June 29, 1943. G. AMERY 2,323,184

FUEL INJECTION IN INTERNAL COMBUSTION ENGINES

Filed Feb. 11, 1941

Fig. 1.

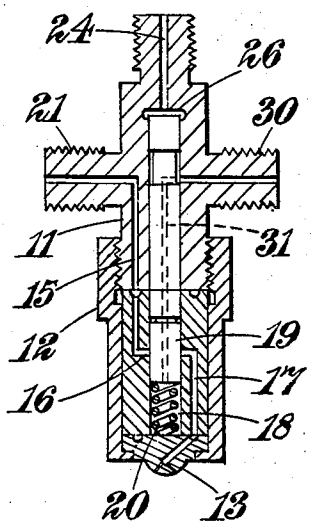


Fig. 2.

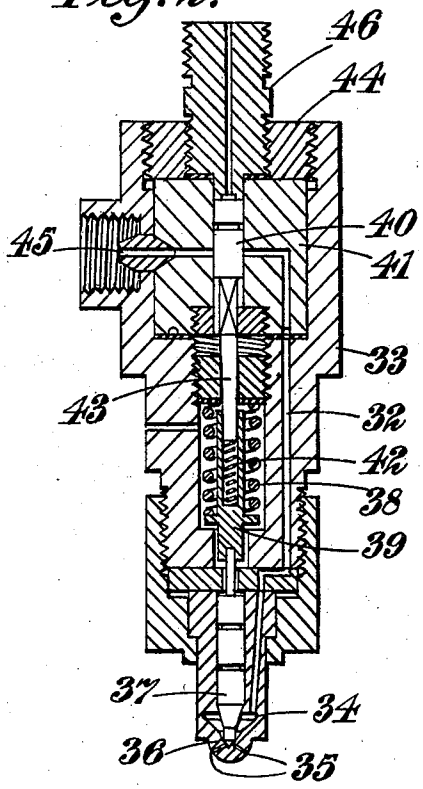
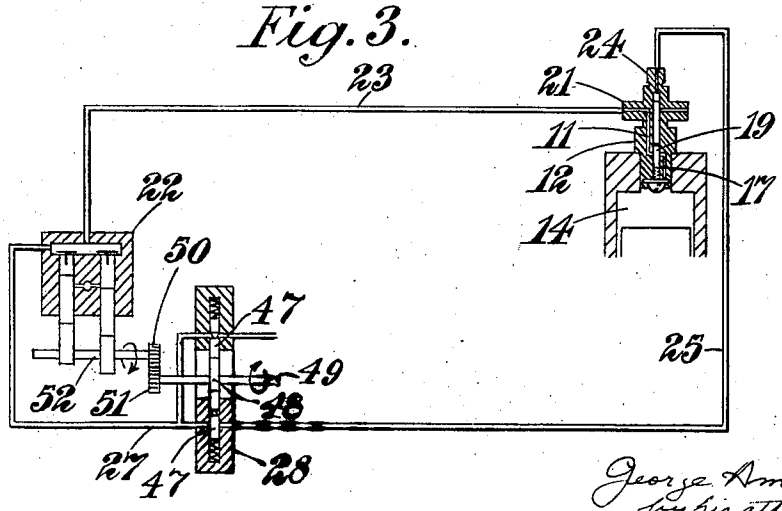


Fig. 3.



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FUEL INJECTION IN INTERNAL COMBUSTION ENGINES

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In Great Britain November 4, 1939

4 Claims. (Cl. 299—107.5)

This invention comprises improvements in or relating to fuel injection in internal combustion engines.

The present invention comprises in a fuel injection system the combination of a fuel pump for delivering fuel at injection pressure, a fuel injection nozzle connected thereto by a conduit, a cut-off valve which in one position opens said conduit and in another position closes said conduit, a piston upon the cut-off valve for operating the same by fluid pressure, a control-cylinder in which the piston works, a second conduit connecting the control-cylinder to a source of fluid pressure, a distributor valve in said second conduit for determining the operation of the cut-off valve and means to operate the distribution valve and thereby determine the admission and termination of fuel injection.

There may in addition be provided between the cut-off valve and the fuel injection nozzle a spring-closed needle-valve or its equivalent, the opening or closing of this valve being determined solely by the presence of fluid pressure at its seating which is in turn determined by the cut-off valve aforesaid and thus the whole control of the opening and closing of the valve is subject to the cut-off valve, in contradistinction to certain previous constructions in which the cut-off valve has been merely subordinate to the opening and closing of the needle-valve by means of pistons and the like, as for example in my prior United States patent specification No. 2,150,574 and application Serial No. 305,971.

The following is a description by way of example of two constructions in accordance with the invention.

In the accompanying drawing—

Figure 1 is a section through one construction of injector in accordance with the invention;

Figure 2 is a section through a second construction;

Figure 3 is a diagram showing the parts associated with the constructions of Figure 1 or Figure 2 in actual use.

In the construction of Figure 1 a fuel injector is provided which comprises a body portion 11 having a cap 12 in which is held a fuel injection nozzle 13, adapted to spray fuel into the combustion chamber 14 of an internal combustion engine. In the body portion 11 is a passage 15 leading to the spray nozzle and this passage at one point 16 in its length passes diametrically across the axis of the injector body and is continued by a second bore 17 being intersected by an axial valve bore 18. Within the bore works a piston-like cut-off valve 19 which in one position of its movement is capable of connecting the two parts of the conduit 15, 17 leading to the spray nozzle while in another position, to which it is normally urged by a spring 20, it shuts off the fuel conduit.

