

Dec. 15, 1936.

M. HURST

2,064,750

PISTON PUMP FOR THE CONVEYANCE OF LIQUIDS

Filed April 8, 1933

2 Sheets-Sheet 1

Fig. 1

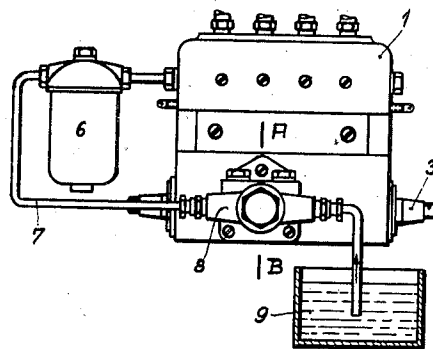
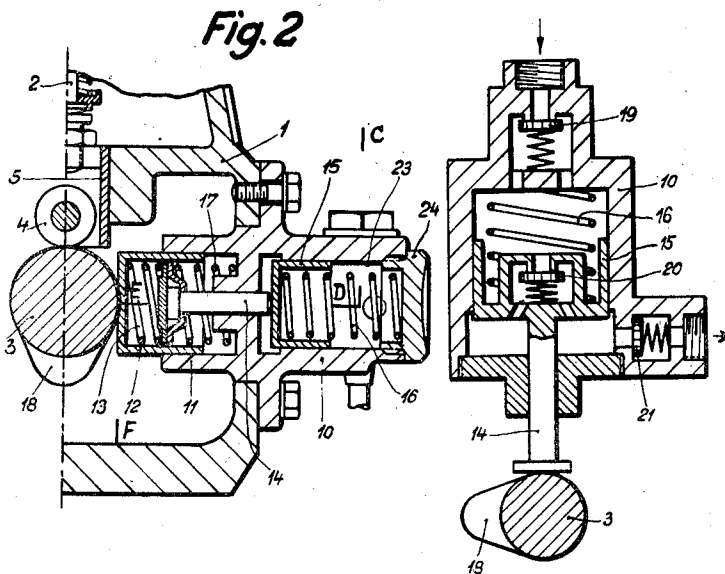


Fig. 6

Fig. 2



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2 Sheets-Sheet 2

Fig. 3

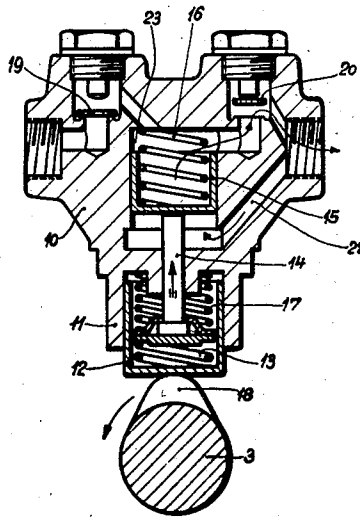


Fig. 4

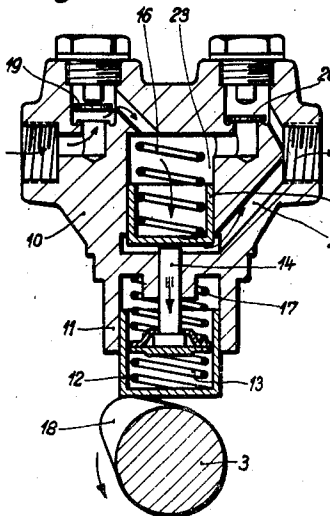
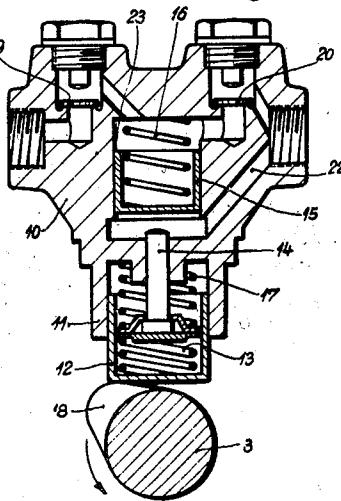


Fig. 5



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UNITED STATES PATENT OFFICE

2,064,750

PISTON PUMP FOR THE CONVEYANCE
OF LIQUIDS

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Application April 8, 1933, Serial No. 665,228
In Germany April 23, 1932

