Aug. 20, 1957

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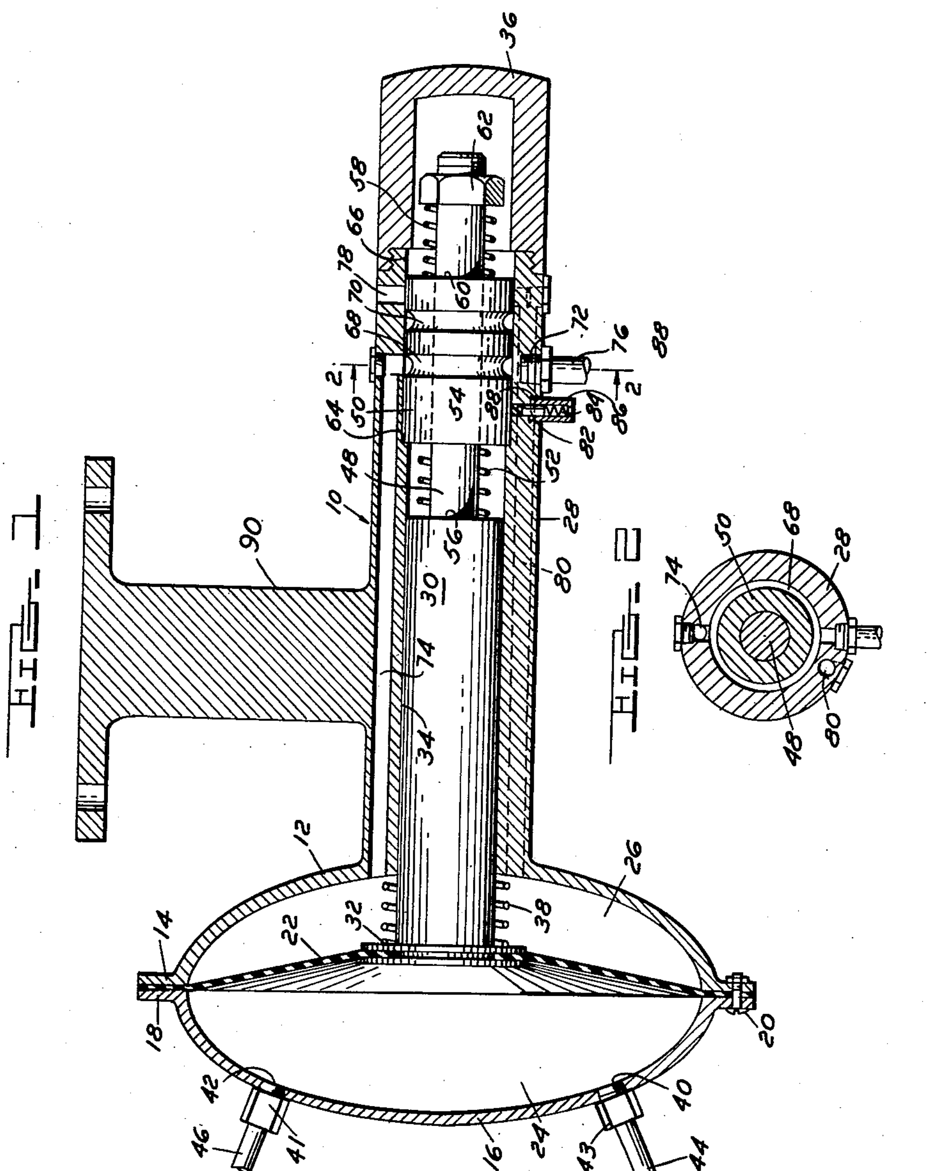
2,803,195

FUEL PUMP

Filed Feb. 19, 1953



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2,803,195
Patented Aug. 20, 1957

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FUEL PUMP

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Application February 19, 1953, Serial No. 337,790
14 Claims. (Cl. 103—152)

This invention relates to fuel pumps and more particularly to fuel pumps for internal combustion engines.