The fuel conduit emerges from the side of the injector body in a screwed union connection 21 which is connected to a fuel pump 22 by a pipe 23 (Figure 3) in which constant pressure is maintained, or at all events continuous pressure which may in certain cases be proportional to the engine speed or a function thereof.

In the end of the injector body there is a conduit 24 which is connected by a pipe 25 to a distributor 28 and this conduit opens into a control-cylinder 26 in the injector body 11 to which the cut-off 19 has access, the end of the cut-off valve forming a piston which works in the cylinder 26. The distributor serves to admit fuel pressure derived from the pump 22 through pipe 27 to the chamber 26 at such times as injection is to take place.

When therefore the distributor 28 applies pressure to the control chamber 26, the cut-off valve 19 moves into the position where the fuel conduit 15, 17 is opened, this movement taking place against the operation of the spring 20, and injection occurs. As soon as the distributor relieves the pressure from the chamber 26 the cut-off valve is returned by the spring and injection ceases. An outlet 30 for seepage is provided in the side of the injector body 11 and is connected by a passage 31 running axially through a part of the cut-off valve to the chamber containing the valve spring 20. This prevents the chamber from hindering the movements of the valve.

In the construction of Figure 2 a conduit 32 within the injector body 33 is led to a chamber 34 behind the nozzle openings 35 and a valve-seating 36 is provided in this chamber behind the nozzle-openings, which seating is closed by a needle-valve 37. Thus when the fuel pressure is permitted to pass towards the nozzle-openings 35, before injection actually takes place the pressure has to lift the needle-valve 37, which it does against the action of a spring 38 situated within the injector body.

The needle-valve spring 38 surrounds and acts upon a shouldered cylindrical pressure-member 39 which it presses against the back of the needle-valve. A cut-off valve 40 is located within a plug 41 in the injector body 33 and a spring 42 within the pressure-member 39 bears (in the opposite direction from the spring 38) on a stem 43 which extends down into the pressure-member 39 from

the cut-off valve. This is an arrangement which makes for compactness as one spring is within the other and the cut-off valve spring **42** also helps the needle-valve spring **39** to close the needle-valve **37**.

The plug **41** is held in place by a screwed member **44**, a lateral fuel inlet **45** similar to the connection **21** of Figure 1 being provided to feed the conduit **42** and a connection **46** similar to the connection **24**, to work the cut-off valve **40**.

In the case where a multiplicity of injectors are used, on a multi-cylinder engine, the pump **22** is common to all the injectors; preferably its pressure is a function of the engine speed and a relief valve to prevent excessive pressure may be embodied in the manner described in prior United States patent specification No. 2,191,186.

It will be appreciated that while the cut-off valve (**19** or **40**) has been described as opening the fuel passage (**15** or **32**) when pressure is applied by the distributor **28**, it could equally well be arranged to close the passage under such pressure and open it when the pressure is relieved, providing the distributor is suitably modified as to the timing of application and relief of pressure. The distributor **28** has valves **47** operated by cams **48** from a camshaft **49** and is driven by gearing **50**, **51** from the shaft **52** of the pump **22**, both parts being driven by gearing from the crankshaft of the engine **14**.

The distributor pressure is shown as derived from the same pump **22** as the fuel pressure but it may be derived from a separate supply at a different pressure if desired. The cut-off valve instead of being spring-returned may be returned by fluid-pressure acting upon a return piston-face.

I claim:

1. A fuel injection nozzle comprising a nozzle body having a central bore therethrough and carrying a spray nozzle at one end and a fluid passage at the other end, a fuel passage in said body intersecting said bore and communicating with said spray nozzle, a cut-off valve in said bore having a passage therein, means for normally maintaining said valve with the passage in the valve out of registry with the fuel passage to close the same, a control piston in said bore aligned with and rigidly attached to said cut-off valve and means to apply fluid pressure to one face of said piston to force the cut-off valve into position to align the passage in the valve with the fuel passage to open said passage; the supply to the fuel passage and to the piston being independent.

2. A fuel injection nozzle as claimed in claim 1, wherein there is also provided a needle valve and seat therefor between the cut-off valve and the injection nozzle, said needle valve being adapted to close said fuel passage and to open under the effects of fuel pressure at the seat.

3. A fuel injection nozzle as claimed in claim 1, wherein there is also provided a needle valve and seat therefor between the cut-off valve and the injection nozzle, the needle valve being coaxial with the cut-off valve, and wherein a return spring for the cut-off valve also presses upon a member connected to the needle valve to assist in closing it.

4. A fuel injection nozzle comprising a nozzle body having a central bore therethrough and carrying a spray nozzle at one end and a fluid passage at the other end, a fuel passage in said body intersecting said bore and communicating with said spray nozzle, a cut-off valve in said bore having a passage therein, means for normally maintaining said valve with the passage in the valve out of registry with the fuel passage to close the same, a control piston mechanically connected to said cut-off valve to move therewith and means to apply fluid pressure to one face of said piston to force the cut-off valve into position to align the passage in the valve with the fuel passage to open said passage; the supply to the fuel passage and to the piston being independent.

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