May 23, 1967 E. A. JOHNSON 3,320,900

FUEL PUMP

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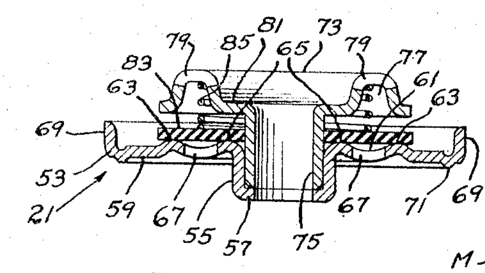


FIG. 4.

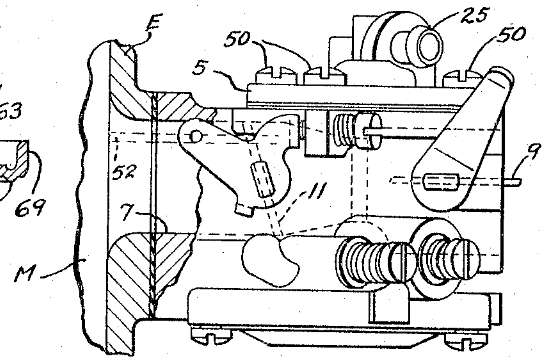


FIG. 1.

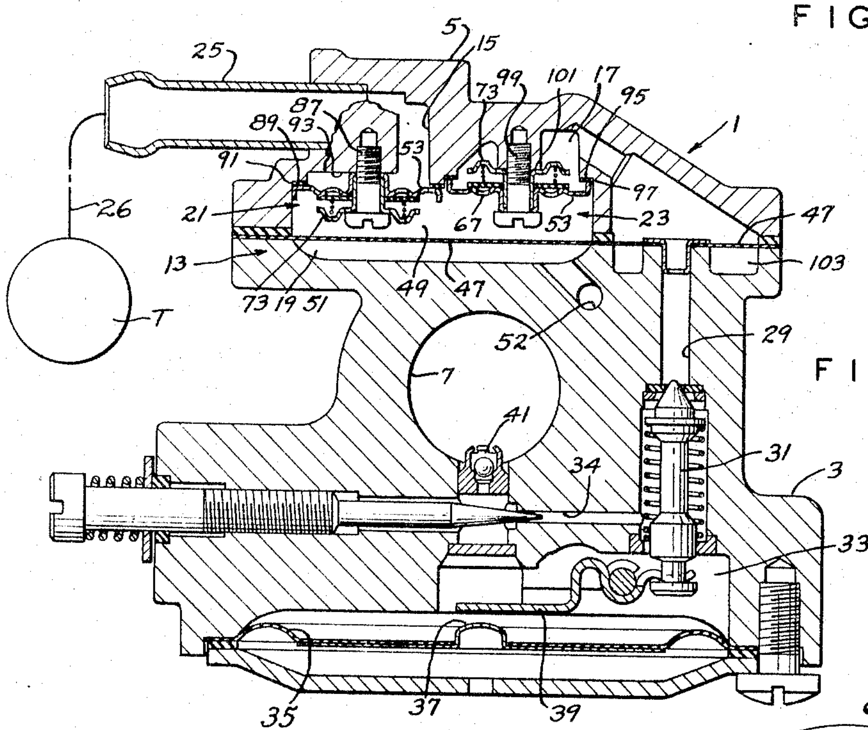


FIG. 2.

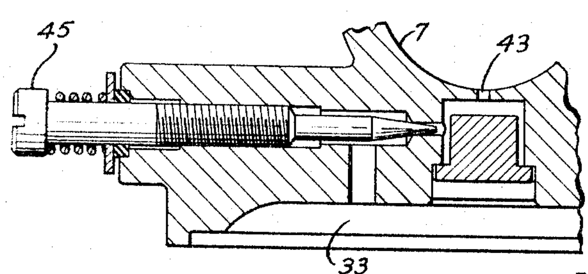
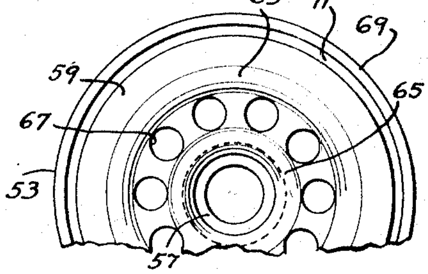


FIG. 3.

