

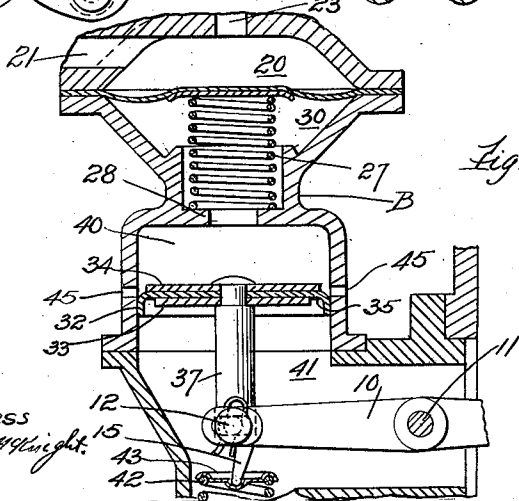
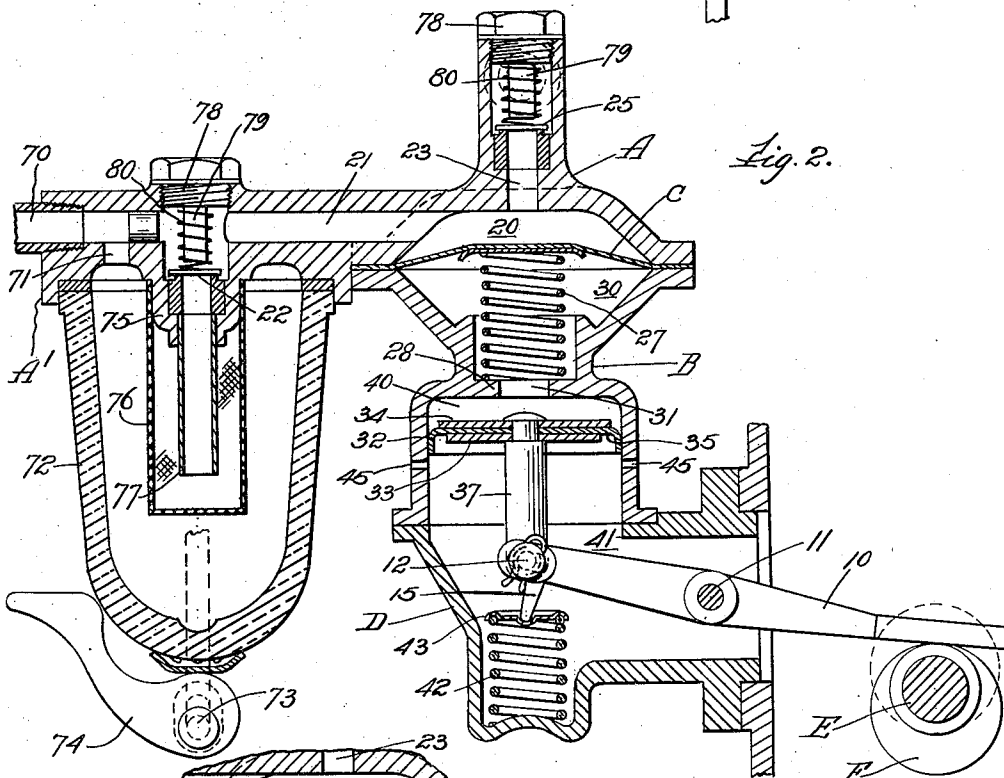
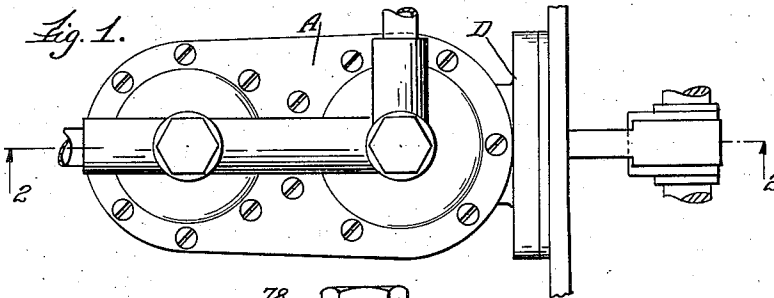
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L. H. WHEELER

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FUEL PUMP FOR INTERNAL COMBUSTION ENGINES

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Witness
H.C. Wright

Inventor
Leonard H. Wheeler.
by Burton Burton
his Attorneys.

