May 24, 1966 J. B. WITT 3,252,425

VALVE PULSATOR DIAPHRAGMS FOR FUEL PUMPS

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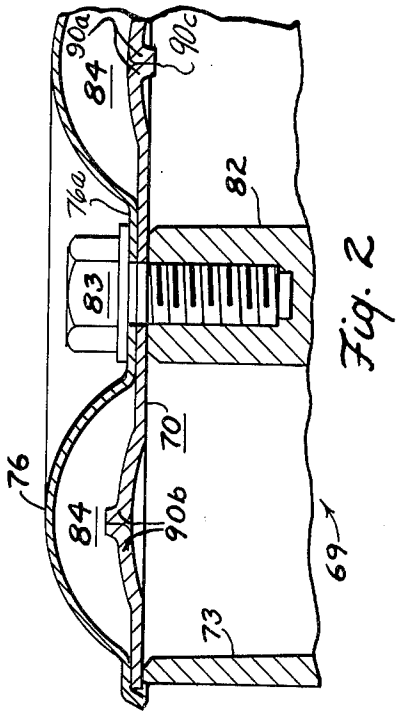


Fig. 2

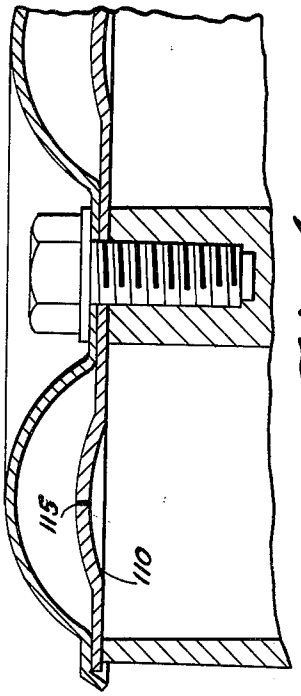


Fig. 4

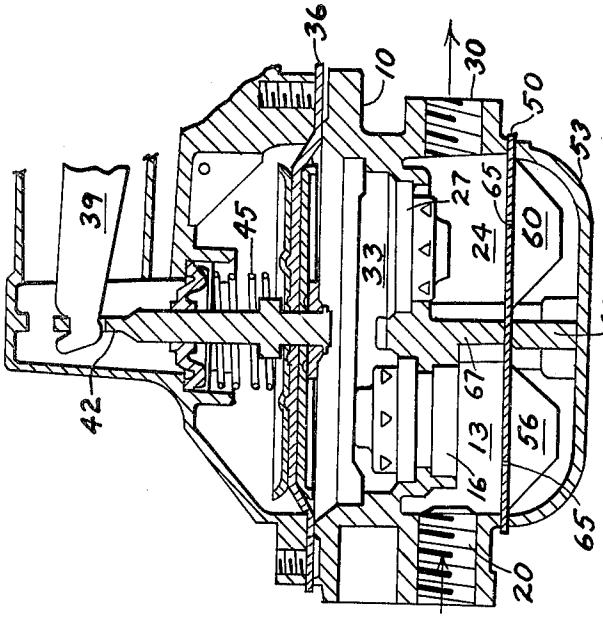


Fig. 1

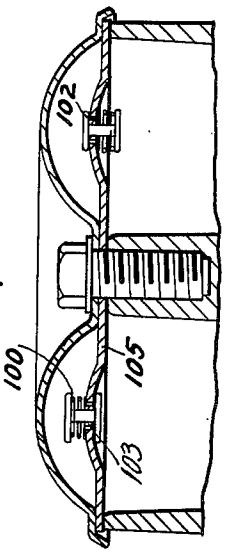


Fig. 3

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VALVE PULSATOR DIAPHRAGMS FOR FUEL PUMPS

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This invention relates to fuel pumps for automobile engines and more particularly to fuel pumps of the type which use air domes for cushioning and smoothing the pulses in the inlet and outlet chambers in a flexible diaphragm type of fuel pump.

The conventional automobile fuel pumps comprise a diaphragm which is rapidly flexed so that upon moving in one direction it sucks gasoline in from the car tank through an inlet valve and, when flexing in the opposite direction, forces the charge of gasoline out to the carburetor through an outlet valve. It is common practice to provide the inlet chamber and/or outlet chamber, or the common fuel chamber with a flexible pulsator diaphragm. Such diaphragm faces on one side into a sealed air dome or domes so as to flex with respect to such air domes as the pressure in the respective chambers pulsates with movement of the pumping diaphragm. The flexing of this pulsator diaphragm alternately rarifies and compresses the air in the respective air domes or in a single air dome and this has the effect of smoothing out the pumping pulses of the device. As a matter of fact, the effect is far more important than that since the compression within the air domes, in particular an outlet chamber air dome, provides the pressure which forces fuel to the carburetor from that chamber after the outlet valve has closed. Many designs of fuel pumps would not operate properly or even at all except for the accumulator action of the outlet chamber air dome. The inlet chamber air dome is believed to have a likewise beneficial effect in assisting the movement of fuel, both into and out of the inlet chamber.