FIG. 5.



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3,320,900
FUEL PUMP

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1 Claim. (Cl. 103—150)

This invention relates to fuel pumps, and more particularly to fuel pumps for small engine driven devices such as chain saws and other portable tools.

In engines for power driven tools the fuel pump may be adjacent to and built in the same housing or body as the carburetor and both the fuel pump and carburetor are expected to operate in all attitudes and under widely varying operating conditions. Minimum size and weight are required of all parts and they must also be responsive to sudden changes in operating conditions, such as from high speed to idle speed. The cost of making and assembling the parts must be held to a minimum and the number of parts manufactured for a particular fuel pump should be reduced as much as possible. If feasible, one part should be constructed for use in more than one location or perform multiple functions, thereby reducing the total number of separate parts required or extending production runs to the extent that more economical manufacturing operations are achieved.

Among the several objects of this invention may be noted the provision of improved fuel pumps for engines of power saws and other portable tools which has interchangeable intake and discharge valves; the provision of an improved fuel pump which is quickly responsive to changes in engine operation to regulate rate of fuel flow from the pump; the provision of an improved check valve for fuel pumps or the like; the provision of an improved fuel pump check valve which is reversible and can be mounted at either the fuel intake or discharge cavities of a fuel pump; and the provision of an improved check valve construction by means of which deflection of the valve seat is limited. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claim.

In the accompanying drawings in which one of various possible embodiments of the invention is illustrated,

FIG. 1 is a view in elevation of a combination carburetor and fuel pump connected to the manifold of a gasoline and incorporating the fuel pump and novel check valve of this invention;

FIG. 2 is an enlarged cross section through the carburetor and fuel pump of FIG. 1;

FIG. 3 is an enlarged cross section of a portion of the carburetor of FIG. 1 showing the low speed or idle fuel ssytem; and

FIG. 4 is an enlarged cross section of a check valve of this invention used for both the intake and discharge check valves in the fuel pump.

FIG. 5 is an enlarged partial top plan view of the valve body of FIG. 4.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Referring now to the drawings in detail, a combination carburetor and fuel pump is indicated in its entirety by the reference numeral 1 and is particularly adapted for use with engines of power saws, small tools or the like which are intended to be operated in various attitudes or positions and where size and weight considerations are important. The carburetor 1 includes a body casting 3 and a cap 5. The body of the carburetor has an air and fuel mixture passage 7. Air is reecived at the inlet or right end of the passage 7 as viewed in FIG. 1 and the outlet or left end of the passage 7 is in communication with the intake manifold M of an engine E. Mounted within the conduit or passage 7 is a choke valve 9 and a throttle valve 11.

Within base 3 and cap 5 is a fuel pump indicated generally at 13. Cap 5 has an intake cavity 15 and a discharge cavity 17 which are in comunication with a chamber 19 formed in body 3 and cap 5. Fuel pump 13 has an intake check valve 21 and a discharge check valve 23 for controlling admission of fuel to chamber 19 and discharge of fuel from chamber 19.

A fitting or nipple 25 is connected to cap 5 for connection through a fuel line 26 to a source of fuel as tank T, shown schematically in FIG. 2. Fuel is supplied through nipple 25 to intake cavity 15 and through intake check valve 21 to chamber 19, and subsequently the fuel is passed to discharge cavity 17. Fuel flows from the cavity 17 to a chamber 27 leading to a conduit or passage 29 in the body 3. At the lower end of conduit or passage 29 is a carburetor fuel inlet valve 31 to regulate passage of fuel from conduit 29 to a chamber 33 in the carburetor. Within chamber 33 is a diaphragm 35 fixed to a backing plate 36 having a button 37 engaging an arm 39 connected to the valve 31 to operate the valve 31.

