Jan. 13, 1953 K. I. ROBINSON ET AL 2,625,113

FUEL PUMP

Filed June 18, 1949 2 SHEETS—SHEET 1

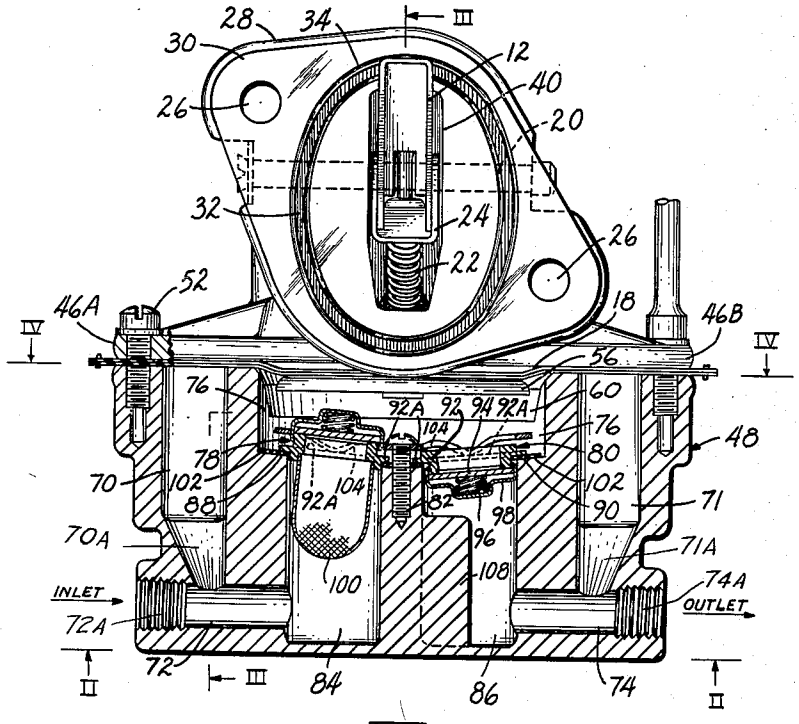



FIG. I

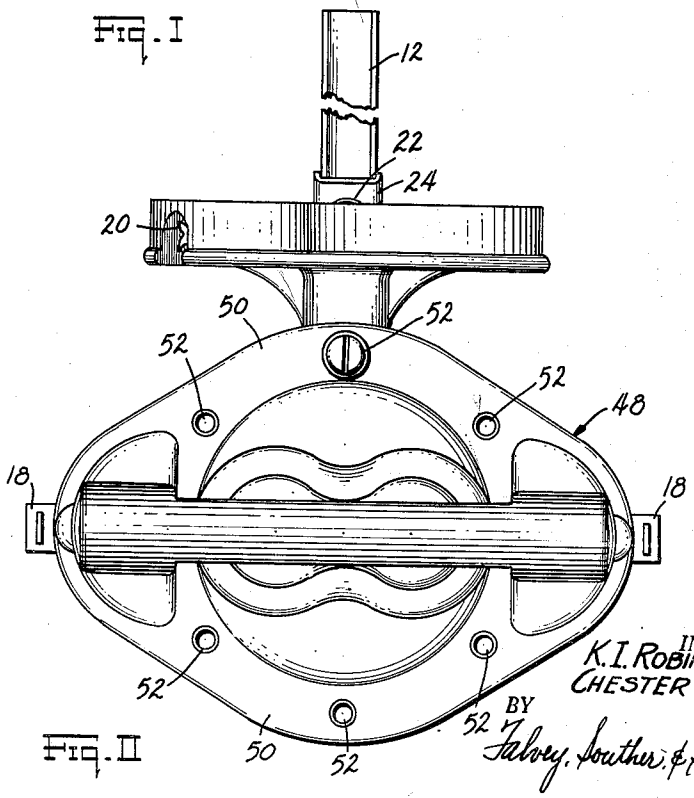



FIG. II

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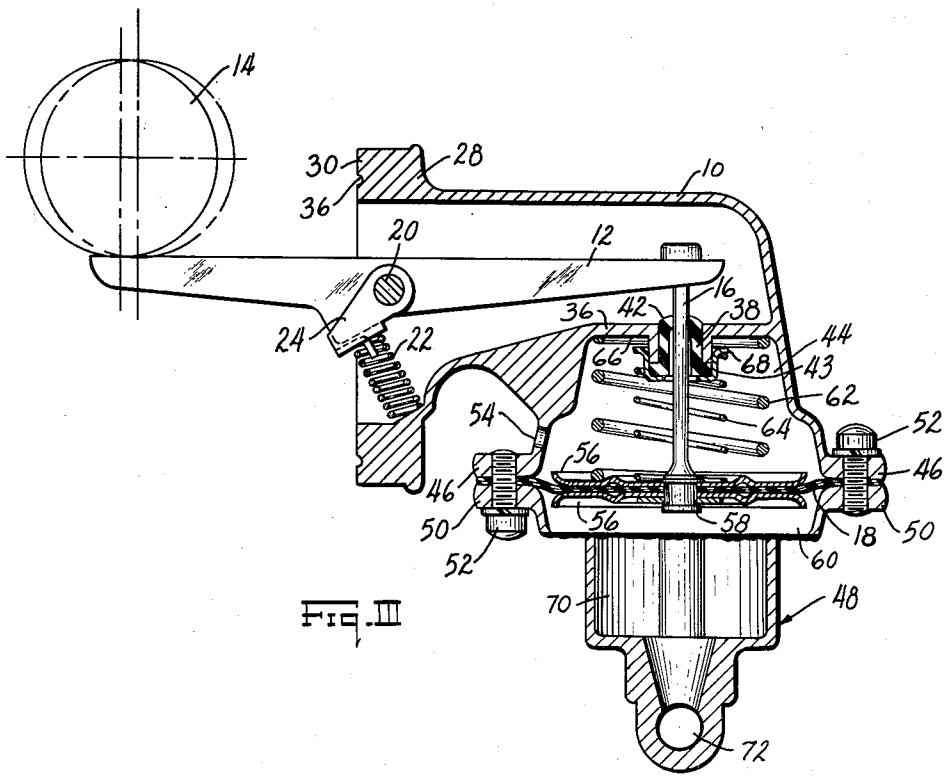



FIG. III

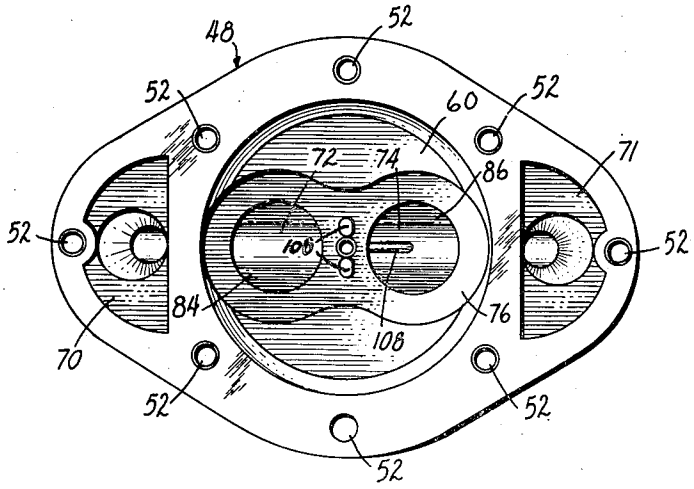



FIG. IV

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2,625,113

## FUEL PUMP

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3 Claims. (Cl. 103—150)

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This invention relates to fuel pumps of the oscillating-diaphragm type, more particularly to fuel pumps having flexible, oscillating diaphragms forming an expansible chamber with cooperating air domes for both inlet and outlet sides of the pump, exteriorly of the pump valves.

