Jan. 23, 1968 C. QUATREDENIERS ETAL 3,364,870

DIAPHRAGM PUMPS

Filed Feb. 21, 1966 4 Sheets-Sheet 1

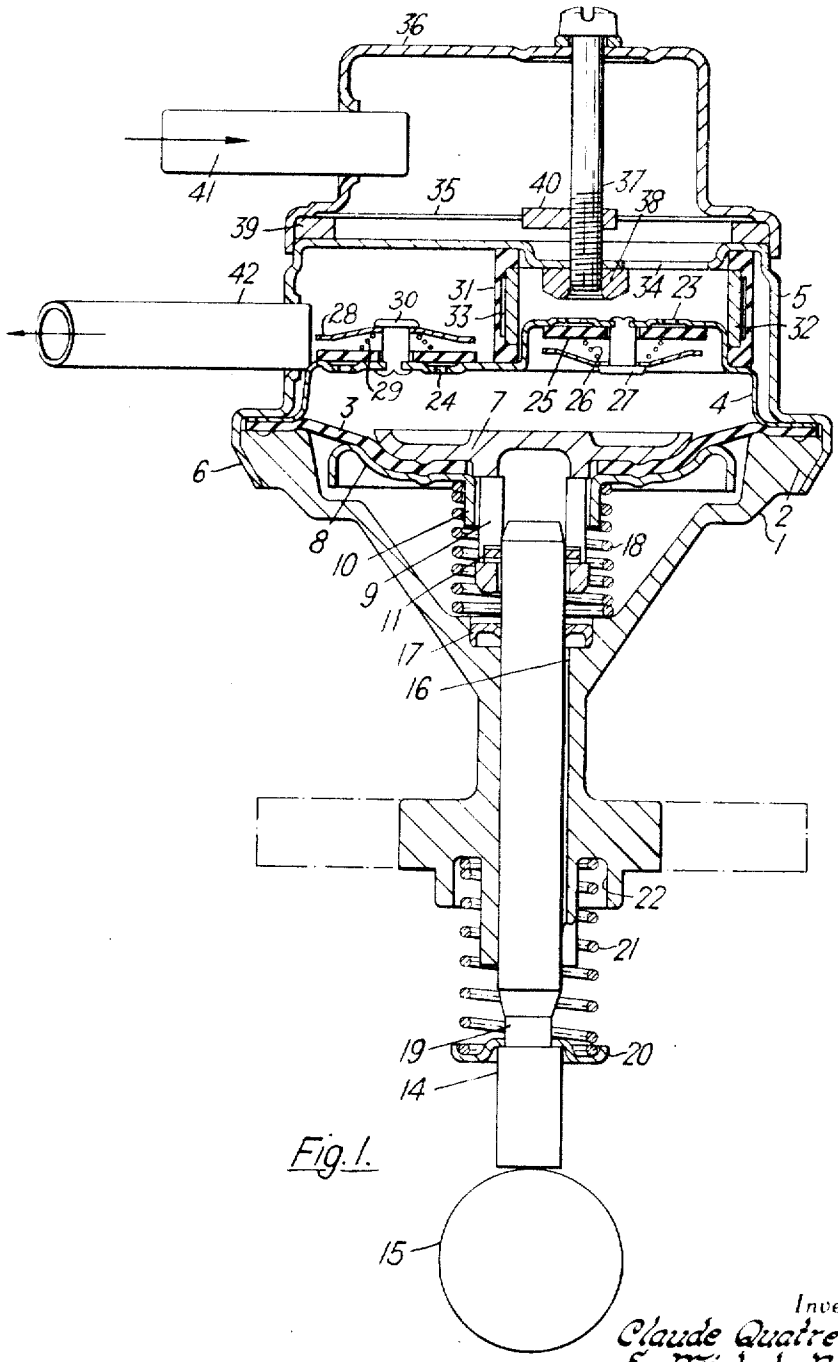


Fig. 1.