UNITED STATES PATENT OFFICE

LEONARD H. WHEELER, OF CHICAGO, ILLINOIS, ASSIGNOR TO STEWART-WARNER CORPORATION, OF CHICAGO, ILLINOIS, A CORPORATION OF VIRGINIA

FUEL PUMP FOR INTERNAL-COMBUSTION ENGINES

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The purpose of this invention is to provide an improved construction of a pumping device for supplying fuel to an internal combustion engine in which the pumping element derives actuation from a positively actuated part through the medium of an elastically compressible fluid as atmospheric air, as distinguished from being positively actuated in either direction by the positively actuated part. The invention consists in the elements and features of construction shown and described as indicated in the claims.

In the drawings:—

Figure 1 is a top plan view of a pumping structure embodying this invention.

Figure 2 is a section at the line 2—2 on Figure 1 showing the parts in normal position of rest or as at the limit of the feeding stroke of the pumping element.

Figure 3 is a view similar to Figure 2 showing the parts in position which they may occupy at the opposite limit of the movement of the actuating lever.

Referring to the drawings for observing the structure in general, it may be understood to comprise a diaphragm pumping device having intake and discharge, and check valves controlling inflow and outflow opening for one-way flow through the pumping chamber and seating against reverse flow. The diaphragm of this pump may be seen to be stressed by a spring, 27, in the direction of its feeding stroke, and the chamber at the side of the diaphragm in which this spring is situated, being at the opposite side from the pumping chamber, will be seen to be connected with the cylinder of a piston pump of which the piston is actuated by connection with a lever which in turn is actuated by a cam on a shaft of the engine; and the means by which the piston, positively actuated by the engine cam, communicates movement to the diaphragm, consists merely of the air enclosed between the diaphragm and the piston, this movement being communicated moreover by suction and not by compression, that is, by exhausting the air from the space enclosed between the piston and the diaphragm in the positive stroke of the piston due to the cam,—the re-

turn stroke of the piston being produced by a spring reacting on the piston stem and serving at the same time to hold the lever in touch with the cam. A special characteristic of the construction may be noticed, namely that the piston cylinder is provided with air vent apertures which are passed by the piston in its suction stroke, admitting air to the piston chamber for restoring the pressure therein to atmospheric, before the return stroke of the piston which is caused by the spring mentioned. In said return stroke the air passes by the cup leather so readily that very little pressure for discharge is due to the piston return stroke, the discharge pressure being almost wholly afforded by the reaction of the spring, 27.

Referring to the drawings for details of construction:—The pump body comprises parts A and B between which the diaphragm C is clamped, the part A having the recess, 20, spanned by the diaphragm and constituting the pumping chamber, and having the intake passage, 21, controlled by the inlet check valve, 22, and discharge passage, 23, controlled by the discharge check valve, 25. The pump body member, B, has a recess, 30, facing the recess which forms the pumping chamber, 20, and which, in view of the diaphragm spanning said recess, becomes a closed air chamber. This air chamber communicates by a port, 31, with the piston chamber, 40, in which the piston, 32, is reciprocated as hereinafter described. The pump body comprises a third part, D, by which the pump body in its entirety is adapted to be mounted upon the body of the engine from which actuation of the pumping structure is to be derived, said pump body part, D, being chambered and having its chamber, 41, communicating with and constituting substantial continuation of the piston chamber and open at the end at which the structure is arranged for mounting on the engine, so that the cavity of the pump body part, D, communicates with the crank case of the engine. The piston, 32, is arranged to be actuated in one direction by a cam, F, on a cam shaft, E, through the medium of the lever, 10, fulcrumed at 11 on the end portion of the pump body member,

D, which protrudes into the crank case, and has its inner end in the crank case overhanging the cam, F, for actuation by the latter as mentioned, the opposite end of the lever being pivotally connected at 12 with the stem, 37, of the piston, 32. The pump body member, D, is provided at its lower side with a pocket for seating and positioning a coil spring, 42, having at its upper end a cap disk, 43, which reacts upon the piston, 32, through the medium of its stem and the lever 10, the latter having at the end at which it is pivoted to the piston stem a downwardly projecting lug, 15, for seating in the cap, 43, at the head of the spring to insure the maintenance of proper connection between the parts for causing the spring to react as stated.

