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FLUID PUMP

Filed Oct. 10, 1960

Fig. 1

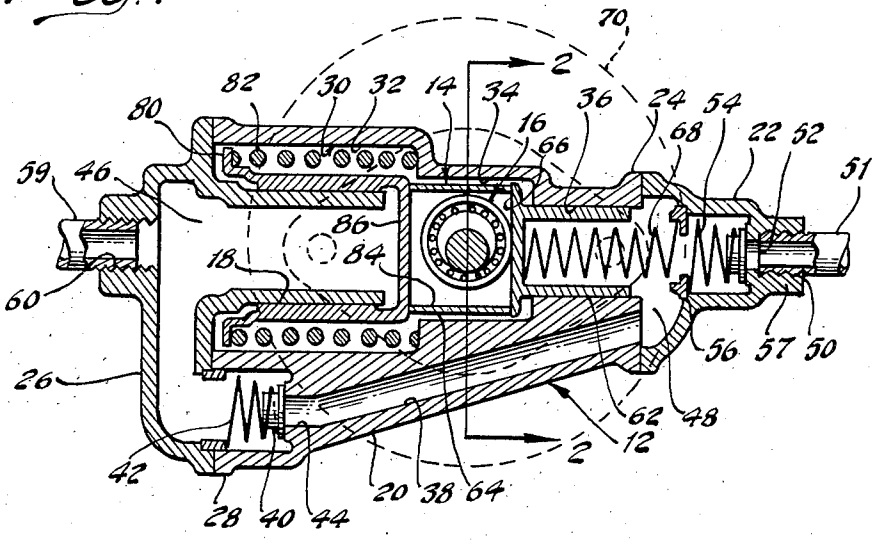


Fig. 2

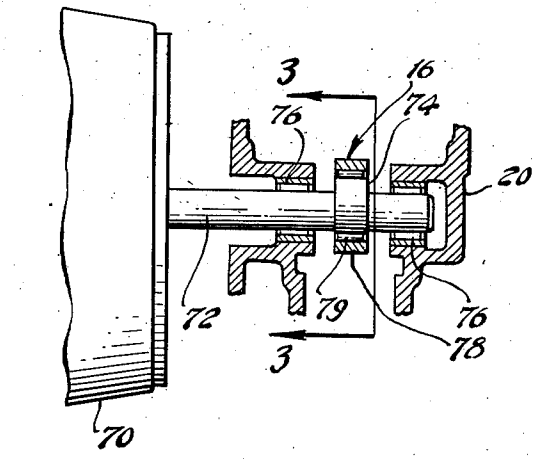
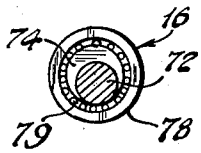


Fig. 3



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FLUID PUMP

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The invention relates to pumps and refers more specifically to a positive displacement, constant pressure, variable volume, fluid pump including a reciprocal piston combination accumulator and fuel flow limiter.

In the past, the supply of high pressure fuel to systems such as shuttle piston fuel injection systems has been accomplished through the use of two separate pumps. The two pumps previously required in such systems were a boost pump usually of the centrifugal type mounted at a supply reservoir and generally driven by an electric motor and a second high pressure, generally piston type pump and operating motor therefor. The use of two separate pumps in such installations is wasteful of space and adds additional weight to the mechanism in which the pumps are installed in addition to being uneconomical in the use of production facilities and materials.

It is therefore one of the objects of the present invention to provide an improved, simplified, positive displacement, constant pressure, variable volume pump operable in itself to supply fluid under a high pressure to systems such as shuttle piston fuel injection systems.

Another object is to provide a pump including a pumping piston, means for reciprocating the pumping piston in pumping and suction strokes, and means for maintaining the pressure output from the pump substantially constant.

Another object is to provide a pump as set forth above wherein the means for reciprocating the pumping piston comprises an eccentric cam mounted on a rotatable shaft.

Another object is to provide a pump as set forth above wherein the means for maintaining the pressure output from the pump substantially constant comprises a reciprocal piston acting as both an accumulator and a fuel flow limiter.

Another object is to provide a pump as set forth above wherein the pumping piston, reciprocating means therefor and accumulator piston are in line axially of the pump.

