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FUEL DISTRIBUTING VALVE FOR FUEL INJECTION SYSTEM

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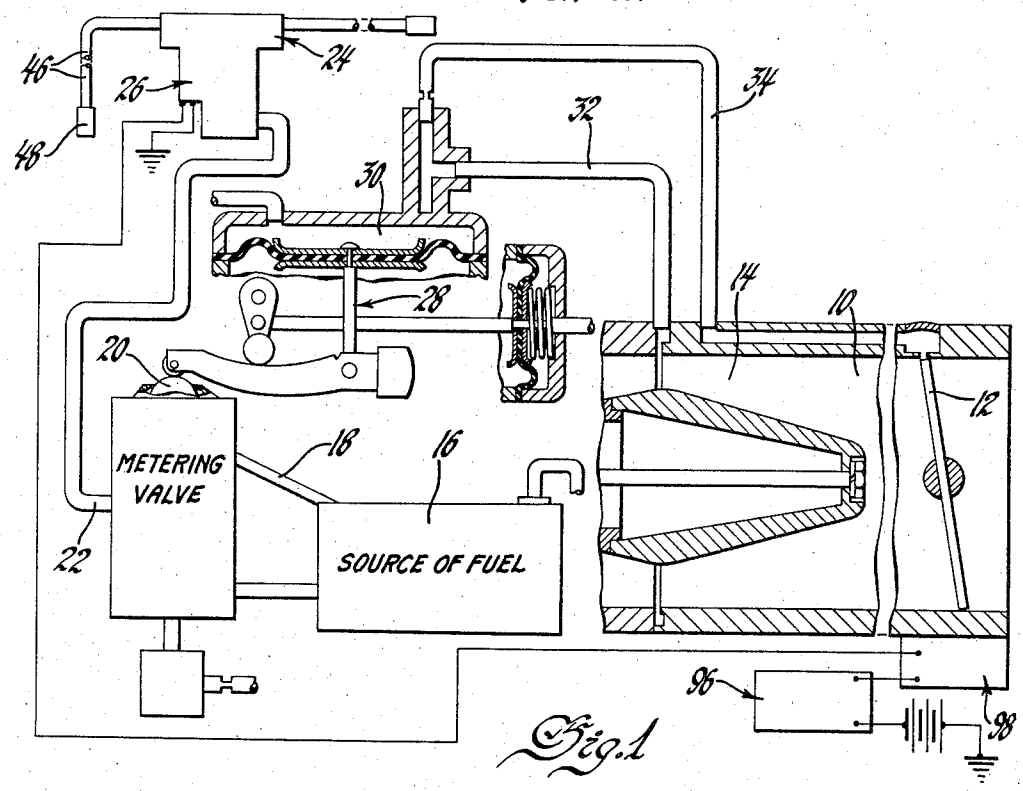


Fig. 1

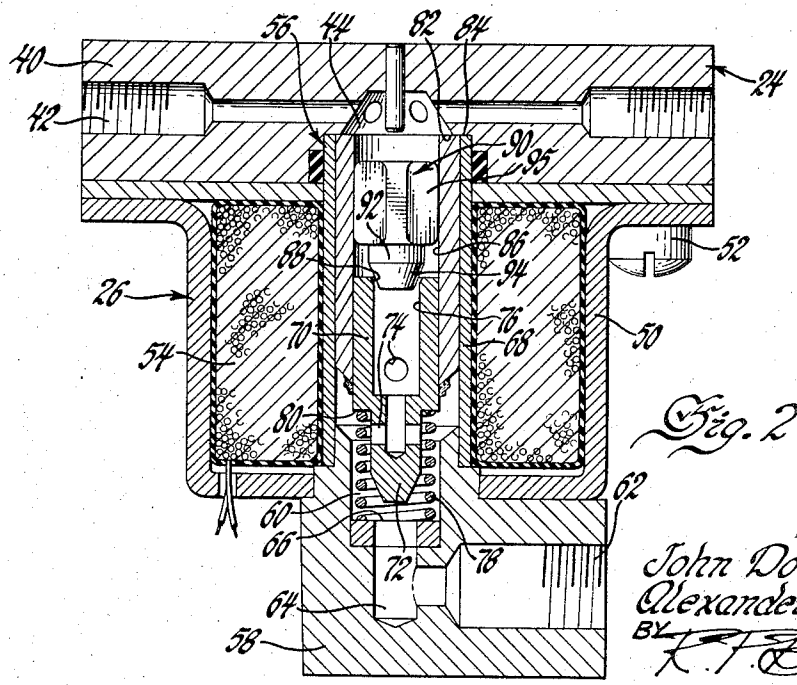


Fig. 2

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FUEL DISTRIBUTING VALVE FOR FUEL INJECTION SYSTEM

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5 Claims. (Cl. 261—23)

