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2,975,941

FUEL METERING AND PUMPING DEVICE

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FIG. 1.

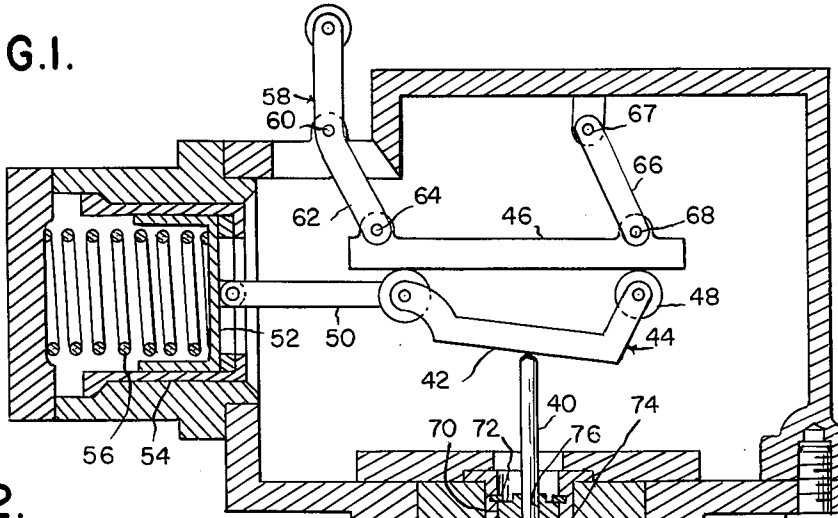


FIG. 2.

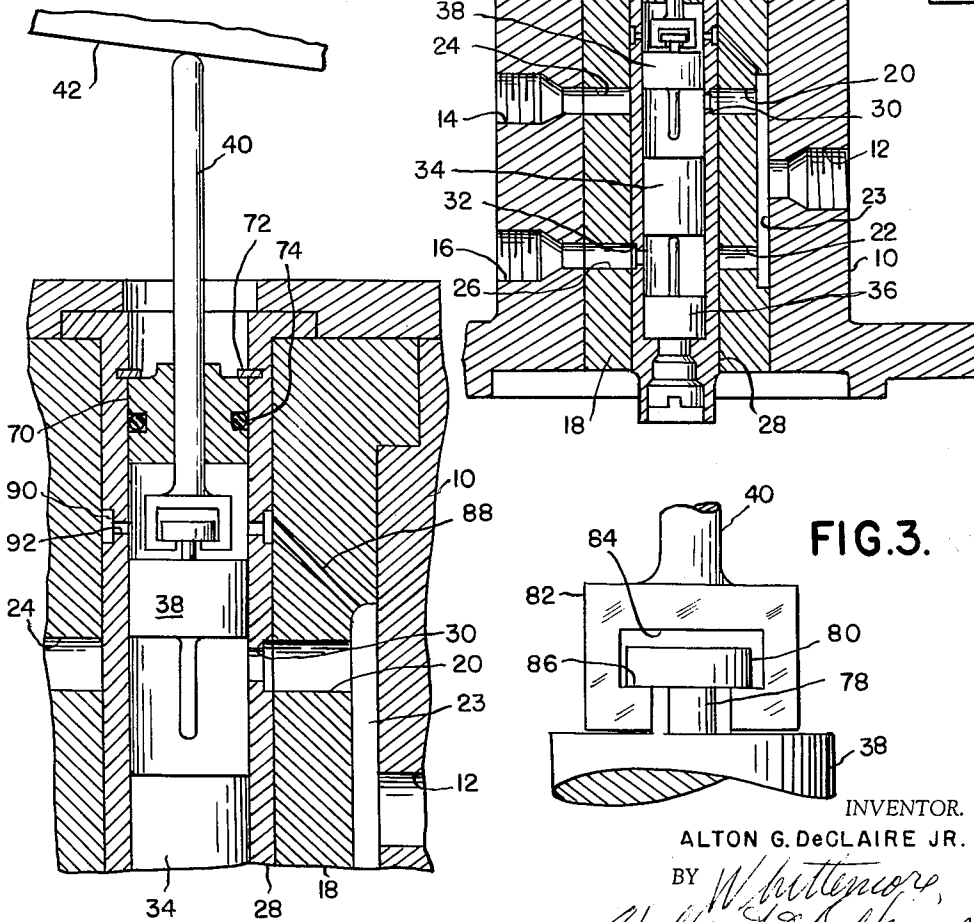
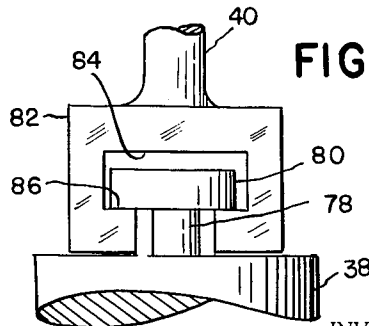


FIG. 3.