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DIAPHRAGM PUMPS

Filed Feb. 21, 1966 4 Sheets-Sheet 2

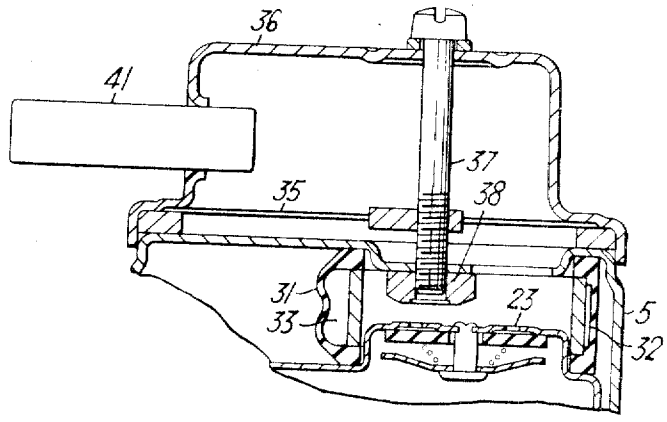


Fig. 2.

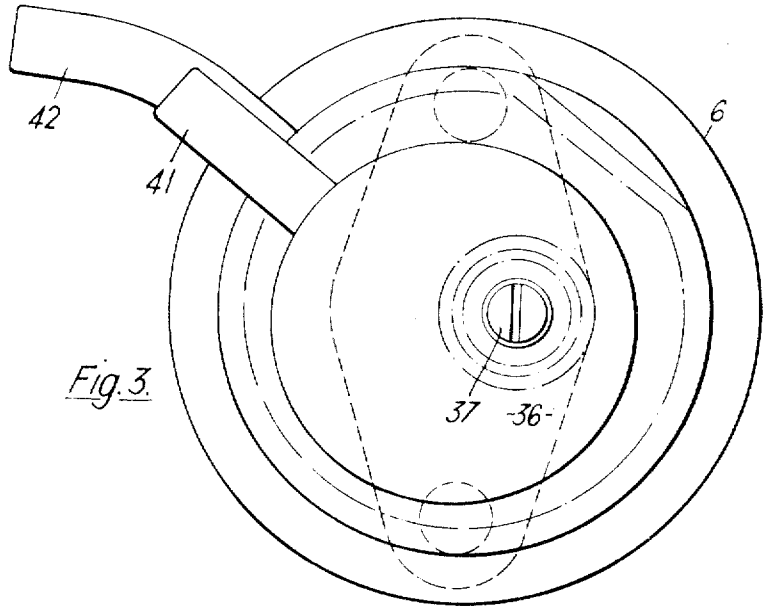


Fig. 3.

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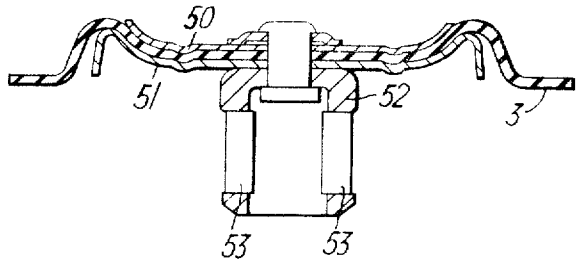


Fig. 4.

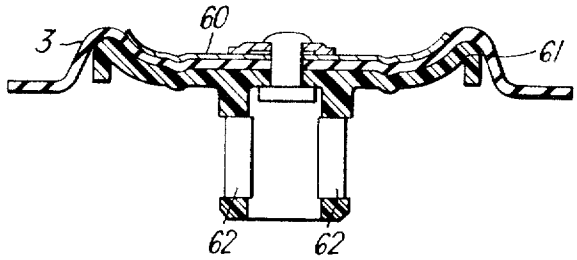


Fig. 5.



Fig. 6.

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DIAPHRAGM PUMPS

Filed Feb. 21, 1966 4 Sheets-Sheet 4

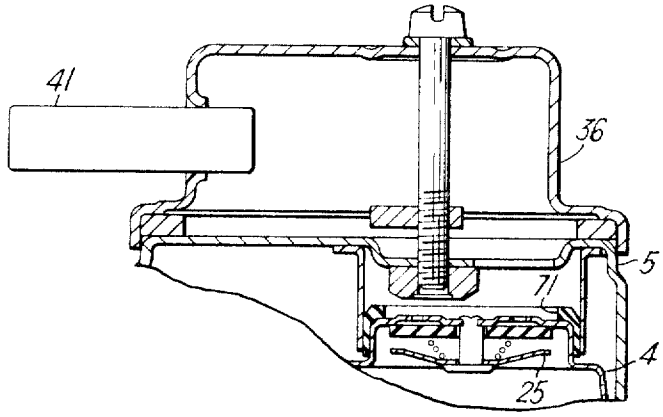


Fig. 7.

