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COMBINED PRIMING PUMP AND PRESSURE REGULATOR

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FIG. 1.

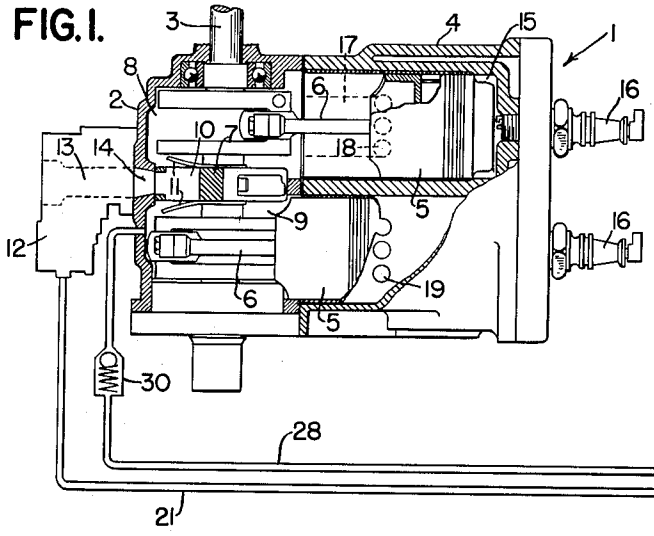


FIG. 3.

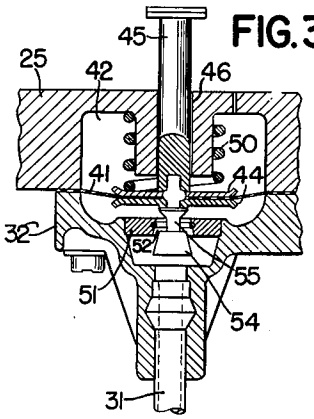
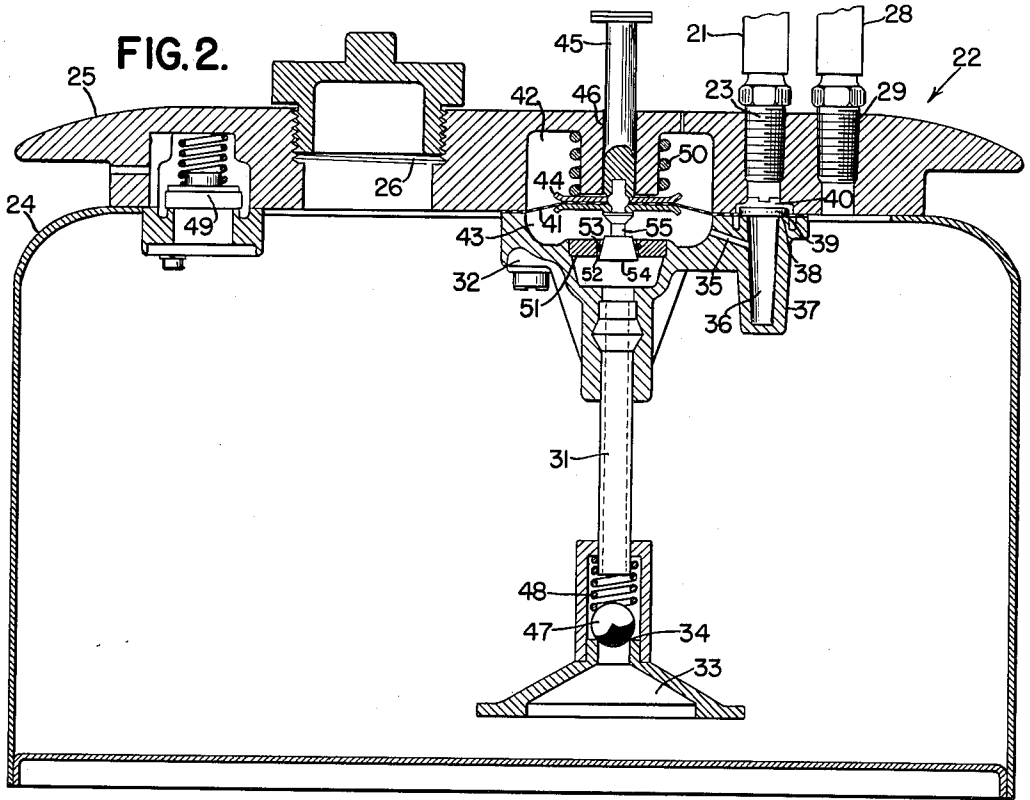


FIG. 2.