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FUEL METERING AND PUMPING DEVICE

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The present invention relates to an improved fuel metering and pumping device.

It is an object of the present invention to provide an improved fuel metering and pumping device characterized by relatively low leakage, and particularly by the reduction of forces required to effect adjustment of the device.

More specifically, it is an object of the present invention to provide a fuel metering and pumping device including a metering and pumping shuttle type piston movable between a fixed and an adjustable abutment in which the adjustable abutment has associated therewith means to apply fluid pressure to opposite sides thereof so as to reduce the external force required to effect adjusting movement thereof.

More specifically, it is an object of the present invention to provide, in a construction as described in the preceding paragraph, an adjustable abutment in the form of a piston having a mechanical actuated connection thereto, and means for admitting fluid to both ends of said piston-like abutment.

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

Figure 1 is a diagrammatic sectional view through a pumping and metering device constructed in accordance with the present invention.

Figure 2 is an enlarged sectional view showing the adjustable abutment and associated mechanism.

Figure 3 is a still further enlarged fragmentary elevational view showing the connection between the adjustable abutment and the external actuator.

In Figure 1 there is illustrated a fuel metering and pumping device designed for use in a fuel injection system. The system is quite similar to that illustrated and described in Downing Patent 2,731,175. However, for completeness here, the operation will be briefly reviewed.

The device comprises a support 10 having a fuel inlet passage 12 and a plurality of axially and circumferentially or angularly spaced outlet passages of which the passages 14 and 16 illustrated in Figure 1 are but two. Fixed within the support 10 is a sleeve 18 having axially spaced inlet passages 20 and 22 both of which communicate at all times with the inlet passage 12 through an axially extending passage 23. The fixed sleeve 18 has outlet passages 24 and 26 communicating respectively with the outlet passages 14 and 16.

Rotatable within the fixed sleeve 18 is a cylinder 28 having a first passage 30 adapted to register alternately with inlet passage 20 and one of the outlet passages 24, and a second passage 32 adapted to register alternately with inlet passage 22 and one of the outlet passages 26. Mounted for reciprocating movement in the cylinder 28 is a shuttle piston 34 movable between a fixed abutment 36 and an adjustable abutment 38.

With the parts in the position illustrated in Figure 1, high pressure fuel from a suitable source is being admitted

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through passages 12, 20 and 30 into the cylinder 28 above the movable piston 34. The pressure of the fuel thus admitted forces the piston 34 downwardly against the stationary abutment 36 and fuel is expelled through the passages 32, 26 and 16 to an internal combustion engine. The fuel admitted above the piston 34 is metered in quantity, dependent upon the spacing between the abutments 36 and 38. Further rotation of the cylinder 28 interrupts communication between the fuel inlet 12 and the cylinder above the piston and establishes communication through passages 22 and 32 to the space below the piston. This results in upward movement of the piston, expelling a metered charge of fuel through the passages 30, 24 and 14 to the engine. The cylinder 28 is of course connected to the engine for rotation at a speed dependent on engine speed.

The position of the adjustable abutment 38 is determined in accordance with a number of variable conditions, or it may be manually controlled. As illustrated in Figure 1, the adjustable abutment 38 is connected to a slidable rod 40 engageable with the inclined surface 42 of a carriage 44 movable along an adjustable rail 46. The carriage 44 includes rollers 48 and is connected by a link 50 to a piston 52 movable in a cylinder 54 against a compression spring 56. The interior of the cylinder 54 may be subjected to the reduced pressure existing within the engine manifold and accordingly the carriage 44 is variably positioned by means responsive to manifold pressure or engine load.

Additional means are provided for effecting adjustment of the fuel metering and this comprises a lever 58 pivoted as indicated at 60 and having an arm 62 pivoted to the rail 46 as indicated at 64. The outer end of the rail is supported by a link 66 pivoted at 67 and 68. Suitable means may be provided for moving the lever 58 and this means may be responsive to engine temperature, engine or vehicle speed, or other conditions the specific nature of which does not enter into the present invention. The lever 58 may also be manually adjustable.

