Nov. 14, 1961 M. R. FOSTER ET AL 3,008,427

FUEL PUMP

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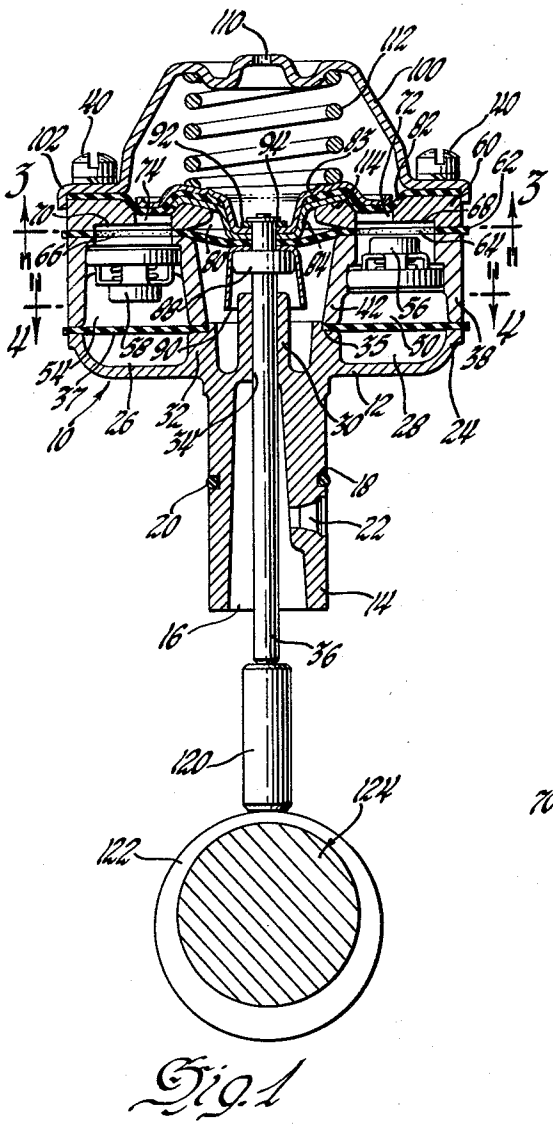


