May 20, 1941. S. JENCICK 2,242,582

FUEL PUMP

Filed Sept. 29, 1938 2 Sheets-Sheet 1

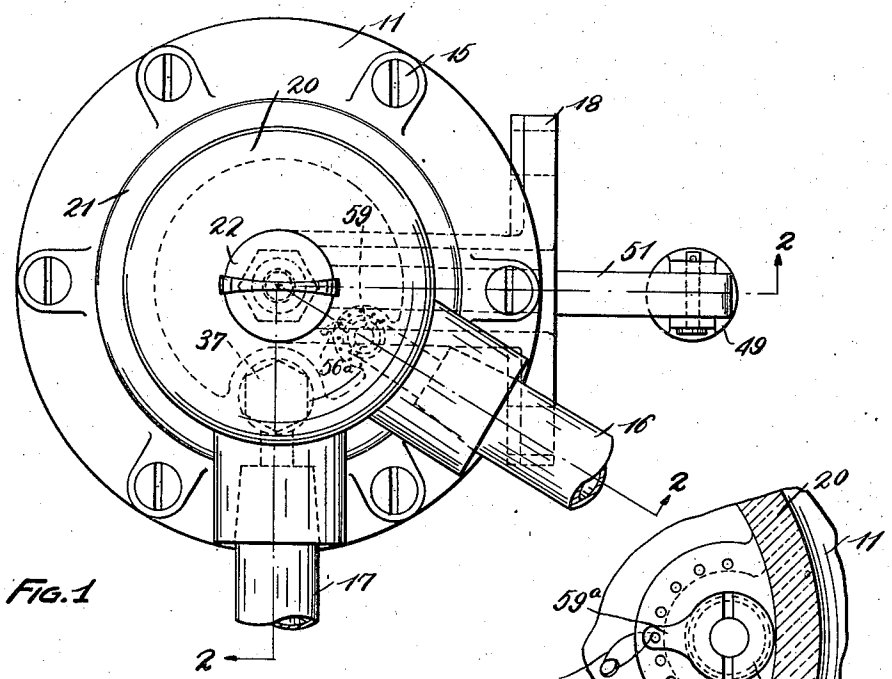

FIG. 1

FIG. 5

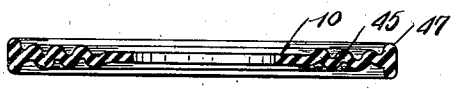

FIG. 6

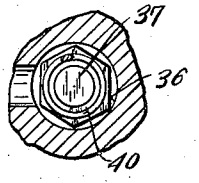

FIG. 4

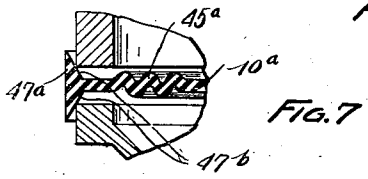

FIG. 7

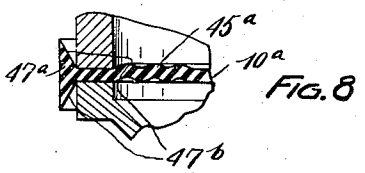

FIG. 8

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FUEL PUMP

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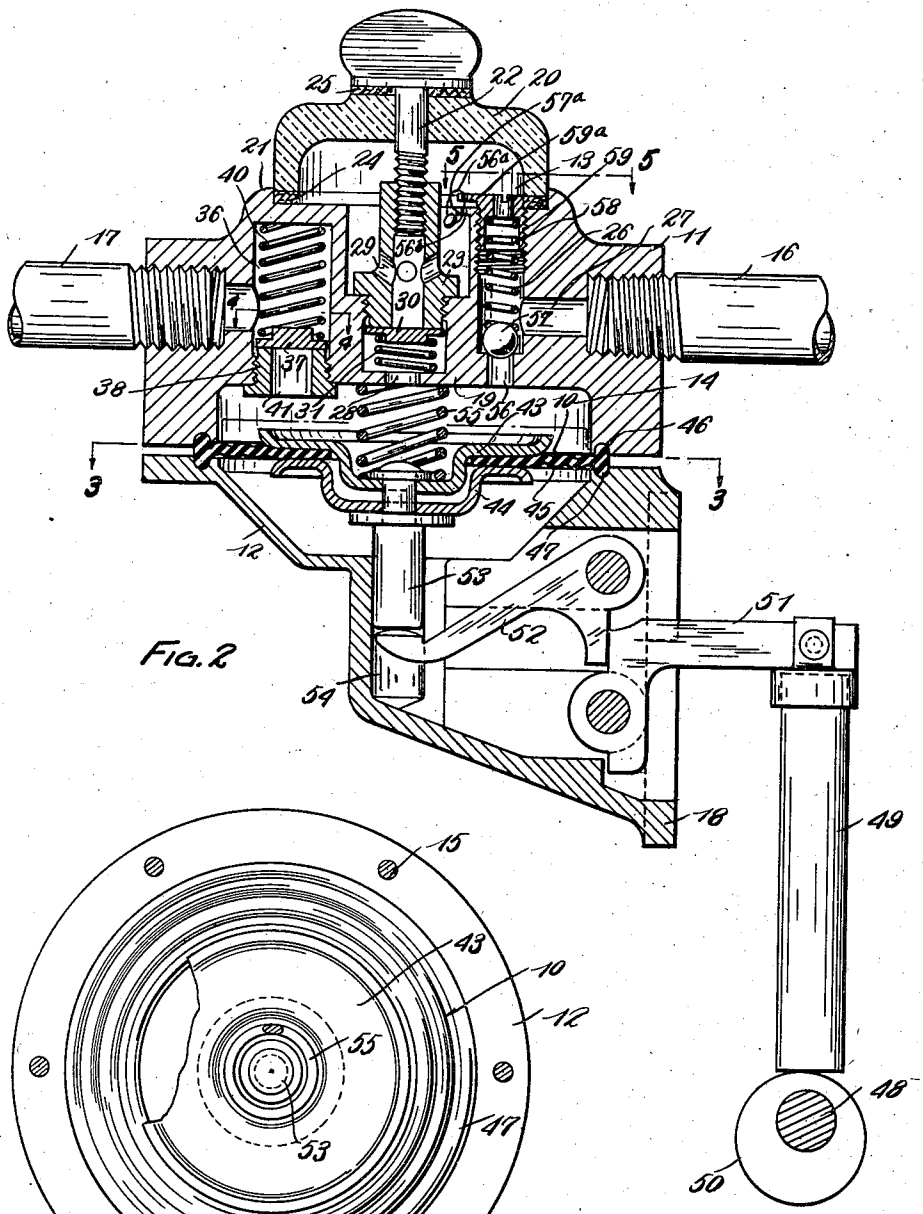

FIG. 2

FIG. 3

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FUEL PUMP

Stephen Jencick, Chagrin Falls, Ohio, assignor of two-fifths to Leo L. Williams, Cleveland Heights, Ohio

Application September 29, 1938, Serial No. 232,363

4 Claims. (Cl. 103—150)

This invention relates to pumps and more particularly to a diaphragm pump of improved and simplified construction which is especially suitable for use in the fuel supply systems of motor vehicles.

An object of my invention is to provide a fuel pump of improved and simplified construction having highly desirable operating characteristics, such that the fuel supply at the carburetor nozzle or jet can be maintained at a substantially constant head throughout widely varying conditions of operation of the vehicle.

Another object of my invention is to provide an improved pump of the diaphragm type having an elastic diaphragm which is adapted to yield under the influence of abnormal pressure or vacuum in the pump casing whereby a sensitive self-regulation of the pumping action can be obtained.

A further object of my invention is to provide an improved pump of the diaphragm type having valves operable to automatically regulate the pumping action and in which the diaphragm is elastic and supplements the automatic regulation afforded by the valves.

Still another object of my invention is to provide an improved fuel pump having a novel arrangement of chambers and control valves enabling the pump to operate in a highly efficient manner and to accurately maintain a desired fuel level in the carburetor throughout widely varying conditions of vehicle operation.

Yet another object of my invention is to provide an improved fuel pump having an intake chamber or reservoir in which a vacuum can be maintained for preventing the fuel in the supply line from draining back into the storage tank, thus insuring an immediate supply of fuel at the pump at all times.