It is contemplated that the system disclosed herein shall operate to supply fuel adjacent the intake valve of each cylinder of the internal combustion engine, or alternatively, directly into the engine cylinder, at relatively high pressure as for example on the order of 100 p.s.i. Accordingly, fuel is delivered to the inlet passage 12 at approximately this pressure. For this purpose the fuel will be supplied to the metering and pumping device illustrated herein by a suitable fuel pump such for example as an electrically operated fuel pump which may be energized at or before operation of the engine starter.

Fuel admitted to the cylinder 28 above the piston 34 acts not only on the piston but also applies an equal force to the adjustable abutment 38 tending to move the abutment 38 upwardly. Upward movement of the abutment 38 must of course be opposed by the carriage 44 and the support of the rail 46. In order to provide sensitive response to variable control conditions, it is desirable to reduce the total force on the adjustable abutment 38.

The foregoing is accomplished in the present instance by providing an end closure 70 in the upper end of the cylinder, the closure being fixed against upward movement by suitable means such for example as the snap ring 72. The closure 70 is further sealed against leakage as indicated at 74. The closure 70 is provided with a relatively small opening 76 through which the rod 40 is slidably movable.

A separable connection between the rod 40 and the adjustable abutment 38 is provided as best illustrated in Figures 2 and 3. For this purpose the upper end of the adjustable abutment 38 includes a projecting pin 78 having a head 80. The lower end of the rod 40 has an enlarged head 82 provided with a transversely extending

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slot 84 terminating at its lower end with inwardly extending lips 86 adapted to extend below the head 80 on the adjustable abutment 38. Preferably, the lips are dimensioned so as to fit relatively snugly in the space between the lower surface of the head 80 and the upper end of the adjustable abutment 38, thereby eliminating lost motion between the rod 40 and the adjustable abutment.

Referring now more particularly to Figure 2 the axially extending fuel inlet passage 23 provided in the sleeve 18 communicates by a passage 88 with a circumferentially extending outwardly facing channel 90 extending around the outer surface of the rotatable cylinder 28. The channel 90 communicates by a plurality of radially extending passages 92 with the interior of the cylinder 28 adjacent the upper end thereof and specifically, between the fixed closure 70 and the adjustable abutment 38. Accordingly, fuel under the inlet pressure as supplied to the inlet passage 12 is present in the cylinder 28 above the adjustable abutment 38 and acts to substantially counterbalance the upward pressure exerted by fuel in the space between the upper end of the pumping piston 34 and the adjustable abutment 38.

It will of course be apparent that so long as the adjustable abutment 38 and the headed rod 40 are related in axial alignment as illustrated in the figures, separation between these members is effectively prevented. On the other hand, when the adjustable abutment 38 is removed from the cylinder 28 the parts may be readily separated.

Attention is also called to the fact that fuel under inlet pressure acts on the undersurface of the adjustable abutment 38 when fuel is admitted beneath the piston as well as when fuel is admitted above the piston.

With the present construction the fluid pressure acting at opposite sides of the adjustable abutment 38 is substantially balanced so that only a relatively small and substantially constant pressure differential must be overcome in effecting adjustment of the abutment by the movement of the carriage 44 or adjustment of the rail 46. This relatively small and relatively constant fluid pressure differential may of course be taken into account in designing the control equipment so that no appreciable errors are attributable thereto.

The drawing and the foregoing specification constitute a description of the improved fuel metering and pumping device 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 fuel metering and pumping device comprising a body having a cylindrical chamber therein, angularly and axially spaced inlet and outlet passages opening into said chamber, a tubular rotor in said chamber having axially spaced passages each of which communicates alternately with an inlet and an outlet passage of said body, a shuttle type piston movable axially in said tubular rotor between the axially spaced passages of said rotor, a fixed abutment at one end of said rotor engageable with one end of said piston, an adjustable piston-like abutment member movable axially within said tubular rotor at the other side of said piston from said fixed abutment, an apertured plug at the end of said rotor containing said adjustable abutment member, an actuating rod extending through the aperture in said plug and connected to said adjustable abutment member, condition responsive means connected to said rod for adjusting said adjustable abutment, means for maintaining a supply of fluid fuel under pressure at the inlet passages of said body, and passage means for admitting fluid fuel at all times at inlet pressure to the space within said tubular rotor between said adjustable abutment member and said plug to maintain a constant balancing pressure effective at all times on the side of said piston-like abutment member remote from said shuttle type piston.