For many years it has been found that the pulsator diaphragm becomes loose and causes leaking of fuel from the pump. In some instances, it may become so loose as to pull away from the surfaces between which it is clamped and may even rupture.

Wear and tear on pulsator diaphragms, over and above that expected, has remained a mystery for some time, particularly in instances where the apparent force acting on such diaphragms were such as to cause them to stretch far enough to impede the action of the valves by closing off the cavities in which the valves are located. This, of course, renders a pump inoperative.

After considerable investigation and experimentation, I have discovered that the fault is not due to the material of the pulsator diaphragm nor the normal function of it, the diaphragm, nor the mount structure, but to the fact that the air sealed between the pulsator and the air dome develops considerable heat causing it to expand and bulge the pulsator outwardly into the valve chambers. This causes an extreme stress whereat leakage, rupture, and actual blocking of fuel flow can and has occurred.

The invention herein eliminates this hazard by the expedient of providing valving for the pulsator diaphragm to relieve high air pressure formed in the air dome, the expanding air escaping to the fuel chamber. Such relief may be effected in various ways, for example, a simple form of valve in the diaphragm material effected by a needle hole has been discovered to be quite expedient. Other types of valving are disclosed herein. While valving the pulsator diaphragm appears to be the simplest solution to the problem, it is also believed that the air dome chamber cap could be valved for pressure relief as the air expands due to heat effected by rapid and repetitive molecular agitation as the pulsator diaphragm flexes. However, valving the air dome cap may have a drawback, in that fuel leaking past the pulsator diaphragm may escape the pump body. Accordingly, valving the pulsator diaphragm is preferred since it can be accomplished by a simple needle hole which remains normally closed but can be opened by air pressure build-up in the dome to effect relief.

A detailed description of the invention now follows in conjunction with the appended drawing, in which:

FIG. 1 is an elevation in cross section taken longitudinally through a conventional automobile fuel pump;

FIG. 2 is a section through another pump construction, shown fragmentarily and illustrating a modification of the invention; and

FIGS. 3 and 4 are views similar to FIG. 2 illustrating still other modifications of the invention.

Referring to FIG. 1, a fuel pump is illustrated having a conventional pump body **10** with the inlet chamber **13** and inlet valve **16**, wherein an inlet **20** leads to the inlet chamber. The pump has an outlet chamber **24**, an outlet valve **27**, and an outlet port **30**. Above the valves is the pump or fuel chamber **33** closed by a flexible diaphragm **36** of the usual construction and shown as clamped between backing plates in a conventional manner so as to be raised by the cam lever **39** via the rod **42** for a suction stroke, and pushed downwardly by the spring **45** for the pressure stroke. The inlet and outlet chambers are closed by a flexible diaphragm **50** clamped between the body member and an end cap **53** to thus form an air dome **56** for the inlet chamber and an air dome **60** for the outlet chamber. It will be understood that the end cap **53** is secured to the pump body as by bolting (not shown) and that the wall **63** divides the end cap into the chambers **56** and **60** while the wall **67** divides the pump body into inlet and outlet chambers **13** and **24**. The general constructon may be shown in the patent to J. F. Waldherr, Jr., 2,832,295, issued April 29, 1958.

The particularly novel features reside in providing a small puncture **65** in the diaphragm **50** for each of the valve chambers. The bore shown in FIG. 1 is exaggeratedly large for illustrative purposes and would actually be normally closed in the course of oscillatory flexing of portions of the diaphragms which lie over the respective air domes **56** and **60**. Such apertures can be formed by piercing the diaphragm with an ordinary sewing needle and the characteristics of the material, being essentially rubber, would tend to keep such aperture closed. However, should there be pressure build-up, due to heating of the air in the air domes, such pressure can be released through the apertures by leakage therethrough in an obvious manner. The apertures being exceedingly tiny, do not interfere with the proper operation of the diaphragm in compressing air within the air domes, particularly since the pressure conditions met are normally not so great as to force the apertures to open from the fuel chamber side. Conceivably, some leakage of gasoline might occur through the apertures into the air domes, but this is of very little consequence, since the amount is very small and would evaporate in the air domes, and the vapor thus be ultimately forced out by the repetitive flexing of the air dome as the apertures open upon excessive pressure build-up within the domes.