Diaphragm pumps for advancing fuel from a storage tank generally positioned at the rear of an automobile to the carburetor have been operated by an oscillating arm connected to the center of the diaphragm, the arm being oscillated by a cam on the cam shaft operating the valves of the engine. A lost motion connection is provided between the oscillating arm and the diaphragm to provide a power suction stroke and a spring-urged feed stroke, so that the fuel is delivered to the carburetor at a predetermined maximum pressure determined by the spring urging the diaphragm during the feed portion of the stroke. However, the delivery under the usual conditions is not as smooth as could be desired and the present invention provides a means whereby the delivery is facilitated and improved to thereby improve the performance of the automobile.

It is, therefore, a principal object of this invention to facilitate and improve the delivery of fuel to the carburetor of an automobile by means of an improved fuel pump.

It is a further object of this invention to improve and cheapen the construction of an automotive fuel pump.

It is a further object of this invention to improve the delivery of a fuel pump of an automobile by providing a novel air dome construction cooperating with both the inlet and outlet sides of the pump.

Other objects and advantages of this invention relating to the arrangement, operation and function of the related elements of the structure, to various details of construction, to combinations of parts and to economies of manufacture, will be apparent to those skilled in the art upon consideration of the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

Fig. I is an elevational view, partly in section, of a pump incorporating the invention;

Fig. II is a bottom plan view of Fig. I;

Fig. III is a sectional elevation taken along line 3—3 of Fig. I; and

Fig. IV is a top plan view of the lower casting of the pump.

Referring now to the drawings, particularly to Figs. I and III, a fuel pump suitable for an automobile is shown having an upper casing member 10, in which is positioned an oscillating

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lever 12, preferably of channel shape, adapted to cooperate at one end with its web with a cam 14 (Fig. III) positioned on the cam shaft of the automotive engine, and at its other end with a headed stem 16 attached to the center of a flexible diaphragm 18. The lever 12 is pivoted at a central location on a pin 20 journaled in the housing 10, and is urged in a clockwise direction about the pin 20 against the lower side of the cam 14 by a spring 22, which is anchored on a projection on the casing at one end and acts against a clip 24 also pivoted on the pin 20 as shown. The casing 10 is attached to the engine block (not shown) by bolts in apertures 26 formed in a vertical flange 28 which is provided with a flat forward face 30 to fit against a pad on the engine block, a seal being provided by a gasket ring 32, seated in a circumferential groove 34 in the face 30.

The casing member 10 is provided with a dividing wall 36 pierced by flanged aperture 38, through which extends the headed stem 16 to cooperate with the diaphragm 18. The upper chamber formed by the wall 36 houses the lever 12 and communicates with the crank case of the engine by an aperture 40, through which the lever extends to cooperate with the cam 14. In this way, oil may enter the upper chamber of the casing from the crank case to lubricate the moving parts. To prevent egress of the oil from the chamber through the aperture 38, a gasket 42 is provided to embrace the stem 16 and extend a slight distance above the floor of the chamber. The lower end is seated by an outwardly-extending flange against the lip of the aperture 38 by a cup-shaped member 43 as will be described hereinafter.

Below the dividing wall 36, the casing 10 is provided with an open chamber 44, into which the stem 16 extends to cooperate with the diaphragm 18, which extends across the open end of the casing 10 to cooperate with a horizontal flange 46, against the lower face of which the diaphragm 18 is adapted to be clamped by a lower casing member 48 having a complementary flange 50 by screws 52 as shown. The chamber 44 is vented to the atmosphere by an aperture 54 in the casing 10 immediately above the diaphragm 18.

The diaphragm 18 is of laminated construction such as is well known in the art comprising at least three plys of impregnated flexible fabric held together at a central location by two plates 56 riveted on the end of an enlarged portion 58 formed on the bottom end of the stem 16, and also clamped together at their perimetral edges between the flanges 46 and 50 through the binding action of the screws 52. The diaphragm has a further function of sealing the air dome chambers as will be described hereinafter.