Fuel delivered to chamber 33 flows through a passage 34 to nozzle port 41 opening into the passage 7 and to mix with the air in passage 7 for engine operation in the known manner. For idle operation, an idle port 43, FIG. 3, is provided and fuel from chamber 33 flows through passage 44 to port 43 and to passage 7 when the engine is idling and in the well-known manner. Adjusting screw 45 regulates the amount of fuel that is provided from the chamber 33 to the port or opening 43.

The fuel pump 13 of this invention includes a diaphragm 47 which is positioned across chamber 19 and divides the chamber into a pump chamber 49 and a pulsation chamber 51. Diaphragm 47 is held in place by bolts 50 which also hold cap 5 on base 3. The pulsation chamber 51 is connected by a passageway 52 to the crankcase at manifold M of the engine, so that pulsations in the crankcase cause the diaphragm 47 to be flexed or pulsed. Flexing of diaphragm 47 alternately increases and decreases pressure in pump chamber 49.

The check valves 21 and 23 of this invention are preferably of the same construction and FIG. 4 is an enlarged cross section of the check valve 21. The valve 21 includes a valve seat 53 constituted by a sheet metal stamping which has a generally cylindrical tubular boss 55, with an inturned shoulder or flange 57 extending radially inwardly at the outer end of the boss 55 (its lower end as shown in FIG. 4). The seat has a body portion 59 which extends outwardly from the boss 55 in a generally radial direction and is located at the end of boss 55 opposite from the internal shoulder 57. The body 59 is dished on a portion of one surface thereof to provide a concave recess 61 having annular ribs 63 and 65 at the outer and inner edges thereof, respectively. The body 59 has a multiplicity or ports 67 arranged in a circle between the ribs 63 and 65.

An annular rim 69 is located at the radially outer edge of one surface of the body 59 of the valve seat 53, this rim being substantially coaxial with boss 55 and extending axially from the one surface of the body 59 of the seat 53. The outermost edge of the rim 69 preferably tapers to a narrow edge for engagement with a seat or gasket as explained hereinafter. A narrow annular land 71 projects from the other surface of the body 59 of the seat 53, this land 71 being positioned radially inwardly a slight distance from the rim 69 and spaced radially outwardly from the boss 55. The land 71 is engageable with a seal or gasket as explained hereinafter when mounting the valve 21 on the cap 5.

A valve stop member 73 constituted by a sheet metal stamping has a generally cylindrical stem 75 which is axially longer than the boss 55. Stem 75 is telescoped into the boss 55 with the end of the stem engaging the flange 57. The valve stop 73 has an annular recess 77 in the lower surface thereof, that is, the surface that faces the body portion 59 of the seat 53. Valve stop 73 has a plurality of holes or openings 79 through the recess 77. The recess 77 is generally coaxial with the stem 75 and is generally aligned with the concave surface 61 on the valve seat 53. Between the stem 75 and recess 77 and on the surface opposite from the recess 77 is a flat surface 81 surrounding the stem 75. This surface 81 is adapted to be engaged by the head of a mounting bolt or by a projection on the pump body when the valve 21 is mounted.

A flexible valve-closing member 83 is positioned around the stem 75 of the stop 73. This valve member 83 is constituted by a disk of a flexible rubber or rubber-like material, including synthetic rubbers or other flexible materials which are fuel resistant. Disk 83 extends radially outwardly from the stem 75 and portions of one surface of the disk are engageable with the annular ribs or ridges 63 and 65 bounding the annular recess 61 thereby to close the ports 67 against passage of fuel.

Disk 83 is biased toward closed position by a light coil spring 85 which has one end engaging the disk and its other end seated in the recess 77 of the valve stop 73. The stated one end of the spring 85 engages the surface of the disk 83 directly opposite from the recess 61 and ports 67 intermediate the ribs 63 and 65, and presses the disk 83 into seating engagement with the ribs 63 and 65.

Fluid forced upward through the ports 67 from the bottom of the valve seat moves the disk 83 toward valve stop 73 to open the valve for the passage of the fuel from the bottom of the valve as illustrated in FIG. 4 to the top of the valve. The disk 83 may engage the valve stop member 73 on both sides of the recess 77 and, should such engagement occur, the holes or ports 79 prevent adherence of the valve closing member 83 to the valve stop. Since the coil spring 85 is light, very little fluid pressure is required to unseat the valve disk 83.