The present device relates to a fuel distributing valve for a fuel injection system of the type shown generally in copending application Serial No. 608,853, Dolza, filed September 10, 1956. More specifically, the present device represents an improvement in a solenoid controlled coasting fuel shut-off valve of the type shown in copending application Serial No. 648,300, Olson et al.

In a fuel injection system of the Dolza type means is normally provided for shutting off the flow of fuel to the cylinders under vehicle decelerating conditions in order to economize on the use of fuel as well as to prevent the discharge of unburned hydrocarbons into the atmosphere. In the present device a solenoid controlled fuel distributing valve is utilized which is capable, in addition to shutting off the fuel flow under decelerating conditions, of preventing fuel from draining through the fuel metering system due to any static fuel pressure head developed due to a height differential between the nozzles and the fuel metering unit.

The present fuel distributing valve also provides means for initiating the flow of a limited quantity of fuel to the engine nozzles upon the deenergization or opening of the fuel distributing valve upon the termination of its fuel cut-off function. This latter feature is designed to prevent engine stuttering or stalling prior to the resumption of normal fuel flow after coasting fuel shut-off operation.

The details of the present invention as well as other objects and advantages are set forth in the description which follows.

In the drawing:

Figure 1 is a diagrammatic representation of a fuel injection system embodying the subject fuel distributing valve; and

Figure 2 is an enlarged sectional view of the fuel distributing valve.

The fuel injection system functions in the manner set forth in the aforenoted Dolza application and only that much of the system will be described as is necessary to provide the proper environment to an understanding of the subject invention. In general, an air induction passage is shown at **10** and includes a venturi **14** formed therein. A throttle valve **12** is disposed in the induction passage **10** posteriorly of the venturi **14**. A source of fuel under pressure is shown at **16** and is adapted to supply fuel through a conduit **18** to a metering valve **20**. The metered fuel from valve **20** is delivered to a conduit **22** which leads to a fuel distributor **24** having a solenoid controlled fuel cut-off mechanism **26** associated therewith. The metering valve **20** is controlled by a diaphragm linkage mechanism **28** which is actuated in response to vacuum changes in chamber **30** which are variable with the mass of air flow through venturi **14**. The venturi vacuum signal is conveyed to the diaphragm chamber **30** through a passage **32**. An additional vacuum passage **34** communicates with chamber **30** and with the induction passage adjacent the throttle valve **12** to provide a supplemental control force during idle and off-idle operation as described in Serial No. 608,797, Olson.

Referring to Figure 2, a fuel distributor casing is provided at **40** and includes a plurality of radially extending passages **42** formed therein and which centrally communicate with a common supply chamber **44**. Passages **42** are

adapted to connect at their radially outer ends with conduits **46** leading to individual cylinder nozzles **48**.

A cup-shaped housing or casing **50** is adapted to be secured to the fuel distributor casing **40** through suitable stud means **52**. An annular solenoid coil **54** is disposed in casing **50**. A fuel cut-off valve mechanism **56** is disposed within the solenoid coil **54** and is adapted to communicate at one end with the common supply chamber **44**.

A fuel inlet casing **58** is suitably secured to cup-shaped casing **50** and includes a counterbored portion **60** with which the fuel cut-off valve mechanism is adapted to coact to control the flow of fuel. An inlet passage **62** is formed in casing **58** and communicates with a longitudinally extending passage **64** which opens into the counterbored portion **60** of the casing and defines a circular seat **66** therewith.

