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FUEL INJECTOR FOR FLUID PUMPS FOR INTERNAL
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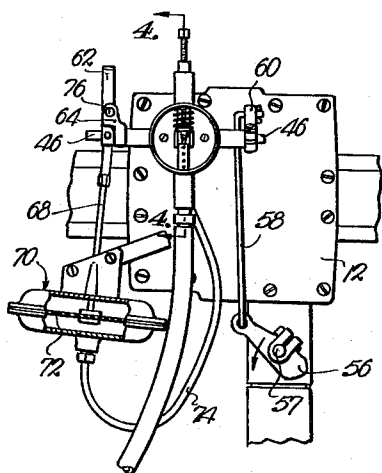


Fig. 1.

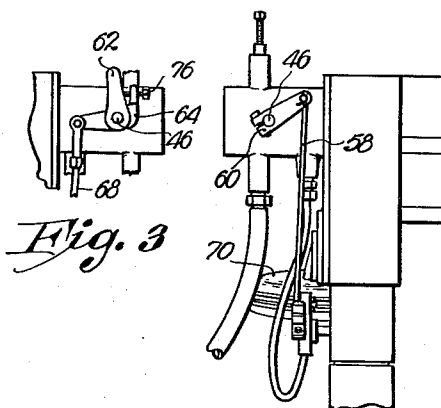


Fig. 2.

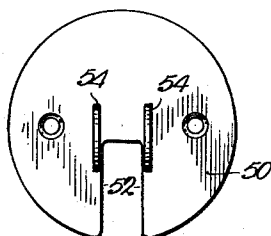


Fig. 3.

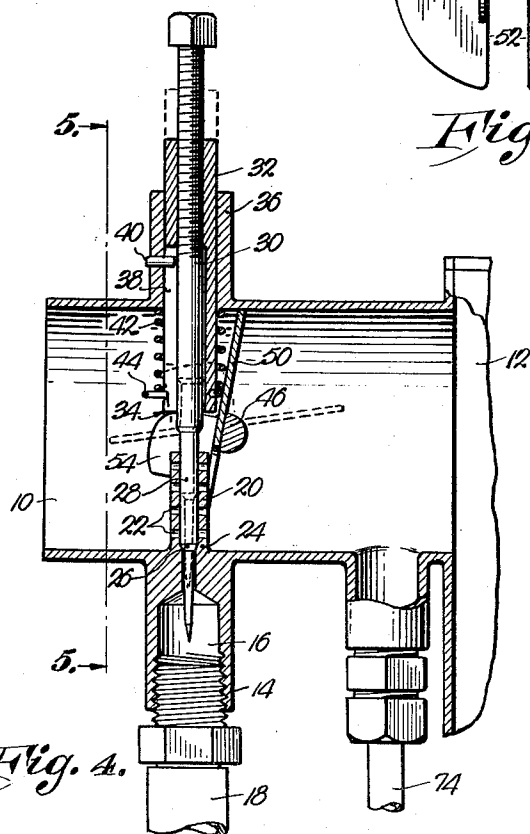


Fig. 4.

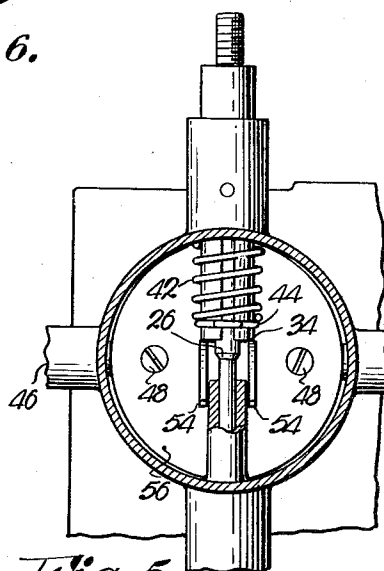


Fig. 5.

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FUEL INJECTOR FOR FLUID PUMPS FOR INTERNAL COMBUSTION ENGINES

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3 Claims. (Cl. 261—50)

This invention relates to internal combustion engines and particularly to the fuel injector for the fluid pumps of such engines.

The primary object of this invention is to provide a fuel injector for fluid pumps for internal combustion engines having structure capable of controlling the flow of fuel in response to and in direct proportion to changes in size of the throttle opening.

A further object of the present invention is the provision of a fuel injector of the aforementioned character wherein is included valve means associated with the throttle of the engine in such fashion as to completely close the valve and prevent the flow of fuel when the engine is not running.

A yet further aim of this invention is to provide a fuel injector which receives and controls the flow of fuel from a pressurized tank and which receives air through an intake port of a size sufficient to support combustion when the engine is operating at maximum speed.

A still further object of this invention is to provide a fuel injector wherein the fuel valve is mechanically operated in direct response to action of the air intake valve.

Further objects will become apparent from the following specifications referring to the accompanying drawing wherein:

FIG. 1 is a fragmentary elevational view of a portion of an internal combustion engine showing a fuel injector embodying the invention and operatively associated with the fluid pump thereof;

FIG. 2 is a side elevational view of the assembly shown in FIG. 1.

