

[54] FUEL INJECTION SYSTEMS

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[58] Field of Search **123/139.11 A, 32 E, 139.6,
123/102, 97 B**

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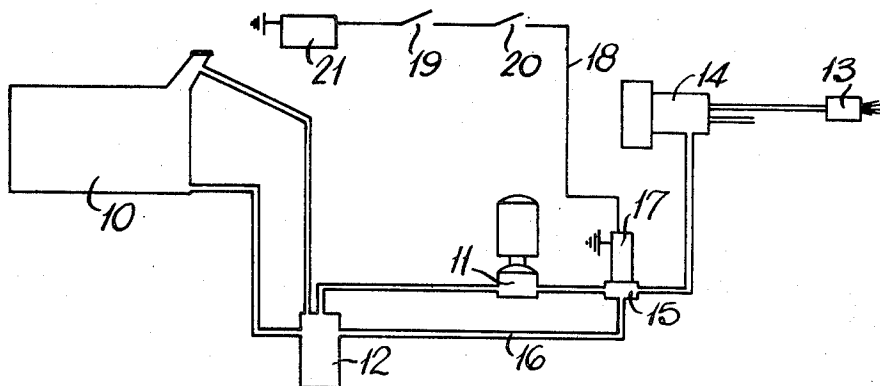
Attorney, Agent, or Firm—Holman & Stern

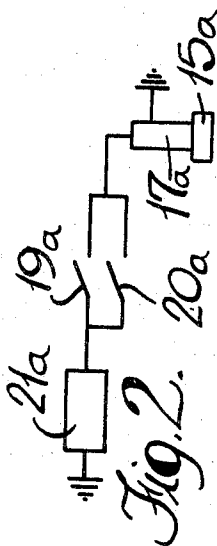
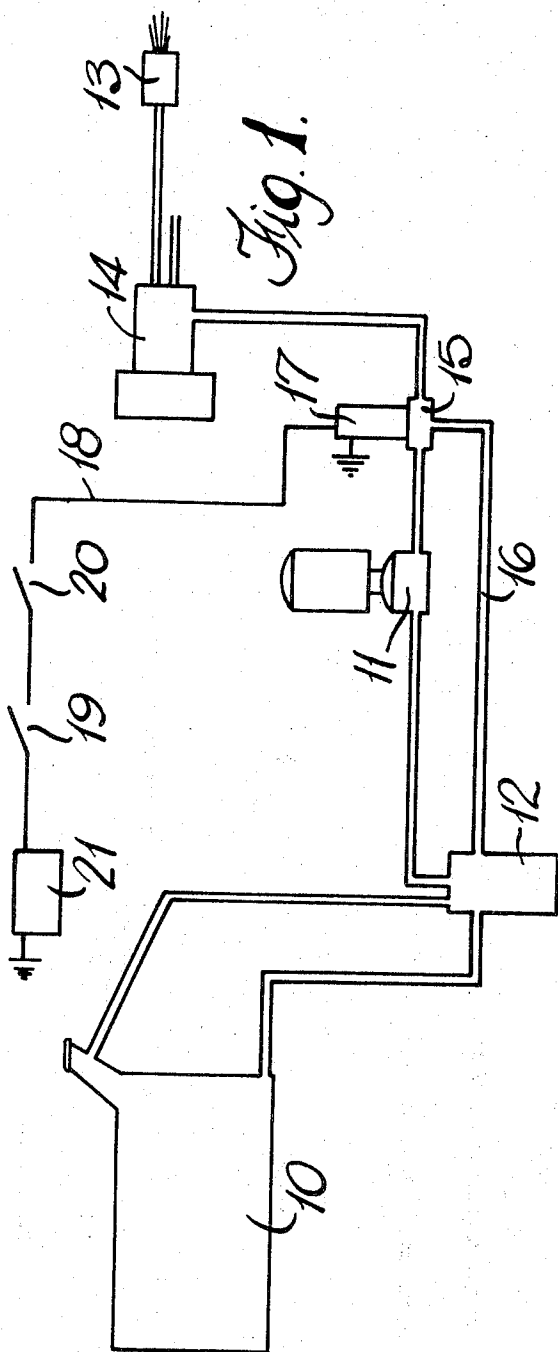
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ABSTRACT

A fuel injection system for an internal combustion engine comprising a pump, a fuel pressure operated metering and distributing unit, and at least one nozzle in the inlet manifold of the engine, a pressure relief means disposed between the pump and the metering and distributing unit and control means including an electrical solenoid for operating the pressure relief means, so that under certain engine operating conditions fuel reaches the metering and distributing unit at a pressure which is insufficient for delivery to the nozzle.

5 Claims, 2 Drawing Figures





FUEL INJECTION SYSTEMS

BACKGROUND OF THE INVENTION

This invention relates to fuel injection systems for internal combustion engines, such systems being of the kind comprising a pump which draws fuel from a reservoir, at least one nozzle intended to be disposed in an engine, and a fuel pressure operable metering unit whereby measured quantities of fuel delivered from the pump are discharged at a predetermined pressure from the nozzle or nozzles, with the metering unit being controlled in accordance with engine operating conditions.

The object of the invention is to provide a fuel injection system of the kind specified in a form in which the quantities of fuel discharged during various engine operating conditions can be controlled.