The intake check valve 21 is mounted on the cap 5 of the pump body by a mounting screw 87. The shank portion of the mounting screw 87 passes through the hollow stem 75 and the annular shoulder 57 of the seat 53 and is threaded into a tapped hole in the cap 5 adjacent the intake cavity 15. The head of screw 87 engages surface 81 on valve stop 73. An annular shoulder 89 is formed in the cap 5 around the cavity 15 and a gasket or seal 91 is positioned on the shoulder 89. The land 71 of intake check valve 21 engages the seal or gasket 91. Tightening of screw 87 places the land 71 in sealing engagement with the gasket or seal 91 and simultaneously places the flange 57 of the valve seat in engagement with a relieved surface 93 in cap 5. Thus the valve seat 53 is firmly engaged with the cap 5 both at the boss portion and at the outer edge thereof. This positive stop arrangement limits total deflection of the valve seat 53. With this mounting, the flat portion 59 of the valve seat is substantially in the position illustrated in FIG. 4 when the screw 87 is tightly fastened to the cap 5 and as a result the valve disk 83 is placed in engagement with both of the annular ribs 63 and 65 by spring 85 to close the ports 67.

With the valve 21 mounted as shown in FIG. 2, the valve seat 53 is positioned between cavity 15 and pump chamber 49. The only communication between cavity 15 and pump chamber 49 is through ports 67.

The check valve 23 is identical in construction with check valve 21 and is mounted in an inverted position relative to valve 21. An annular shoulder 95 is provided in the cap 5 around the discharge cavity 17. A seal or gasket 97 is positioned on the annular shoulder 95 and the outermost edge of rim 69 of the check valve 23 is placed in engagement with the gasket or seal 97. A mounting screw 99 is used to mount the check valve 23 on the cap 5 and the shank of the screw 99 passes through the annular shoulder 57 and the boss 55 of the valve seat and through the hollow stem 75 of the valve stop and is threaded into a tapped hole in the cap 5. The head of the screw 99 engages the flange 57 of the valve seat 53 and holds surface 81 of stop 73 in engagement with a surface 101 on cap 5. The surface 101 is annular and dimensioned so that the projection on the valve stop 73 resulting from formation of the recess 77 will not engage the cap 5. Thus the seat 53 of the discharge check valve 23 is also positively located in the cap 5 so that little or no deflection of the valve seat occurs. It will be observed from FIG. 2 that the shoulder 95 is nearer the top of the cap than is the shoulder 89 and as a result the heads of screws 87 and 99 are substantially coplanar and are out of the way of the diaphragm 47.

Operation of the fuel pump is as follows:

During operation of the engine associated with the fuel pump, pulse chamber 51 is responsive to pulsations in the crankcase of the engine. As the pressure in the pulse chamber 51 increases and decreases relative to the pressure in chamber 49, the diaphragm 47 is moved upwardly and downwardly in the chamber 19. As the diaphragm moves downwardly as viewed in FIG. 2, a suction is created in the pumping chamber 49 which moves the disk 83 of the intake check valve 21 downward against the pressure of the spring 85 and as a result the ports 67 of the check valve 21 are opened and fuel in cavity 15 is drawn into the pumping chamber 49.

As the diaphragm 47 is moved upwardly in pumping chamber 49, fluid pressure increases within the chamber 49 which, together with the spring 85, forces the disk 83 of check valve 21 into the closed position against the ribs 63 and 65. Pressure in pumping chamber 49 acts against the disk 83 and spring 85 of the discharge check valve 23 to move the disk member 83 away from its seat 53 and thereby permit passage of fuel from chamber 49 through the ports 67 of the discharge check valve 23. This fuel enters the discharge cavity 17 and then passes into the chamber 27, through conduit 29 and, when carburetor valve 31 is opened, fuel is delivered to chamber 33 for subsequent delivery to the ports 41 and 43 and into the air-fuel conduit 7. From the conduit 7 the fuel and air mixture is provided to the engine in the usual manner. The discharge check valve 23 is closed when the diaphragm 47 moves downwardly as viewed in FIG. 2 to result in a suction in the pumping chamber 49, the suction together with the spring 85 of the discharge check valve 23 moving the disk 83 into engagement with the valve seat 53 to thereby close the ports 67 to the passage of fuel.

