July 14, 1959 A. D. McDUFFIE 2,894,459

FUEL PUMP

Filed Jan. 4, 1957 2 Sheets-Sheet 1

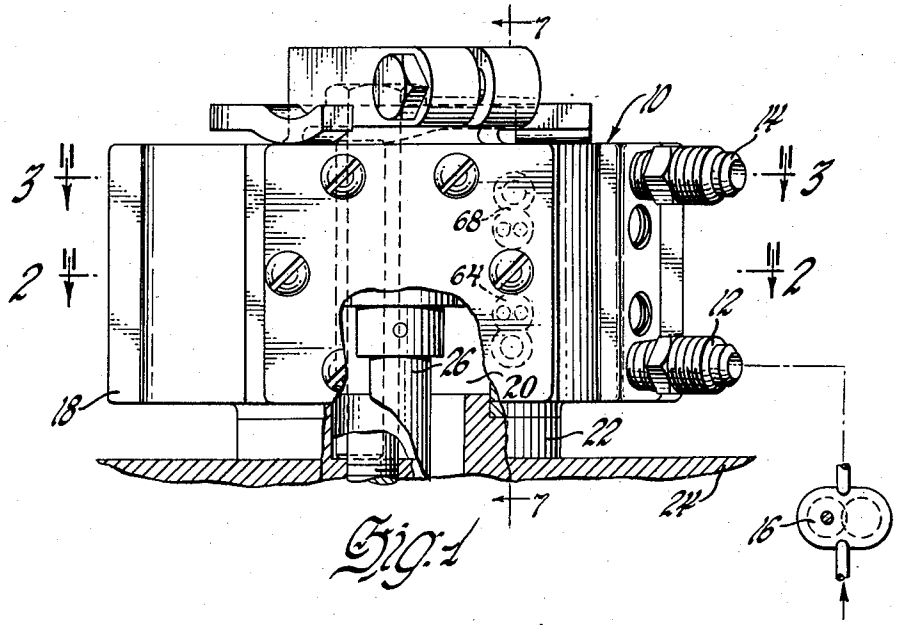


Fig. 1

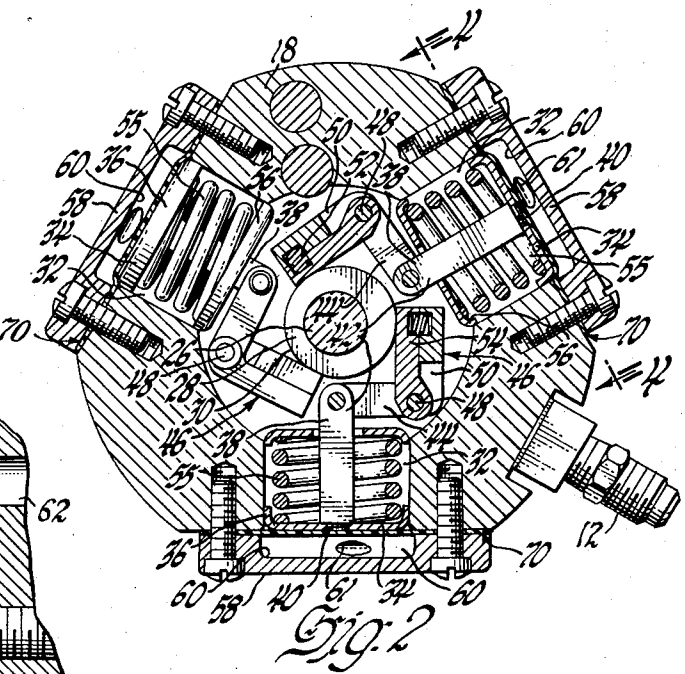


Fig. 2

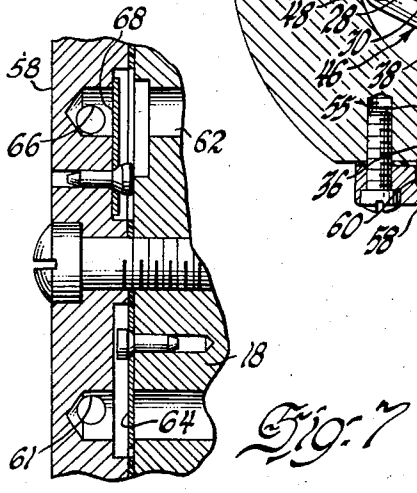


Fig. 7

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FUEL PUMP

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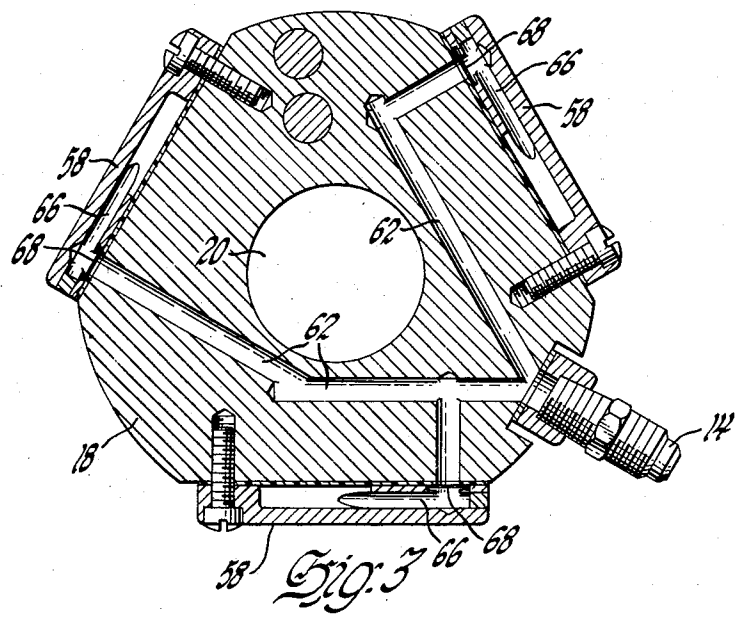


Fig. 3