It is an object of this invention to provide a fuel pump which is quiet in operation and which operates only in response to the demand for fuel by the engine.

In the drawings:

Fig. 1 is a sectional view of a fuel pump embodying the present invention.

Fig. 2 is a sectional view along the line 2—2 in Fig. 1.

Referring to the drawing the fuel pump includes a casing generally designated **10** fashioned with a circular enlargement **12** at one end having a peripheral flange **14** to which a cover member **16** having a peripheral flange **18** may be secured as by screws **20**. Between the flanges **14** and **18** there is clamped a flexible diaphragm **22**. Diaphragm **22** divides the interior of members **12** and **16** into a fuel chamber **24** and an air chamber **26**. The casing **10** is provided with a tubular extension **28** in which a stem **30** is axially movable. Stem **30** is connected at one end as at **32** with diaphragm **22** and extends through air chamber **26** into the bore **34** of extension **28**. At its free end tubular extension **28** has threaded thereon a hollow cap **36** which closes the outer end of bore **34**. A spring **38** acting between extension **28** and diaphragm **22** urges diaphragm **22** and stem **30** in a direction towards the left as viewed in Fig. 1, that is, in a direction tending to decrease the volume of fuel chamber **24**.

Chamber **24** is provided with a fuel inlet port **40** and a fuel outlet port **42**. Ports **40** and **42** are controlled by check valves **41** and **43** so that fuel is sucked into chamber **24** through port **40** when diaphragm **22** moves towards the right, and fuel is pumped out of chamber **24** through port **42** when diaphragm **22** moves towards the left. Port **40** is connected as by a conduit **44** with the fuel tank of the engine, and port **42** is connected as by a conduit **46** with the float chamber of the carburetor of the engine.

Stem **30** is provided at the free end thereof with a portion **48** of reduced diameter. A valve spool **50** is slidably mounted on the reduced portion **48** of stem **30**. Valve **50** is biased in a direction towards the right on the stem portion **48** by a coil spring **52** acting between the end face **54** of the valve and the shoulder portion **56** on stem **30**. Valve **50** is biased in the opposite direction on the reduced stem portion **48** by means of a coil spring **58** acting between the opposite end face **60** of valve **50** and a nut **62** which is threaded on the end of the reduced stem portion **48**. Valve **50** is slidable in tubular extension **28** between spaced apart shoulders **64** and **66**. Valve **50** is provided with two annular grooves **68** and **70**. The groove **68** is positioned on valve **50** such that when valve **50** abuts against shoulder **64** groove **68** establishes communication between a vacuum port **72** and a passageway **74** in tubular extension **28** which opens into air chamber **26**. Port **72** is arranged to be connected with the vacuum obtaining in the intake manifold by means of a conduit **76**. Groove **70** is located on valve **50** such that when the valve abuts against shoulder

66 groove **70** establishes communication between a port **78** which is open to atmosphere and a passageway **80** which opens to air chamber **26**.

An oiling wick **82** is arranged to rub against the cylindrical surface of valve **50** as the valve moves between shoulders **64** and **66**. Wick **82** is biased radially against the outer cylindrical surface of valve **50** by means of a spring **84** the tension of which is arranged to be adjusted by a spring retainer **86** having a threaded engagement with tubular extension **28** as at **88**.

