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FUEL METERING AND PUMPING DEVICE

Filed June 17, 1957

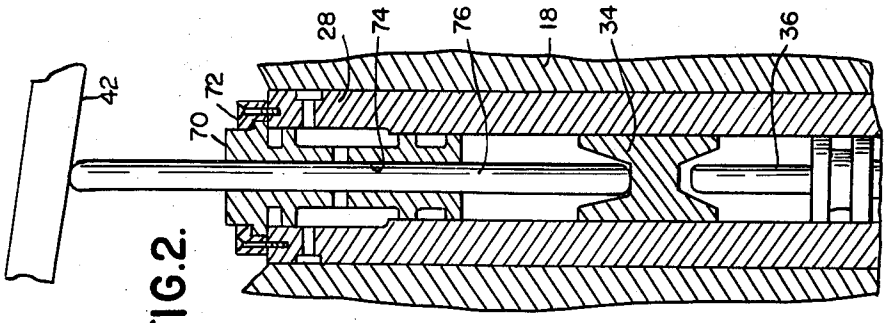


FIG.2.

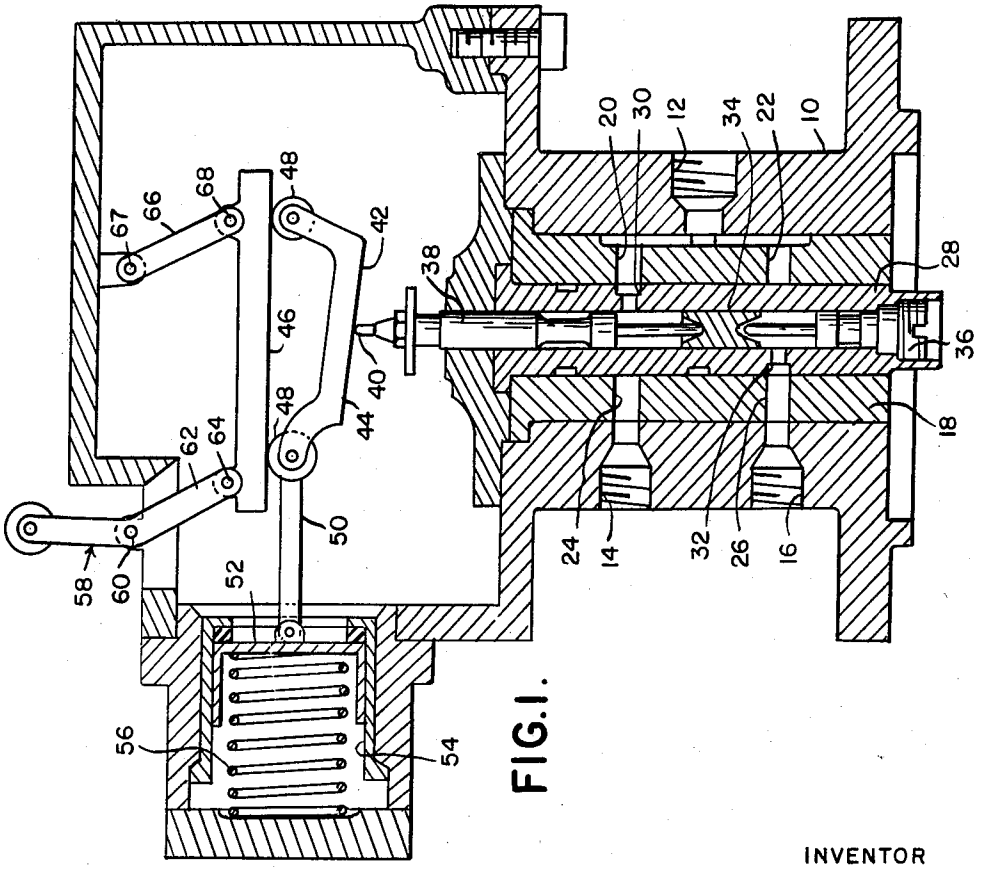


FIG.1.

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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 its relatively low leakage, by the reduction of forces applied to mechanical parts of the structure, and by the avoidance of backfires caused by starving a cylinder during acceleration.

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 is of minimum size to occupy a minimum of volume within a pumping cylinder so that its movement causes a minimum of change in volume thereof.

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

Figure 1 is a diagrammatic sectional view through a pumping and metering device as employed prior to the present invention.

Figure 2 is an enlarged fragmentary sectional view of a portion of the structure of Figure 1 incorporating the improvements of the present invention.

In Figure 1 there is illustrated a fuel metering and pumping device designed for use in a fuel injection system. This device is substantially like that illustrated in Downing Patent 2,731,175. For completeness the operation of the system will be briefly reviewed.