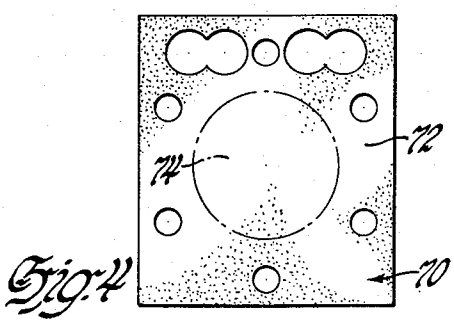


Fig. 4

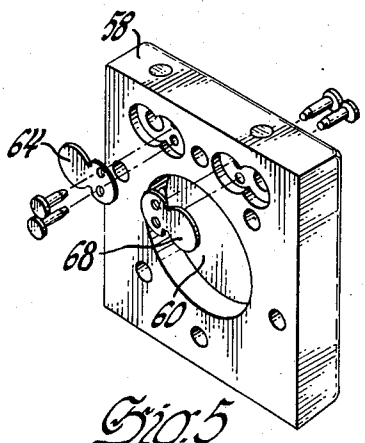


Fig. 5

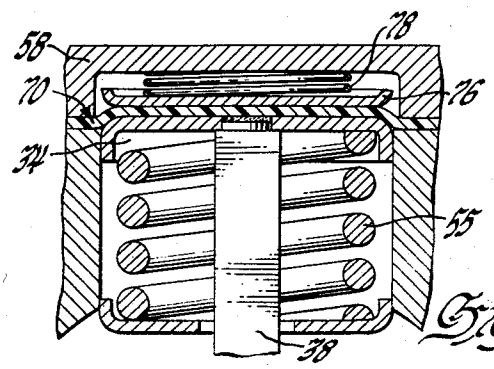


Fig. 6

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FUEL PUMP

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Application January 4, 1957, Serial No. 632,472

1 Claim. (Cl. 103—150)

The present invention relates to pumps and more particularly to fuel pumps.

