

April 5, 1960

R. E. ULM ET AL

2,931,311

DIAPHRAGM FOR FUEL PUMP

Filed April 20, 1955

FIG. 1.

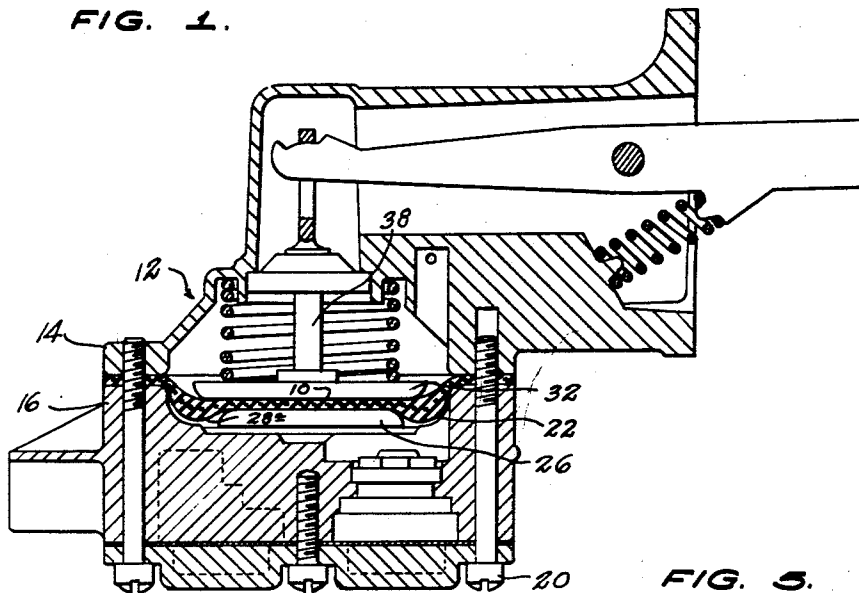


FIG. 2.

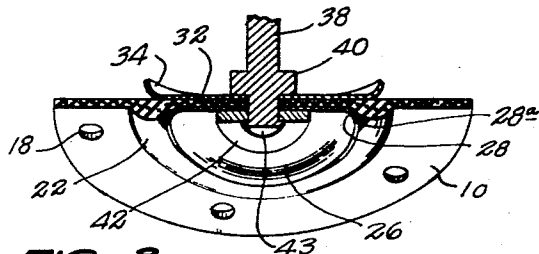


FIG. 3.

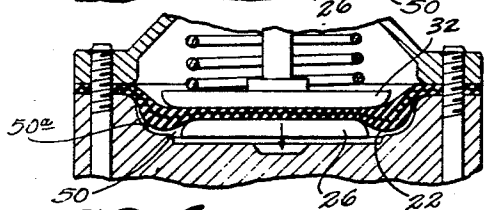
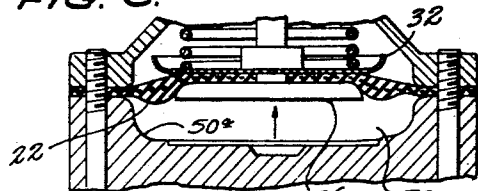


FIG. 4.

FIG. 5.

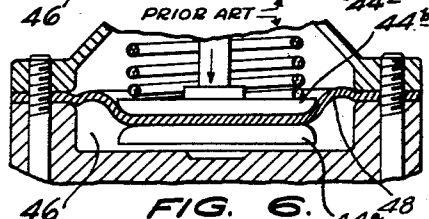
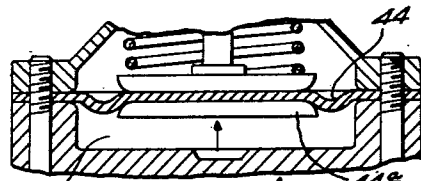
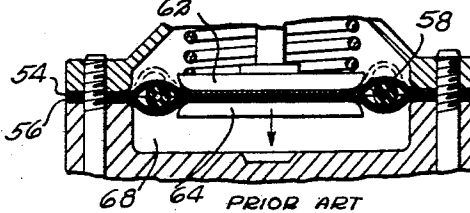


FIG. 6.

FIG. 7.



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DIAPHRAGM FOR FUEL PUMP

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Application April 20, 1955, Serial No. 502,652

4 Claims. (Cl. 103—150)

This invention relates to fuel pumps for gasoline as used in internal combustion engines, and more particularly to the diaphragm element of such pumps.

The present invention is an improvement in pump diaphragms over that shown in Porter Patent #2,658,526, owned by the assignee of the present applicants, and is likewise an improvement over other prior art diaphragms.