16 Claims. (Cl. 103—37)

The present invention relates to piston pumps for the conveyance of liquids and more especially for conveying fuel to the carbureter or the injection pump of an internal combustion engine, in which the pump piston is driven by a driving means arranged outside the fuel-conveying spaces, and is controlled by at least one movable transmission member which acts indirectly or directly on the piston. The invention has for its object to construct the conveying pump in such a way that no air can enter through the place where the transmission member passes into the fuel-conveying chambers, so that a satisfactory and reliable operation of the internal combustion engine is ensured.

For this purpose, according to the invention, both sides of the piston are exposed to the liquid (fuel), and the arrangement of the pump is such that those chambers of the pump whose wall is traversed by a movable member of the drive acting from outside are permanently maintained by the liquid conveyed under a pressure corresponding substantially to the excess pressure in the conveying pipe.

Two examples of construction of the invention are shown in the drawings, in which:—

Figure 1 shows an injection pumping plant for Diesel engines having a conveying pump constructed in accordance with the invention.

Figure 2 shows the first example of construction of the conveying pump in longitudinal section on the line A—B of Fig. 1.

Figures 3, 4 and 5 show the same pump in different working positions, and in section on the line C—D—E—F of Fig. 2.

Figure 6 is a diagrammatic longitudinal section of the second example of construction of the conveying pump.

1 is an injection pump of known construction having four separate pumps, the pump pistons 2 (Fig. 2) of which are lifted as usual by the cam-shaft 3 mounted in the casing of the injection pump through plunger or tappet rollers 4 and plungers 5. The injection pump draws fuel from a filter 6 arranged in advance of it, the inlet side of which is connected through a pipe 7 with the pressure side of a conveying pump 8. This latter draws fuel from the main storage receptacle 9 arranged below it. The conveying pump is flanged to one long side of the injection pump, and in such a way that it lies transversely to its cam-shaft 3 (Fig. 2). The pump body 10 of the conveying pump projects with a tubular extension 11 into the interior of the injection pump. A plunger 12 is guided in the extension

11, and acts on the piston 15 of the conveying pump through a strong spring 13 and a push-rod 14 which passes through into the pump body 10 from the outside. The piston is guided in a passage 23 in the pump body 10 through the bottom of which the push-rod 14 extends co-axially with the passage. The open end of this passage is closed in a liquid-tight manner by a screw-cap 24. At least one back pressure spring 16 acts on the piston 15 and has a tendency to press it against the front end of the push-rod. The plunger 12 and the push-rod 14 are pressed constantly against the driving cam 18 by a common spring 17 bearing between the pump body and the outer head of the push-rod, and the cam serves at the same time also for driving a pump piston 2 of the injection pump 1. In the pump casing 10 a suction valve 19 and a pressure valve 20 are arranged on the side of the piston remote from the push-rod (see Figs. 3–5). The movable members of these valves are formed as plates, which without valve springs simply bear on their seat owing to their own weight. A passage 22 connects the outlet side of the pressure valve with the other side of the piston.

The conveying pump described works as follows:—

On the rotation of the cam-shaft 3 of the injection pump the conveying pump 8 is simultaneously operated by the driving cam 18. Its plunger 12 is moved by the driving cam against the action of the spring 17 and the piston spring 16 into the interior of the pump body 10, as is shown in Fig. 3 by feathered arrows. The movement of the plunger is at the same time transmitted by the push-rod 14 to the piston 15. In this operation, fuel in the pump chamber between the suction valve 19 and the pressure valve 20 is conveyed through the pressure valve 20 when the suction valve is closed. A part of this fuel fills at the same time through the passage 22 that chamber which is freed on the lower side of the piston. This chamber is smaller by the stroke volume of the push-rod than the quantity of fuel pumped through the pressure valve. The quantity of fuel corresponding to this stroke volume is thus forced through the pump outlet into the pipe 7 leading to the filter 6. On the return stroke effected by the two springs 16 and 17, the upper side of the piston draws fresh fuel from the main storage container 9 through the suction valve 19, whilst the lower side of the piston forces the quantity of fuel received in its pump chamber on the preceding stroke by the

passage 22 through the outlet into the pipe 7, as is shown by the unfeathered arrows in Fig. 4.