The device comprises a support **10** having an inlet passage **12** and a plurality of axially and circumferentially or angularly spaced outlet passages of which **14** and **16** 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 times with the inlet passage **12**, and having outlet passages **24** and **26** communicating respectively with passages **14** and **16**. Rotatable within the sleeve **18** is a cylinder or tubular rotor **28** having a first passage **30** adapted to register alternately with inlet passage **20** and outlet passage **24**, and a second passage **32** adapted to register alternately with inlet passage **22** and outlet passage **26**. Mounted for reciprocating movement in the cylinder **28** is a shuttle piston **34** the piston being movable between a fixed abutment **36** and an adjustable abutment **38**.

With the parts in the position illustrated in Figure 1, high pressure fuel is being admitted 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 and fuel is expelled through the passages **32**, **26** and **16** to an internal combustion engine. Fuel being admitted above the piston **34** is being 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 the 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 position of the adjustable abutment **38** is determined in accordance with a number of variable conditions or manually. As illustrated in Figure 1, the adjustable abutment **38** includes a portion **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** is subjected to the reduced pressure existing within the engine manifold and accordingly, the carriage **44** is positioned by means responsive to manifold pressure or engine load. Carriage **44** thus constitutes a continuously movable abutment member.

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 other 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.

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 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.

From an inspection of Figure 1 it will be observed that the fuel above the piston **34** acts on a relatively large area of the adjustable abutment **38**, this area being in effect equal to the cross-sectional area of the piston. In a practical embodiment of the invention the force developed by fuel under pressure within the cylinder and thus transmitted to the carriage **44**, rail **46** and associated structure, may be several pounds in total. This in itself is undesirable. In addition, movement of the movable abutment **38** in the cylinder requires at least nominal clearance and necessarily results in some leakage of fuel past the outer surfaces of the movable abutment. The present construction, as will subsequently appear, substantially reduces oil leakage.

Finally, the most important advantage attained by the modified construction illustrated in Figure 2 is in the preventing of backfires due to starving a cylinder during acceleration.

Referring now to Figure 2, the present invention comprises replacing the adjustable abutment **38** of Figure 1 with a sealed guide sleeve **70**, this sleeve as illustrated being retained in the upper end of the cylinder **28** by an annular flanged retainer **72**. Extending through the guide sleeve **70** is a relatively small cylindrical opening **74** which receives a pin **76** constituting the movable abutment which determines upward movement of the shuttle piston **34**. Except for parts **70**, **72**, and **76**, the parts shown in Figure 2 are the same parts identified by like reference characters in Figure 1.

By this arrangement a cross-sectional area of the movable portion of the adjustable abutment is reduced to a small fraction of the area of the cylindrical opening in the cylinder **28**. Thus, the force acting through the pin **76** on the structure thereabove is reduced and at the same time the leakage around the movable pin **76** is reduced

to a fraction of that present in the old construction. In a practical design the force applied through the adjustable abutment to the adjusting mechanism therefor was reduced from several pounds to a fraction of a pound.

A very important improvement resulting from the substitution of the sleeve **70** and reduced pin abutment **76** is in the reduction of variation of volume above the piston **34** when the pin **76** is retracted during acceleration to produce an increase in the charge of fuel delivered to a cylinder of the engine. It will be recalled that each stroke of the shuttle piston may be regarded as a metering stroke at one side of the piston which takes place during the pumping stroke effected at the other side of the piston. When the carriage **44** is moved suddenly in order to increase the fuel flow for acceleration, the movable abutments move outwardly allowing the shuttle piston **34** to move farther. However, with this longer stroke of shuttle piston **34**, more fuel will not be forced out of the pumping device until the volume of space emptied by outward movement of the adjustable abutment **38** or **76** is filled with fuel. When accelerating an engine with this control this means that a lean fuel mixture will be delivered to one cylinder and a backfire could occur. With the relatively small change in volume caused by withdrawal of pin **76**, this does not happen.

The present invention, while it involves a relatively simple modification of the structure, nevertheless results in important operating advantages and in increased life due to the reduced wear of the parts.

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 stationary sleeve having axially and angularly spaced radially extending inlet and outlet passages, a tubular rotor having an axially extending clindrical opening therethrough and axially spaced radially extending passages each of which communicates with an inlet and an outlet passage of said sleeve during rotation of said rotor, a shuttle type piston movable axially in said rotor between the axially spaced passages of said rotor, a fixed abutment at one end of said rotor engageable with said piston, a guide sleeve fixedly secured in the other end of said rotor, condition reponsive means including a continuously movable abutment member located beyond the end of said rotor in which said guide sleeve is located, said guide sleeve having an elongated opening therethrough in alignment with the cylindrical opening through said rotor, the cross-sectional area of the opening through said sleeve being substantially less than that of the cylindrical opening through said tubular rotor, and an elongated abutment pin freely slidable in said opening and having an inner end exposed to fluid pressure within the cylindrical opening in said rotor and engageable with said piston to limit movement thereof in one direction and having its other end engaged with said abutment member for continuous adjustment thereby, the effective end area of said pin exposed to fluid pressure within said rotor being substantially less than the cross-sectional area of said cylindrical opening.

2. A device as defined in claim 1 in which the effective end area of said pin exposed to fluid pressure within said rotor being less than one-quarter of the cross-sectional area of said cylindrical opening.

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