We have found as a general proposition that there is a loss of efficiency in pump diaphragms due to the fact that they change contour in the course of pumping motion. Thus, on a suction stroke, prior art diaphragms tend to balloon into the fluid being drawn into the pump chamber. This substantially decreases the amount of fluid drawn into the chamber and accordingly adversely affects the quantity of fluid which can be supplied by the pump. Further, the construction of prior art diaphragms, which are conventionally sandwiched between metal reinforcing discs, is such that on the pressure stroke considerable working area of the diaphragm was lost due to the reverse ballooning caused by the pressure of the fluid in the chamber. In other words, diaphragms of the prior art are not capable of giving substantially full piston area motion on pressure strokes. Accordingly, a loss of efficiency results.

In view of these drawbacks of prior art arrangements, it is an object of our invention to provide a pump diaphragm which will not balloon either on suction or compression strokes.

It is another object of our invention to provide a pump diaphragm which will be rugged and of one piece molded construction.

It is a further object of our invention to provide a pump diaphragm of long-lasting quality and one which will stand up well under severe high speed use.

Briefly, our invention comprises the use of a molded rubber diaphragm, preferably having internal textile reinforcing strands, wherein one face of such diaphragm is provided with an integrally molded rib. The diaphragm is used in conjunction with a pair of reinforcing plates, one plate substantially filling the area inside the concentric rib and being located on one face of the diaphragm. The other plate is located on the side of the diaphragm opposite the rib and is of such diameter as to extend beyond the inner diameter of the rib so as to provide support for the diaphragm for a predetermined annular area below the rib. Due to the presence of the rib the diaphragm is effectively prevented from ballooning on a suction stroke. Further, due to the presence of the somewhat enlarged disc on the opposite side of the diaphragm, substantially larger piston area on the pressure stroke is provided because the diaphragm is prevented from being flexed reversely by the pressure in the fluid as such pressure is built up in the pump chamber.

A detailed description of our invention will now be given in conjunction with the appended drawing, in which:

Fig. 1 is an elevation in section of a generally conventional fuel pump incorporating our novel diaphragm.

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Fig. 2 is a perspective in section showing the components of our diaphragm.

Figs. 3 and 4 show positions of our diaphragm for suction and pressure strokes, respectively.

5 Figs. 5 and 6 show the same positions for a conventional prior art diaphragm, while

Fig. 7 shows a diaphragm of the type disclosed in Porter Patent #2,658,526, as mentioned above.

Referring now to Figs. 1 through 4:

10 The invention comprises a diaphragm 10 as used in a fuel pump 12, being clamped between upper and lower body portions 14 and 16 in a conventional manner.

The diaphragm 10 is provided with a series of perforations 18 through which the bolts 20 pass.

15 On one surface of the diaphragm 10 there is provided an integrally molded rib 22. Preferably the diaphragm is of rubber or other suitable flexible composition as heretofore known and used in this art, and preferably of the type having embedded fibre reinforcing.

20 Disposed within the hollow effected by the rib 22 is a reinforcing plate 26 which is substantially of the same diameter as the inner diameter of the rib and has a curved flange 28 which is smoothly engageable with the curved surface 28a of the rib. On the opposite side of the diaphragm is a somewhat enlarged reinforcing plate 32 having a curved peripheral rim 34. It will be noted that the plate 32 is larger than the plate 26 and extends beyond the area of rib 22. The actuating rod 38 passes through suitable bores in the reinforcing plates and diaphragm and by virtue of the flange 40 and the washer 42 the plates and diaphragm are suitably sandwiched at their central portions by swaging of the end of the rod at 43.

By reference to Fig. 3, it will be noted that on the suction stroke no ballooning of the diaphragm takes place as would occur, for example, in the prior art arrangement of Fig. 5. Thus, in Fig. 5, ballooning of an ordinary diaphragm is indicated by the valley 44 which forms around the lower reinforcement plate 44a owing to a lowering of pressure in chamber 46.

40 By reference to Fig. 4, it will be noted that on the pressure stroke our novel diaphragm is fully supported by the plate 32 so that it cannot reversely balloon. Note, however, the prior art construction shown in Fig. 6, wherein the crest 48 occurs around the upper plate 44b due to pressure in the chamber 46, plates 44a and 44b being of equal diameter.