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COMBINED PRIMING PUMP AND PRESSURE REGULATOR

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6 Claims. (Cl. 123—136)

This invention relates to a combined priming pump and pressure regulator for pressurized engine fuel supply systems.

According to the invention, a priming pump is modified to operate also as a pressure regulator and is advantageously located remote from the engine and not subject to the vibration of the engine.

The invention is particularly intended for outboard motors of the type including a crankcase-induction, two-cycle internal-combustion engine supplied with fuel from a tank remote from the engine. During operation of the engine the intermittent pressure developed in the crankcase is utilized to pressurize the fuel tank.

The priming pump, as customarily provided, and carried by the tank, when in operation as a pressure regulator, limits the pressure of the fuel supplied to the engine carburetor to within the safe pressure limit of the carburetor.

The pressure developed in the tank by crankcase compression is not uniform and the regulation of the pressure at a constant value assures more consistent engine performance. Furthermore, the regulating valve of any carburetor is adapted to handle the fuel only within a limited pressure range. The pressure regulator maintains the fuel pressure within the range to prevent flooding of the engine.

The drawings furnished herewith illustrate the best mode of carrying out the invention as presently contemplated and set forth hereinafter.

In the drawings:

Figure 1 is a side elevation of a two cylinder, two-cycle engine with parts broken away and sectioned and showing a fuel line connected to the carburetor and a pressure line to one crank chamber;

Fig. 2 is an enlarged section of a fuel tank with a priming pump incorporating the invention and with the remote ends of the fuel supply and pressure lines shown in Figure 1 connected to the tank; and

Fig. 3 is a sectional view of the priming pump shown in Fig. 2 and in open position.

The engine 1 shown in the drawings includes the crankcase 2 carrying the vertical crankshaft 3. The cylinder block 4 joined to crankcase 2 carries the pistons 5 connected by the rods 6 to the corresponding crank throws of crankshaft 3. The bearing member 7 intermediate the crank throws of crankshaft 3 divides crankcase 2 into the upper and lower crank chambers 8 and 9, respectively, and is provided with the induction passage 10 opening into chambers 8 and 9 as by the reeds 11. The carburetor 12 shown diagrammatically is secured to crankcase 2 and includes a mixing passage 13 which communicates through the opening 14 in crankcase 2 with passage 10 for the delivery of air and carbureted fuel to chambers 8 and 9 in the operation of the engine.

The upward stroke of each piston 5 compresses the fuel charge in the respective combustion chamber 15 above the piston for ignition by the corresponding spark

plug 16, and at the same time effects the induction of air from carburetor passage 13 into the crank chamber below the piston. With the downward stroke of each piston 5 as effected by the burning of the fuel charge in the combustion chamber, the fuel and air mixture in the crank chamber below the piston is compressed for transfer through the communicating passage 17 shown in dotted lines and the ports 18 formed in the cylinder wall on one side of the piston. Ports 18 and the opposite exhaust ports 19 in each cylinder are controlled by the corresponding piston and opened substantially simultaneously for the discharge of the exhaust gases through the ports 19 and the recharging of the cylinder.

The liquid fuel is supplied to carburetor 12 by the supply line 21 connected to the carburetor at one end and to the tank 22 provided with the fitting 23 to receive the line 21. The tank 22, shown in Fig. 2, includes the stamped shell 24 and the top member 25 provided with the threaded opening 26 for filling the tank.

The line 28 from chamber 9 of the engine case 2 is connected to the fitting 29 of member 25 to communicate with tank 22 provided with the check valve 30 which allows air and carbureted fuel to pass from crankcase 9 to the tank and maintains in the tank the maximum pressure attained in the crankcase.