The diaphragm 18 closes the bottom of the chamber 44 as has been pointed out before, and also forms a distendable, movable wall for a pumping chamber 60 formed by the cooperative relation between the diaphragm and the lower casing member 48. The diaphragm is urged downwardly to collapse the pumping chamber 60 by means of a pair of concentric helical springs 62 and 64, the larger of which is anchored on a flat portion 66 on the lower side of the division wall 36 in the chamber 44, being positioned concentric with the stem 16, and seated at its other end on the upper plate 56 to urge the diaphragm downwardly. The smaller inner spring 64 is also seated on the upper plate 56 but is anchored on an outwardly-extending flange 68 on the cup-shaped member 43 positioned around the flange of the aperture 38 to hold the gasket 42 in position. The spring 64 resiliently urges the member 43 upwardly and seals the flange of the gasket on the lip of the flange of the aperture 38 to prevent oil seepage into the chamber 44.

The upper casing member 10 is conveniently made as a die casting, formed in a mold with retractable inserts, one insert forming the upper chamber by being withdrawn laterally through the aperture 40, and a second insert forming the chamber 44 by being withdrawn at right angles to the first. The parting line for the mold is vertical with the member 10 as shown in Fig. I.

The conformation of the lower casing member 48 is best understood by viewing Fig. IV which is a plan view thereof. The pumping chamber 60 is formed in a central location, and is flanked on either side, preferably at right angles to the lever 12, by open-ended recesses 70 and 71 which are of relatively large volume, and communicate at their lower ends with inlet and outlet passages 72 and 74 to form air domes to cushion the flow of fuel through the pumping chamber 60. These air domes will be described in further detail hereinafter. The diaphragm 18 which comprises the deformable wall and volume-changing member of the pumping chamber forms a seal between the flanges 46 and 50 on the upper and lower casing members respectively, the upper flanges being provided with lateral extensions 46A and 46B to cover the open-ended recesses 70 and 71 respectively, with the diaphragm positioned therebetween to form seals at their open ends. These elements are all located in planes, so that the screws 52 in the flanges 46 and 50 are pulled down, the diaphragm is compressed to form a seal. This seal comprises the closing off of the pumping chamber 60, and also the closing off of the open ends of the recesses 70 and 71, so that an air volume may be trapped in the air domes to form a resilient cushion for the flow of fuel through the pumping chamber.

The pumping chamber 60 is proportioned to the maximum excursions of the diaphragm 18 which is controlled by the throw of the cam 14, so that the greatest possible volumetric change may occur with the full oscillation of the diaphragm as compared with the initial volume of the pumping chamber. In other words, it is desirable to be able to collapse a maximum percentage of the volume of the pumping chamber every full stroke as is consistent with ample clearance to give a maximum compression ratio. It has been found that a compression ratio of approximately two to one is preferred. This is highly advantageous in the event of an air lock in the pumping system. In order to carry this into practice, the pumping chamber is made shallow in depth and is provided with a recess 76, in which the inlet and outlet valves 78 and 80 are positioned. The floor of the recess 76 is made slightly oblique, tilting downwardly from the outer longitudinally disposed ends and forming a low point at a central location adjacent a screw 82 which is threaded into the casing 48 between two wells 84 and 86 which open into the recess 76 at the upper ends and form valve seats 88 and 90 therewith.