Fig. 1

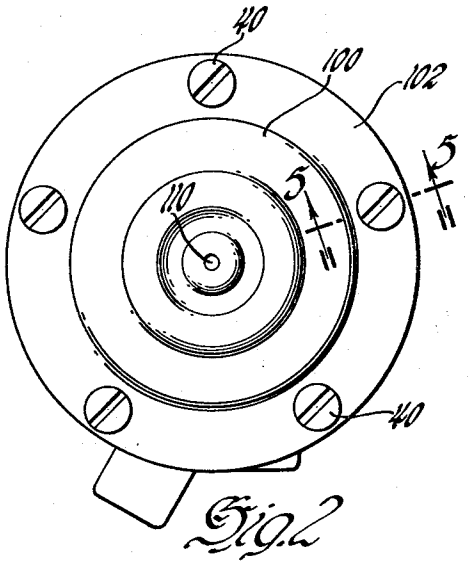


Fig. 2

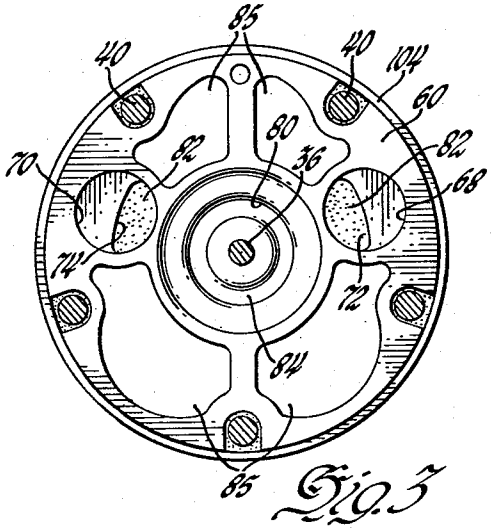


Fig. 3

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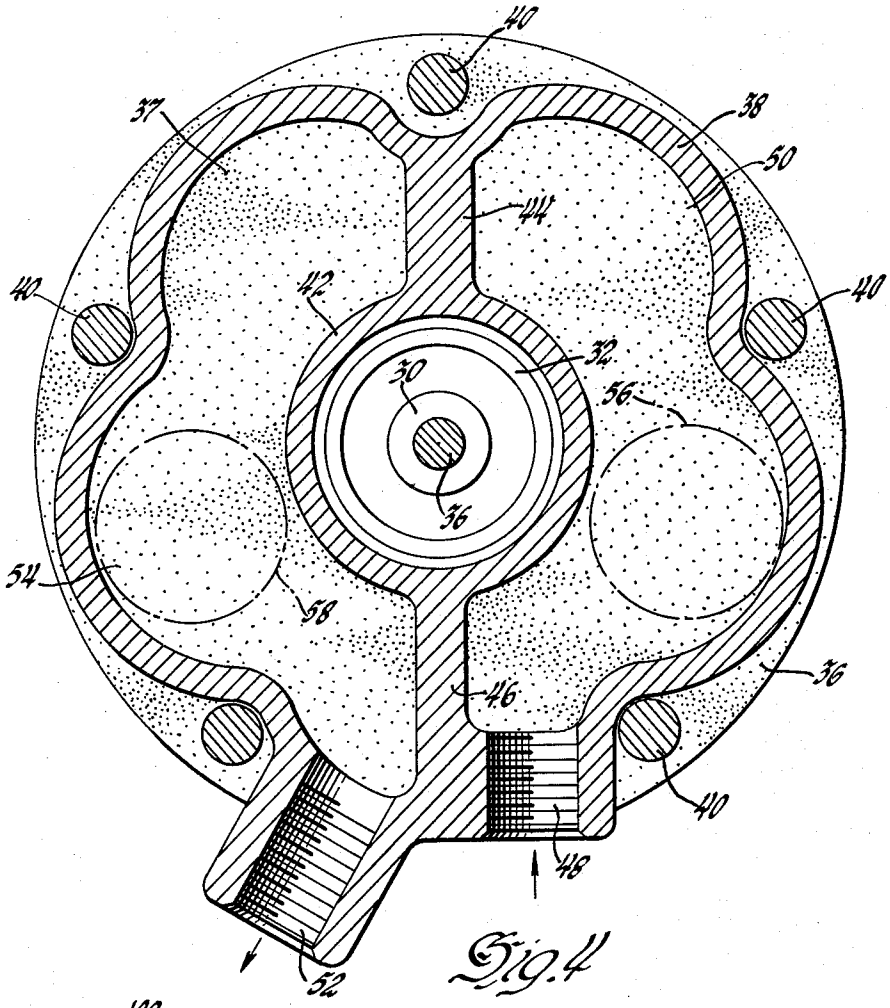


Fig. 4

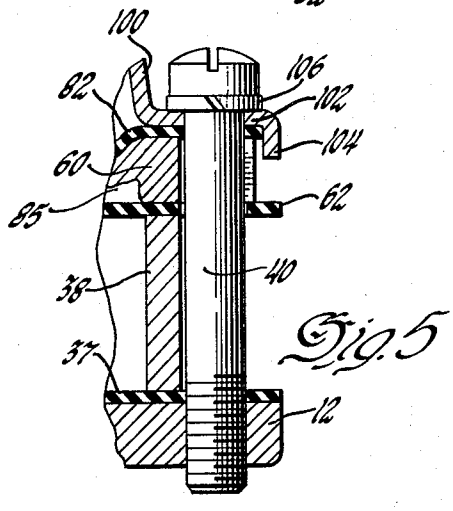


Fig. 5

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United States Patent Office 3,008,427 Patented Nov. 14, 1961

3,008,427

FUEL PUMP

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Filed Feb. 11, 1959, Ser. No. 792,601
7 Claims. (Cl. 103—150)

This invention relates to pumps and more particularly to fuel pumps of the diaphragm type which are specially but not necessarily adapted for automotive use.

Automotive diaphragm pumps usually employ engine cam shaft mechanisms to actuate the diaphragms during the suction stroke and utilize biasing springs to actuate the diaphragms during the discharge stroke. This provides a variable discharge stroke of a given diaphragm in accordance with the pressure desired in the fuel line downstream from the pump, i.e., pump delivery is automatically in accordance with fuel demand or pump discharge pressure is automatically regulated by features such as spring loading inherent in the pump structure. Pulsation chambers for improving fuel pump performance have also been used as exemplified in the United States Patent 2,640,424 grant June 2, 1953, in the name of A. M. Babitch. It has become desirable to provide a fuel pump combining the features giving pressure regulation and the pulsator action and at the same time insuring compactness, structural simplicity and the use of a minimum mass of reciprocating parts. Such an improved pump would be subjected to less wear and be more effective at high speeds.

