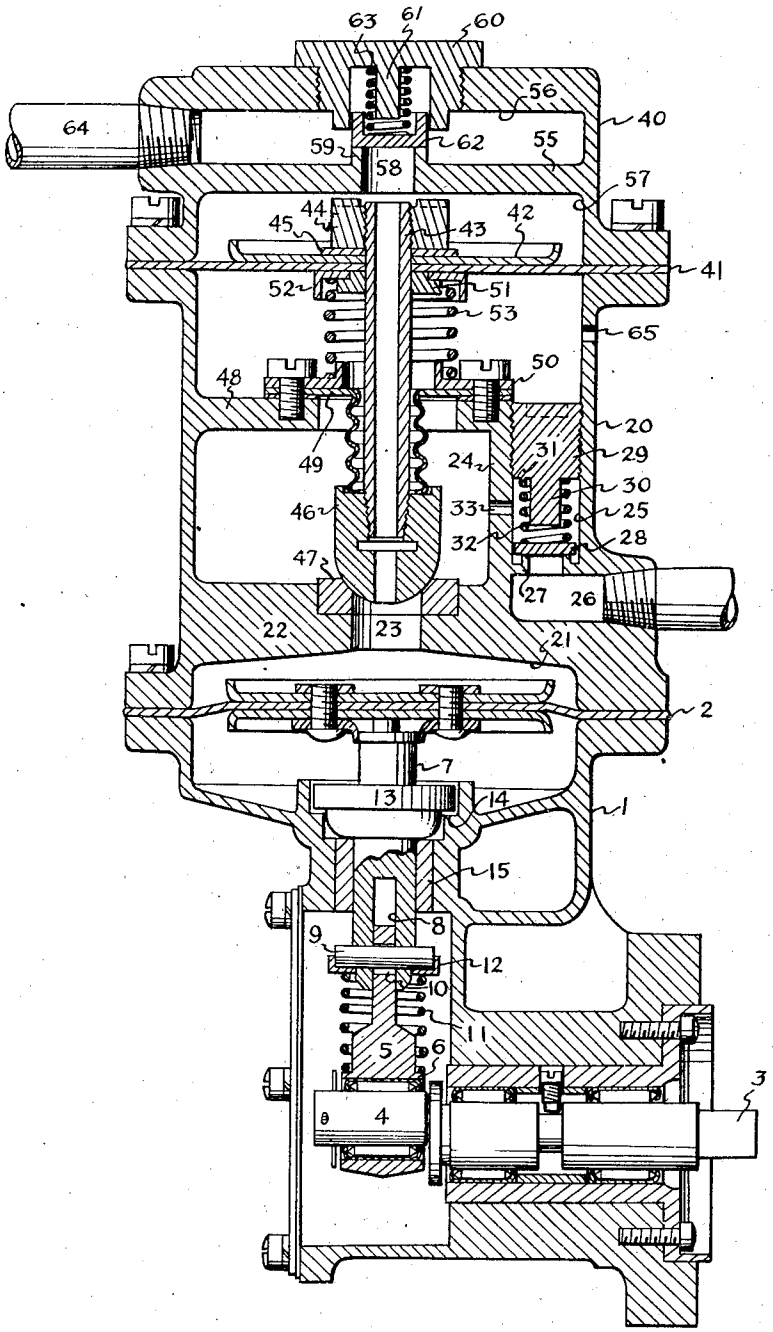
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PRESSURE REGULATOR FOR PUMPS

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## PRESSURE REGULATOR FOR PUMPS

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

The present invention pertains to a combined pressure pump and pressure regulator designed particularly for use in connection with a carburetor associated with an internal combustion engine.

The usual fuel pump of the diaphragm type is rendered inoperative by the development of a predetermined pressure in the carburetor bowl, occurring when the motor and hence the carburetor bowl do not require fuel. This apparatus, however, is subject to the influence of vapor pressure developed in the fuel reservoir, especially in a closed or unvented pressure system. Such pressure has the same effect as reduced pressure in the carburetor, opening the needle valve, freeing the pump diaphragm for action, and permitting the bowl to fill. When the bowl has become filled and the needle valve closed, the vapor pressure again opens the valve against the buoyancy of the carburetor float, whereupon the carburetor is flooded.

The object of this invention is to protect the carburetor mechanism from vapor pressure developed in the fuel tank and transmitted through the system. The device for accomplishing this object is in the nature of a regulator mounted over the pump diaphragm and containing a regulator valve mounted on another diaphragm. Vapor pressure is transmitted through this valve and upon the latter diaphragm in a direction which seats this valve and obstructs flow of fuel to the carburetor. When the motor requires more fuel and has reduced the pressure sufficiently, the pressure upon the regulator diaphragm is correspondingly reduced, and a spring at the opposite side thereof moves the diaphragm in the direction which unseats the regulator valve. The fuel path to the carburetor is thus opened, and the fuel pump again operates in the normal manner.