Another object of my invention is to provide an improved vehicle fuel pump having adjustable means for regulating its delivery capacity whereby the pump is adapted to serve as a speed governor for the vehicle.

My invention may be further briefly summarized as consisting in certain novel combinations and arrangements of parts hereinafter described and more particularly set out in the appended claims.

In the accompanying sheets of drawings,

Fig. 1 is a top plan view of a pump embodying my invention;

Fig. 2 is a vertical sectional view taken through the pump as indicated by the section lines 2—2 of Fig. 1 and illustrating the construction and manner of operation;

Fig. 3 is a transverse sectional view taken through the pump on line 3—3 of Fig. 2;

Fig. 4 is a partial transverse sectional view taken on line 4—4 of Fig. 2;

Fig. 5 is another partial transverse sectional view, on a larger scale, taken on line 5—5 of Fig. 2;

Fig. 6 is a detached sectional view taken through the diaphragm;

Fig. 7 is a partial vertical sectional view taken through a modified form of diaphragm and the clamping portions of cooperating housing sections; and

Fig. 8 is a similar sectional view but showing the diaphragm stretched and the housing sections in clamping engagement therewith.

For the purpose of describing the construction and operation of my improved pump more in detail, further reference will now be made to the drawings, but before proceeding with such more detailed description it should be understood that my invention is not limited to the construction, manner of operation, or specific use of the particular pump herein disclosed but may be embodied in various other similar devices coming within the scope of the appended claims.

As shown in Figs. 1 and 2 my improved pump is of the diaphragm type having, in this instance, the diaphragm 10 and a housing formed of sections 11 and 12 and containing the chambers 13 and 14. The housing sections 11 and 12 may be formed of cast metal or any other suitable material and may be connected by screws 15, with the diaphragm assembled therebetween in a manner to be explained more fully hereinafter. The housing section 11 has fluid supply and discharge pipes or conduits 16 and 17 connected therewith and through which the gasoline or other fluid flows to and from the pump. The housing section 12 may have an attaching portion or bracket 18 for cooperation with an available part of the vehicle structure for mounting the pump thereon.

The housing section 11 may be constructed with recesses in the top and bottom thereof for forming the chambers 13 and 14 and with a transverse wall portion 19 extending between such recesses. A cover 20 of cup-like shape, and which may be formed of a transparent substance or any other suitable material, may be mounted on the top of the housing section 11 to complete the chamber 13. This chamber forms an intake chamber or reservoir to which the fuel

is supplied by the pipe 16. As will be hereinafter explained, a partial vacuum may be maintained in the chamber 13 and for this reason this chamber may at times be referred to as a vacuum chamber.

The cover 20 may be retained in place on the housing section 11 by the annular bead 21 of the latter and by the clamping screw or wing bolt 22. The bolt 22 may extend through the cover and may have threaded engagement with the wall portion 19, or as in this instance, with a hollow member or valve seat 23 mounted on such wall portion. A gasket 24 may be provided between the cover 20 and the housing section 11 and a packing washer 25 may be used between the cover and the head of the wing bolt 22.

The diaphragm 10 extends transversely of the housing section 11 to close the lower recess thereof and complete the chamber 14. This chamber is the working chamber of the pump which is expanded and contracted in volume by flexing or moving of the diaphragm 10 whereby fluid is drawn into the pump through the supply connection 16 and expelled therefrom through the discharge connection 17.

The housing section 11 may have an upright inlet passage or bore 26 therein of which the upper end communicates with the chamber 13 a substantial distance above the bottom or wall portion 19. At a lower point thereof the bore 26 is in open communication with the supply pipe 16 through the lateral supply passage or port 27. Fluid entering the chamber 13 through the pipe 16 and the bore 26 passes downwardly from the hollow member 23 and the passage 28 of the wall portion 19 into the working chamber 14. The member 23 may be a plug-like member which is screwed into a threaded recess of the wall portion 19 and may have openings 29 therein which communicate with the chamber 13 adjacent the bottom thereof. The flow of fluid downwardly through the passage 28 into the chamber 14 may be controlled by a check valve 30 which is normally held in seating engagement with the lower end of the member 23 by a compression spring 31.