If the quantity of fuel delivered by the conveying pump to its outlet in a certain period of time is greater than the fuel consumption of the internal combustion engine (for example, when running idle), the pressure then increases behind the pressure valve 20, and thus also on the lower side of the piston, until the back pressure exerted on the rear face of the piston 15 exceeds the pressure of the piston spring 16. As soon as this condition is reached, the spring 16 cannot fully return the piston 15 any longer, as is shown for example in Fig. 5. The quantity conveyed by the conveying pump thus adapts itself automatically to the fuel consumption of the engine.

The spring 13 provided between the head of the push-rod 14 and the bottom of the plunger 12 serves as a buffer, and is of such strength that it cannot be compressed during normal working. This spring thus prevents the transmission of shocks and the like to the push-rod 14 and so to the piston 15.

In the second form of conveying pump, shown in Fig. 6, the piston 15 works through two spring-loaded pressure valves 20 and 21, the first of which is arranged in the piston coaxially with the suction valve 19, which is also spring-loaded, and with the push-rod 14. The push-rod is here made integral with the piston.

The mode of action of this pump is essentially the same as that of the conveying pump first described. On the downward movement of the piston, which is effected by the back pressure spring 16, fuel is drawn through the valve 19 from the upper side of the piston 15, whilst the fuel on the lower side of the piston is forced away through the second pressure valve 21 arranged in the pump body 10. The pressure valve 20 provided in the piston is at the same time closed. As soon as the driving cam 18 acts on the head of the push-rod 14, the piston is moved against the pressure of the spring 16 into the interior of the pump. During this action the suction valve 19 remains closed, whilst the fuel in front of the piston is pressed through the first pressure valve arranged in the piston and into the chamber below the piston.

It is common to both constructions of the conveying pump that on the side of the piston 15 towards the push-rod 14 an excess pressure relative to the external surroundings of the pump prevails both on the outward stroke and also on the inward stroke. In this way air is prevented from penetrating along the push-rod into the conveying pump.

The second pressure valve 21 provided in Fig. 6 may also be omitted without anything being essentially altered in the action of the pump.

I declare that what I claim is:

1. A piston pump for conveying liquids comprising a pump casing having an inlet passage and an outlet passage, a piston reciprocable in said casing, driving means adapted to loosely engage and positively displace said piston in one direction only, resilient means for displacing the piston in the other direction, a suction valve controlling said inlet passage and communicating with that side of the piston remote from the driving means and a discharge valve communicating at all times with the outlet passage and with the side of the piston adjacent to the driving means, said resilient means yielding to permit said piston to become substantially inop-

erative when the pressure created by said pump reaches a predetermined degree.

2. A piston pump for conveying liquids comprising a pump casing having an inlet passage and an outlet passage, a piston reciprocable in said casing, driving means adapted positively to displace said piston in one direction only, a transmission member located between said driving means and the piston and extending into said casing to loosely engage one side of the piston, resilient means for displacing the piston in the other direction, a suction valve controlling the inlet passage and communicating with that side of the piston remote from the driving means and a discharge valve communicating with the outlet passage and with that side of the piston engaged by said transmission member, said resilient means yielding to permit said piston to become substantially inoperative when the pressure created by said pump reaches a predetermined degree.

3. A piston pump for conveying liquids comprising a pump casing having an inlet passage and an outlet passage, a piston reciprocable in said casing, driving means adapted positively to displace said piston in one direction only, a transmission member located between said driving means and the piston and extending into said casing to loosely engage one side of the piston, means for displacing the piston non-positively in the other direction, a suction valve controlling the inlet passage and communicating with that side of the piston remote from the driving means and a discharge valve communicating with the outlet passage and with that side of the piston engaged by said transmission member, the means for displacing the piston non-positively yielding to permit said piston to become substantially inoperative when the pressure created by said pump reaches a predetermined degree.