The piston, 32, comprises disks, 33 and 34, between which there is clamped a single cup leather, 35, which has its flanged margin for giving it the cup form extending downwardly, and the lower disk, 33, is slightly less in diameter than the upper disk, 34, to permit the cup leather to yield downwardly in the up-stroke of the piston, so that it operates as a check valve seating for perfect piston action in the down-stroke of the piston and yielding to permit the fluid above to pass it in the up-stroke of the piston. At a point in the length of the piston chamber toward the lower limit of the stroke of the piston there are formed atmosphere vents, 45, which are passed by the piston in its down-stroke in which it operates positively for suction, that is, producing a rarefied condition of the air above it in the piston chamber and in the air chamber, 30, below the diaphragm, so that when in this down-stroke the piston passes the atmosphere vent ports, the vacuum produced above the piston in that stroke is relieved by the entrance of air through said ports and the diaphragm, C, which has been flexed downwardly in said suction stroke of the piston, is relieved from the suction and left free to be returned for its feeding stroke by the reaction of a spring, 27, seated at its lower end on the partition, 28, between the air chamber, 30, and the piston chamber, 40, around the port, 31. And it will be observed that in the return stroke of the piston caused by the spring, 42, the air between the diaphragm and the piston is forced past the piston and the pressure in the piston chamber below the piston and in the cavity of the pump body part, D, will be substantially atmospheric, and that this return stroke of the piston will not operate to any material extent for giving the diaphragm its feeding stroke so that that stroke will be given by the stress only of the spring, 27. And it will be understood that the air taken in through the atmosphere vent ports, 45, will mainly be driven into the crank case, but that opportunity is afforded for relieving any pressure thus produced in the crank case by the up-

stroke of the piston passing the atmosphere vent ports, 45, so that the connection of the device with the engine crank case has no tendency to interfere with the operation of the engine.

The drawings show the pump body part, A, having formed integrally with it a part, A¹, which extends off horizontally at and above the parting plane between the pump parts, A and B, said extension, A¹, having the fuel intake connection and intake valve, and having mounted on it the parts constituting a familiar form of strainer or filter for the fuel through which it passes before entering the pumping chamber. This construction is familiar, but for the identification of the several parts may be further described in detail as follows: A bored and tapped passage, 70, affords connection for a fuel pipe leading from the fuel source. A port, 71, opening from the passage, 70, admits the fuel to the fuel cup, 72, which is clamped to the part, A¹, by the yoke, 73, operated for tightening by a cam lever, 74. A boss, 75, projecting downwardly from the part, A¹, serves for mounting the strainer or filter member, 76, which depends in the cup, 72, and the part, A¹, is bored from the upper end in line with said boss, the bore being counterbored at the upper end to within a short distance of the lower end of the boss to afford a valve seat, and a pipe member, 77, is joined to the boss at the lower end protruding up slightly into the counterbore to form by its upper end the seat for the inlet check valve, 22, above mentioned, a plug, 78, being screwed into the upper end of the counterbore having a central pin, 79, projecting downward for stopping the opening movement of the check valve at a proper distance from its seat. A spring, 80, is interposed around the pin between the check valve and the head of the plug for reacting on the spring to insure its normal seating. The intake passage, 21, above mentioned extends in part, A¹, to the counterbore through which the fuel passing the check valve, 22, reaches said intake passage, 21.

Upon considering the operation of this construction it will be seen that the feeding stroke of the diaphragm pump, being effected by the reaction of the spring, 27, may be limited by the adjustment of the spring as to length and tension, so that the carbureter will not be exposed to excessive pressure, and it will be observed that the suction or fuel lifting stroke of the diaphragm is produced by a suction stroke of the piston. The purpose of this arrangement is to obviate the defect in certain other types of fuel feeding apparatus due to the fact that the rapid succession of the piston strokes which are positively caused by the cam on the engine shaft in not exceeding one-half of the revolution of said shaft will not ordinarily be respond-

ed to by the instant and corresponding movement of the liquid, due to its inertia and the friction in the passages through which it must move from the source to the pumping chamber. Accordingly, positive connection between the positively actuating means and the pumping member, whether it be a diaphragm or piston, as found in certain other types, is liable to be rapidly destructive of the operative parts, and, in any event, is effective for lifting the fuel only for a very small portion of each positive stroke. By the interposition of the elastic means of communicating the suction stroke consisting in the air which is exhausted by the suction stroke,—which is the positive stroke,—of the piston, the force exerted by the action of the cam on the lever and thereby on the piston may be said to be “trapped” in the air space between the piston and the diaphragm in which the condition of partial vacuum is produced by the suction stroke of the piston, and this trapped force, reacting during the return stroke of the piston, has time to overcome the inertia of the fuel and to cause it to move through the passages leading to the pumping chamber. Thus there is obtained for movement of the fuel the entire time of the suction stroke.

