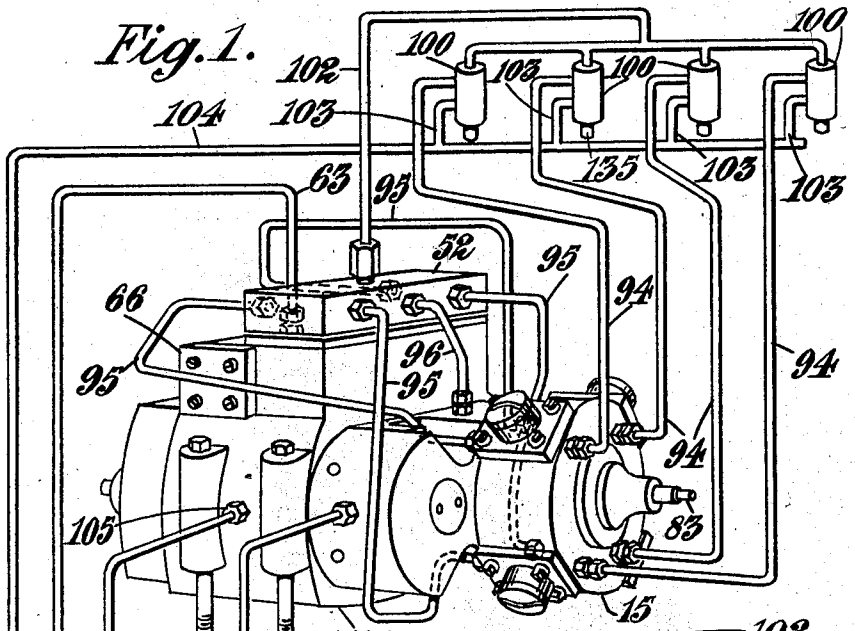
March 14, 1939. G. AMERY 2,150,574

FUEL-INJECTION CONTROL DEVICE

Filed Aug. 15, 1938

Fig. 1.



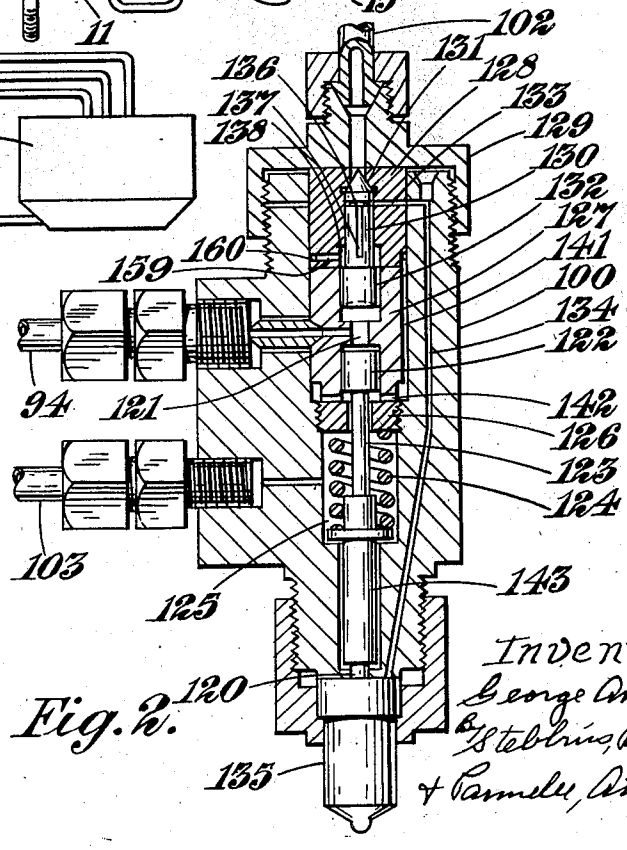


Fig. 2.

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FUEL-INJECTION CONTROL DEVICE

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8 Claims. (Cl. 299—107.5)

This invention comprises improvements in or relating to fuel-injection controlling devices for internal-combustion engines.

The invention is applicable in the case of fuel injection systems in which a fuel-nozzle is provided having a nozzle-valve, a valve-closing piston and means to apply valve-closing fluid pressure thereto so as to close the nozzle-valve while the fuel pressure at the nozzle-valve is still maintained.

The present invention comprises in a fuel-injection system as above referred to the provision of an auxiliary cut-off valve actuated by the valve-closing pressure for cutting off fuel pressure from the nozzle-valve upon the said valve being closed.

The invention further comprises a fuel-injection nozzle comprising in combination a nozzle orifice, a fuel passage thereto, a nozzle-valve for closing said nozzle orifice but capable of being opened by fuel pressure, a valve-closing piston, means for admitting fluid under pressure to said valve-closing piston and an auxiliary cut-off valve opened to the same pressure as the valve-closing piston for closing the said fuel passage.

The auxiliary cut-off valve when closed may serve to open a communication between a drain passage and the portion of the fuel passage which lies between the cut-off valve and the nozzle-valve.