A discharge passage or recess 36 may be formed in the wall portion 19 of the housing section 11 to accommodate a check valve 37 and to connect the discharge pipe 17 with the working chamber 14. A bushing 38 may be screwed into the lower end of the recess 36 to form a seat against which the valve 37 is normally pressed by the compression spring 40. The opening of the bushing provides a communicating passage 41 leading into the working chamber 14.

The diaphragm 10 forms a portion of the wall of the working chamber 14 and when moved or flexed causes variation in the volume of this chamber to produce a pumping action. In my improved pump the diaphragm is of novel form and produces operating characteristics not heretofore obtainable in fuel pumps of the diaphragm type. This diaphragm is formed of an elastic rubber-like material, such as synthetic rubber, or any other suitable elastic substance which will withstand the deteriorating effects of gasoline or other liquid fuels to be pumped. The diaphragm may be in the form of a disk having a central portion adapted to be clamped between the cooperating cup-shaped sheet metal clamping members 43 and 44 and may have an outer or marginal portion adapted to be clamped or held between the cooperating portions of the housing sections 11 and 12. The portion of the diaphragm intermediate such central and marginal portions may be provided with preformed annular corrugations 45 which increase the elasticity and flexibility of the diaphragm and otherwise improve its characteristics and suitability for use in a fuel pump.

The elasticity of the diaphragm 10 is a very important characteristic of this member because it enables the pump to operate with a self-regulating action whereby a desired predetermined head of fuel can be more accurately maintained at the carburetor nozzle despite widely varying operating conditions for the engine and vehicle. The elasticity of the diaphragm enables it to yield in response to abnormal or excessive pressure or vacuum conditions existing in the chamber or chambers of the pump. When the pressure in the working chamber 14 increases the diaphragm yields, that is, stretches and bulges downwardly and prevents the pressure increase from immediately causing an excessive amount of fuel to be delivered into the pipe 17. On the other hand, a vacuum condition occurring in the chamber 14 will tend to cause the diaphragm to yield and bulge upwardly and this will reduce the volume of the working chamber thereby enabling the pump to maintain a desired pressure in the discharge pipe 17. The elasticity of the diaphragm also permits energy to be stored therein during one portion of the stroke and to be expended during another portion of the stroke whereby pulsations in the pump discharge can be more or less eliminated.

I have observed that a diaphragm formed of rubber-like material or other substances suitable for hydrocarbon fuel pump diaphragms are usually subject to more or less swelling as the result of the action of the fuel thereon. Such swelling of the diaphragm material is apt to cause undesirable variation in the operation of the pump. I find that the undesirable effects of such swelling of the diaphragm material can be largely overcome by assembling my pump so that the diaphragm 10 is in an initially stretched or tensioned condition. When the pump is assembled with the diaphragm in such a stretched condition the subsequent swelling of the diaphragm material, which may result from the action of the fuel thereon, will cause very slight change, if any, in the operating characteristics of the pump.

To facilitate the assembling of the pump with the diaphragm 10 in such an initially stretched condition, I construct one or both of the housing sections 11 and 12 with an annular groove 46 in the diaphragm engaging portion thereof and provide the diaphragm with an annular bead 47 of smaller diameter but adapted to engage in such groove or grooves when the diaphragm is stretched. In the assembly operation the housing sections 11 and 12 are pressed together with the diaphragm therebetween and with the bead 47 of the diaphragm engaging, for at least a portion of its circumference, in the grooves 46. The diameter of the bead 47 being somewhat less than the diameter of the grooves 46 does not freely engage itself therein, but by relative rotation of the housing sections with pressure applied thereto the bead of the diaphragm can be subjected to a wedging action which will result in the diaphragm being stretched or tensioned as the bead shifts into the grooves. After the bead of the diaphragm has been thus engaged in the grooves the housing sections may be clamped together by the

screws 15 to hold the diaphragm in the desired initially stretched or tensioned condition. The corrugations 45 increase the flexibility and elasticity of the diaphragm, as mentioned above, and thus also facilitate the stretching or tensioning of the diaphragm at assembly of the pump. In addition to serving as a means for stretching the diaphragm during the assembling operation the bead 47 cooperates with the housing sections to provide a fluid tight seal around the edges of the diaphragm.