I claim:

1. In a pump for supplying fuel to an internal combustion engine, in combination with a casing having two cavities in communication with each other; a flexible diaphragm partitioning one of said cavities to form at one side of the diaphragm a pumping chamber, and at the opposite side an air chamber; a spring reacting on said opposite side of the diaphragm to hold the latter normally flexed in the direction for reducing the pumping chamber and enlarging the air chamber, the pumping chamber having inflow and outflow passages and valves controlling them respectively, for one-way flow through the pumping chamber; the second cavity comprising a piston chamber, the communication mentioned being between the air chamber and said piston chamber; a piston reciprocally mounted in the piston chamber; a spring reacting on the piston in the direction for holding it normally intrust in the piston chamber toward the air chamber; means for positively retracting the piston in opposition to said spring away from the air chamber for exhausting the latter of air through the communication between the two chambers, and retracting the diaphragm in pumping chamber enlarging direction, the piston chamber having an atmospheric vent port past which the piston is retracted in said positive stroke; whereby the piston chamber and the air chamber are vented and the diaphragm is thrust by its spring in pumping chamber reducing and fuel feeding direction.

2. In the construction defined in claim 1,

the piston being constructed for limited passage of air past it in its spring-caused thrust toward the air chamber and for positive forcing of the air in its opposite stroke, the casing being arranged to be mounted on the engine crank case, and with the cavity which comprises the piston chamber communicating with the interior of the crank case, whereby air entering the piston chamber through the vent ports is forced into the crank case.

3. In a construction for the purpose indicated, a diaphragm pump comprising casing members, and a diaphragm clamped between them, the casing member at one side of the diaphragm having a recess spanned by the diaphragm forming the pumping chamber, said chamber having fuel inflow and outflow connections valve-controlled for one-way flow of the fluid pumped through the pumping chamber, the casing member at the opposite side having a recess spanned by the diaphragm constituting an air chamber, and a pump connected for exhausting the air from the air chamber for giving the diaphragm its suction stroke, and a spring reacting on the pump diaphragm in the same direction as the air pressure from the air pump, the air pump being arranged to withdraw air from the air chamber into the air pump in the early part of the suction stroke of the air pump for producing vacuum in the air chamber of the diaphragm pump in that part of its stroke, the air pump having an atmospheric vent which is uncovered in the latter part of the piston stroke to relieve the vacuum in the air pump chamber and in the air chamber of the diaphragm pump, permitting the diaphragm spring to react on the diaphragm for giving it its pumping stroke free from restraint due to vacuum developed in the early part of the stroke.

4. A construction for the purpose indicated comprising casing members and a diaphragm clamped between them, the casing member at one side of the diaphragm having a recess spanned by the diaphragm forming the pumping chamber, said chamber having fuel inflow and outflow connections valve-controlled for one-way flow of the fluid pumped through the pumping chamber, the casing member at the opposite side having a recess spanned by the diaphragm constituting an air chamber, the second mentioned casing member having a piston chamber in free communication with the air chamber of the diaphragm pump, and a piston reciprocally mounted in said piston chamber for movement toward and from the end of the piston chamber at which it communicates with the air chamber, said piston being constructed and arranged for piston fit in the chamber in its stroke away from the air chamber port, and for relatively free movement of air past it in the opposite stroke; whereby its reciprocation operates for suc-

tion on the diaphragm; means mounted in the casing connected with the piston for positive actuation of the piston in the direction of said piston fit, and a spring reacting on the piston for its return stroke.

5 5. In a fuel pumping apparatus for supplying an internal combustion engine, a diaphragm pump comprising a pumping chamber and an air chamber, a flexible diaphragm separating the two chambers, said pump being connected for deriving fuel by suction from the lower source and delivering it by pressure to the engine; means for giving the diaphragm its suction movement consisting of a piston suction pump having its intake connected with the air chamber of the diaphragm pump, and means for reciprocating the piston, the piston operating means of the piston pump being arranged for positive actuation of the piston in its intake stroke, and the piston chamber being co-operatively constructed for passing the air by the piston in the return movement of the latter from the intake stroke.

25 6. In a fuel pumping apparatus for supplying an internal combustion engine, a diaphragm pump comprising a pumping chamber and an air chamber, a flexible diaphragm separating the two chambers, said pump being connected for deriving fuel by suction from a lower source and delivering it by pressure to the engine; means for giving the diaphragm its suction movement consisting of a piston suction pump having its intake connected with the air chamber of the diaphragm pump, and means for reciprocating the piston, the piston being provided with only one cup leather for its piston fit in the cylinder, said cup leather having its marginal flange turned in the direction of the intake stroke of the piston, whereby the suction action of that stroke is positive, and the air by-passes the piston in the opposite stroke.

