fashioned with a passage **46** which receives a

tenon portion of a second nipple 48, the tenon being pressed into the passage 46. The nipple is connected with a fuel tank (not shown) by a tube 50 of flexible material resistant to hydrocarbon fuels.

The adjacent central regions of the body components 12 and 14 are shaped or configurated to form a cavity, the diaphragm 18 extending across the cavity to form a pumping chamber 54 and a fuel receiving chamber 56. The chambers 54 and 56 are concave and substantially circular, the gasket member 16, fashioned of conventional gasket material, having a circular opening 58 in registration with the chamber 54, and the valves carrying member 20 having a circular opening 60 registering with the circular chamber 56.

The member 20 is fashioned with integral tongue-shaped flap valves 62 and 64 for controlling inlet and outlet ports, the flap valve 62 controlling an inlet port 66, shown in FIGURE 5, and the flap valve 64 controlling the outlet port 68. The flap valves are formed as integral tongues of the member 20 by removing material from the member 20 providing spaces 70 and 72 to facilitate fuel flow. The valves 62 and 64 are flexed about hinge regions provided by the integral connection of each valve with the body of the member 20.

As shown in FIGURE 6, the fuel inlet passage 46 is in communication with an annular chamber 74 by a passage 76, a portion 77 of the diaphragm 18 forming a flexible wall for the chamber 74. The closed chamber 74 provides a medium which receives the potential energy of momentum of the successive increments of fuel moving in the inlet passage 46, the flexing of the portion 77 of the diaphragm absorbing or dissipating the pulsations of the fuel caused by the pumping action of the diaphragm. The passage 46 is in communication with the inlet port 66 adjacent the inlet flap valve 62.

The body 12 is fashioned with a recess 80 which accommodates opening movement of the inlet flap valve 62. The recess 80 is in communication with the fuel receiving chamber 56 by interconnecting passages 81 and 82 whereby fuel admitted through the port 66 when the valve 62 is opened flows into the fuel chamber. Fuel from the chamber 56 flows through passage 84 to the outlet port 68 thence past the outlet flap valve 64 when the same is opened. The member 12 is fashioned with a recess 86 to accommodate opening movement of the outlet valve 64.

The fuel flowing past the outlet valve 64 flows through a chamber 88 and passage 31 to the inlet passage 36 provided in the boss 34 of the carburetor body. An annular recess 92, defining a boss 90 on member 14, and the chamber 88 serve to absorb or dissipate energy of momentum of the fuel moving past the outlet valve 64 to promote more smooth flow of liquid fuel to the inlet passage 36 of the carburetor.

The flap valves 60 and 62 are integral components of the planar body or member 20 which is separate from, but disposed adjacent, the diaphragm 18. In prior constructions, flap valves have been made integral with the pumping diaphragm as shown in Phillips Patent 2,796,838. It is essential that the pumping diaphragm 18 be fashioned of a highly flexible material in order to assure rapid flexing of the diaphragm during pumping operations. The diaphragm 18 is preferably fashioned of cotton cloth or the like coated or impregnated with a synthetic rubber which is substantially uneffected by hydrocarbon fuel.

It has been found that in pump constructions wherein flap valves are fashioned as integral components of the pumping diaphragm that the flap valves of highly flexible or soft material do not properly seat to close the inlet and outlet ports whereby pumping efficiency is reduced. In order to provide flap valves having a degree of resiliency or spring action in order to secure better closing of the ports, the material of the member 20 is preferably fashioned of a fine mesh textile or fabric of glass fibers or filaments coated or impregnated with Teflon (polytetrafluoroethylene).

It is found that the glass fabric-reinforced Teflon is endowed with a degree of resilience of spring action whereby the flap valves 62 and 64 normally tend toward port-closing position even under high speed opening and closing movements of the valves. By providing a material for the flap valves which tends to return to its normal position, improved valve closing action is obtained and the pumping efficiency substantially increased so that ample fuel is delivered to the inlet valve region of the carburetor at all engine speeds.

The member 20, which is provided with the integral flap valves, fashioned of glass fiber-reinforced Teflon may be of a thickness in a range of from .003 of an inch to .015 of an inch and preferably of a thickness of about .005 of an inch. The pumping diaphragm 18, preferably fashioned of cotton fiber or fabric impregnated with a synthetic rubber to render the diaphragm impervious, should be of a thickness between .0015 of an inch to .020 of an inch and is preferably of a thickness about .008 of an inch. As the material comprising the diaphragm embodies soft cotton fiber, the thickness of the pumping diaphragm may vary within the range above specified and provide a high degree of flexibility so as to be readily vibrated or flexed at six thousand or more cycles per minute and attain high pumping efficiency.

Another material that has been found satisfactory for member 20 having integral flap valves is a film of polyfluoride resin which is available commercially as Du Pont H film. The polyfluoride film may be of a thickness in a range of from .003 of an inch to .015 of an inch.

In the use of the pump construction of the invention, the threaded tenon 30 of the pump body member 14 is connected with a carburetor by threading the tenon into an opening in a boss 34 provided on the carburetor body. The pumping chamber 54 is connected with a source of varying fluid pressure, such as a crankcase of a two cycle engine, by means of the tube 44 and the nipple 42. The fuel inlet nipple 48, which is in communication with the fuel passage 46 in the pump body member 14, is connected with a conventional fuel tank or reservoir (not shown) by means of the flexible tube 50, shown in FIGURE 6.