2. A fuel metering and pumping device comprising a

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body having a cylindrical chamber therein, angularly and axially spaced inlet and outlet passages opening into said chamber, a tubular rotor in said chamber having axially spaced passages each of which communicates alternately with an inlet and an outlet passage of said body, a shuttle type piston movable axially in said tubular rotor between the axially spaced passages of said rotor, a fixed abutment at one end of said rotor engageable with one end of said piston, an adjustable piston-like abutment member movable axially within said tubular rotor at the other side of said piston from said fixed abutment, an apertured plug at the end of said rotor containing said adjustable abutment member, an actuating rod extending through the aperture in said plug and connected to said adjustable abutment member, condition responsive means connected to said rod for adjusting said adjustable abutment, means for maintaining a supply of fluid fuel under pressure at the inlet passages of said body, and passage means for admitting fluid fuel at inlet pressure to the space within said tubular rotor between said adjustable abutment member and said plug, said passage means comprising an annular recess at the outside of said tubular rotor, a passage in said body connecting the source of fuel to said annular recess, and generally radial passages connecting said annular recess to the interior of said tubular rotor.

3. A fuel metering and pumping device comprising a body having a cylindrical chamber therein, angularly and axially spaced inlet and outlet passages opening into said chamber, a tubular rotor in said chamber having axially spaced passages each of which communicates alternately with an inlet and an outlet passage of said body, a shuttle type piston movable axially in said tubular rotor between the axially spaced passages of said rotor, a fixed abutment at one end of said rotor engageable with one end of said piston, an adjustable piston-like abutment member movable axially within said tubular rotor at the other side of said piston from said fixed abutment, an apertured plug at the end of said rotor containing said adjustable abutment member, an actuating rod extending through the aperture in said plug and connected to said adjustable abutment member, condition responsive means connected to said rod for adjusting said adjustable abutment, means for maintaining a supply of fluid fuel under pressure at the inlet passages of said body, and passage means for admitting fluid fuel at inlet pressure to the space within said tubular rotor between said adjustable abutment member and said plug, said adjustable abutment member having a headed projection at its end remote from said piston, said rod having a coupling head provided with means for releasably engaging said headed projection.

4. A fuel metering and pumping device comprising a body having a cylindrical chamber therein, angularly and axially spaced inlet and outlet passages opening into said chamber, a tubular rotor in said chamber having axially spaced passages each of which communicates alternately with an inlet and an outlet passage of said body, a shuttle type piston movable axially in said tubular rotor between the axially spaced passages of said rotor, a fixed abutment at one end of said rotor engageable with one end of said piston, an adjustable piston-like abutment member movable axially within said tubular rotor at the other side of said piston from said fixed abutment, an apertured plug at the end of said rotor containing said adjustable abutment member, an actuating rod extending through the aperture in said plug and connected to said adjustable abutment member, condition responsive means connected to said rod for adjusting said adjustable abutment, means for maintaining a supply of fluid fuel under pressure at the inlet passages of said body, and passage means for admitting fluid fuel at inlet pressure to the space within said tubular rotor between said adjustable abutment member and said plug, said adjustable abutment member having a headed projection at its end remote from said piston, said rod having a cou-

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pling head provided with a transverse slot releasably receiving said headed projection upon relative movement therebetween transverse to their axes, said coupling head and headed projection being thereby prevented from separating while assembled in said device.

5. In a pumping device comprising a cylinder, a free piston therein, passage means for admitting fluid under pressure from a pressure source alternately to said cylinder at opposite sides of said piston, a fixed abutment in said cylinder, a movable piston-like abutment in said cylinder on the opposite side of said piston from said fixed abutment and continuously adjustable to cooperate with said fixed abutment to control the length of stroke of said piston, an apertured plug fixed in the end of said cylinder containing said movable abutment, an externally actuated adjusting rod of relatively small size extending through the aperture of said plug and connected to said movable abutment, and passage means connecting the space within said cylinder between said plug and movable abutment at all times to said pressure source. 20

6. A pump comprising a cylinder, a free pumping piston in said cylinder, spaced abutments in said cylinder

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engaged by said piston to determine the stroke thereof, a fluid inlet port and a fluid outlet port in said cylinder at both sides of said piston, means for supplying fluid under pressure to said inlet ports, means for alternately opening and closing the inlet and outlet ports at opposite sides of said piston to cause said piston to pump fluid from said outlet ports and to meter a charge of fluid into said cylinder to be pumped therefrom upon reversal of said piston, one of said abutments being in the form of a piston movable in said cylinder and subjected at all times at its inner side to fluid pressure substantially as supplied to said inlet ports, means for maintaining at all times at the outer side of said movable piston-like abutment a balancing fluid pressure substantially as supplied to said inlet ports, and external condition responsive means mechanically connected to said movable piston-like abutment for adjusting the same.

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