Other objects and features of the invention will become apparent as the description proceeds especially when taken in conjunction with the accompanying drawings, illustrating a preferred embodiment of the invention, wherein:

FIGURE 1 is a longitudinal section of a fluid pump constructed in accordance with the invention.

FIGURE 2 is a partial longitudinal section of the pump illustrated in FIGURE 1 taken on the line 2—2 in FIGURE 1.

FIGURE 3 is a cross section of the means for reciprocating the pumping piston taken on the line 3—3 in FIGURE 2.

With particular reference to the figures, a specific embodiment of the present invention will now be disclosed.

The pump 10 illustrated best in FIGURE 1 is a positive displacement, constant pressure, variable volume, fluid pump. Pump 10 comprises housing 12 and reciprocal pumping piston 14, actuating means 16 for pumping piston 14, and the accumulator piston 18 positioned in line axially within the housing 12 as illustrated.

More specifically, the housing 12 includes the central body member 20 housing the pumping piston 14, the actuating means 16, and the accumulator piston 18. In addition, an inlet portion 22 of housing 12 is secured to the end 24 of the central body member 20 by convenient means not shown. The accumulator portion 26 of the housing 12 is secured to the other end 28 of the central

body member 20 of housing 12 also by convenient means not shown.

The central body member 20 is shaped as shown in FIGURE 1 and includes the axial passage 30 extending therethrough having radial offsets therein providing the stepped recesses 32, 34 and 36. The central body member 20 further includes the passage 38 extending therethrough axially inclined with respect to the passage 30 through which fuel is pumped to the accumulator chamber 46 from the pumping chamber 48. The check valve 40 and spring 42 cooperating therewith in the usual manner is provided to close the end 44 of the passage 38 when the pressure of the fuel within the accumulator chamber 46 is greater than that in the pumping chamber 48.

The inlet portion 22 of the housing 12 is provided with means such as the threads 50 to which a fuel inlet conduit 51 may be secured. A check valve 52 is also provided in inlet portion 22 of housing 12 operable in conjunction with the spring 54 held in position by ring 56 to close the end 57 of the inlet housing 22 during the pumping stroke of the pumping piston 14 and to permit entry of fuel into the pumping chamber 48 from the fuel conduit 51 during the suction stroke of the pumping piston 14 as will be understood by those in the art.

The accumulator portion 26 of the housing 12 is shaped as shown best in FIGURE 1 and includes the cylindrical portion 58 over which the accumulator piston 18 is sleeved for reciprocal movement in surface to surface contact therewith. The portion 26 of the housing 12 is further provided with means for securing outlet conduit 59 thereto such as threads 60.

Pumping piston 14 includes the oppositely faced portions 62 and 64 having a common base 66 reciprocally mounted within the recesses 34 and 36 of the central body member 20. Portion 62 of piston 14 is in surface to surface contact with recess 36 as shown in FIGURE 1. The pumping piston 14 is biased toward the actuating means 16 therefor by spring 68 acting between the ring 56 and the common base 66 as shown.

The actuating means 16 for the pumping piston 14 is shown best in FIGURES 2 and 3. The actuating means 16 includes the motor 70 for rotating the shaft 72 having the eccentric cam 74 thereon. Shaft 72 is journaled for rotation in the bearings 76. As shown best in FIGURE 3, the eccentric cam 74 acts against bearings 79 which are held between the cam 74 and the retaining ring 78 therefor. The retaining ring 78 is in contact with the base 65 of the pumping piston 14. Thus, on rotation of the shaft 72, the eccentric cam 74 in conjunction with the bias spring 68 causes the pumping piston 14 to reciprocate within the stepped recesses 34 and 36.

The accumulator piston 18 is a cup shaped member as shown best in FIGURE 1 having a radially outwardly extending annular flange 80 at the open end thereof. The accumulator piston 18 is sleeved upon the cylindrical portion 58 of the accumulator part of the housing 12 in surface to surface contact therewith as previously indicated and is biased toward the accumulator portion 26 of the housing 12 by means of the spring 82 within the stepped recess 32 as shown.

The accumulator piston 18 operates in conjunction with the spring 82 to maintain the fluid output pressure from the pump substantially constant as will be understood by those in the art. In addition, the accumulator piston 18 contacts the open end 84 of the portion 64 of the pumping piston 14 during periods of low fuel demand to limit the volume of fuel pumped by the puming piston 14.