45 7. In a fuel pumping apparatus for supplying an internal combustion engine, a diaphragm pump comprising a pumping chamber and an air chamber, a flexible diaphragm separating the two chambers, said pump being connected for deriving fuel by suction from a lower source and delivering it by pressure to the engine; means for giving the diaphragm its suction movement consisting of a piston suction pump having its intake connected with the air chamber of the diaphragm pump, and means for reciprocating the piston, the piston chamber of the piston pump having an atmospheric vent at a point in the piston's path which is passed by the piston in the latter part of the intake stroke, whereby the vacuum developed in said intake stroke is released at the finish of the stroke.

80 8. In a fuel pumping apparatus for supplying an internal combustion engine, a diaphragm pump comprising a pumping chamber and an air chamber, a flexible diaphragm

separating the two chambers, said pump being connected for deriving fuel by suction from a lower source and delivering it by pressure to the engine; means for giving the diaphragm its suction movement consisting of a piston suction pump having its intake connected with the air chamber of the diaphragm pump, and means for reciprocating the piston, the piston operating means of the piston pump being arranged for positive actuation of its piston in the intake stroke, and said piston and piston chamber being co-operatively constructed for passing the air by the piston in the return movement of the latter from its intake stroke, and resilient means for giving the piston its return stroke.

9. In a fuel pumping apparatus for supplying an internal combustion engine, a diaphragm pump comprising a pumping chamber and an air chamber, a flexible diaphragm separating the two chambers, said pump being connected for deriving fuel by suction from a lower source and delivering it by pressure to the engine; means for giving the diaphragm its suction movement consisting of a piston suction pump having its intake connected with the air chamber of the diaphragm pump, and means for reciprocating the piston, the piston being provided with only one cup leather for its piston fit in the cylinder, said cup leather having its marginal flange turned in the direction of the intake stroke, whereby the suction action of that stroke is positive, and the air by-passes the piston in the opposite stroke, and resilient means for giving the piston its said opposite air return stroke.

10. In a fuel pumping apparatus for supplying an internal combustion engine, a diaphragm pump comprising a pumping chamber and an air chamber, a flexible diaphragm separating the two chambers, said pump being connected for deriving fuel by suction from a lower source and delivering it by pressure to the engine; means for giving the diaphragm its suction movement consisting of a piston suction pump having its intake connected with the air chamber of the diaphragm pump, and means for reciprocating the piston, the piston chamber of the piston pump having an atmospheric vent at a point in the piston's path which is passed by the piston in the latter part of its intake stroke, whereby the vacuum developed in said intake stroke is released at the finish of said stroke, the piston operating means of the piston pump being arranged for positive actuation of the piston in its intake stroke, and said piston and the piston chamber being co-operatively constructed for passing the air by the piston in the return movement of the latter in its intake stroke.

11. In a fuel pumping apparatus for supplying an internal combustion engine, a diaphragm pump comprising a pumping cham-

ber and an air chamber, a flexible diaphragm separating the two chambers, said pump being connected for deriving fuel by suction from a lower source and delivering it by pressure to the engine; means for giving the diaphragm its suction movement consisting of a piston suction pump having its intake connected with the air chamber of the diaphragm pump, and means for reciprocating the piston, the piston chamber of the piston pump having an atmospheric vent at a point in the piston's path which is passed by the piston in the latter part of its intake stroke, whereby the vacuum developed in said intake stroke is released at the finish of said stroke, the piston operating means of the piston pump being arranged for positive actuation of the piston in its intake stroke, and said piston and the piston chamber being co-operatively constructed for passing the air by the piston in the return movement of the latter in its intake stroke, and resilient means for giving the piston its return stroke.

12. In a pump for supplying fuel to an internal combustion engine, in combination with a casing having two cavities in communication with each other, a flexible diaphragm partitioning the first of said cavities to form at one side of the diaphragm a pumping chamber and at the other side an air chamber, the second cavity comprising a piston chamber, the communication mentioned being between the air chamber and said piston chamber; a spring reacting on the diaphragm conditioned for holding it normally flexed in the fuel discharge direction; a second spring reacting on the piston conditioned for holding the piston normally in thrust in the piston chamber toward the chamber; means for positively retracting the piston in opposition to said second spring for exhausting the air chamber and thereby giving the diaphragm its fuel intake movement against the reaction of the first spring, the piston being formed for air movement past it in its opposite stroke; whereby the successive strokes of the piston operate for building up the reaction of the first spring on the diaphragm for the fuel feeding action of the latter.

In testimony whereof, I have hereunto set my hand at Chicago, Illinois, this 9th day of November, 1928.

LEONARD H. WHEELER.

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