In operation, assuming that the parts are in the positions illustrated in Fig. 1, it will be observed that valve **50** abuts shoulder **64** and places vacuum port **72** in communication with vacuum passageway **74** through groove **68** thereby exhausting chamber **26** and causing diaphragm **22** to move to the right. Movement of diaphragm **22** in this direction causes the admission of fuel through inlet **40** into chamber **24**. As stem **30** moves to the right, it will be noted that springs **38** and **52** are compressed and spring **58** is expanded. Valve **50** will remain in the position abutting shoulder **64** until the force exerted upon the valve by spring **52** and tending to slide the valve to the right exceeds the restraining effect imposed upon the valve by oiling wick **82**. When this occurs spring **52** will slide valve **50** axially to the right to a position where valve **50** abuts against shoulder **66**. In this position groove **68** will be moved out of registration with vacuum port **72** and passageway **74**, and groove **70** will establish communication between atmosphere port **78** and passageway **80**. Thus, atmospheric pressure is admitted to chamber **26** and diaphragm **22** is permitted to flex toward the left under the influence of compression spring **38**. When diaphragm **22** flexes towards the left fuel is discharged from chamber **24** through outlet **42**.

The rate at which the fuel can be discharged from chamber **24**, of course, depends upon the rate at which the fuel is being consumed by the engine, line **46** being connected with the float chamber of the carburetor. Thus, diaphragm **22** and stem **30** move slowly in a direction toward the left in response to the rate of discharge of fuel from chamber **24**. During the discharge of fuel from chamber **24**, valve **50** will remain in a position wherein the chamber **26** is connected with atmosphere until the force exerted on valve **50** by compression spring **58** exceeds the restraining effect of wick **82** on the cylindrical surface of valve **50**. When stem **30** has moved to the left a predetermined distance so that the force exerted on valve **50** by spring **58** exceeds the frictional effect of wick **82**, valve **50** slides axially to the left to a position abutting shoulder **64**.

Thus, it will be seen that I have provided a compact, very efficient and very quiet fuel pump. The pump operates relatively slowly, diaphragm **22** and stem **30** moving to the left at a rate proportional to the rate at which fuel is consumed by the engine. The fuel pump of this invention therefore avoids many of the objectionable features of fuel pumps with which I am familiar. Valve **50** moves to its two extreme positions relatively slowly; and since stem **30** is not positively driven by mechanical means, the fuel pump does not produce a continuous thumping sound, as is true of conventional fuel pumps with which I am familiar. Furthermore, it will be appreciated that the threaded adjustment of nut **62** and of retainer **86** enables adjustment of the operation of the pump in accordance with the conditions under which the pump is to operate.

The pump may be arranged to be mounted on an engine in any suitable manner. For the purpose of illustration the tubular extension **28** is shown fashioned with a lateral projecting portion **90** which forms a mounting bracket for the pump.

I claim:

1. A fuel pump for an internal combustion engine comprising a casing, a diaphragm in said casing dividing the casing into a fuel chamber and an air chamber, a fuel intake and a fuel outlet in said fuel chamber, a stem connected with said diaphragm to move therewith, means biasing said diaphragm in a direction tending to decrease the size of said fuel chamber and to increase the size of said air chamber, a support in which said stem is axially slidable in response to movement of said diaphragm, a pair of passageways communicating with said air chamber, a valve movable in opposite directions to connect said air chamber through one of said passageways with a source of vacuum in one position and through the other passageway to atmosphere in a second position whereby fuel is pumped into and out of said fuel chamber in response to movement of said valve alternately to said two positions and means for moving said valve to said two positions comprising a pair of springs each operatively connected at one end with said stem and at the opposite end with said valve, one of said springs biasing said valve to move towards said first position and the other spring biasing said valve to move toward said second position and means yieldably resisting movement of said valve against the force applied thereto by said springs.

2. A fuel pump for an internal combustion engine comprising a casing, a diaphragm in said casing dividing the casing into a fuel chamber and an air chamber, a fuel intake and a fuel outlet in said chamber, said air chamber having a port for connecting said chamber with a source of vacuum and a second port for connecting said air chamber to atmosphere, a stem connected with said diaphragm for movement therewith, a shiftable valve controlling said ports, and a connection between said stem and said valve for shifting said valve to a position opening one of said ports when the stem moves axially in one direction and to a position closing said one port and opening the other of said ports when the valve moves axially in the opposite direction, said connection between said stem and valve including a pair of springs acting between said valve and said stem, one of said springs urging said valve in one direction to a position opening said vacuum port and the other spring urging said valve in the opposite direction towards a position opening said atmosphere port.