The inlet and outlet valves 78 and 80 are of generally similar conformation, comprising a flanged seat 92, a valve plate 94 seated on one side thereof, a spring 96 and a spider 98 as is well known in the art. The inlet valve 78 is provided with a dome-shaped filtering screen 100, facing the direction of fuel flow to separate from the fuel particles of foreign matter before it enters the pumping chamber. The flange 92A of the respective seats rest against the termination edge of the wells 84 and 86 respectively, and are provided with a unitary gasket 102 extending across the recess 76 to provide a seal. A double armed spring member 104 having a pair of loops, each with a pair of depressed portions resiliently pressing at two points on each flange 92A, urges the inlet and outlet valves against the gasket 102 by the pulling down action of the screw 82, which cooperates with the spring member 104 at a central location. The spring member is given better purchase by the slight angular relation of the inlet and outlet valves as provided by the oblique floor of the recess 76, and is seated against an abutment 106 immediately below the central portion adjacent the screw. The well 86 on the outlet side is provided with an integral fin 108, to prevent reversal of the valves, due to the interference provided with the filtering element 100 on the inlet valve, so that it cannot be positioned in the outlet well.

Adjacent the bottom of the wells 84 and 86, transverse bores are provided forming the inlet and outlet passages 72 and 74, which, at their outer ends, are provided with threaded sections 72A and 74A for convenient connection into the fuel lines of the automobile to which the pump is applied. Adjacent an intermediate location between the threaded portions 72A and 74A, conical interconnecting passages 70A and 71A are provided between the inlet and outlet passageways 72 and 74, and the recesses 70 and 71, located directly above. The constricted portion of the conical passageways 70A and 71A communicate with the upper portion of the passageways 72 and 74 and tend to separate air bubbles which are often to be found in the fuel flowing through the pump. The recesses 70 and 71 are given volumes at least 75 per cent as great as the maximum volumetric displacement of the pumping chamber to give greater efficiency for the pump by providing an enlargement above the conical passages 70A and 71A below the relative position of the valves 78 and 80. It has been found that if the volume of each of the recesses or air domes 70 and 71 is equal to the maximum volumetric displacement in the pumping chamber, that is, the volumetric change created by the movement of the diaphragm 18 from collapsed to fully distended position, an efficient pump is obtained. Due to the trapped air in these air domes, the flow through the pump is smoother and the pump develops greater efficiency. The air domes are self-cleansing and remain efficient during sustained operation of the pump.

The lower casing member 48 is preferably made

as a die-casting, in which the mold has a horizontal parting line with the casing member as shown in Fig. II. Retractable inserts withdrawn from the upper side with the casing member 48 as shown in Fig. I are used to form the recesses 70 and 71 including their conical sections which form the air domes in the completed pump, as well as to form the pumping chamber 60, the valve recess 76, and the wells 84 and 86, including the fin 108 formed in the well 86.

The pump operates with a power suction stroke as provided by the cam 14 oscillating the lever 12 to thrust the diaphragm 18 upwardly by means of the stem 16 against the springs 62 and 64. The feed stroke is spring-urged with the power being provided by the compressed springs 62 and 64 at the end of the suction stroke. When fuel is not demanded by the carburetor of the car, with which the pump is being used, it will remain in the pumping chamber 60, so that no feed stroke will be had, but the diaphragm 18 will remain at full distended position by the action of the lever 12, which returns the diaphragm to full stroke position on the suction stroke with each revolution of the cam. The interaction of the headed stem 16 and the bifurcated end portion of the lever 12, which form a seat for the head of the stem, provides a lost motion connection to attain the above-described interaction of the parts.

It has been found that large air domes are essential on both the outlet and inlet sides to have this pump operate at its greatest efficiency and it has been a problem to provide sufficiently large air domes within die castings which can be made with economy and speed on a production line. The pump disclosed hereinbefore has very desirable characteristics for use with the fuel systems of modern automobiles.

It is to be understood that the above detailed description of the present invention is intended to disclose an embodiment thereof to those skilled in the art, but that the invention is not to be construed as limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of being practiced and carried out in various ways without departing from the spirit of the invention. The language used in the specification relating to the operation and function of the elements of the invention is employed for purposes of description and not of limitation, and it is not intended to limit the scope of the following claims beyond the requirements of the prior art.