Since the fuel pump may be operated when valve 31 is closed it is desirable to provide some means to prevent the pump from operating against a column of fuel in discharge cavity 27. For this purpose a cavity 103 is formed in base 3 and separated from cavity 27 by diaphragm 47. Diaphragm 47 may flex into cavity 103 when fluid pressure increases in cavity 27.

The construction of the check valve 21 and 23 together with the manner in which the valve seats 53 are mounted in the cap 5 of the pump body results in little or no deflection of the valve seats relative to the cap when they are mounted to the cap. The mounting screw 87 of the inlet valve 21 can only force stem 75 against flange 57 and that in turn against cap surface 93. Parts are so dimensioned that annular land 71 simultaneously seals against gasket 91. Any further forcing of screw 87 cannot move land 71 against the cap as cap surface 93 is a stop for flange 57. Thus the body 59 of the valve seat cannot be forced out of its substantially planar configuration. This then, results in the valve member 85 making sealing contact with the annular ribs 63 and 65.

In a similar manner, mounting the valve in a reverse position by a screw **99** again forces stem **75** and flange **57** together with surface **81** against cap surface **101**. The parts are dimensioned so that rim **69** makes sealing contact with gasket **97**, but prevents any further tightening of screw **99** from warping or bending valve body **59** from its planar configuration. In this described manner the valve members **83** will operate effectively in either arrangement of the valve and positive sealing action is obtained by the valve member **83** at all times.

By utilizing a single check valve construction and oppositely mounting two of them in the intake and discharge positions of the pump, the usual requirement for two distinct models of check valves is eliminated and the check valves can be made in larger quantities, thereby resulting in efficient production runs for manufacture of the check valves. This reduces the per unit cost of the check valves and thus reduces the cost of the pump.

By using a very light coil spring **85** to oppose the fluid pressure for opening the valves **21** and **23**, the valves are quickly responsive to small pressure changes and are thus quickly responsive to changes in engine operation. In addition, the stem **75** of the valve stop **73** need not be press-fitted in the boss **55** of the valve seat **53** as in some prior art valves, thereby reducing tolerance requirements and reducing the cost of producing the cost of producing the valves.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

A fuel pump having a pump body, the body having a chamber and an intake-cavity and a discharge cavity in communication with the chamber the, pump body having a first annular shoulder surrounding the intake cavity and a second annular shoulder surrounding the discharge cavity said shoulders having substantially equal diameters, an intake check valve, said check valve comprising a valve seat having a tubular boss with a shoulder therein and an annular rim at the outer periphery of the periphery of the seat, said valve seat having a port therein between said boss and said rim, said valve having a valve stop member having a stem positioned in said boss, said valve having a flexible valve-closing member positioned around said stem and positionable on said seat to close said port, said valve having a spring engaging said flexible member to urge said flexible members to a position to close said port, said intake valve being mounted on said pump body with said boss engaging said pump body and with said seat having a sealing connection with said first annular shoulder around said intake cavity, said valve being opened by suction in said chamber and closed by pressure in said chamber, a discharge check valve having the same construction as said intake check valve, said discharge check valve being mounted on said pump body with its stem engaging said pump body and with the rim of its seat having a sealing connection with the other of said annular shoulders surrounding said discharge cavity, said discharge check valve being opened by pressure in said chamber and closed by suction in said chamber, and a flexible diaphragm in said chamber operable to alternatively create a suction and pressure in said chamber whereby said valves are alternately opened and closed to thereby transfer fuel through said chamber from said intake cavity to said outlet cavity, said sealing connection between said respective inlet and discharge valves and said first and second annular shoulders being provided by angular sealing gaskets positioned between said respective shoulders and said valves, and said fuel pump includes two mounting screws passing through said tubular stems of said respective valves and mounted in said pump body to position said valves body with said valves seats in engagement with said gaskets.

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