3. The combination set forth in claim 2 including means for adjusting the tension of said springs.

4. The combination set forth in claim 2 including friction means acting on said valve and yieldably resisting movement of said valve, said springs when tensioned being of sufficient strength to overcome the effect of said friction means.

5. A fuel pump for an internal combustion engine comprising a casing, a diaphragm in said casing dividing the casing into a fuel chamber and an air chamber, said fuel chamber having a fuel inlet and a fuel outlet, spring means urging said diaphragm in a direction tending to pump fuel out of said fuel chamber through said fuel outlet, a stem connected with said diaphragm to move therewith, means defining a vacuum passageway communicating with said air chamber, means defining an atmosphere passageway communicating with said air chamber, valve means movable axially in one direction on said stem to a first position connecting said vacuum passageway with a source of vacuum and movable in the opposite direction on said stem to a second position connecting said atmosphere passageway to atmosphere, a pair of opposed springs on said stem each operatively connected at one end with said valve means and at the opposite end with said stem, one of said springs urging said valve means to move in a direction toward said first position and resisting movement of said valve means in a direction towards said second position, said other spring urging said valve means to move in a direction toward said second position and resisting movement of said valve means in a direction towards said first position, said stem when moved axially in one direction acting through one of said springs to move said valve means to said first position and when moved axially in the opposite direction acting through said other spring to move said valve means to said other position, and means yieldably resisting movement of said valve means until the force acting on the valve means through said springs exceeds a predetermined value.

6. The combination set forth in claim 5 including means for adjusting the tension of said springs to vary the extent through which said stem must move to produce movement of said valve means.

7. The combination set forth in claim 5 wherein said last mentioned means comprises a friction member having rubbing contact with said valve means, said friction member being arranged to apply a greater restraining effect on said valve means when the valve means is at rest than when the valve means is in motion.

8. The combination set forth in claim 5 wherein said valve means is slidably mounted on said stem and said springs comprise a pair of compression springs on said stem acting against opposite ends of said valve means.

9. The combination set forth in claim 5 including a guide member in which said valve means is slidably mounted and wherein said last mentioned means comprises a rubbing element in said guide member slidably contacting said valve means and yieldably resisting movement thereof.

10. The combination set forth in claim 9 wherein said rubbing member comprises an oiling wick.

11. The combination set forth in claim 9 including means for varying the pressure with which said rubbing element contacts said valve means.

12. A fuel pump for an internal combustion engine comprising a casing, a flexible diaphragm in said casing and dividing said casing into a fuel chamber and an air chamber, said fuel chamber having a fuel inlet and a fuel outlet, said casing also including a tubular extension, a stem mounted for reciprocation in said tubular extension and connected at one end with said diaphragm, an axially reciprocable valve mounted in said tubular extension and having a sliding connection with said stem, a pair of springs each operatively connected at one end with said valve and at the opposite ends with said stem and biasing said valve in opposite directions in said tubular extension, means limiting the movement of said valve in said tubular extension in opposite directions, means forming vacuum and atmosphere passageways communicating with said air chamber, said valve in one of said extreme positions placing said air chamber in communication with a source of vacuum through said vacuum passageway and when in its other extreme position placing said air chamber in communication with atmosphere through said atmosphere passageway, and means in said tubular extension frictionally engaging said valve and yieldably resisting the movement of said valve against the force exerted on said valve by said springs.

13. The combination set forth in claim 12 wherein said springs engage opposite ends of said valve and including a threaded member on said stem for varying the tension of said springs.

14. The combination set forth in claim 13 wherein said last mentioned means comprises a spring biased member having rubbing contact with the outer surface of said valve and including means for varying the pressure with which said spring biased member bears against said valve.

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