To these ends, an object of the present invention is to provide an improved diaphragm pump with inherent discharge pressure regulation. Another object is to provide a diaphragm pump with at least one pulsator chamber so arranged that the pump drive mechanism may be simplified giving compactness and simplicity to the over-all pump structure.

A feature of the present invention is a diaphragm pump characterized by a spring and a reciprocable stem cooperating from opposite sides of a pumping diaphragm for actuating the latter. Another feature of the present invention is a pump having an actuating stem together with pumping and pulsator chambers located at one side of a pumping diaphragm. Another feature is a simplified drive arrangement employing a stem axially slidable against the force of a spring, the stem and pressure actuated valves being at one side of a pumping diaphragm to which the stem is attached and a biasing spring acting on the other.

These and other important features of the invention will now be described in detail in the specification and then pointed out more particularly in the appended claims.

In the drawings:

FIGURE 1 is a sectional view through a pump embodying the present invention and showing its relation to a cam shaft for driving the pump;

FIGURE 2 is a plan or top view of the pump shown in FIGURE 1;

FIGURE 3 is a sectional view looking in the direction of the arrows 3—3 in FIGURE 1;

FIGURE 4 is an enlarged sectional view looking in the direction of the arrows 4—4 in FIGURE 1; and

FIGURE 5 is an enlarged sectional view taken along the line 5—5 in FIGURE 2.

A fuel pump is discolsed having a casing generally indicated at 10 in FIGURE 1. This casing comprises a base section 12 which has a depending and integral hub 14 adapted to be inserted in a port formed to accommodate the same, this port being made in an engine block or crankcase as will be understood. The hub is

hollow as at 16 and bears an outside peripheral recess or groove 18 receiving an O-ring 20 for sealing purposes with the wall of the engine port. An aperture 22 is formed in the hub to permit securing of the pump to the engine. A top portion of the base section 12 is made with an enlarged diameter as at 24 to form a circular wall partially defining two pulsator chambers 26 and 28. Two concentric bosses 30 and 32 are formed on the member 12 and the boss 30 is bored as at 34 to serve as a bearing for reciprocal stem 36. The boss 32 serves as an inner wall for the two pulsator chambers 26 and 28 and is joined with a diametrical wall not shown in the drawings but separating these two chambers on opposite sides of the boss 32. The latter is recessed at 35 to accommodate the inner annular margin of a pulsator diaphragm 37. The outer margin of the latter is held between outer margin of the base casing section 12 and a main casing or pump section 38. The outer wall of the latter (see FIGURE 4) curves inwardly at five spaced places around its perimeter to clear five bolts 40. The main casing 38 also is provided with a tapered inner wall 42 which is coaxial with the stem 36 in the pump. This inner wall 42 is joined to the outer wall of the casing 38 by diametrically opposed walls 44 and 46 (see FIGURE 4). These walls cooperate with the wall separating the pulsator chambers 26 and 28 in tightly engaging opposite sides of the diaphragm 37. The bottom edge of the inner wall 42 cooperates within the recessed portion 35 of the boss 32 and the diaphragm 37 in forming a seal between the pulsator chambers on the one hand and chambers on the other which are formed in the main section 38. Inlet port 48 is formed in the section 38 and is threaded for connection to an inlet line for fuel. This inlet port communicates with a pump inlet chamber 50. Section 38 is also provided with an outlet port 52 which is threaded to receive a discharge line leading to the engine carburetor. This port communicates with outlet chamber 54. A pressure actuated inlet valve 56 of conventional design is mounted in section 38 to control the discharge from the inlet chamber 50 as will be understood. A similar but inversely positioned pressure actuated valve 58 is mounted to control the admission of discharge fluid to the discharge chamber 54. Such valves are customarily employed in automotive fuel pumps and are one-way valves utilizing springs biasing them to the closed positions.