In the operation of an internal combustion engine of the spark ignited variety, the combustible charge of air and fuel may be formed by injecting atomized fuel into the charge by means of a pressurized fuel system that includes metering means responsive to the fuel demands of the engine and effective to meter the fuel in proportion thereto. Such a system is disclosed and claimed in copending applications Serial No. 634,915, filed January 18, 1957 and Serial No. 671,933, filed July 15, 1957. Satisfactory operation of such a system is dependent upon the fuel being pumped thereto in sufficient quantity and under adequate pressure to insure proper action of all of the elements in the system. In addition, the pressure should be substantially constant and free from pulsations. Although there are numerous pumps that are suitable for this type of service they are expensive and troublesome in operation and generally not well adapted for use in automotive vehicles.

Due to their simplicity and economy diaphragm type pumps are desirable. However, heretofore, such pumps have employed a pliable member or diaphragm that has the center thereof clamped between a pair of backing plates riveted together and reciprocably driven to produce the pumping action. Although such pumps are adequate at low pressures, at high pressures the perforations in the diaphragm resulting from the riveting frequently produce leaks. This is particularly true when pumping a fuel such as gasoline.

It is therefore proposed to provide an economical and reliable diaphragm pump that is adapted to pump fuels at a substantially constant pressure output free from objectionable pulsations. More particularly, this is to be accomplished by providing a plurality of diaphragm cells that draw fuel from a common source and discharge the fuel through a common outlet. Each cell includes an imperforate diaphragm draped over a reciprocating member or backing plate biased by a spring having the desired tension. The diaphragm is retained against the backing plate by the pressure of the fuel or, if necessary, by a second backing plate and spring that are disposed inside of the pumping chamber for biasing the diaphragm against the first backing plate. Since the diaphragm is free of any perforations there will be a hermetical seal that is free of leakage. Each of the several cells produces a substantially constant pressure and if they are properly phased, at least one cell will always be discharging and thus maintaining the pressure.

In the two sheets of drawings:

Figure 1 is a side view, with a portion thereof broken away, of a pump embodying the present invention.

Figure 2 is a cross-sectional view taken substantially along the plane of line 2—2 in Figure 1.

Figure 3 is a cross-sectional view of the pump housing taken substantially along the plane of line 3—3 in Figure 1.

Figure 4 is a plan view of a cover for one of the cells

taken substantially along the plane of line 4—4 in Figure 2.

Figure 5 is an exploded perspective of the cover in Figure 4 and the valves therefor.

Figure 6 is a fragmentary cross-sectional view similar to Figure 2 but of a modification.

Figure 7 is a fragmentary view along line 7—7 of Figure 1.

Referring to the drawings in more detail, the present invention is embodied in a pump **10** having an inlet **12** that is adapted to be interconnected with a source of fuel and an outlet **14** that is adapted to discharge the fuel under pressure therefrom. It has been found desirable for the source of fuel to include a transfer pump **16** that will supply the fuel in large quantities and under a lower pressure. The outlet **14** of the pump may be connected to a fuel system such as that disclosed in the above-identified applications.

The pump **10** includes a cylindrical housing **18** having a passage **20** extending axially through the center thereof. The lower end of the housing forms a base **22** that is adapted to be mounted on an engine **24** so that a driveshaft **26** may extend downwardly through the passage **20** and be driven by a suitable source of power such as the engine crankshaft or the camshaft. The center of the driveshaft **26** includes an eccentric **28** having a working surface **30** on the exterior thereof.

A plurality of enlarged bores **32**, three in the present instance, are radially disposed about the axial passage **20** so as to form three separate pumping cells. Each of the cells includes a backing plate **34** which is reciprocably disposed in the bore **32**. Each plate **34** has a flat end and a rolled collar **36** therearound that is a close fit inside of the bore **32**. Each of these backing plates **34** is reciprocably driven by means of a pin **38** that has the upper end **40** thereof riveted to the plate **34** substantially flush therewith while the lower end **42** thereof is attached to one arm **44** of a bell crank **46**. The bell crank **46** pivots about a stationary pin **48** so that the other arm **50** thereof engages the working surface **30** of the eccentric **28**. The latter arm preferably is bifurcated to provide a lost motion means comprising a spring **52** disposed intermediate the arm and a shoe **54** whereby the shoe will always be kept in contact with the eccentric **28** thereby preventing undue wear of the parts as would occur with intermittent engagement between the arm and the eccentric.