FIG. 2 illustrates a modification of a pump which is inverted in mounting positions as compared with the pump of FIG. 1. Thus, it will be understood in conjunction with FIG. 2 that the pump chamber **69** is the equivalent of the pump chamber **33**. In this instance, the chamber is closed by a pulsator **70** of flexible diaphragm material peripherally clamped to the pump body **73** by the end cap **76**. The pulsator **70** may be supported at its central

area by a support post **82** and the depressed center **76***a* of the end cap may be clamped against the diaphragm as by a bolt **83**. It will be understood that the support post **82** can be integral with the valve housing construction and extend upwardlly therefrom, being cast therewith in place of the wall **67** of FIG. 1. Thus, an air dome **84** of generally toroidal configuration is formed over the fuel chamber **69**. This is in contrast to separate air domes, such as **56**, **60**, for the valve chambers of FIG. 1.

The pulsator **70** has reversely acting check valves so that air can move under pressure from the air dome through the lips **90***a* or excess pressure of vapor in the pump chamber can move into the air dome via the lips **90***b*. The diaphragm is of molded construction and the venting lips are formed in a conventional manner so that they are normally closed but openable at a predetermined pressure in either respective direction. Thus, the slit, such as **90***c* formed by the lips is maintained closed by resiliency of the material and the length of such slit is not regarded as critical, it being believed that, in a practical pump, an opening of ⅛ of an inch, possibly even to an inch, would be usable. Also, the vertical height of the slit is not regarded as critical, although it will be recognized that the greater the height, the more resistance to opening will be afforded. Accordingly, a predetermined calibration for opening at a desired pressure can be achieved by designing any particular diaphragm so as to have a height of slit which will provide desired resistance to opening prior to a particular pressure being experienced. Thus, the resistance to opening may be different as between the two valves.

FIG. 3 shows an arrangement similar to FIG. 2 except that conventional spring pressed check valves **100** and **102** are utilized seating in reverse directions against respective ports **103** in the pulsator material **105**. In this instance, the pulsator is of flexible molded construction, as in FIG. 2.

In the form of the invention shown in FIG. 4, the pulsator **110** may be of molded material construction or it may be a simple flat disc cut from sheet material. In any event, the mounting and end cap construction is the same as in FIGS. 2 and 3, whereas the valving is a single puncture **115** similar to the puncture **65** of FIG. 1 and remaining normally closed but openable by pressure of heated air on the dome side or excess vapor pressure on the fuel chamber side.

Having thus described the invention, it is realized that changes may be made without departing from the spirit thereof and, therefore, it is not desired that the invention be limited to the precise illustration herein given, except as set forth in the following claims.

What is claimed is:

1. A fuel pump comprising a body member having valves and a pump chambers with an actuatable pumping means therein, and an end closure for said body member, a flexible pulsator element intermediate said end closure and said body member and substantially isolating said end closure from said body member wherein said end closure thus effecting an air dome for said pump, said pulsator element having a normally closed port therethrough adapted to open in response to excess pressure in said end closure beyond normal operational limits to vent said excess pressure into said pump body.

2. In a pump as set forth in claim **1**, said port comprising a puncture in said pulsator element wherein said pulsator element is of rubber-like material normally effecting closure of said puncture except when subjected to said excess pressure.

3. In a pump as set forth in claim **2**, said pulsator element being normally a flat disc of rubber-like material.

4. In a pump as set forth in claim **1**, said pulsator element comprising a molded diaphragm of rubber-like material, said port comprising a slit therethrough and formed by lips contiguous with each other so as to normally maintain closure of said slit.

5. In a pump as set forth in claim **1**, said port having a check valve normally effecting closure thereof.

6. In a pump as set forth in claim **1**, said pulsator element having an additional port and a one-way valve closure therefor whereby excess pressure fluid in said pump body may vent into said air dome.

7. In a pump as set forth in claim **1**, said pump body having a support post extending toward said pulsator element for support of the central area thereof, said end closure having a centrally depressed portion engageable with the central portion of said pulsator element, fastening means for clamping said end closure at said central portion to said support post with the central portion of said pulsator element clamped therebetween.

8. In a pump as set forth in claim **1**, said end closure comprising a bulblessly formed toroidal shaped member having an indented central portion, said pulsator element being in the form of a ring having a central aperture registrable with said indented portion of said end closure, and means for effecting clamping at the engaged portions thereof.

9. In a pump as set forth in claim **8**, said means comprising a post within said pump chamber and extending toward said central portions of said end closure and said pulsator element, and fastening means securing said engaged central portions to said post to effect clamping of said central portions.

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