A port section 60 is located above the section 38 with a sealing diaphragm 62 interposed. This diaphragm is ported as at openings 64 and 66 to permit flow of fuel from and to the valves 56 and 58. The port section 60 bears two shallow recesses 68 and 70 registering with the openings 64 and 66 respectively. Two approximately half circular or primary ports 72 and 74 pass up through the port section 60 for communication with a pumping chamber 80 defined by the port section 60 and a pumping diaphragm 82. Four irregular recesses 85 independent of the ports 72 and 74 and the shallow recesses 68 and 70 are formed in the underside of the section 60 as shown in FIGURE 3. They are closed by the sealing diaphragm 62 in the pump assembly. Preferably, and as shown, the chamber is also partially defined by a stem seal diaphragm 62 as will further appear. The inner portion of the diaphragm 82 is tightly held between two nested and cupped plates 84 and 83, the latter two plates being held tightly together to clamp the sealing diaphragm 62 with the aid of a joinder to the reciprocal stem 36. In forming the connection, an enlarged shoulder portion 88 is formed on the stem 36 and is received in an inverted cup 90 in turn bearing against the underside of the cupped plate 84. Washers 92 and 94 are also used at the end of the stem 36 in forming a tight joint between the stem and the diaphragm 82. It will be noted

that a clearance exists between the end of the boss **30** and the enlargement **38** on the stem as well as between the base section **12** and the depending skirt **90**.

A support in the form of an inverted cup **100** is fixed to the exterior of the pump and is provided with an annular flange **102** having a rolled edge **104**. The bolts **40** pass through the flange **102** and the three diaphragms **82**, **62** and **37** and are threaded for connection to the base section **12**. It will be noted (FIGURE 3) that the port section **60** is notched at its periphery to clear the bolts. The latter serve to hold the casing or main portions of the pump tightly together in sealed relation. A spring washer **106** is utilized between the flange **102** and the head of each bolt **40**. The top of the support or cup **100** is apertured as at **110** in order to form a vent to the atmosphere. The inverted bottom surface of the open support or cup **100** is so formed as to provide an annular groove for the retention of one end of a coil spring **112**. The other end of the coil is adapted to bear down against the pumping diaphragm plate **83**. This spring biases the pumping diaphragm **82** downwardly at all times and toward an annular shoulder portion **114** formed on the ported section **60**.

It will be understood that the pump could be driven or actuated in other ways but in the drawings is shown a short rod **120** which is adapted to be mounted for reciprocation in a vertical bore formed in the engine casing or crankcase. The rod is so located that it engages the lower end of the stem **36**. The lower end of the rod **120** is so placed as to engage a cam surface **122** of the engine camshaft **124**.

In the operation of the pump, rotation of the camshaft **124** will bring about reciprocation in a linear direction of the rod **120** and the stem **36** with respect to the casing base section **12**. During the suction stroke of the pump, the cam surface **122** will cause the pumping diaphragm **82** to rise against the loading of the spring **112** and as a result, fuel will be drawn in through the port **48**, into the chamber **50**, through the valve **56** and the ports **72** and **85** into the pumping chamber **80**. The diaphragm **62** will prevent loss of fuel or of suction by way of the inner or outer periphery of the main section **38** or because of the stem **36**. As the cam surface **122** continues to rotate, the pumping diaphragm **82** and the stem **36** will lower under the potential force previously given the spring **112** and the fuel will be forced from the pumping chamber **80** through the ports **74** and **85** and the valve **58** into the chamber **54** from which it will pass by way of the outlet port **52**. The pulsator diaphragm **37** will serve to smooth out the flow of the fluid path in coming into the pump and in discharge therefrom as the dead air or pulsator chambers **28** and **26** permit it to yield slightly.

It will be appreciated that either or both of the pulsator chambers **26** and **28** may be eliminated without avoiding the present invention insofar as some features are concerned. The presence of at least one pulsator chamber is preferred, however, and the present arrangement permits its presence without unduly adding to the over-all pump dimensions.

We claim:

1. A fuel pump having a casing and a pumping diaphragm cooperating with and joined to said casing to define a pumping chamber, an inlet and an outlet in said casing leading to said chamber, pressure actuated valves controlling said inlet and outlet, open supporting means exterior to said casing, a spring in ambient air and compressed between said supporting means and one side of said diaphragm for actuating the latter during a pumping stroke, diaphragm actuating means including a reciprocable stem slidably mounted in said casing and extending from the other side of said diaphragm and attached to the latter, said casing including pulsator chambers, and pulsator diaphragm means separating said inlet and outlet from said pulsator chambers.