A coil spring **55** is disposed in each bore **32** so as to be supported by a seat **56** pressed into the inner end of the bore **32**. The other end of the spring **55** engages the inside of the backing plate **34** and urges it radially outwardly. It may be seen that when the spring **55** urges the backing plate **34** outwardly, it will tend to retain the arm **50** against the eccentric and rotation of the eccentric **28** will produce a reciprocating motion or a pumping action in the backing plate **34**.

As best seen in Figures 2, 5 and 7, in order to form a pumping cell a cover plate **58** is secured over the outer end of each bore **32** by cap screws. Each cover plate **58** has a recessed center portion **60** registering with the bore **32**. An inlet passage **61** in each cover **58** communicates with an intake or supply manifold in the housing **18** and has an intake valve **64** therein. In addition, an outlet passage **66** is provided which includes an outlet valve **68** and discharges into a high pressure outlet manifold **62**.

In order to seal the pumping chamber a diaphragm **70** is provided so that the periphery **72** thereof is clamped and sealed between the cover **58** and the side of the housing **18**. The center portion **74** is merely draped over the end of the backing plate **34** and since there is not a second backing plate riveted to the first plate, there are no troublesome perforations in the center portion **74**. By

supplying the fuel to the pumping chamber under a slight pressure, for example, by a transfer pump **16**, the diaphragm **70** will be retained against the backing plate.

Normally the fuel pressure produced by the transfer pump **16** will retain the diaphragm **70** against the backing plate even during the intake strokes. However, if a transfer pump **16** is not employed or such a pump fails to insure the desired action, the modification disclosed in Figure 6 may be employed. This embodiment is substantially identical to the foregoing arrangement except that a secondary backing plate **76** and spring **78** are disposed inside of the pumping chamber. This spring **78** biases the secondary plate **76** against the diaphragm **70** and retains it on the first backing plate **34** at all times. Thus even though a secondary backing plate **76** is employed the diaphragm **70** will still remain imperforate and free of any openings that might tend to develop into leaks.

It may thus be seen that a high pressure diaphragm pump has been provided in which a plurality of pumping cells are provided. Each of these cells has a substantially identical output pressure and they are fixed with respect to each other so that at least one cell will always be discharging the fuel and therefore the output pressure will be substantially free of any pulsations therein. Also the plurality of cells will permit a very short stroke for each individual backing plate. As a result of this there will be a minimum amount of flexing of the individual diaphragms and since the periphery of the backing plate is a close fit in the radial passage, the diaphragm will have support over its entire area and therefore will be able to withstand the higher pressures. In addition since there are no perforations in the center portion there is no chance of any leakage occurring at the higher pressures.

It is to be understood that although the invention has been described with specific reference to particular embodiments thereof it is not to be so limited since changes and alterations therein may be made which are within the full intended scope of this invention as defined by the appended claim.

I claim:

A pump comprising a housing having an axial passage with a rotating eccentric member therein a plurality of passages radially disposed about said eccentric member forming openings in the side of said housing a cover closing each opening to form a pumping chamber fuel inlet and outlet valves disposed within said chamber, a member reciprocably disposed in each of said radial passages, a flexible diaphragm disposed in each of said chambers and peripherally clamped between said cover and said housing, said diaphragm having an imperforate center portion adapted to overlay said reciprocable member, pressure means adapted to act upon said diaphragm to maintain the latter in engagement with said reciprocable member, spring means in each of said radial passages for resiliently biasing the associated reciprocable member into said pumping chamber, and drive means for each reciprocable member comprising a bell crank lever, a pin articulated between one arm of said lever and said reciprocable member, a follower pivotally connected with the other arm of said lever, spring means biasing said follower into continuous engagement with said eccentric member, said bell crank lever being pivotally supported upon said housing intermediate said arms whereby rotation of the eccentric member causes said bell crank lever to compress said spring to draw fuel into said inlet valve into said pumping chamber, each of said drive means being equally spaced about the circumference of said eccentric.

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