It is not necessary that the housing sections, or either of them, be provided with an annular groove to receive the diaphragm bead because the diaphragm can be assembled in an initially stretched condition between housing sections having solid clamping portions 45*a*, as shown in Figs. 7 and 8. When the housing sections have such solid clamping portions the bead 47*a* of the diaphragm 10*a* has relatively steep angular or beveled annular faces 47*b* against which the outer edges of the housing sections exert a wedging action as their clamping portions are brought together. The diaphragm is made of such diameter that this wedging action will cause it to be stretched laterally, as indicated in Fig. 8.

Although I have described the elastic diaphragm as being a very desirable feature in a fuel pump, it should be understood that this feature is not restricted in utility to fuel pumps but is also desirable in vacuum pumps and in pumps for handling various fluids.

For actuating or flexing the diaphragm 10, motion may be transmitted from any available moving part of the vehicle, such as the cam shaft 48. A push rod 49 cooperating with the cam face 50 is reciprocated to cause swinging movement of a bell crank lever 51 which is pivoted in the housing section 12. A second bell crank lever 52 may be pivoted in the housing section 12 to receive motion from the bell crank lever 51 and to cause reciprocation of a plunger 53. This plunger may be guided in an opening 54 of the housing section 12 and may have its upper end connected with the clamping members 43 and 44 for imparting upward movement to the diaphragm. A spring 55 seating in a recess of the clamping member 43 and engaging the wall portion 19 is adapted to be stressed during upward movement of the diaphragm so as to subsequently cause a return movement of the diaphragm.

My improved fuel pump also embodies a valve-controlled by-pass 56 through which fluid may be returned from the working chamber 14 to the supply passage 27. The passage or port 56 may be formed in the wall portion 19 and is normally closed by a check valve or relief valve contained in the upwardly extending bore or inlet passage 26. This valve may comprise a ball 57 and a compression spring 58 acting thereon to normally hold the ball seated. A hollow screw or bushing 59 mounted in the upper end of the passage 26 forms a seat and guide for the upper end of the spring 58. The opening through this bushing forms a port or fluid connection between the passage 26 and the chamber 13.

In addition to the valve 57 serving as a relief valve I may use this valve for regulating the delivery capacity of a vehicle fuel pump so as to enable the pump to act as a governor for limiting or controlling the speed of the vehicle to a predetermined maximum value. This may be especially desirable in fuel pumps for motor trucks, taxicabs and other vehicles. To this end I provide for a step-by-step or predetermined adjustment of the tension of the valve spring 58 so that by permitting more or less fuel to be returned to the supply passage 27 the delivery capacity of the pump can be regulated to a value corresponding with the maximum or desired speed for the vehicle.

This adjustment of the spring 58 may be made by screwing the bushing 59 in or out of the threaded upper portion of the passage 26. When the desired adjustment has been made the bushing may be held against accidental or unauthorized shifting as by a wire seal 56*a*. For this purpose the housing section 11 may have a flange portion 57*a* adjacent the upper end of the passage 26 and provided with spaced openings 56*b* which indicate the different adjustments for the bushing and accommodate the seal 56*a*. The bushing may have a lug or ear 59*a* thereon which serves as a pointer and is provided with an opening to accommodate the seal.

It will be noted that the supply passage 27 extends at substantially right-angles to the upwardly extending bore or inlet passage 26 and communicates with the latter at a point just above the valve-controlled by-pass 56. With this arrangement it will be seen that the passage 56 will direct the by-passed fuel upwardly as a jet across the open end of the supply passage 27 and this jet will tend to produce a vacuum or suction in the supply passage 27 which will prevent the fuel from draining out of the supply pipe 16 back into the fuel tank. Thus the supply pipe 16 and passage 27 will always be maintained full of a solid body of liquid fuel ready to be immediately drawn into the pump and discharged thereby through the discharge pipe 17.