The invention is disclosed in the following description and in the accompanying drawings in which the single figure is a vertical section of the device.

The conventional diaphragm fuel pump comprises a housing 1 across which is mounted a diaphragm 2. A drive shaft 3 is journalled in the housing and is formed with a crank 4. A plunger 5 having a flange 6 at its lower end, is journaled upon crank 4.

To the diaphragm 2 is attached a suspended

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stem 7 having in its lower end a cavity 8 slidably receiving the upper end of plunger 5. A cross pin 9 passes through both the stem and the plunger, the aperture 10 in the plunger being somewhat oversized. Upon the flange 6 is mounted a coil spring 11 supporting in turn a seat 12 in which the pin 9 rests. The upper portion of the stem 7 is formed with a collar 13 limited in its downward movement by a shoulder 14 formed in the housing 1. The lower part of the stem is guided in a suitable bushing 15 fitted in the housing structure. The fuel inlet is at the upper or opposite side of the diaphragm and will be presently identified.

In the normal operation of the pump, a predetermined pressure in the carburetor acts upon the diaphragm to prevent oscillation of the latter. The motion of the crank 4 is absorbed in the spring 11. When the pressure is relieved, the diaphragm is free to oscillate and pump liquid.

The regulator portion of the apparatus is built within a housing 20 secured upon the housing 1, over the diaphragm 2, and having in its lower end a chamber 21 of ample size to permit movement of the diaphragm. A wall 22 across the housing 20 divides the housing into upper and lower chambers and is formed with a passage 23 therethrough to permit passage of liquid to and from the diaphragm 2.

A curved wall 24 within the housing 20 forms a valve chamber 25 communicating at its lower end with a fluid inlet 26. Between the inlet and the chamber is a valve seat 27 on which rests a check valve disk 28 having adequate peripheral clearance from the inner wall of the chamber 25.

When the disk rests securely upon the seat, it obstructs flow through the seat. A plug 29 is secured in the top of the chamber 25 and has a reduced lower end 30 forming a shoulder 31. The end 30 is surrounded by a compressed coil spring 32 bearing against the shoulder and upon the disk 28 to hold the disk upon the seat 27 with pressure. A port 33 in the wall 24, above the seat 27, places the chamber 25 in communication with the lower section of the upper chamber and with passage 23.

A head 40 is secured upon the housing 20 and clamps a regulator diaphragm 41 across the top of the housing to thereby divide the upper chamber into a first compartment above the diaphragm and a second compartment below the same. On the upper surface of the diaphragm is the usual stiffening plate 42. A hollow valve stem 43 passes through the diaphragm and plate and is held by a nut 44 and washer 45 around its upper end.

The lower end of the valve stem carries a valve head 46 cooperating with a valve seat 47 around the passage 23.

A web 48 is formed across the housing 20, between the wall 22 and the diaphragm 41, to support an inwardly projecting disk 49 and a spring seat 50, both surrounding the valve stem 43 and spaced therefrom. This web divides the aforesaid second compartment into first and second, or upper and lower, sections. At the lower surfaces of the diaphragm 41, a stepped ring 51 is secured either to the diaphragm or to the valve stem 43 and supports a downwardly facing spring seat 52. A compressed coil spring 53 is inserted between the seats 50 and 52. The tendency of this spring is to raise the diaphragm 41 and the valve head 46 from its seat 47.

A transverse wall 55 in the head 40 divides the interior thereof into two sections. Directly over the stem, the wall 55 is formed with a passage 58 around the upper end of which is a valve seat 59. A hollow plug 60 is screwed into the top of the head 40 and is formed with a downwardly extending stem 61. A cup valve 62 controls the passage 58 and is normally held on the seat 59 by a spring 63 surrounding the stem 61. The valve 62 is guided in the cap 60. The outlet of the apparatus leads from the first compartment and is connected by a line 64 to the carburetor. The housing 20 is vented at 65. Communication between the upper and lower sections defined by web 48, is cut off by a flexible bellows device 66 attached at one end of valve head 46 and at the other end of the periphery of the opening in disk 49.

In the normal operation of the fuel pump, without a regulator, a predetermined pressure built up in the carburetor is transmitted to the top of the diaphragm 2 and prevents the pump from operating. Tihs conditions persists until the pressure is less than that of the spring 11. However, there is nothing to prevent vapor pressure at the pump inlet from being transmitted to the carburetor, opening the needle valve thereof against the buoyancy of the float, and permitting the pump to resume operation and fill and flood the bowl.

