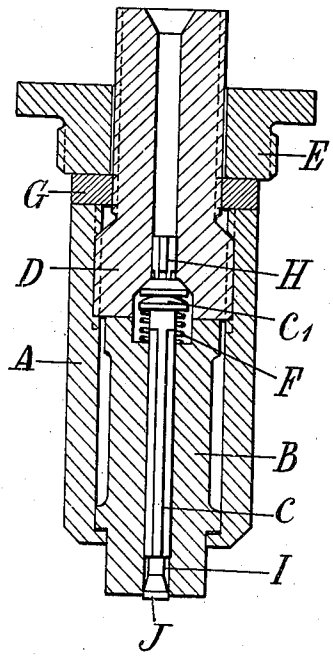
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INJECTOR FOR INTERNAL COMBUSTION ENGINES

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Fig. 1



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INJECTOR FOR INTERNAL COMBUSTION ENGINES

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1 Claim. (Cl. 299—107.6)

This invention relates to injectors for internal combustion engines and is primarily, although not necessarily, concerned with injectors for use with light fuels.

It is known to provide a nozzle with a piston valve which moves outwardly, that is, in a direction out of the nozzle into the cylinder or other space into which the fuel is to be injected, instead of the more usual form of inwardly opening valve. Such an outwardly opening piston valve has the advantage that it can be of smaller dimensions and can be inserted from the end of the injector remote from the nozzle. As hitherto constructed it has, however, the disadvantage that the powerful return spring for the valve occupies a relatively large space close to the nozzle. There is thus quite a large quantity of fuel near the nozzle which is accordingly exposed to high temperatures, and this is particularly undesirable in the case of light fuels having a low boiling point, since the heat of combustion tends to vaporize such fuel.

The main object of the present invention is to provide an improved construction in which the above-mentioned disadvantage is avoided.

In the improved injector according to the invention, a piston valve has a sliding fit in a guide bore through which the fuel to be injected is also delivered, the piston valve having a control surface which co-operates with the injection end of the bore to obturate fuel injection and which moves beyond such end to permit fuel injection.

With such a construction, it is possible to arrange the return spring, and hence the volume of fuel surrounding it, at any desired distance from the injection end of the guide bore, which constitutes the nozzle, and to conduct the fuel to the injection end of the guide bore in such a manner as to reduce to a minimum heating of the fuel prior to injection.

The piston valve preferably comprises a guide spindle having at least one passage through which the fuel flows to an annular recess in the guide spindle adjacent to the control surface.

A non-return valve is preferably disposed in the path of the fuel before it reaches the piston valve and is subjected to the force exerted on the piston valve by both the pressure in the combustion chamber and the pressure of the return spring for the piston valve. According to one embodiment of the present invention the non-return valve has a conical seat, and is separate from, but actuated by, the piston valve.

The piston valve may comprise a guide spindle having a control surface at one end thereof. If the diameter of the guide bore for the guide spindle of the piston valve is smaller than that portion of the guide bore for the control surface, it is difficult to make the very small gap through which the fuel is uniformly injected. According to a further feature of the invention, an injector is provided in which the guide bore is of uniform diameter throughout its length and both the guide spindle and the control surface of the piston valve have a sliding fit therein.

In order that the invention may be more readily understood and practised, a preferred embodiment thereof will now be described with reference to the accompanying drawing, in which the single figure illustrates an axial sectional view of a fuel injector according to the present invention.

The injector illustrated comprises a housing A in which is mounted a nozzle member B. The nozzle member B is retained in position in the housing A by a member D which screws into the top of the housing A and is locked in position by a lock nut G. The construction of the member B and the housing A is such that only a small portion of the surface of the member B actually engages with the housing A so that the conduction of heat from the housing A to the member B is reduced to a minimum. The member D has a central bore through which the fuel flows, and the top end of the bore is formed as a conical seating for connection to a corresponding seating at the end of the supply pipe of the injector.

The injector is arranged to be pressed by a screw cap E against a conical seating therefor in the wall or head of the cylinder of the internal combustion engine on which the injector is mounted.