The upper end of tube 31 is secured to the hollow member 32 bolted to the lower face of member 25 of tank 22 and extends downwardly within the tank. The screen 33 across the enlarged lower open end of the valve 34 fixed to the lower end of tube 31 prevents foreign particles in the fuel from entering tube 31. The upper end of tube 31 opens into member 32 and communicates through the passage 35 with the adjacent well 36 provided in the trap 37. The annular valve seat 38 defining the upper open end of well 36 carries the valve disc 39 which is seated by gravity and fits within the lower end of the passage 40 associated with fitting 23 of member 25. Trap 37 and member 32 are integrally formed and secured to the lower face of member 25 of tank 22 with the outer margins of the diaphragm 41 therebetween. Diaphragm 41 separates the upper annular chamber 42 formed in member 25 and the lower chamber 43 formed in member 32 and is centrally retained between the discs 44 carried by the stem 45 which is adapted for manual reciprocation in the bore 46 concentric of chamber 42 whereby the diaphragm operates as a pump. The upward movement of stem 45 enlarges the volume of chamber 43 to draw fuel from the tank past the ball-check 47 of valve 34 while disc 39 remains seated. Upon downward movement of diaphragm 41, the ball-check 47 closes and forces the fuel past disc 39 through passage 40 into fuel line 21 to the carburetor 12. A light spring 48 may be employed, as required to assure closing of ball-check 47.

The movement of the diaphragm effects the initial supply of fuel to carburetor 12 as required to start engine 1. Thereafter the pressure developed in crankcase 9 is maintained in tank 22 by check valve 30 in line 28, provides for the delivery of fuel to carburetor 12 under the pressure referred to. A spring biased valve assembly 49 in member 25 provides for the relief of excess pressures developed in the tank.

According to the invention, the diaphragm 41 is biased by the spring 50 in chamber 42 against the pressure of the fuel in the chamber as supplied to carburetor 12 and is utilized to prevent the delivery of fuel to the chamber whenever the pressure therein exceeds a predetermined maximum.

The plug 51 seated in member 32 closes the entry of tube 31 into chamber 43 and is provided with a central opening 52 fitted with an O-ring seal 53. The conical

valve member 54 is formed at the lower end of the rivet 55 which secures discs 44 to the lower end of the stem 45, and is disposed to seat upwardly against O-ring 53 upon upward movement of diaphragm 41.

The capacity of spring 50 is predetermined by the desired pressure to be maintained in fuel line 21 and the effective area of diaphragm 41 while of a practicable normal size for pump operation is of considerable size respecting its responsiveness to pressure variations. Accordingly, pressure of the fuel in chamber 43 and also line 21 to carburetor 12 raises diaphragm 41 to close valve 52 which prevents the further delivery of fuel by tank pressure through tube 31. As the carburetor receives the fuel from line 21 the pressure drop in the line and chamber 43 allows spring 49 to lower valve member 54 and allows fuel to pass into chamber 43 until the predetermined maximum pressure is again reached. In regular operation, the pressure and valve opening approach an equilibrium to maintain a relatively constant pressure of the fuel supplied to carburetor 12 for consistent engine operation.

The pressure responsive diaphragm 41 located remote from engine 1 is not subject to the vibration of the engine so that the reliable pressure control allows the carburetor to be designed for lower pressures and the larger area of the pump diaphragm provides the desired sensitive operation of the valve.

Various modes of carrying out the invention are contemplated as within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

We claim:

1. In an engine fuel supply system, a pressurized fuel supply tank, a fuel supply line from said tank for connection with the engine and delivery of fuel thereto, a delivery control valve in said fuel supply line, a movable member exposed to the pressure within the tank and connected to said valve to close the valve in response to pressure within the tank, means biasing said movable member in a direction to open said control valve and yieldable to a predetermined minimum pressure within the tank to maintain within a maximum limit the pressure of the fuel supplied to the engine, check valves in said fuel supply line, and means for manually moving said member, said check valves being disposed for operation with said movable member to provide for pumping of the fuel through the supply line to the engine for initial engine operation.