With the regulator attached, the pump discharges through passage 23, the hollow valve head 46 and stem 43, passage 58 and valve 62 to the carburetor supply line 64. When an excessive vapor pressure develops, it does not affect the carburetor unless the valve head 46 is raised by a sufficient reduction in pressure in the carburetor to permit the spring 53 to lift the diaphragm 41. Thereupon the vapor pressure is transmitted through the check valve 27—28, port 33, the valve head 46 and stem 43 to the top of diaphragm 41, again bringing the pressure on the diaphragm to a point where it closes the valve head 46 on the passage 23 against the thrust of spring 53. In this manner the carburetor mechanism is effectively shielded from excessive vapor pressure.

Although a specific embodiment of the invention has been illustrated and described, it will be understood that various alterations in the details of construction may be made without departing from the scope of the invention as indicated by the appended claims.

What I claim is:

1. A pressure regulator comprising, in combination with a fuel pump, a housing on the fluid-moving side of said pump, a valve chamber with an inlet thereto, a transverse wall in said housing spaced from said pump and having a passage therethrough providing access to said pump and communicating with said chamber, means for checking back-flow through said inlet, a valve head in said housing and controlling said passage, said housing having an outlet beyond said valve head, and means for closing said valve head on said passage.



2. A pressure regualtor comprising, in combination with a fuel pump, a housing on the fluid-moving side of said pump, a valve chamber with an inlet thereto, a transverse wall in said housing spaced from said pump and having a passage therethrough providing access to said pump and communicating with said chamber, means for checking back-flow through said inlet, a valve head in said housing and controlling said passage, said housing having an outlet beyond said valve head, a diaphragm supporting said valve head, the side of said diaphragm more remote from said passage being exposed to pressure in said passage, and the side nearer said passage being shielded from such pressure, whereby such pressure closes said valve head on said passage.

3. A pressure regulator comprising, in combination with a fuel pump, a housing on the fluid-moving side of said pump, a valve chamber with an inlet thereto, a transverse wall in said housing spaced from said pump and having a passage therethrough providing access to said pump and communicating with said chamber, means for checking back-flow through said inlet, a valve head in said housing and controlling said passage, said housing having an outlet beyond said valve head, a diaphragm supporting said valve head, a hollow valve stem passing through said diaphragm and attached thereto, the valve head being also hollow and supported by said stem in communication therewith, whereby pressure in said means of communication is transmitted to the side of said diaphragm more remote from said passage, when said passage is open, to close the valve head on said passage.

4. A pressure regulator comprising, in combination with a fuel pump, a housing on the fluid-moving side of said pump, a valve chamber with an inlet thereto, a transverse wall in said housing spaced from said pump and having a passage therethrough providing access to said pump and communicating with said chamber, means for checking back-flow through said inlet, a valve head in said housing and controlling said passage, said housing having an outlet beyond said valve head, a diaphragm supporting said valve head, a hollow valve stem passing through said diaphragm and attached thereto, the valve head being also hollow and supported by said stem in communication therewith, whereby pressure in said means of communication is transmitted to the side of said diaphragm more remote from said passage, when said passage is open, to close the valve head on said passage, and means shielding the other side of said diaphragm from said pressure.

5. A pressure regulator as claimed in claim 1, further characterized by a spring urging said valve head to open position.

6. A pressure regulator as claimed in claim 3, further characterized by a spring urging said valve head to open position.

7. In a pressure regulator for the fuel feed line of an internal combustion engine, a housing having a wall dividing the same into upper and lower chambers, said wall having a passage therethrough connecting said chambers, a diaphragm

extending across and dividing said upper chamber into first and second compartments, a valve stem attached to and having one end extending though said diaphragm, a valve head on the end of said stem remote from said diaphragm and adapted in a first position to seat upon the rim of said passage in one position of said diaphragm, said stem and head having aligned channels connecting said lower chamber with said first compartment, an inlet leading to and in continuous communication with said second compartment, an outlet leading from said first compartment, means yieldingly urging said head away from said first position, and first and second check valves formed in said housing and positioned respectively between said inlet and second compartment and between said first compartment and said outlet.

8. In a pressure regulator for the fuel feed line of an internal combustion engine, a housing having a wall dividing the same into upper and lower chambers, said wall having a passage whose rim defines a valve seat, a diaphragm in said upper chamber dividing the same into first and second compartments, a tubular stem secured at one end to, and extending through said diaphragm, a head on the other end of said stem adapted to seat on said valve seat in one position of said diaphragm, said head and stem having aligned channels placing said lower chamber and said first compartment in communication, a fluid inlet leading to said second compartment, a fluid outlet leading from said first compartment, a web in said second compartment fixed to said housing, said stem passing through an aperture in said web, means sealing said web with respect to said stem to form a portion open to the atmosphere below said diaphragm, a coil spring interposed between said web and diaphragm to urge said head away from engagement with said seat, a first check valve between said inlet and second compartment and a second check valve between said first compartment and said outlet.