The fuel cut-off valve mechanism includes a sleeve **68** fixed at its respective ends to the fuel distributing casing **40** and the fuel inlet casing **58**. A valve element **70** is slidably disposed in sleeve **68** and terminates at its lower end in a reduced portion **72** the inner end of which is tapered to coact with the valve seat **66** formed in inlet casing **58**. The slidable valve member **70** includes a plurality of radial ports **74** formed therein which communicate at their inner ends with a longitudinally extending passage **76** formed through the slidable valve member. A spring member **78** is seated within the counterbored portion **60** of fuel inlet casing **58** and surrounds the reduced portion **72** abutting against a shoulder **80** of the slidable valve element **70** and biases said element in an upper position in which the upper end **82** of the slidable element seats against an annular shoulder **84** formed in distributor casing **40**.

A counterbore **86** is formed in the slidable valve element **70** so as to provide a tapered valve seat **88**. A valve element **90** is slidably disposed within the counterbored portion **86** of valve element **70** and includes a reduced end portion **92** tapered at **94** to coact with tapered seat **88**.

As thus far described and with the solenoid **54** deenergized, metered fuel from conduit **22** is supplied to passages **62** and **64** where it enters the counterbored portion **60** of casing **58**. Fuel flows from the counterbored portion through the radial ports **74** in the slidable valve element **70** where it flows upwardly through passage **76** to raise valve element **90** off of its seat permitting the fuel to flow between the fluted portions **95** formed therein to the common fuel chamber **44** where the fuel is equally distributed to the radial passage **42**.

Under coasting or engine decelerating conditions solenoid **54** will be energized by any suitable mechanism such as a speed governed switch **96** and a throttle controlled switch **98**, as described in the aforenoted Olson application, whereby the slidable valve element **70** will be moved downwardly against the force of spring **78** causing the tapered end of portion **72** to seat against and block the flow of fuel through valve seat **66**.

As the slidable valve element **70** moves downwardly to cut off the flow of fuel, a portion of the fuel remaining in the counterbore **60** and passage **76** will be forced upwardly around valve element **90** and into the common supply chamber **44**.

Having cut off the flow of fuel to the cylinders, a continuous flow fuel injection system of the type herein involved normally requires two revolutions of the engine for a given nozzle to furnish the requisite amount of fuel to the corresponding cylinder for any constant rate of operation. Heretofore, this situation, particularly as aggravated under rapid decelerating conditions, has frequently caused the engine to stall or stutter until the fuel metering system was able to resume the supply of fuel to the cylinders. This situation is alleviated in the present

mechanism by virtue of the operation of the valve element **90**. As noted, when the slidable valve element **70** moves downwardly to cut off the supply of fuel any fuel remaining in the counterbore portion **60** of the inlet casing **58** flows into the common chamber **44**. Thus the space above the valve element **90** will be filled with fuel. Thereafter upon the deenergization of the solenoid coil **54** spring member **78** will move the slidable valve element **70** upwardly under which condition the pressure head of the fuel above the valve element **90** coupled with the weight of the valve element causes the valve to seat and force the fuel from the fuel chamber **44** through the radial passages **42** momentarily supplying fuel to the cylinder fuel supply passages **46**. In this way the needs of the engine are satiated until such time as the fuel metering system resumes normal delivery of fuel to the cylinders.

An important additional function is served by the valve element **90**. Under normal conditions the fuel nozzles **48** are disposed below the level of the fuel metering valve **20**, a pressure will, therefore, obtain on the fuel downstream of the metering system and which pressure is equal to the head of fuel represented by the height differential noted. Because of this static pressure head, the fuel downstream of the metering valve drains out of the various passages into the intake manifold proximate the nozzles with the result that such passages must be refilled with a consequent delay in starting. In the present fuel cut-off mechanism construction the weight of the valve element **90** is made slightly greater than the static fuel pressure head noted, as a consequence, when the engine is shut off the weight of the valve element **90** will cause the latter to seat preventing the draining or siphoning flow of fuel through the system. In this manner the system remains charged with fuel and ready for easy and rapid restarting. Thus tapered portion **94** of valve element **90** is adapted to seat upon seat **88** against the force of the static pressure head and to be unseated by the dynamic pressure head of fuel upstream thereof. The dynamic pressure head is, of course, created by the fuel source **16**. The static pressure head, as noted, is equal to the weight of the column of upstream fuel of the valve **90**.