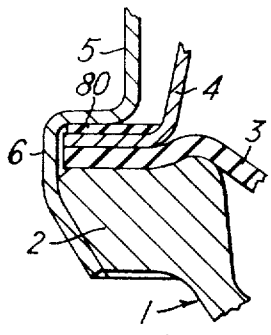


Fig. 8.

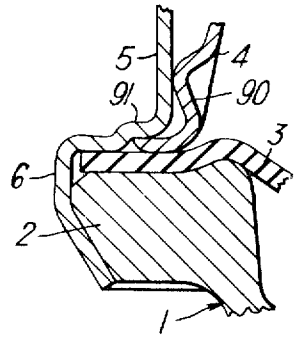


Fig. 9.

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United States Patent Office 3,364,870 Patented Jan. 23, 1968

3,364,870

DIAPHRAGM PUMPS

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Filed Feb. 21, 1966, Ser. No. 529,044
Claims priority, application Great Britain, Mar. 25, 1965, 12,644/65
2 Claims. (Cl. 103—150)

ABSTRACT OF THE DISCLOSURE

A diaphragm fuel pump in which two coaxial sleeves surround a pressure actuated inlet valve to define at least one pulsator chamber between the sleeve walls for favorably affecting pump discharge.

This invention relates to diaphragm pumps and in particular to diaphragm pumps such as are commonly used as fuel pumps for internal combustion engines.

A diaphragm pump according to the invention has a flexible diaphragm the periphery of which is pressed into sealing engagement with a seat in a pump body by means of a valve and seat plate assembly, shaped from sheet material, the periphery of which is pressed into sealing contact with the diaphragm by a peripheral flange of a pressed sheet metal cover which is crimped over the pump body adjacent the seat therein.

The valve and seat plate assembly comprises a valve seat plate with inlet and outlet valve ports controlled by movable valve members which are engageable with valve seats on the plate; and a sleeve extends around one of said valves, preferably the inlet valve, and is sealed at opposite ends to said cover and said seat plate to divide the space therebetween into an inlet and an outlet chamber. The sleeve may be of resilient material the ends of which are clamped between the cover and the seat plate; or a metal sleeve may be used, one end thereof being welded to the cover and the other end being press-fitted on to a boss which extends around the valve, a seal ring being interposed between the sleeve and boss.

The pump cover preferably has an opening therein which is in communication with the inlet chamber, and a filter screen is preferably secured over said opening by means of a cap which is secured to the cover.

Conveniently the filter screen has a peripheral gasket and also a central gasket, the latter being a sliding fit on a bolt which extends through the cap and said central gasket and is secured in a nut fixed to the pump cover so that the cap can be tightened into sealing contact with the cover, the peripheral gasket being clamped between the cap and cover.

The sleeve, if of resilient material, may be formed at opposite ends with integral inwardly directed flanges which are clamped over opposite ends of a sleeve of rigid material arranged within the resilient sleeve, the body of the resilient sleeve being formed so as to provide between the outer periphery of the rigid sleeve and the inner periphery of the resilient sleeve a plurality of air pockets which, when the pump is in operation act as pulsator chambers or cells and stabilize the discharge pressure of the pump.

The pump diaphragm is preferably pre-moulded and is clamped between a pair of press-fitted cup members either or both of which may be formed of a synthetic plastics material resistant to hydrocarbon fuels.

The diaphragm is preferably arranged for reciprocation by a push rod which is slidably mounted in a bore in the pump body, one end of the rod being adapted to engage one of said cup members and the other end being adapted to be engaged by a rotary cam on the engine to which the pump is fitted.

Reference will now be made to the accompanying informal drawings which illustrate a preferred embodiment of the invention and in which:

FIGURE 1 is a vertical section through a diaphragm pump according to the invention intended for use as a fuel pump for an internal combustion engine;

FIGURE 2 is a vertical section of a detail of FIGURE 3;

FIGURE 3 is a plan of FIGURE 1;

FIGURE 4 is a vertical section through a modified diaphragm **3** clamped therebetween. The upper plate **7**

FIGURE 5 is a vertical section through a further modification of the diaphragm assembly of the pump;

FIGURE 6 is a perspective view of the assembly which constitutes one form of the pulsator in the pump;

FIGURE 7 is a vertical section through part of a modification of the pump shown in FIGURE 1;

FIGURE 8 is a vertical section of a detail of the seal between the pump body and cover; and

FIGURE 9 is a modification of the construction shown in FIGURE 8.