FIG. 3 is a fragmentary view of the linkage forming a part of the throttle control;

FIG. 4 is an enlarged, fragmentary sectional view taken along line 4—4 of FIG. 1;

FIG. 5 is a cross-sectional view taken on line 5—5 of FIG. 4; and

FIG. 6 is a plan view of the air valve plate.

The constant flow of fuel injection device hereinafter described is for use with an internal combustion engine having a pump or similar means for delivering the fuel to the cylinders. The injector will not only assure a constant flow and the desired mixture of fuel, but will close the fuel line completely when the engine is not in operation.

The fuel injection device is operably mounted on an air intake tube 10 which communicates at its one end with a fluid pump 12 which pump 12 feeds the mixture of fuel and air to the cylinder of the engine. Pump 12 is of the type described in U.S. Letters Patent 2,948,230, issued to me on August 9, 1960, entitled, "Fluid Pump," which pump requires no check or reed valves therein for controlling the flow of fluid therethrough, but provides a means for permitting a continuous flow of fuel therethrough by virtue of the fact that the pumping action of the pump operates on both sides of a rotatable swash plate. By virtue of this construction the pump is interposed between the injection device and the cylinders of an engine to increase the pressure of the fuel to facilitate more effective combustion within the cylinders while, at the same time maintaining a continuous flow of fuel from said injection device to said cylinders. Integral with straight, cylindrical tube 10 is boss 14 having a longitudinal passage 16 therethrough coupled at one end with

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a fuel supply line 18, which delivers fuel under pressure from a suitably pressurized fuel tank (not shown). The opposite end of passage 16 communicates with tube 10, the opening into said tube 10 being surrounded by an inwardly extending, cylindrical, hollow sleeve 20 having a plurality of radial perforations 22 therein whereby to place passage 16 into communication with tube 10. Formed within sleeve 20 at the lowermost portion thereof, and below the lowermost of perforations 22 is a valve seat 24, which cooperates with and receives a tapered shoulder 26 formed intermediate the ends of a longitudinally reciprocable valve stem 28. Stem 28 fits loosely within sleeve 20 to allow fuel to pass therearound and into tube 10 through perforations 22 when not seated. Stem 28 has an elongated shank 30, carried by a cylindrical housing 32, surrounding shank 30 whereby to present a continuous, annular downwardly facing shoulder 34. Housing 32 is in turn reciprocally mounted within a boss 36 formed on the outer surface of tube 10 at a point diametrically opposite boss 14. Housing 32 is internally threaded, and shank 30 has complementary external threads whereby shank 30 may be adjusted longitudinally within housing 32 when rotated. Housing 32 is further provided with a longitudinal slot 38 through the wall thereof and into which slot pin 40 extends from a fixed position in boss 36. Downward movement of housing 32 and shank 30 is limited by pin 40.

Housing 32 and shank 30 from which depends stem 28, are normally biased downwardly by a spring 42 surrounding housing 32, said spring 42 having its lowermost end held in place by a collar 44 and its uppermost end abutting the interior surface of the wall of tube 10.

Extending through tube 10 and in intersecting relationship thereto is a rotatable shaft 46. Affixed to shaft 46, by screws 48, or other suitable means is a butterfly valve plate 50, of an area equal to and coextensive with the cross sectional inner area of tube 10, whereby plate 50 may entirely close said tube 10 and prevent the flow of air therethrough.

Butterfly valve plate 50 is provided with a notch 50 to accommodate sleeve 20 as plate 50 is rotated by shaft 46. Formed on one face of plate 50 and projecting laterally therefrom is a pair of identical cams 54, centrally disposed with respect to said face of plate 50. Cams 54 are formed on the face of plate 50 opposite that to which shaft 46 is attached and a cam 54 is on each side of notch 52 as illustrated in FIG. 6.

As shown in FIGS. 4 and 5 of the drawing, cams 54 are so positioned that shoulder 34 is resiliently biased thereagainst by spring 42. When shaft 46 is rotated, plate 50 moves clockwise, viewing FIG. 4, and as such movement takes place, cams 54, acting against shoulder 34, move housing 32, and valve stem 28 upwardly resulting in moving shoulder 26 from seat 24 to allow passage of fuel from line 18 into sleeve 20 and through perforations 22 into tube 10 to be mixed with air entering tube 10 as a result of the opening of plate 50. The mixture of fuel and air is then carried into pump 12 and delivered to the cylinders of the engine.

As is evident from the foregoing, the fuel injector valve is directly responsive to the action of the air intake valve plate 50 and when said plate is swung open to allow air to pass therebeyond a predetermined amount of fuel is simultaneously allowed to enter tube 10. When plate 50 is closed by the rotation of shaft 46 in the opposite direction from that opening plate 50, spring 42 acting against collar 44 moves shank 30 and its associated valve stem 28 downwardly whereby shoulder 26 seats within seat 24 to prevent the passage of fuel into tube 10. To insure that valve 28 is tightly closed when plate 50 is closed, said valve stem 28 may be adjusted by shank 30. When

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valve 50 is closed and the engine stopped, flow of fuel to tube 10 is entirely shut off.