4. A piston pump for conveying liquids comprising a pump casing having an inlet passage and an outlet passage, a piston reciprocable in said casing, driving means adapted positively to displace said piston in one direction only, a transmission member located between said driving means and the piston and extending into said casing to loosely engage one side of the piston, loading means opposed to said driving means and adapted to cause displacement of the piston in the other direction, a suction valve controlling the inlet passage and communicating with that side of the piston remote from the driving means and a discharge valve communicating with the outlet passage and with that side of the piston engaged by said transmission member, said loading means yielding to permit said piston to become substantially inoperative when the pressure created by said pump reaches a predetermined degree.

5. A piston pump for conveying liquids comprising a pump casing having an inlet passage and an outlet passage, a piston reciprocable in said casing, driving means adapted positively to displace said piston in one direction only, a transmission member located between said driving means and the piston and extending into said casing to engage one side of the piston, a resilient buffer interposed between said transmission member and said driving means, a suction valve controlling the inlet passage and communicating with that side of the piston remote from the driving means and a discharge valve communicating with the outlet passage and with that side of the piston engaged by said transmission member.

6. A piston pump for conveying liquids comprising a pump casing having an inlet passage and an outlet passage, a piston reciprocable in said casing, driving means reciprocable through a wall of said pump casing and adapted positively to displace said piston in one direction only, resilient means for displacing the piston in the other direction, a suction valve communicating with the induction side of the piston and a discharge valve mounted on the piston and communicating at all times with both sides of the piston and with said outlet passage, said resilient means yielding to permit said piston to become substantially inoperative when the pressure created by said pump reaches a predetermined degree.

7. A piston pump for conveying liquids comprising a pump casing having an inlet passage and an outlet passage, a piston reciprocable in said casing, driving means adapted positively to displace said piston in one direction only, a transmission member located between said driving means and the piston and extending into said casing to engage one side of the piston, resilient means for displacing the piston in the other direction, a suction valve controlling the inlet passage and communicating with that side of the piston remote from the driving means and a discharge valve mounted on the piston and communicating at all times with the outlet passage and with that side of the piston engaged by said transmission member, said resilient means yielding to permit said piston to become substantially inoperative when the pressure created by said pump reaches a predetermined degree.

8. A pump comprising a pump casing having an inlet and a discharge, valves controlling said inlet and discharge, a piston reciprocable in said casing, said inlet communicating with one side of said piston and said discharge communicating with both sides of said piston, resilient means for moving the piston in one direction, and means including a push rod reciprocable through a wall of said pump casing and loosely connected to the piston for moving it in the opposite direction, said resilient means yielding to permit said piston to become substantially inoperative when the pressure created by said pump reaches a predetermined degree.

9. A piston pump for conveying liquids comprising a pump casing having an inlet passage and an outlet passage, a piston reciprocable in said casing, driving means adapted positively to displace said piston in one direction only, a transmission member located between said driving means and said piston and extending into said casing to loosely engage one side of said piston, resilient means urging said transmission member into contact with said driving means, resilient means for displacing the piston in the other direction, both of said resilient means tending to move said piston and transmission member in the same direction, a suction valve controlling the inlet passage and communicating with that side of the piston remote from the driving means, and a discharge valve communicating with the outlet passage and with that side of the piston engaged by said transmission member.

10. In a pump structure, in combination, a cylinder having an inlet adapted to be connected with a source of supply and an outlet adapted to be connected with a point of use, check valves for said inlet and outlet, a piston reciprocable in said cylinder and adapted to discharge liquid therefrom, resilient means constantly urging said

piston in a direction to discharge fluid through said outlet, and a plunger reciprocable independently of said piston projecting into said cylinder, said plunger adapted to move said piston against the urge of said resilient means when in contact with said piston and when moving in opposition to said resilient means, and being of a size sufficient to displace a material amount of fluid from said cylinder through said outlet during movement toward and when free of contact with said piston.

11. In a pump structure, in combination, a cylinder having an inlet adjacent one end and an outlet adjacent the other end, a piston reciprocable between said inlet and outlet, spring means constantly urging said piston in a direction to discharge fluid through said outlet, a check valve in said inlet preventing reversal of flow therethrough, a bypass between opposite ends of said piston and communicating with said outlet, a check valve in said bypass opening toward said outlet, and means at the outlet end of said piston movable relative thereto for moving said piston against the force of said spring means and reducing the effective cross sectional area thereof subject to the pressure of fluid at said end, whereby movement of said piston toward the inlet end of said cylinder will displace a greater volume of fluid through said bypass to the outlet end of said cylinder than the volume simultaneously created at said outlet end by said movement of said piston.