The nozzle member B has a central guide bore for a piston valve C controlling fuel injection, the lower end of this bore constituting the injection nozzle. The guide bore is of uniform diameter throughout its length, and the piston valve C has a guide spindle formed on its outer surface with four straight grooves, between which four guide ribs are left, so that fuel supplied to the upper end of the guide can pass downwardly through the grooves and bore to an annular recess I in the guide spindle adjacent to a control surface J at the injection end of the guide bore. The guide spindle and the control surface J have a sliding fit in the guide bore, and the control surface J co-operates with the injection end of the guide bore to obturate fuel injection and moves beyond such end to permit fuel injection.

The piston valve C is normally held in its closed position by a compression return spring F sur-

rounding the valve spindle and disposed between a head C_1 integral with the upper end of the piston valve C and a shoulder at the upper end of the guide bore in the member B. The arrangement is such that the piston valve C moves downwardly when the pressure of the fuel delivered by the pump to the injector reaches a predetermined value, whereupon the control surface J moves beyond the injection end of the bore in the member B to permit the injection of the fuel.

In the embodiment illustrated, a non-return valve H having a conical seating is employed, and in this case, in order to avoid the possibility of jamming of the piston valve in its bore, the conical non-return valve H is made separate from the piston valve C. The valve H is arranged to be pressed against its seating by the head C_1 of the piston valve C, the upper surface of the head C_1 advantageously being formed as a part of a sphere. The non-return valve H is subjected to the force exerted on the piston valve by both the pressure in the combustion chamber and the pressure of the return spring F.

Any suitable arrangement of grooves may be employed on the outer surface of the guide spindle, provided that the guide spindle of the piston valve C guides the control surface J so that said control surface moves coaxially with the guide bore and, in its closed position, forms a fluid-tight fit therein.

Prior to the commencement of injection, the non-return valve, that is the conical valve H in the arrangement illustrated is loaded on one side with the full pump pressure, while the pressure in the combustion chamber and the return spring F act on the other side thereof. As soon as the non-return valve opens, however, only the differential pressure due to the velocity of the flow of the fuel acts on the non-return valve to press it against the return spring F, the pressure being exerted indirectly through the intermediary of the head C_1 in the construction illustrated.

Since the piston valve C remains closed slightly longer than the non-return valve owing to the relative arrangement of the control surface J and the co-operating portion of the injection end of the guide bore, the piston valve C is loaded on one side upon the opening of the non-return valve by the pump pressure reduced by the pressure drop across the non-return valve, and on the other side by the pressure in the combustion chamber and the return spring F.

Immediately the piston valve C opens, that is when the control surface J moves beyond the injection end of the guide bore, the area of the annular passage through which the fuel is injected determines the pressure opposing that of the return spring F. The piston valve C will always open to such an extent that the area of the passage for the injection of fuel is such that the velocity of flow produces a hydraulic pressure on the valve equal and opposite to the returning force exerted by the spring F. It is thus possible by suitable selection of the strength of the return spring F to produce a predetermined relationship between the injection velocity of the fuel with a small opening of the piston valve C and the injection velocity with a larger opening of the piston valve C. In any case, the highest velocity of the fuel produced by the pressure is utilised for atomisation of the fuel, and only the substantially smaller fraction of flow energy which is produced at the opening through which the fuel is injected is lost.

What is claimed as the invention and desired secured by Letters Patent of the United States is:

An injector for light fuels comprising a nozzle having an axial bore through which fuel to be injected is delivered under pressure, said bore including an upper portion, an intermediate portion of enlarged diameter communicating with said upper portion, and a lower guide portion communicating with said intermediate portion; a valve seat adjacent the juncture between said upper and intermediate portions; a non-return valve cooperating with said valve seat to control the flow of fuel from the upper portion to the intermediate portion of the bore; a piston valve slidably mounted within said guide and intermediate portions and including a passage through which fuel may flow from said intermediate portion to the lowermost end of said guide portion, said piston valve having a head at its upper end disposed within the intermediate portion of the bore and beneath the non-return valve positioned within said portion, and said piston valve having a valve surface at its lower end for controlling the flow of fuel from the lowermost end of the bore; and a compression return spring within said intermediate portion of the bore and beneath said head to maintain said head in contact with said non-return valve to maintain said valve in contact with said valve seat and to maintain said valve surface in position to prevent the flow of fuel from the lowermost end of the bore until said non-return valve is subjected to a sufficient, predetermined fuel pressure to overcome the force exerted by said spring.

RUDOLF L'ORANGE.

Executor of the Estate of Prosper L'Orange, Deceased.