In a preferred construction the fuel-nozzle comprises a valve-closing pressure chamber coaxial with the nozzle-valve, within which the valve-closing piston operates, and the auxiliary cut-off is provided with a valve-closing piston which is located in the said pressure chamber.

The following is a description, by way of example, of one fuel-injection system and fuel-nozzle for use therewith, reference being made to the accompanying drawing, in which:

Figure 1 is a diagram of a fuel-injection system, and

Figure 2 is a longitudinal section through a fuel-nozzle.

Referring to Figure 1, this shows in diagrammatic form a casing 11 which contains a pump mechanism and governor for regulating the pressure of the fuel oil. On the end of the casing 11 there is secured a casing 15 for a distributor which determines the time and order in which fuel is delivered to a number of injectors 100, through distributor pipes 94. The operation of the parts inside the casings 11 and 15 is more fully described in co-pending patent application No. 225,025 of even date herewith.

Fuel is drawn from a tank 101 by the pump in the casing 11 through an inlet pipe 63 and is delivered by the pump under pressure to a delivery box 52. The delivery pressure of the pump is controlled by the governor in the casing 11 operating upon a relief valve. The relief valve acts in a chamber connected to the delivery box by the pipe 96. Pipes 95 convey fuel oil to valves in the distributor 15, which valves are operated by a cam in the distributor and are opened in their correct sequence to deliver fuel oil through the distributor pipes 94. A plunger 83 projects from the end of the distributor casing 15. This plunger extends to the interior of the casing and is capable of moving the distributor cam axially so as to vary the time during which pressure is applied in each of the pipes 94. The plunger 83 is connected to a hand control or accelerator, not shown in the drawing, for determining the power output of the engine with which the injection system is employed.

The injectors 100 are constructed as shown in section in Figure 2. Each injector comprises a connection for the distributor pipes 94, a second connection for a drain 103 and a third connection for a pipe 102, which is connected directly to the delivery box 52 of the pump and therefore is continuously maintained full of fuel oil under injection pressure. The fuel oil which is actually injected into the engine is delivered by the pipe 102 and the oil periodically put under pressure in the pipes 94 is not injected into the engine but is used for controlling the opening and closing of a needle-valve 120 in the injector body 100.

In the injector body there is a valve chamber 121 to which the oil in the pipe 94 has direct access. The valve-closing pressure-chamber 121 contains a needle-valve closing-piston 122 which bears, by means of a stem 123, on the back of a push-rod 143 which bears on the needle-valve 120. Closing pressure on the needle-valve is further exerted by means of a spring 124. This spring determines the minimum pressure of injection. The drain pipe 103 is connected to the space 125 in which the spring 124 works and it will be seen that any leakage of fuel oil past the piston 122 enters this space and therefore such leakage is carried away by the drain which returns it to the tank 101 through the pipe 104 (Figure 1).

The strength of the spring 124 may be adjusted by means of a screwed plug 126 in the injector body 100.

The pressure chamber 121 is formed in a plug 127 which abuts against the back of the screwed plug 126 and is a close fit in a bore in the in-

jector body 100. The plug 127 is itself held down by a second plug 128 and the whole is pressed firmly together by a cap 129 to which the fuel oil delivery pipe 102 is connected. In the outer plug 128 is a seating 131 for an auxiliary cut-off valve 130. The auxiliary cut-off valve 130 has a head 132 which constitutes a piston and works in the chamber 121 in the plug 127. From a point in the outer plug 128 close behind the seating 131 there extends a passage 133 to the periphery of the plug and this passage registers with a passage 134 in the injector body which extends to the needle-valve 120. The needle-valve has a seating in a removable nozzle 135 and the passage 134 enters the nozzle and surrounds the stem of the needle-valve so that when the needle-valve is lifted fuel can pass into the engine cylinders through sprayer apertures in the nozzle 135. The needle-valve and nozzle may be of any construction, such as the construction which is commonly used in fuel-injection nozzles whereby pressure around the needle valve tends to lift it and permit fuel to be sprayed into the engine cylinder. In the present case the lifting of the needle-valve will take place against the action of the spring 124.

Returning to the auxiliary cut-off valve 130 this has a groove 136 around its stem which registers with the passage 133 when the valve is closed and communicates with a longitudinal groove 137. The groove 137 serves when the auxiliary cut-off valve is closed to connect the passage 133 with a drain chamber 138 formed in the outer plug 128. The drain chamber communicates by a radial passage 159 with a groove 160 around the plug 128 and this groove in turn communicates with a longitudinal groove 141 in the outside of the plug 127 which contains the valve-closing pressure-chamber 121. The drain groove 141 communicates, by means of a slot 142 cut in the end of the screwed plug 126, with the chamber 125 and thence with the drain pipe 103. Thus when the auxiliary cut-off valve 130 is closed the nozzle 135 will be connected by the passage 134 with the drain 103 and pressure will be relieved from the space around the needle-valve 120.