2. A fuel pump having a casing and a pumping diaphragm with their margins joined in defining a pumping chamber, an inlet and an outlet forming a passage in said casing leading to and from said chamber, pressure actuated valves controlling the passage leading through said inlet and outlet, pulsator diaphragm means in said casing and partially defining said passage, supporting means exterior to said casing, a spring placed under compression between said supporting means and one side of said diaphragm, a sealing diaphragm fixed to said casing and joined to said pumping diaphragm on the other side of the latter, pulsator chambers in said casing and separated from said inlet and outlet by said pulsator diaphragm means, and an actuating stem slidable in said casing and extending through said pulsator diaphragm means and attached to said sealing and pumping diaphragms.

3. A fuel pump having a casing and a pumping diaphragm cooperating with and joined to said casing to define a pumping chamber for handling a liquid fuel, an inlet and an outlet to said chamber, pressure-actuated valves controlling said inlet and outlet, a cup at one side of said diaphragm cooperating with the latter in defining a vented spring chamber, spring means in said spring chamber and urging said diaphragm in one direction automatically to regulate the discharge pressure in said outlet, and a reciprocable stem operable from the exterior of said casing at the other side of said diaphragm for actuating the latter in the opposite direction as a suction stroke.

4. A single acting fuel pump having a casing and a pumping diaphragm, the latter and said casing defining a pumping chamber on one side of said diaphragm for handling liquid fuel, an inlet and an outlet to said pumping chamber, pressure actuated one-way valves controlling said inlet and outlet, open supporting means located at the other side of said pumping diaphragm, a spring compressed between said supporting means and said pumping diaphragm and cooperating with atmospheric pressure in biasing said pumping diaphragm toward said one side, a reciprocable stem fixed to said pumping diaphragm and slidably mounted in said casing on said one side of said diaphragm, and means forming a seal between said stem and casing to constrain fuel flow between said valves to said pumping chamber.

5. A fuel pump having a casing including a base section, a main section and a ported section, a sealing diaphragm having ports and being interposed between said main section and one side of said ported section, a pumping diaphragm at the other side of said ported section and cooperating with said main section, sealing diaphragm and ported section in defining a pumping chamber, shallow recesses in said ported section, an inlet and an outlet located in said main section and forming a passage communicating through the ports of said sealing diaphragm and said shallow recesses with said pumping chamber, pressure actuated valves controlling said inlet and outlet, supporting means exterior to said casing, a spring with one end acting against said supporting means and the other end urging said pumping diaphragm toward said pumping chamber to effect a pumping stroke, a pulsator chamber in said base section, a pulsator diaphragm separating said pulsator chamber from said passage in said main section, and an actuating stem slidably mounted in said base section, extending through said sealing diaphragm and fixed to said pumping diaphragm.

6. A fuel pump having a casing, said casing including a port section and a pumping diaphragm cooperating in partially defining a pumping chamber between them and on one side of said pumping diaphragm, said port section having primary ports leading to and from said pumping chamber and recesses in its side facing away from said pumping chamber, said casing also including a main casing section, pressure-actuated valves, an inlet passage and an outlet passage in said main casing section controlled by said pressure-actuated valves and leading

through said main casing section to said primary ports, a sealing diaphragm clamped between said port section and said main casing section and extending in a plane parallel with said pumping diaphragm thereby separating said recesses from said passages and primary ports, openings in said sealing diaphragm giving communication between said inlet and outlet passages and said primary ports, open supporting means exterior to said casing, a spring acting between said supporting means and said pumping diaphragm to urge the latter toward said pumping chamber, an actuating stem slidably mounted in and accessible for actuation from the exterior of said casing at the one side of said pumping diaphragm and having one end fixed to the said pumping and sealing diaphragms, and said sealing diaphragm completing the definition of said pumping chamber.

7. A sub-assembly for use in a diaphragm pump, said sub-assembly comprising two nested and cupped plates, a pumping diaphragm having its central area interposed between said plates and a peripheral margin extending radially from said plates, a sealing diaphragm adjacent

one of said plates and extending radially beyond the edges of said plates, a plunger holding said plates and diaphragms in fixed relation, a relatively rigid metal section having fluid inlet and outlet ports therein located between said diaphragms and surrounding a central portion of said one plate to define a clearance space, said diaphragms and metal section being adapted cooperatively to define a pumping chamber, and inlet and outlet ports in said sealing diaphragm in registry with inlet and outlet ports respectively in said metal section.

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Notice of Adverse Decision in Interference

In Interference No. 92,997 involving Patent No. 3,008,427, M.R. Foster and R. G. Taylor, FUEL PUMP, final judgment adverse to the patentees was rendered Oct. 30, 1964, as to claims 3 and 4.

[*Official Gazette March 30, 1965.*]