In operation, as the eccentric cam 74 rotates to permit the spring 68 to move the pumping piston 14 toward the accumulator piston 18 in a suction stroke, the check valve 52 will be caused to open whereby fuel from fuel conduit

51 will be drawn into the pumping chamber 48. As the cam 74 then rotates to cause the pumping piston 14 to move away from the accumulator piston 18, the check valve 52 is closed and the fuel drawn into the chamber 48 during the suction stroke of the pumping piston is forced through passage 38 and into the accumulator chamber 46 through the check valve 40 as will be understood by those in the art.

As the fuel is pumped into the accumulator chamber 46, the accumulator piston 18 moves toward or away from the actuating means 16 as necessary to maintain the fluid pressure in the accumulator chamber 46 substantially constant in conjunction with the spring 82 whereby the fuel supplied by the pump 10 will be at a substantially constant pressure. During low periods of demand for fuel, the fuel pumped into the accumulator chamber 46 will move the accumulator piston 18 toward the actuating means 16 to such an extent that the open end 84 of the part 64 of the pumping piston 14 will rest on the closed end 86 of the accumulator piston 18 so that the piston 14 will not be allowed to follow the cam 74 to make an extended suction stroke of the pumping piston 14. Thus, the volume of fuel pumped by the piston 14 is regulated in accordance with the fuel demand by accumulator piston 18.

It is therefore seen that the accumulator piston 18 acts both as a means for maintaining a constant pressure fuel output from the pump 10 and as a means for varying the volume of fuel pumped by the pump 10. Further, it will be seen that due to the in line arrangement of the pumping piston 14, the actuating means 16 therefor and the accumulator piston 18, the pump of the invention is particularly simple in structure whereby it is economical to manufacture and efficient in use.

The drawings and the foregoing specification constitute a description of the pump of the invention in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What I claim as my invention is:

1. A pump comprising a pumping chamber and an accumulator chamber, a reciprocal piston for pumping fluid from said pumping chamber into said accumulator chamber on actuation thereof, accumulator means within said accumulator chamber for maintaining the pressure of the fluid within the accumulator chamber substantially constant and engageable with the piston during low fuel demand to limit the quantity of fluid pumped by said piston, and rotatable eccentric cam actuating means for said piston positioned between said piston and said accumulator means directly engageable with said piston.

2. A pump comprising a housing having inlet and outlet openings therein, a pumping chamber operably associated with the inlet opening and an accumulator chamber operably associated with the outlet opening, means for passing a flowable medium under pressure from the pumping chamber to the accumulator chamber, pumping means mounted for reciprocation within said housing in pumping and suction strokes operable to draw the flowable medium into the pumping chamber on the suction stroke thereof and to force the flowable medium into the accumulator chamber on the pumping stroke thereof, reciprocal accumulator means within the accumulator chamber operable to regulate the pressure of the fluid medium discharged from the accumulator chamber through the outlet opening, and rotatable eccentric cam actuating means for said pumping means positioned between said pumping means and accumulator means directly engageable with said pumping means.

3. A fluid pump comprising a housing having inlet and outlet openings therein, a pumping chamber operably associated with the inlet opening and an accumulator chamber operably associated with the outlet opening, a check valve within the inlet opening operable to permit fluid flow into but not out of said pumping chamber, said housing also including a passage therethrough for passing a fluid under pressure from the pumping chamber to the accumulator chamber, a check valve within the passage operable to permit fluid flow into but not out of said accumulator chamber, a pumping piston mounted within said pumping chamber for reciprocation in pumping and suction strokes operable to draw the flowable medium into the pumping chamber on the suction stroke thereof and to force the flowable medium into the accumulator chamber on the pumping stroke thereof, a reciprocal accumulator piston closed at one end and biased toward said outlet opening within said accumulator chamber operable to provide a substantially constant pressure output from the pump, said accumulator also directly engaging said pumping piston during periods of low fluid demand to limit the fluid pumped thereby, and a motor driven eccentrically mounted rotatable cam actuator for said pumping piston directly engageable with said piston positioned between said pumping piston and accumulator piston.