The diaphragm pump shown in FIGURES 1 and 2 comprises a pump body **1** (which may be of metal or a synthetic plastics material), in the upper part of which is an annular seat **2** against which is pressed the peripheral portion of a flexible diaphragm **3**, the periphery of the diaphragm being engaged by the peripheral portion of a valve and seat plate assembly **4** which in turn is engaged by the peripheral portion of a pump cover **5** which is pressed against the superimposed peripheral portions of the seat plate **4** and diaphragm **3** and is crimped over the pump body adjacent the seat **3**, as shown at **6**.

The diaphragm **3** is preferably pre-moulded and is clamped at its central portion between an upper and a lower plate **7**, **8** respectively having integral therewith central tubular portions **9**, **10** which are press-fitted together so as to secure the plates **7** and **8** together with the diaphragm **3** clamped therebetween. The upper plate **7** may be a plastics moulding resistant to hydrocarbon fuels.

The tubular portion **9** of the upper plate **7** has a longitudinal slot therein extending at diametrically opposed points on the wall of the cylindrical portion and in the slot is slidably engaged a pin **11** which transfixes the upper end of a reciprocatory push-rod **14** the lower end of which is adapted to be engaged by a rotary cam **15**. The push-rod **14** is slidably mounted in a bore in the pump body **1**, the bore being provided with one or more longitudinal grooves **16** to facilitate the entry of lubricant between the push-rod **14** and the bore in the housing **1**.

A seal ring **17** is mounted on the upper end of the push-rod **14** and is seated in an annular groove in the pump body **1** adjacent the upper end of the bore in which the push-rod **14** is mounted. The seal ring prevents leakage of lubricant or other liquid along the push-rod **17**.

A helical spring **18** is seated at one end on the lower clamp plate **8** around the tubular portion **10** thereof and at its other end against an annular seat formed in the pump body **1** adjacent the seat for the seal ring **17**. The spring is arranged so as normally to press the diaphragm **3** upwardly, that is, in a direction to complete a discharge stroke.

Fitted on a reduced diameter portion **19** of the lower end of the push-rod **14** is an annular ring **20**, of trough section, which forms an abutment for one end of a helical spring **21** the upper end of which is seated in an annular seat **22** formed in the lower part of the pump body **1**. The spring **21** is arranged so as normally to press the push-rod **14** into engagement with the cam **15**.

The valve and seat assembly **4** comprises a seat plate,

preferably made as a sheet metal stamping, which has therein inlet openings **23** and outlet openings **24**. A valve disc **25** overlies the inlet openings **23** and is pressed into engagement with a valve seat on the seat plate **4** by means of a coil spring **26** one end of which engages the valve disc **25** and the other end of which engages under the heat of a rivet **27** which is riveted over on to the other side of the seat plate **4**.

Similarly a valve disc **28** overlies the outlet openings **24** and is pressed into engagement with a valve seat on the seat plate **4** (on the opposite side thereof to the inlet valve disc) by means of a helical spring **29** one end of which engages the valve disc **28** and the other end of which engages under the head of a rivet **30** the end of which is riveted over on to the other side of the seat plate **4**.

The portion of the seat plate **4** on which the inlet valve **25** is mounted is of inverted cup shape and forms a seat for one end of a sleeve **31** of resilient material such as rubber, the other end of which is engaged by the cover **5**. The ends of the sleeve **31** engage opposite ends of a rigid sleeve **32** so that the ends of the resilient sleeve **31** are clamped against the ends of the rigid sleeve **32** by the cover **5** and the seat plate **4**.

The resilient sleeve **31** is formed with bulges, as shown in FIGURES 2 and 6 so as to provide between the facing walls of it and the rigid sleeve **32** one or more cells **33** in which air is trapped by the sealing of the ends of the sleeve **31** against the ends of the rigid sleeve **32**. The space within the rigid sleeve **32** constitutes an inlet chamber which is separated by the sleeves **31**, **32** from the remainder of the space, constituting the outlet chamber of the pump, between the cover **5** and the seat plate **4**.

The cover **5** has therein an opening **34** overlying the inlet valve **25**; and a filter disc **35** overlies the opening **34** and is secured to the top of the cover by means of a cap **36** which is secured to the cover **5** by a bolt **37** which engages in a nut **38** secured to the cover **5**. The filter disc **35** has a peripheral gasket **39** which is clamped between the cap **36** and the cover **5** and also has a central gasket **40** which is a sealing fit over the bolt **37**.

An inlet pipe **41** is secured in the cap **36** and an outlet pipe **42** is secured in the cover **5**, the inlet and outlet pipes respectively communicating with the inlet and outlet chambers of the pump.