12. In a pump structure, in combination, a cylinder having an inlet adjacent one end and an outlet adjacent the other end, a piston reciprocable between said inlet and outlet, spring means constantly urging said piston in a direction to discharge fluid through said outlet, a check valve in said inlet preventing reversal of flow therethrough, a bypass between opposite ends of said piston and communicating with said outlet, a check valve in said bypass permitting flow therethrough only in the direction of said outlet, and means at the outlet end of said piston movable relative thereto for moving said piston against the force of said spring means, said means including a member reducing the effective cross sectional area of said piston subject to the pressure of fluid at said end, whereby movement of said piston toward the inlet end of said cylinder will displace a greater volume of fluid through said bypass to the outlet end of said cylinder than the volume simultaneously created at said outlet end by said movement of said piston.

13. In a pump structure, in combination, a cylinder having an inlet adjacent one end and an outlet adjacent the other end, a piston reciprocable between said inlet and outlet, spring means constantly urging said piston in a direction to discharge fluid through said outlet, a check valve in said inlet preventing reversal of flow therethrough, a bypass in said piston between opposite ends thereof and communicating with said outlet, a check valve in said bypass permitting flow therethrough only in the direction of said outlet, driving means movable independently of said piston for moving said piston against the action of said spring means, and a transmission member between said driving means and said piston reducing the effective cross-sectional area of the outlet end of said piston whereby movement of said piston toward the inlet end of said cylinder will displace a greater volume of fluid through said bypass to the outlet end of said cylinder than the volume simultaneously created at

said outlet end by said movement of said piston.

14. In a pump structure, in combination, a cylinder having an inlet adjacent one end and an outlet adjacent the other end, a piston reciprocable between said inlet and outlet, means urging said piston toward the outlet end of said cylinder, a check valve in said inlet preventing reversal of flow therethrough, a bypass between opposite ends of said piston and communicating with said outlet, a check valve in said bypass opening toward said outlet, and a member at the outlet end of said piston engageable therewith to move it against the force of said means and reducing the effective cross-sectional area of said piston subject to the pressure of fluid at said end, whereby movement of said piston toward the inlet end of said cylinder will displace a greater volume of fluid through said bypass to the outlet end of said cylinder than the volume simultaneously created at said outlet end by said movement of said piston, said member being movable independently of said piston whereby when it is moving relative to and toward said piston it acts to displace fluid from said outlet end of said cylinder.
15. In a pump structure, in combination, a housing providing a cylinder having an inlet adjacent one end and an outlet adjacent the other end, a piston reciprocable between said inlet and outlet, spring means constantly urging said piston in a direction to discharge fluid through said outlet, a check valve in said inlet preventing reversal of flow therethrough, a bypass in said housing between opposite ends of said piston and

communicating with said outlet, a check valve in said bypass opening toward said outlet, a member reciprocable independently of said piston engageable therewith for moving it in one direction against the action of said spring means, said member reducing the effective cross sectional area of the outlet end of said piston whereby movement of said piston toward the inlet end of said cylinder will displace a greater volume of fluid through said bypass to the outlet end of said cylinder than the volume simultaneously created at said outlet end by said movement of said piston, and means for positively moving said member in at least one direction.

16. In a pump structure, in combination, a cylinder having an inlet and an outlet, a check valve for said inlet, a piston reciprocable in said cylinder and adapted to discharge liquid therefrom, resilient means constantly urging said piston in a direction to discharge fluid from said cylinder through said outlet, a plunger of a diameter different from said piston projecting into said cylinder and adapted to abut and move said piston against the action of said resilient means, said plunger being reciprocable independently of said piston and adapted to displace a material amount of liquid from said cylinder through said outlet when moving toward abutting relation with respect to said piston, and means including a check valve opening toward said outlet for passing fluid in said cylinder from the inlet thereof to the outlet thereof.

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