During the operation of my improved fuel pump the diaphragm 10 is subjected to a rapid flexing and the resulting pumping action causes fluid to be drawn in through the pipe 16 and the passage 26 into the vacuum chamber 13. The fluid is drawn downwardly past the valve 30 into the working chamber 14 and is then forced past the check valve 37 into the discharge pipe 17 which carries the fuel to the carburetor or other desired point. If the delivery pipe 17 is closed as by closure of the float valve of the carburetor, or if the delivery capacity of the pump exceeds the rate of consumption, the pressure in the working chamber 14 will increase and upon reaching a predetermined value will lift the valve 57 and cause fluid to be returned to the supply passage 27. A partial vacuum is always maintained in the chamber 13 and this prevents the fuel in the pipe 16 from draining back into the fuel tank of the vehicle and thus the fuel supply line remains filled or charged so that fuel will always be immediately available at the pump. The valves 30, 37 and 57 afford self-regulating pumping action whereby the pressure or head in the discharge line 17 can be maintained approximately constant. The elasticity of the diaphragm 10 supplements the regulating action of these valves by permitting a yielding or bulging of the diaphragm in response to excessive pressure or vacuum conditions in the pump. Such elasticity of the diaphragm affords a more sensitive self-regulating action whereby the pressure or head in the discharge line 17 can be maintained more nearly constant than would be possible by means of the valves alone.

From the foregoing description and accompanying drawings it will now be readily seen that

I have provided an improved fuel pump of simple construction, but which is highly efficient in operation and is capable of accurately maintaining a desired head or pressure in the discharge line. It will be seen furthermore that the vacuum chamber and valve arrangement contribute to this desired end and also maintain the supply line charged with fluid so that an instantaneous delivery of fuel can be had and initial idle strokes of the pump can be avoided. The adjustable relief or by-pass valve permits the delivery capacity of the pump to be regulated to correspond with a desired maximum speed for the vehicle. Moreover, it will be seen that the elasticity of the diaphragm substantially eliminates pulsation in the discharge stream and provides for a more accurate and sensitive self-regulating operation of the pump. Furthermore the assembly of the diaphragm under initial tension eliminates undesirable variations in operation heretofore resulting from swelling and other deteriorating effects of the fuel on the diaphragm material.

While I have illustrated and described the improved fuel pump of my invention in a somewhat detailed manner it will be understood of course that I do not wish to be limited to the details of construction and arrangements of parts herein disclosed, but regard my invention as including such changes and modifications as do not constitute a departure from the spirit of the invention and the scope of the appended claims.

Having thus described my invention, I claim:

1. In a pump of the diaphragm type, a pair of housing sections having cooperating annular clamping portions, and an elastic diaphragm held between said housing sections in an initially stretched condition, said diaphragm having thereon an annular bead provided with oppositely beveled faces and being of a diameter to be wedgingly engaged by said portions for causing stretching of the diaphragm as said portions are brought into clamping cooperation therewith.

2. In a pump of the diaphragm type, a housing section having a recess therein and a clamping portion surrounding said recess, a second housing section having a clamping portion for cooperation with the clamping portion of the first housing section, one of said clamping portions having an annular groove therein, and a diaphragm extending transversely of the recess and having thereon an annular bead the initial diameter of which is smaller than the diameter of said groove and which is adapted to be pressed into said groove by the cooperation of said clamping portions, said diaphragm being elastic and subjected to stretching upon assembly with the housing sections.

3. In a liquid fuel pump, a housing having a vacuum chamber and a working chamber therein, a fuel inlet passage extending upward in said housing and opening into the vacuum chamber a substantial distance above the bottom of the latter, a fuel supply passage extending substantially normal to the direction of said inlet passage and opening into the latter, a diaphragm forming a portion of the wall of the working chamber, means for moving the diaphragm for expanding and contracting the working chamber, a discharge connection leading from the working chamber and having a check valve therein, a passage connecting the vacuum chamber with the working chamber and having therein a check valve opening toward the latter chamber, and a check-valve-controlled by-pass connecting the working chamber with said inlet passage and arranged to direct by-passed fuel across the opening of said supply passage.

4. In a pump of the diaphragm type, a housing having therein a working chamber and inlet and discharge passages, a diaphragm forming a portion of the wall of said chamber, and means for flexing said diaphragm for causing a flow of fluid through said passages, said diaphragm being formed of a synthetic rubber capable of resisting the deteriorating action of liquid fuel and having between its center and outer margin a series of concentric annular corrugations, the diaphragm being also elastic and yieldable by stretching to abnormal pressure and being assembled with the housing so as to be in an initially stretched condition.

STEPHEN JENCICK.