2. In an engine fuel supply system, a pressurized fuel supply tank, a fuel supply line from said tank for connection with the engine, a priming pump in said supply line including a movable member and check valves disposed to provide for the delivery of fuel from the tank to the engine upon manual reciprocation of the movable pump member, a control valve in said fuel supply line including a movable element connected to the movable member of said priming pump, said valve being disposed to close said fuel supply line upon movement of said pump member in a given direction and in response to pressure within the supply tank, and a regulator spring biasing said movable pump member in the opposite direction, said spring being yieldable to the manual reciprocation of the pump member and otherwise to a minimum pressure within the tank to establish a predetermined maximum limit of pressure of the fuel delivered to the engine.

3. In a two-cycle engine employing crankcase induction and precompression and having a carburetor, a fuel supply tank, a pressure line from said crankcase to said fuel supply tank and having non-return valve means disposed whereby the maximum intermittent pressure within the crankcase is maintained within the fuel supply tank, a fuel supply line from said tank to said engine carburetor for delivery of fuel thereto, a delivery control valve in said fuel supply line, a flexible diaphragm responsive to the pressure within the tank and connected to said control valve to close the control valve in response to pressure within the tank, biasing means acting on the diaphragm in a direction to open the control valve and determine a maximum pressure of the fuel supplied to the engine less than said maximum intermittent pressure, a check valve provided in the supply line on each side of the control valve, and means for manually operating said diaphragm, said check valves cooperating with the manually operated diaphragm to provide a pump for initially priming the fuel supply system.

4. In an engine fuel supply system, a pressurized fuel supply tank, a fuel supply line interconnecting the tank and engine for delivery of fuel to the engine, a priming pump in said supply line including a flexible diaphragm, means for manually actuating said diaphragm, check valves disposed in the supply line and with respect to the diaphragm to provide for the initial delivery of fuel from the tank to the engine upon manual actuation of the diaphragm, a control valve in said supply line including a movable element connected to the flexible diaphragm of the priming pump and being disposed to close the fuel line upon movement of the diaphragm in response to pressure within the fuel tank, and a regulator spring biasing the diaphragm in the opposite direction to establish a predetermined maximum limit of pressure of the fuel delivered to the engine in operation.

5. In combination with an engine having a crankcase wherein intermittent pressure is developed as an incident to engine operation, a fuel tank remote from the engine, a pressure line interconnecting the crankcase and the tank for communicating crankcase pressure to the tank, a check valve in said pressure line to maintain pressure in the tank substantially uniform and equal to the maximum pressure reached in the crankcase, a fuel supply line interconnecting the tank and the engine for delivery of fuel to the engine by the pressure maintained in the tank, a delivery control valve in said fuel line, a movable member responsive to the pressure within the fuel line and connected to said control valve to close the same in response to tank pressure, biasing means acting on said movable member in a direction to open the control valve and yieldable at a predetermined limit to the pressure of the fuel supplied to the engine, check valves in said fuel supply line, and means for manually operating said movable member, said check valves in the fuel supply line being disposed to cooperate with the movable member and provide for pumping of the fuel through the supply line to the engine for initial engine operation.

6. In combination with a crankcase fuel induction engine, a pressurized fuel supply system including a crankcase wherein intermittent pressure is developed as an incident to engine operation, a fuel tank remote from the crankcase, a pressure line in communicative connection between the fuel tank and the crankcase, non-return valve means in the pressure line to maintain crankcase pressures to a substantially uniform pressure in the tank, a fuel supply line interconnecting the tank and the engine for delivery of fuel to the engine by virtue of the pressure maintained in the tank, a pressure control valve in the supply line, a flexible diaphragm responsive to the tank pressure and connected to the control valve to close the same in response to the tank pressure, a regulator spring acting on the diaphragm in a direction to open the control valve and establish the maximum predetermined pressure of the fuel supplied to the engine, a check valve provided in the supply line on each side of the control valve, and means for manually operating said diaphragm, said check valves in the fuel supply line cooperating with the manually operated diaphragm to provide a pump for initially priming the fuel supply system.

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