In the operation of the pump, increase in crankcase pressure by movement of the piston of the engine toward the crankcase sets up a fluid pressure pulse which is communicated to the pumping chamber 54 and flexes the diaphragm 18 downwardly as viewed in FIGURES 6 and 7. Downward flexure of the diaphragm forces liquid fuel in the fuel chamber 56 through passage 84 past the outlet flap valve 64 and through the passages 86, 88, 31 and 36 to the region of the inlet valve (not shown) in the carburetor. Pressure on the liquid fuel in the chamber 56 is exerted on the inlet flap valve 62 to close the fuel inlet port 66.

Upon reverse direction of movement of the piston of the engine, a reduced pressure or suction is developed in the crankcase which is communicated to the chamber 54 and the diaphragm 18 flexed upwardly, as viewed in FIGURES 6 and 7, setting up or establishing reduced pressure in the fuel chamber 56.

The reduced pressure in the fuel chamber 56 is transmitted through passage 82 to the flap valve 62 causing the flap valve to be opened, the reduced pressure causes fuel flow from the fuel tank through the tube 50, passage 46, port 66 past the flap valve 62, through chamber 80 and passages 81 and 82 into the fuel chamber 56.

This action takes place at every revolution of the crankshaft of the engine and hence occurs at upwards of six thousand or more frequencies or times per minute, depending upon engine speed. The flap valves 62 and 64, fashioned of glass fiber or fabric reinforced Teflon or polyfluoride film normally tend to remain in or to return to closed position. The resiliency or spring action of the flaps substantially eliminates any tendency for the flap valves to remain open even at high frequency flexing

movements of the valves whereby pumping efficiency is substantially improved over pump constructions wherein the flap valves are formed integrally with the pumping diaphragm.

The annular chamber **74** in communication with the fuel inlet passage **46** and the chambers **88** and **92** in communication with the fuel flow outlet passages from the fuel chamber of the pump provide means for cushioning or damping the momentum or ram effect set up in the liquid fuel flow channels of the pump by pumping movements of the diaphragm **18**. The fuel pump of the invention provides for improved starting or priming of the engine as the flap valves are effectively closed at the proper times in the pumping cycle, and the construction provides for increased volume of liquid fuel delivered by the pump at all engine speeds.

I claim:

1. In combination, pumping means for pumping liquid fuel including a pump body construction provided by two body members, the pump body construction being formed with a cavity, a diaphragm disposed between the members and extending across the cavity forming a pumping chamber and a liquid fuel receiving chamber, said pumping chamber adapted to be in communication with a source of varying fluid pressure for actuating said diaphragm to establish pumping impulses in said fuel receiving chamber, inlet and outlet ports in said body construction in communication with the fuel receiving chamber, an element of flexible material disposed contiguous with the pumping diaphragm having an opening at the pumping region of the diaphragm, the region of the flexible element defining the opening engaging the pumping diaphragm and one of said body members, the element of flexible material being formed with integral valve means cooperating with the inlet and outlet ports for controlling flow of liquid fuel through the fuel receiving chamber, and means for securing the body members, the diaphragm and flexible element in assembled relation.

2. The combination according to claim **1** wherein the element is of planar shape and the valve means being flaps integral with the element.

3. The combination according to claim **1** wherein the valve carrying element is a fine mesh textile of glass fibers impregnated with a resinous material.

4. The combination according to claim **1** wherein the element is a fine mesh textile of glass fibers impregnated with polytetrafluoroethylene.

5. The combination according to claim **2** wherein the element is of polyfluoride resin.

6. The combination according to claim **2** wherein the element is of a thickness in a range of from .003 of an inch to .015 of an inch.

7. The combination according to claim **1** wherein the diaphragm is of cotton cloth impregnated with synthetic rubber.

8. The combination according to claim **1** including a gasket disposed between one of the body members and the pumping diaphragm.

9. In combination, pumping means for pumping liquid fuel including a pump body construction comprising a first body member and a second body member, a recess in each of said body members, a diaphragm disposed between the body members and forming with the recesses a pumping chamber and a liquid fuel receiving chamber, the pumping chamber being in the first body member, means adapted to connect the pumping chamber with a source of varying fluid pressure for actuating said diaphragm to establish pumping impulses in the fuel receiving chamber, means formed on the second body member for connecting the pump construction with a charge forming apparatus, passage means in said pump construction for conveying liquid fuel from a supply through the fuel receiving chamber to the charge forming apparatus, said passage means including inlet and outlet ports for the fuel receiving chamber, a flexible planar element of glass fiber reinforced resin disposed between and engaging the second body member and the pumping diaphragm, said element having flap valves integral therewith disposed for cooperation with the inlet and outlet ports for controlling flow of liquid fuel through fuel receiving chamber, a first nipple in communication with the pumping chamber adapted to be connected with varying fluid pressure, a second nipple adapted for connection with a supply of liquid fuel, and means for securing the pump body members, the diaphragm and valve-carrying element in assembled relation.

10. The combination according to claim **9** wherein the second body member has a threaded portion for connection with a charge forming apparatus, the threaded portion being tubular for conveying liquid fuel from the fuel receiving chamber to the charge forming apparatus.

11. The combination according to claim **9** including a gasket disposed between and engaging the first body member and the pumping diaphragm, said gasket having an opening in registration with the recess in the first body member, and said valve-carrying element having an opening registering with the recess in the second body member.

12. The combination according to claim **9** wherein the pumping diaphragm is of cotton cloth impregnated with synthetic rubber, the valve-carrying element being of textile fabric of glass fibers impregnated with polytetrafluoroethylene, said valve-carrying element being less flexible than the pumping diaphragm.

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WILLIAM L. FREEH, *Primary Examiner.*

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