4. A fluid pump comprising a housing having fluid inlet and outlet openings therein, a fluid inlet conduit secured in the inlet opening, a fluid outlet conduit secured in the outlet opening, a pumping chamber within the housing adjacent the inlet opening, a check valve between the inlet opening and pumping chamber for permitting flow of fluid into the pumping chamber from the inlet conduit and preventing flow of fluid from the pumping chamber into the conduit, an accumulator chamber within the housing adjacent the outlet opening, a passage within the housing extending between the pumping and accumulator chambers for transferring fluid from the pumping chamber to the accomulator chamber, a check valve between the passage and the accumulator chamber for permitting flow of fluid from the passage into the accumulator chamber and preventing flow of fluid from the accumulator chamber into the passage, a pumping cylinder formed in the pumping chamber, a pumping piston reciprocally mounted in the pumping cylinder having oppositely extending open ends secured to a common base, resilient means within the pumping chamber urging the pumping piston out of the pumping chamber, an accumulator cylinder in the accumulator chamber, an accumulator piston closed at one end reciprocally mounted on the accumulator cylinder and engageable with one end of the pumping piston for limiting reciprocation thereof, resilient means operable between the accumulator piston and housing urging the accumulator piston toward the accumulator chamber, and a motor driven eccentrically mounted rotatable cam actuator for the pumping piston positioned between the pumping piston and accumulator piston engageable with the base of the pumping piston to produce reciprocation thereof in conjunction with the first mentioned resilient means.

5. Structure as claimed in claim 4 wherein the inlet conduit, check valve between the inlet opening and pumping chamber, pumping piston, eccentric cam pumping piston actuator, accumulator piston and outlet conduit are aligned axially of the pump.

6. A pump comprising a pumping chamber and an accumulator chamber, a pumping cylinder formed in the pumping chamber, a pumping piston reciprocally mounted in the pumping cylinder having oppositely extending open ends secured to a common base, accumulator means within said accumulator chamber for maintaining the pressure of the fluid within the accumulator chamber substantially constant and engageable with one open end of the pumping piston for limiting the quantity of fluid pumped by said pumping piston, and oscillatory means engageable with the base of said pumping piston between the pumping chamber and accumulator chamber for producing reciprocal movement of the pumping piston.

7. A fluid pump comprising a housing having fluid inlet and outlet openings therein, a fluid inlet conduit secured in the inlet opening, a fluid outlet conduit se-

cured in the outlet opening, a pumping chamber within the housing adjacent the inlet opening, a check valve between the inlet opening and pumping chamber for permitting flow of fluid into the pumping chamber from the inlet conduit and preventing flow of fluid from the pumping chamber into the conduit, an accumulator chamber within the housing adjacent the outlet opening, a passage within the housing extending between the pumping and accumulator chambers for transferring fluid from the pumping chamber to the accumulator chamber, a check valve between the passage and the accumulator chamber for permitting flow of fluid from the passage into the accumulator chamber and preventing flow of fluid from the accumulator chamber into the passage, a pumping cylinder formed in the pumping chamber, a pumping piston reciprocally mounted in the pumping cylinder having oppositely extending open ends secured to a common base, resilient means within the pumping chamber urging the pumping piston out of the pumping chamber, an accumulator cylinder in the accumulator chamber, an accumulator piston closed at one end reciprocally mounted on the accumulator cylinder and engageable with one end of the pumping piston for limiting reciprocation thereof, resilient means operable between the accumulator piston and housing urging the accumulator piston toward the accumulator chamber, and a motor driven oscillatory actuator for the pumping piston positioned between the pumping piston and accumulator piston engageable with the base of the pumping piston to produce reciprocation thereof in conjunction with the first mentioned resilient means.

8. A pump comprising a housing having inlet and outlet openings therein, a pumping chamber operably associated with the inlet opening and an accumulator chamber operably associated with the outlet opening, means for passing a flowable medium under pressure from the pumping chamber to the accumulator chamber, pumping means comprising a piston including a pair of open ended axially oppositely extending portions having a common base mounted for reciprocation within said housing in pumping and suction strokes operable to draw the flowable medium into the pumping chamber on the suction stroke thereof and to force the flowable medium into the accumulator chamber on the pumping stroke thereof, a reciprocable accumulator means within the accumulator chamber engaging the open end of one of the portions of said piston during low demand for the flowable medium from said pump to limit the quantity of medium pumped and operable to regulate the pressure of the flowable medium discharged from the accumulator chamber through the outlet opening, and rotatable eccentric cam means for said pumping means positioned between said pumping means and accumulator means.

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