Thus, on the suction stroke in our novel construction, the complete volume of chamber 50 is filled without any undue turbulence or forming of bubbles while on the pressure stroke is substantially completely exhausted. As shown in Fig. 4, by virtue of our rib construction it is possible to utilize a chamber such as 50 having no waste space. The convexly contoured diaphragm rib 22 comes very close to meeting the complementarily shaped concave wall ledge 50a of the chamber at the end of its stroke, due regard being had, of course, for some clearance to prevent actual engagement with the wall. This is advantageous since it minimizes the amount of fluid which would be trapped in the chamber and be worked upon with each stroke without, however, actually being forced out for use in the engine. Thus, turbulence and fluid frictional losses are minimized. Comparison should be had with Fig. 6 wherein it will be seen that a considerable volume of the chamber remains unexhausted at the end of the pressure stroke. The unexhausted portion of the chamber is merely a trap for fluid which is being constantly compressed and decompressed without any useful effect thereby due to crest 48 formed by pressure on the diaphragm.

70 Particular attention is now drawn to Fig. 7 showing the general construction of the prior art patent owned by the present assignee.

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In this instance the diaphragm is comprised of two laminations 54 and 56 and a rib on both sides of the diaphragm is effected by means of a resilient toroidal element 58 sandwiched between the diaphragm elements. The plates 62 and 64 are of equal diameter. It has been found that on the pressure stroke the reverse ballooning effect as indicated by dotted lines is considerable, resulting in inefficient operation since the full capacity of the chamber 68 is not exhausted due to the fact that plate 62 cannot be extended without interfering with the rib. Our present invention overcomes this difficulty by virtue of the enlarged reinforcement plate 32 backing up the area behind the integrally molded rib 22. Thus, it is not possible for the rib to balloon reversely since it is actually pushed toward the end of the chamber by plate 32. Further simplicity of construction results in the use of the single integral rib as compared with a composite laminated arrangement.

We are aware that various changes can be made in the invention herein and accordingly we do not seek to be limited to the precise illustration except as set forth in the appended claims.

We claim:

1. In a diaphragm pump comprised of a single disc of flexible material, an integral rib concentrically disposed on one side thereof, including a reinforcement plate on the side of said diaphragm opposite to that on which the rib is disposed and being secured to said diaphragm; said reinforcing plate having a diameter larger than the inner diameter of said rib, but less than the outer diameter of said rib, including an additional reinforcement plate on the same side of said diaphragm as said rib and disposed within the confines of said rib, said additional reinforcing plate having a diameter substantially equal to the inner diameter of said rib, said opposite side of said diaphragm being substantially planar, including the portion thereof opposite said rib.

2. In a diaphragm pump, a pump diaphragm comprising a flexible disc, a solid concentric rib integrally molded on one surface thereof, said rib being arcuate in cross-section, a reinforcing plate secured against said diaphragm within the confines of said rib and having a curved flange engageable with said rib on a suction stroke, a second reinforcing plate secured to said diaphragm on the opposite side thereof and having an area exceeding the area of said first reinforcing plate so as to extend substantially into the area behind said rib to force said rib on a pressure stroke into fluid being pumped, said opposite side of said diaphragm being substantially planar, including the portion thereof opposite said rib.

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3. A pump body having a chamber and a pump diaphragm reciprocal therein; a ledge in said chamber extending substantially therearound in a plane normal to the direction of reciprocation of said diaphragm, said diaphragm comprising an integral solid rib on one surface thereof facing said ledge and being substantially planar on its opposite surface including the portion thereof opposite said rib, a reinforcing plate secured to said diaphragm on the opposite surface thereof and having an area in excess of that part of the diaphragm area which is demarcated by the inner perimeter of said rib so as to force the ribbed area of said area toward said ledge during a pressure stroke, said rib being of generally convex cross-sectional contour and said ledge being of generally concave cross-sectional contour, said rib having a solid volume sufficient to substantially fill said chamber at the end of said pressure stroke by fitting substantially into the concave contour of said ledge at that time.

4. In a pump, a housing comprising a pump chamber, said chamber being closed at one end with a reciprocal flexible diaphragm, said diaphragm having an integral solid rib protruding from one surface thereof and extending circularly about the axis of reciprocation of said diaphragm, said rib protruding into said chamber, a ledge extending circuitously about said chamber, said rib and ledge having complementary cross-sections whereby said rib may closely approach said ledge at the end of a pressure stroke to minimize volume in said chamber, a reinforcing plate secured to said diaphragm on the chamber side thereof and extending across said plate up to the inner periphery of said rib, a second reinforcing plate on the other side of said diaphragm and secured thereto and being larger than said first-mentioned plate so as to cover an area of said side of the diaphragm between the inner and outer periphery of said rib, said other side of said diaphragm being substantially planar, including the portion thereof opposite said rib.

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