In the modification of the invention shown in FIGURE 4 the diaphragm **3** is clamped between upper and lower plates **50**, **51**, the assembly of the diaphragm and the plates being secured together and to a tubular member **52** having therein diametrically opposed slots **53** to receive the ends of the pin **11**.

In the modification shown in FIGURE 5 the upper clamp plate **60** is riveted to a lower clamp plate **61** so as to secure therebetween the diaphragm **3**, the lower clamp plate **61** being made of plastics material and having an integral central tubular portion with diametrically opposed slots **62** therein in which can be engaged the ends of the cross-pin **11**.

In operation, rotation of the cam **15** will effect vertical reciprocation of the push-rod **14** so as to reciprocate the pump diaphragm **3**, liquid fuel entering by way of the inlet pipe **41** and then passing through the space within the cap **36**, through the filter **35**, the inlet opening **34** and through the inlet valve **25** to the space below the seat plate **4** and then, during the movement of the diaphragm in the opposite direction passing by way of the outlet valve **28** to the outlet chamber and then through the outlet pipe **42**.

The air cells **33** in the outlet chamber of the pump damp the pulsations resulting from pressure changes during operation of the pump and thus act to stabilise the pump output pressure and increase the flow rate of the pump.

The axial length of the slots in which the pin **11** is movable is arranged so as to permit reciprocation of the push-rod **14** when the pump is under shut-off pressure.

In the modification shown in FIGURE 7 the sleeve assembly **31**, **32** is replaced by a rigid tubular metal sleeve **70** which is welded at its upper end to the cover **5** and the lower end of which is press-fitted onto the cup-shaped seat formed on the seat plate **4** around the inlet valve **25**, an annular gasket **71** being interposed between the sleeve **70** and the cup-shaped seat on the seat plate **4**.

FIGURE 8 shows a method of ensuring a fluid tight seal between the cover **5**, seat plate **4**, diaphragm **3** and pump body **1**, in which an annular gasket **80** is interposed between the crimped over edge **6** of the cover **5** and the edge of the seat plate **4**, the seal between the seat plate **4** and the seat **2** on the pump body **1** being formed by the peripheral portion of the diaphragm **3** which is also clamped with the gasket **80** and seat plate **4** by the crimped over portion of the cover **5**.

An alternative construction for ensuring the seal between the cover **5**, seat plate **4**, diaphragm **3** and pump body **1** is shown in FIGURE 9, the seat plate **4** in this construction being formed with an annular bead **90** which abuts the cover **5** and the latter also being formed with an annular shoulder **91** which engages the peripheral edge of the seat plate **4** below the bead **90** so as to press the latter into sealing contact with the peripheral portion of the diaphragm **3** overlying the seat **2** of the body **1**. The crimped over portion **6** of the cover **5** in addition to ensuring such sealing contact between the seat plate **4** and diaphragm **3** also clamps the extreme outer peripheral portion of the diaphragm **3** into sealing contact between the cover **5** and the seat **2**.

We claim:

1. A diaphragm pump having a body and a flexible diaphragm the periphery of the latter being pressed into sealing engagement with a seat on said pump body by means of a valve and seat plate assembly shaped from sheet material, a sheet metal cover retaining said diaphragm periphery and valve and seat plate assembly in position on said pump body, inlet and outlet valves mounted on said valve and seat plate assembly, a resilient sleeve extending around one of said valves and dividing space defined between said cover and valve plate into an inlet and an outlet chamber, a rigid sleeve arranged within the said resilient sleeve, and said sleeves cooperating to define at least one air pocket between their facing walls, and said air pocket being adapted to act as a pulsator chamber.

2. A pump having a valve and seat plate assembly supporting inlet and outlet valves, a cover cooperating with said seat plate assembly to define inlet and outlet chambers, a pump body, a pumping diaphragm, the latter being interposed between said pump body and said seat plate assembly to define a pumping chamber, two sleeves with coaxial facing walls surrounding one of said valves and separating said inlet and outlet chambers, one of said sleeves being yieldable to a greater extent than the other and at least one air pocket being defined between the said facing walls of said sleeves.

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WILLIAM L. FREEH, *Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,364,870 January 23, 1968

Claude Quatredeniers et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 14, for "diaphragm 3 clamped therebetween. The upper plate 7" read -- diaphragm assembly of the pump; --.

Signed and sealed this 18th day of March 1969.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

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Commissioner of Patents

UNITED STATES PATENT OFFICE

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