We claim:

1. A fuel distributing mechanism for an internal combustion engine comprising a casing having a plurality of fuel outlet passages formed therein, a common supply chamber adapted to communicate with said outlet passages, a fuel inlet passage adapted to supply fuel to said common supply chamber, first valve means intermediate said inlet passage and said common supply chamber for controlling the flow of fuel, means normally biasing said valve means to a position permitting fuel to flow from said inlet passage to said outlet passages, means for closing said valve when it is desired to cut off the flow of fuel to said outlet passages, and second valve means in series with said first valve means and movable therewith, said second valve means being adapted to seat by gravity when said first valve moves from a closed to an open position to prevent the reverse flow of fuel through said fuel distributing mechanism.

2. A fuel distributing mechanism for an internal combustion engine comprising a casing having a plurality of fuel outlet passages formed therein, a common supply chamber adapted to communicate with said outlet passages, a fuel inlet passage adapted to supply fuel to said common supply chamber, first valve means intermediate said inlet passage and said common supply chamber for controlling the flow of fuel, means normally biasing said valve means to a position permitting fuel to flow from said inlet passage to said outlet passages, means for closing said valve when it is desired to cut off the flow of fuel to said outlet passages, and gravity actuated valve means in series with said first valve means and movable therewith, said gravity actuated valve means being adapted to seat against the static pressure head of fuel upstream of the second valve.

3. A fuel distributing mechanism for a fuel injection system comprising a casing having a plurality of radially disposed outlet passages formed therein, a comon fuel chamber centrally communicating with said outlet passages, a second casing fixed to said first casing, a solenoid controlled valve disposed within said second casing, a third casing secured to said second casing, a fuel inlet passage in said third casing, said solenoid controlled valve adapted to coact with said fuel inlet passage to control the flow of fuel to said outlet passages, means normally biasing said valve in an open position permitting the flow of fuel to said outlet passages, said solenoid controlled valve being shiftable to a position blocking the flow of fuel to said outlet passages, and a gravity seating valve element slidably disposed within said solenoid control valve and movable therewith, the flow of fuel through said solenoid controlled valve being sufficient to unseat said gravity seating valve element to permit the flow of fuel therepast.

4. A fuel distributing mechanism for a fuel injection system comprising a casing having a plurality of radially disposed outlet passages formed therein, a common fuel chamber centrally communicating with said outlet passages, a second casing fixed to said first casing, a solenoid controlled valve disposed within said second casing, a third casing secured to said second casing, a fuel inlet passage in said third casing, a source of fuel under pressure, a conduit communicating said source and inlet passage, said solenoid controlled valve adapted to coact with said fuel inlet passage to control the flow of fuel to said outlet passages, means normally biasing said valve in an open position permitting the flow of fuel to said outlet passages, said solenoid controlled valve being shiftable to a position blocking the flow of fuel to said outlet passages, and a gravity seating valve element in series with and slidably disposed within said solenoid control valve and movable therewith, said gravity seating valve element adapted to be unseated by the dynamic pressure head and seat against the static pressure head of fuel in said inlet passage.

5. A fuel distributing mechanism for a fuel injection system comprising a casing having a plurality of radially disposed outlet passages formed therein, a common fuel chamber centrally communicating with said outlet passages, a second casing fixed to said first casing, a solenoid controlled valve disposed within said second casing, a third casing secured to said second casing, a fuel inlet passage in said third casing, means for supplying fuel under pressure to said inlet passage, said solenoid controlled valve comprising a tubular sleeve, a cylindrical member closed at one end and opened at the other, said member being slidably disposed in said sleeve, a longitudinal passage in said sleeve terminating in the open end thereof, the closed end of said member being of reduced cross-section and terminating in a tapered valve portion, a plurality of radial ports in the reduced portion of said member, said ports communicating the space between said sleeve and said longitudinal passage, the tapered end of said slidable member being adapted to coact with said fuel inlet passage to control the flow of fuel through said mechanism, a counterbore formed in the open end of said slidable member, a valve seat formed in said counterbore, a valve element slidably disposed in said counterbore and including a tapered end portion adapted to seat within said counterbore seat, said valve element adapted to be unseated by the dynamic fuel pressure head acting thereon, said valve element being adapted to seat by gravity against the static fuel pressure head acting thereon.

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