In operation, as long as pressure is maintained in the pipe 94, this pressure will be communicated to the valve-closing pressure-chamber 121 and by means of the pistons 122, 132, both the needle-valve 120 and the auxiliary cut-off valve 130 will be held closed. The distributor 15 is so arranged that, when injection is to take place in any one of the fuel injectors 100, it cuts off the supply of fuel pressure from the pipes 94 and connects them to a drain 106 (Figure 1). A pressure retaining valve is preferably provided between the casing 11 and the drain 106 so as to ensure that a low pressure, much less than the injection pressure, say about 50 lbs. per square inch, is maintained in the pipes 94 notwithstanding their connection to the drain. This low pressure, which persists in the chamber 121, does not suffice to prevent the pressure in the pipe 102 from opening the auxiliary cut-off valve 130. Consequently the passage 134 is disconnected from the drain chamber 138 and connected to the fuel pressure, which immediately lifts the needle-valve 120 and causes injection to commence. As soon as the distributor 15 acts to reapply pressure in the control chamber 121 the needle-valve 120 is closed by the action of the closing piston 122 (which is of larger area than the opening piston on the needle-valve) and this closure takes place against the full pressure of the fuel oil in the passage 134. This closing movement is assisted by the spring 124 and takes place very quickly. The auxiliary cut-off valve 152 is almost immediately afterwards moved to its closed position, seats itself on the seating 131 and opens the channel 134 to the drain 103. The result is that the needle-valve is closed against the full fuel pressure but when it is closed the fuel pressure is held up at the seat 131, the pressure in passage 134 is released to atmosphere or thereabouts and there is therefore no tendency of the fuel oil to dribble into the engine cylinder after the needle-valve is closed. If the needle-valve were closed by releasing pressure from the passage 134 and merely allowing it to close by the spring 124, the fall of pressure at the seating of the needle-valve 120 would prevent the fuel from being properly sprayed into the engine cylinder during the interval of time while the valve is closing. If, on the other hand, the valve were closed against the fuel pressure by the action of the closing piston 122 and the auxiliary cut-off valve 130 were not present the fuel pressure would be maintained around the needle-valve seating during the whole of the cycle of the engine and dribbling might occur if any leakage of the seating developed. By the construction according to the present invention, however, the full fuel pressure is maintained around the needle-valve right up to the moment when it closes and thereafter the fuel pressure is cut off by the auxiliary cut-off valve so that efficient spraying is maintained right up to the time the needle-valve closes without any risk of dribbling afterwards.

Referring again to Figure 1 it will be observed there is a second drain from the casing 11 to the fuel tank 101, the object of which is to permit the escape of any oil which may leak past the pump plungers in the casing 11.

The result of maintaining a residual pressure in the distributor pipes 94 as hereinbefore referred to is to ensure that the operation of the pistons 122, 132 is prompter when the fuel pressure is applied.

I claim:

1. In a fuel-injection system which comprises a fuel-nozzle, a nozzle-valve therefor, a valve-closing piston and means to apply valve-closing fluid-pressure thereto so as to close the nozzle-valve while the fuel-pressure at the nozzle-valve is still maintained, the provision of an auxiliary cut-off valve actuated by the valve-closing pressure for cutting off fuel pressure from the nozzle-valve upon the said valve being closed.

2. A fuel-injector comprising in combination a nozzle, a fuel passage thereto, a nozzle-valve for closing said nozzle but capable of being opened by fuel pressure, a valve-closing piston, means for admitting fluid under pressure to said valve-closing piston and an auxiliary cut-off valve operated by the same pressure as the valve-closing piston for cutting off the said fuel passage from the fuel pressure.

3. A fuel-injector as claimed in claim 2, wherein the auxiliary cut-off valve when closed serves to open communication between a drain passage and the portion of the fuel passage which lies between the cut-off valve and the nozzle-valve.

4. A fuel-injector as claimed in claim 2, comprising a valve-closing pressure-chamber co-axial with the nozzle-valve, within which the valve-closing piston operates, and the auxiliary cut-off valve is provided with a valve-closing piston which is located in the said pressure chamber.

5. A fuel-injector as claimed in claim 2, having additional spring means operatively connected to

the nozzle-valve for assisting in closing the same.

6. A fuel-injector as claimed in claim 2, comprising a valve-closing pressure-chamber co-axial with the nozzle-valve within which the valve-closing piston operates, a spring chamber interposed between said pressure chamber and the nozzle-valve, a spring in said chamber for assisting in closing said nozzle-valve and a drain from said spring chamber to carry away leakage from the nozzle-valve and closing piston.

7. A fuel-injector as claimed in claim 2, comprising a valve-closing pressure-chamber co-axial with the nozzle-valve within which the valve-closing piston operates, a spring chamber interposed between said pressure chamber and the nozzle-valve, a spring in said chamber for assisting in closing said nozzle-valve, a drain from said spring chamber to carry away leakage from the nozzle-valve and closing piston, wherein the auxiliary cut-off valve is provided with a valve-closing piston located in said pressure chamber and the auxiliary valve is provided with means whereby when it is closed it opens communication between the said drain and the portion of the fuel passage which lies between the cut-off valve and the nozzle-valve.

8. A fuel-injector as claimed in claim 2, having additional spring means operatively connected to the nozzle-valve for assisting in closing the same and means for adjusting the force of said spring means.

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