What is claimed:

1. In a pump, a flexible diaphragm, a lost-motion driving connection for the diaphragm cooperating with a continuously rotating cam means for displacing the diaphragm providing a positive suction stroke for the diaphragm, resilient means cooperating with the diaphragm adapted to be compressed by the lost-motion driving connection during the suction stroke to provide a feed stroke for the diaphragm upon the return stroke of the driving connection, a pump casing positioned below the diaphragm comprising a one-piece die casting having a shallow central recess to form a pumping chamber and a pair of deep flanking recesses to form air domes, all of said recesses being sealed by the diaphragm, a valve recess in the pumping chamber, inlet and outlet ports in the casing passage-ways in the pump casing including deep depending wells connecting the valve recess in the pumping chamber with inlet and outlet ports in the pump casing, valves positioned in said valve recess, the pumping chamber being proportioned with reference to the diaphragm displacement including the valve recess to give a two to one compression ratio, said flanking recesses in the casing being in parallel relation to the depending wells and in communication with the passage-ways leading to said inlet and outlet ports by means of conical passages in the casing which communicate with enlargements in the flanking recesses at a level below the valves whereby air domes are provided having a volume at least 75 per cent of the displacement of the pumping chamber.

2. In a pump, a flexible diaphragm, a lost-motion driving connection for the diaphragm cooperating with a continuously rotating cam means for displacing the diaphragm providing a positive suction stroke for the diaphragm, resilient means cooperating with the diaphragm adapted to be compressed during the suction stroke by the lost-motion driving connection to provide a feed stroke for the diaphragm upon the return stroke of the driving connection, a pump casing positioned below the diaphragm comprising a one-piece die casting having a shallow central recess to form a pumping chamber and a pair of deep flanking recesses to form air domes, all of said recesses being open in a plane on the top side of the casing and adapted to be sealed by the diaphragm, inlet and outlet ports in the casing, a valve recess in the pumping chamber, passage-ways in the casing including deep depending wells connecting the valve recess with inlet and outlet ports, valves positioned in the recess, the pumping chamber being proportioned with reference to the diaphragm displacement including the valve recess to give a two to one compression ratio, said flanking recesses in the casing being in parallel relation to the depending wells and in communication with the passage-ways leading to said inlet and outlet ports by means of conical passages in the casing which communicate with enlargements in the flanking recesses in the casing at a level below the valves whereby air domes are provided having a volume at least 75 per cent of the displacement of the pumping chamber.

3. In a pump, a flexible diaphragm, a lost-motion driving connection for the diaphragm cooperating with a continuously rotating cam means to displace the diaphragm providing a positive suction stroke for the diaphragm, resilient means cooperating with the diaphragm adapted to be compressed during the suction stroke by the driving connection to provide a feed stroke for the diaphragm upon the return stroke of the driving connection, a pump casing positioned below the diaphragm comprising a one-piece die casting having a shallow central recess in its upper surface to form a pumping chamber and a pair of deep flanking recesses also opening in the upper surface of the casing to form air domes, all of said recesses terminating in a plane and adapted to be sealed by the diaphragm, a valve recess in the pumping chamber, inlet and outlet ports in the casing, passage-ways in the casing including deep depending wells connecting the valve recess with inlet and outlet ports, valves positioned in the recess, one of said valves positioned on the inlet side being provided with an integral filtering screen extending into its depending well, the pumping chamber being proportioned with reference to the diaphragm displacement including the valve recess to give a two to one compression ratio, said flanking recesses in the casing being in parallel rela-

tion to the depending wells and in communication with the passage-ways leading to said inlet and outlet ports by means of conical passages in the casing which communicate with enlargements in the flanking recesses at a level below the valves whereby air domes are provided having a volume at least 75 per cent of the displacement of the pumping chamber.

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## REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 2,148,957 | Morris et al. | Feb. 28, 1939 |
| 2,203,464 | Harry | June 4, 1940 |
| 2,287,841 | Tabb | June 30, 1942 |
| 2,405,466 | Tabb | Aug. 6, 1946 |