SUMMARY OF THE INVENTION

In accordance with the present invention, a fuel injection system of the kind specified has pressure relief means connected between the pump and the metering unit, said pressure relief means being arranged to spill fuel delivered by the pump in excess of a predetermined pressure, and control means associated with the pressure relief means, with the control means being actuable under selected engine operating conditions, to reduce the pressure at which the pressure relief means operates, to a pressure below that at which the metering unit can deliver fuel to the nozzle or nozzles.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described by way of example with reference to the accompanying drawings, in which:

FIG. 1 represents diagrammatically a fuel injection system for use in a multi-cylinder internal combustion engine, and

FIG. 2 shows an alternative circuit.

DETAILED DESCRIPTION OF THE INVENTION

The fuel injection system illustrated in FIG. 1 comprises a reservoir 10 from which fuel is drawn by an electrically operable fuel pump 11 through a filter 12. The pump 11 is arranged to supply fuel under pressure to a plurality of nozzles, one of which is illustrated at 13, which, in use, are disposed in the inlet manifold of the associated engine.

The fuel quantity reaching the nozzles 13 is metered by a combined metering and distributing unit indicated at 14. The metering unit in this example comprises a shuttle freely slidable in a bore, and to opposite ends of which fuel is alternately delivered. As fuel is delivered to one end of this bore, the shuttle is moved to the opposite end, which is, during this period, in communication with a passage leading to one of the nozzles 13. Fuel will, however, only be delivered to a nozzle from said opposite end if the pressure of the fuel entering the first end is in excess of a predetermined value, which corresponds to the pressure required to open a spring loaded valve in the nozzle itself. If the pressure of the delivered fuel is below this predetermined value, the shuttle will not move, and no fuel will be delivered to the nozzles 13.

Between the pump 11 and the metering and distributing unit 14, there is a pressure relief means 15. The pressure relief means 15 is arranged to spill fuel leaving

the pump 11 when the latter exceeds a predetermined pressure, and the excess fuel escapes through a passage 16 to the reservoir 10.

The pressure relief means, however, has two possible settings. In one of the settings, fuel will only escape through the passage 16 to the reservoir 10, when the pressure of the fuel leaving the pump 11 is substantially in excess of the pressure at which the metering and distributing unit 14 will operate to deliver fuel to the nozzles 13. In the other setting, the pressure relief means 15 will permit escape of fuel from the pump 11 at a pressure which is below that at which the metering and distributing unit 14 will operate.

Thus, in its first setting the pressure relief means 15 allows fuel to be delivered from the pump 11 to the metering and distributing unit 14 at a pressure which will enable fuel to be delivered to the nozzles 13 in turn. In its second setting, however, the pressure relief means 15 will prevent operation of the metering and distributing unit 14, so that no fuel is delivered to the nozzles 13 in the associated engine.

The pressure relief means 15 is operable by means of an electrical solenoid 17 which is inoperative when the metering and distributing unit 14 is intended to be operational, but which is energized when the metering and distributing unit 14 is not to be operated. The electrical solenoid 17 is connected in an electrical circuit 18 having two switches 19, 20, arranged in series with a battery 21.

In this example, the switches 19, 20 are connected to a throttle for controlling air supplied to the engine, and to means responsive to the depression existing in the engine inlet manifold, respectively. Only when the throttle is closed and the pressure in the inlet manifold is above a predetermined value, will both switches be closed. For example, these conditions occur on overrun, that is when the throttle is closed, but the engine speed is falling from a relatively high speed. It is, however, important that the switch 20, which is controlled by the means responsive to manifold depression, shall open before idling speed of the engine is reached, though high depression or low pressure exists under idling conditions. Opening of the switch 20 de-energizes the electrical solenoid, so that the metering and distributing unit 14 is rendered operational to supply fuel to the engine so that the engine will run at its idling speed.

The circuit controlling the electrical solenoid 17 can be modified as shown in FIG. 2 by arranging the switches 19a, 20a in parallel. The switch 19a is closed only when the throttle is closed and the switch 20a is open only when the manifold depression is in excess of the predetermined value.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A fuel injection system having a pump, a metering unit, a pressure relief valve connected between the pump and the metering unit, said pressure relief valve having a first setting in which it can spill fuel delivered by the pump in excess of a predetermined pressure, and electrical control means associated with the pressure relief valve, and the pressure relief valve having a further setting which is selectable by actuation of the control means at selected engine operating conditions to reduce the pressure at which the pressure relief valve opens to a pressure below that at which the metering

3

unit can deliver fuel to at least one nozzle disposed in the inlet manifold of the associated engine.

2. A fuel injection system as claimed in claim 1 in which the control means comprises an electrical solenoid to actuate the pressure relief valve, connected in an electrical circuit containing a switch which is operated when the selective operating conditions exist.

3. The fuel injection system as claimed in claim 2 in which one of the switches is connectable to an engine

4

throttle and the other is operable in response to a manifold depression in the engine.

4. The fuel injection system as claimed in claim 3 in which the switches are arranged in series and both switches are closed to energize the solenoid only when the engine is on overrun conditions.

5. The fuel injection system as claimed in claim 3 in which the switches are in parallel.

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