9. The combination specified in claim 8, said means comprising a bellows surrounding said stem and secured at its ends in fluid-tight connection with said web and head, respectively.

10. In a pressure regulator for the fuel feed line of an internal combination engine, a housing having a wall dividing the housing into upper and lower chambers, said wall having an aperture therethrough whose periphery forms a valve seat, a diaphragm in said upper chamber and dividing the same into first and second compartments, a stem secured at one end to said diaphragm and having a valve head attached to its other end, said head being adapted to engage said valve seat in one position of said diaphragm, there being an axial bore through said head and stem placing said lower chamber and said first compartment in communication, a web in said housing dividing said second compartment into first and second sections, said stem passing through an opening in said web, flexible means sealing the space between said opening and stem, an inlet leading to said second section, an outlet leading from said first compartment, check valves in said housing between said inlet and second section and between said first compartment and said outlet, respectively and spring means between said web and stem to thereby urge said head out of engagement with said valve seat.

11. In a regulator of the type described for controlling the flow of fuel from the fuel pump to the carburetor of an internal combustion engine to protect the carburetor against flooding because of excessive vapor pressure of the fuel, a housing having a wall dividing the same into upper and lower chambers, said lower chamber being adapted to be placed in fluid communication with the fluid-moving side of a fuel pump, a first fluid passage in said wall to permit passage of fluid between said upper and lower chambers, a valve seat defined by the rim of said first fluid passage, a diaphragm in said upper chamber dividing the same into first and second compartments, a valve stem secured at one end to, and extending through said diaphragm to within said first compartment, a valve head on the other end of said stem adapted to seat on said valve seat in one position of said diaphragm, a second fluid passage extending axially through said head and stem permitting fluid flow from said lower chamber to said first compartment, a fluid outlet opening through said housing from said first compartment and adapted to be placed in fluid communication with a carburetor, a fluid inlet opening through said housing into said second compartment and adapted to be placed in fluid communication with a fuel tank, means in said upper chamber yieldingly urging said head from said seat of said one position to open said first fluid passage, a check valve between said inlet and said second compartment, and an outlet check valve between said outlet and said first compartment.

12. In a regulator of the type described for controlling the flow of fuel from the fuel pump to the carburetor of an internal combustion engine to protect the carburetor against flooding because of excessive vapor pressure of the fuel, a housing having a wall dividing the same into upper and lower chambers, said lower chamber being adapted to be placed in fluid communication with the fluid-moving side of a fuel pump, a first fluid passage in said wall to permit passage of fluid between said upper and lower chambers, a valve seat defined by the rim of said first fluid passage, a diaphragm in said upper chamber dividing the same into first and second compartments, a valve stem secured at one end to, and extending through said diaphragm to within said first compartment, a valve head on the other end of said stem adapted to seat on said valve seat in one position of said diaphragm, a second fluid passage extending axially through said head and stem permitting fluid flow from said lower chamber to said first compartment, a fluid outlet opening through said housing from said first compartment and adapted to be placed in fluid communication with a carburetor, a fluid inlet opening through said housing into said second compartment and adapted to be placed in fluid communication with a fuel tank, a web in said second compartment fixed to said housing dividing said second compartment into first and second sections, a coil spring interposed between said web and said diaphragm to urge said head away from engagement with said seat, a check valve in said housing between said inlet and said second compartment, and a check valve in said housing between said outlet and said first compartment.

13. In a regulator of the type described for controlling the flow of fuel from the fuel pump to the carburetor of an internal combustion engine to protect the carburetor against flooding because of excessive vapor pressure of the fuel, a housing having a wall dividing the same into upper and lower chambers, said lower chamber being adapted to be placed in fluid communication with

the fluid-moving side of a fuel pump, a first fluid passage in said wall to permit passage of fluid between said upper and lower chambers, a valve seat defined by the rim of said first fluid passage, a diaphragm in said upper chamber dividing the same into first and second compartments, a valve stem secured at one end to, and extending through said diaphragm to within said first compartment, a valve head on the other end of said stem adapted to seat on said valve seat in one position of said diaphragm, a second fluid passage extending axially through said head and stem permitting fluid flow from said lower chamber to said first compartment, a web in said second compartment fixed to said housing and dividing said second compartment into first and second sections, said stem passing through an opening in said web, a flexible bellows sealing the space between said web opening and said stem, a fluid inlet opening through said housing into said second section and adapted to be placed in fluid communication with a fuel tank, a fluid outlet opening through said housing from said first compartment and adapted to be placed in fluid communication with a carburetor, a check valve in said housing between said inlet and said second section, an outlet



check valve in said housing between said outlet and said first compartment, and spring means between said web and said diaphragm to urge said head out of engagement with said valve seat.

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