As best seen in FIGS. 1 and 2, shaft 46 is operated by suitable linkage connecting the same to a throttle control. This linkage comprises a member 56 pivotally supported as at 57 and suitably connected to operating means (not shown) whereby member 56 may be swung to longitudinally reciprocate an arm 58 which has at its uppermost end a link 60 coupling the same with one end of shaft 46. When member 56 is swung in the direction of the arrow shown in FIG. 1, arm 58 and link 60 rotate shaft 46 clockwise (FIG. 4) to open valve 50.

Affixed to the opposite end of shaft 46 from that to which link 60 is coupled, is a stop element 62. Adjacent element 62 but loosely mounted on shaft 46 is an L-shaped lever 64 having a rod 68 pivotally connected to one leg thereof. Rod 68 is coupled with a vacuum assembly 70 by having one end thereof directly connected to the flexible diaphragm 72 thereof. Vacuum assembly 70 communicates with tube 10 through a pipe 74 which opens into tube 10 at a point between valve 50 and pump 12 (FIG. 4).

The leg of lever 64 not connected to rod 68 is offset to place the free end thereof in the plane of element 62. An adjusting screw 76 is threaded through the offset end of lever 64 and abuts element 62 making element 62 responsive to the action of lever 64 when rod 68 is moved in one direction by vacuum assembly diaphragm 72. When rod 68 returns to the position shown in FIG. 1, screw 76 serves to limit the clockwise movement of element 62 and thus adjustably regulates the rotation of shaft 46 and the closing of its associated fuel and air valves.

In operation shank 30 is adjusted so that shoulder 26, seating within seat 24, closes fuel line 18 when the parts are in the positions shown in the drawing. As the starting of the internal combustion engine is commenced a vacuum is created within tube 10, and more particularly within pipe 74, causing diaphragm 72 to flex downwardly viewing FIG. 1. Such flexing of the diaphragm 72 exerts a downward pull on rod 68, rotating lever 64 about shaft 46 and moving screw 76 against element 62 which is fixed to shaft 46. The movement of lever 64, and its adjusting screw 76 against element 62, and the resulting rotation of shaft 46, causes air intake valve 50 to rotate and thus open the fuel valve a predetermined distance, allowing the necessary fuel and air mixture to reach the engine and insure starting. The distance which such valves are initially allowed to open is controlled by the distance which diaphragm 72 flexes downwardly and the adjustment of screw 76.

After the engine is started the air and fuel valves are operated by linkage 56, 58, 60 which further rotate shaft 46, diaphragm 72 remaining fully downwardly flexed during such operation. When the engine is stopped and the vacuum through pipe 74 ceases, diaphragm 72 returns to its normal position, shown in FIG. 1, causing lever 64 to swing about shaft 46 and leave sufficient room for the

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rotation of element 62 whereby shaft 46 may be rotated to such a position that stem 28 is biased fully downwardly by spring 42 and completely closes fuel line 18 as a result of shoulder 26 tightly engaging seat 24.

Having thus described the invention what is claimed as new and desired to be secured by Letters Patent is:

1. In a fuel injector for a fluid pump for internal combustion engines having a pressurized fuel tank; an air intake tube for the pump; an air intake valve in the tube for controlling the passage of air through the latter into the pump; cams integral with said valve; a fuel line interconnecting the fuel tank and the air intake tube; pressure responsive means communicating with the tube; a fuel valve for controlling the flow of fuel from the line into the tube, said cams being in engagement with said fuel valve whereby said fuel valve is actuated by operation of said air intake valve, said air intake valve being operably coupled with said pressure responsive means whereby a change of pressure within the air intake tube will operate said air intake valve.

2. In a fuel injector for a fluid pump for internal combustion engines having a pressurized fuel tank; an air intake tube for the pump; an air intake valve in the tube; cams integral with said air intake valve; a fuel line interconnecting the fuel tank and the air intake tube; a fuel valve for controlling the flow of fuel from the line into the tube, said cams being in engagement with said fuel valve whereby said fuel valve is responsive to the action of said air intake valve; pressure responsive means communicating with the tube between said air intake valve and said pump; and linkage operably coupling said means with said air intake valve, whereby actuation of said means will operate said air intake valve.

3. In a fuel injector for a fluid pump for internal combustion engines having a pressurized fuel tank; an air intake tube for the pump; an air intake valve in the tube; cams integral with said air intake valve; a fuel line interconnecting the fuel tank and the air intake tube; a fuel valve for controlling the flow of fuel from the line into the tube, said cams being in engagement with said fuel valve whereby said fuel valve is responsive to the action of said air intake valve; a pressure responsive diaphragm; a pipe interconnecting said diaphragm and said tube, said pipe communicating with the tube between said air intake valve and said pump; a rod operably coupled with said diaphragm; and adjustable linkage coupling said rod with said air intake valve whereby the creation of a vacuum within said pipe will cause said air intake valve and said fuel valve to open a predetermined distance.

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