

[54] INJECTION DEVICES FOR INTERNAL COMBUSTION ENGINES

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[63] Continuation of Ser. No. 12,700, Feb. 19, 1970.

[52] U.S. Cl. 123/119 R, 123/139 AW, 123/32 EA

[51] Int. Cl. F02m 51/00

[58] Field of Search 123/32 EA, 139 AW, 119 R

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[57] ABSTRACT

An improved injection device is provided for internal combustion engines. It has on one hand an induction pipe, upstream of a main throttle actuated by the driver, an auxiliary throttle which is opened automatically and progressively in proportion with the increase in air-flow in the pipe, and on the other hand, a source of pressurized liquid fuel connected to an injection orifice. The latter communicates with a zone of the induction pipe downstream of the main throttle. It has also a metering system sensitive to the position of the auxiliary throttle and adapted to regulate the flow of injected fuel in such manner that the richness of the air-fuel mixture passing into the induction pipe is substantially constant, at least under certain operating conditions of the engine. The injection orifice is aligned with an auxiliary orifice opening into the said zone of the induction pipe. The space between the two orifices forms a chamber where the pressure is independent of that in the said zone of the induction pipe. The chamber communicates, at least when the auxiliary throttle is in the slight air-flow position, with the portion of the induction pipe bounded by its two throttles.

2 Claims, 2 Drawing Figures

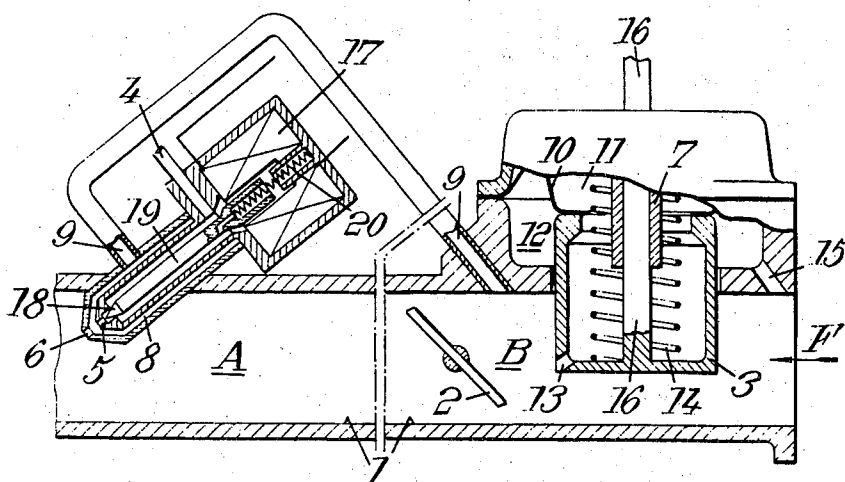


Fig. 1.

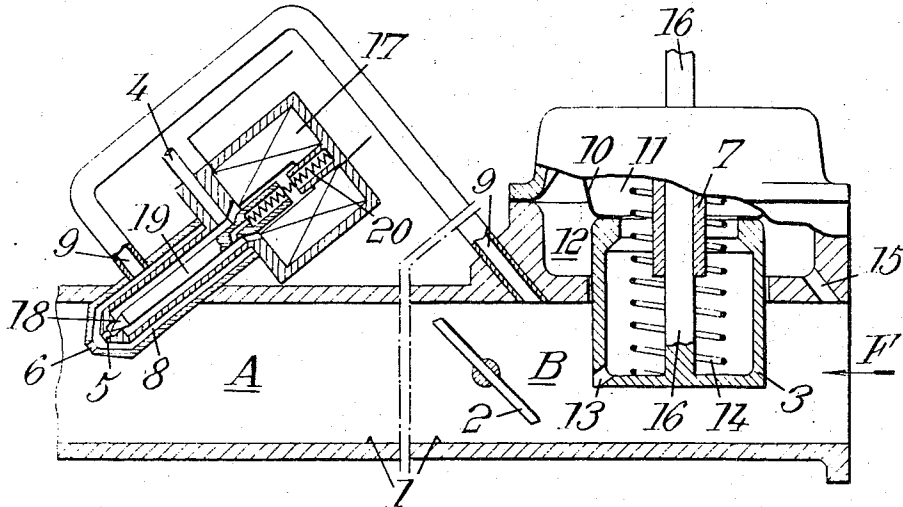
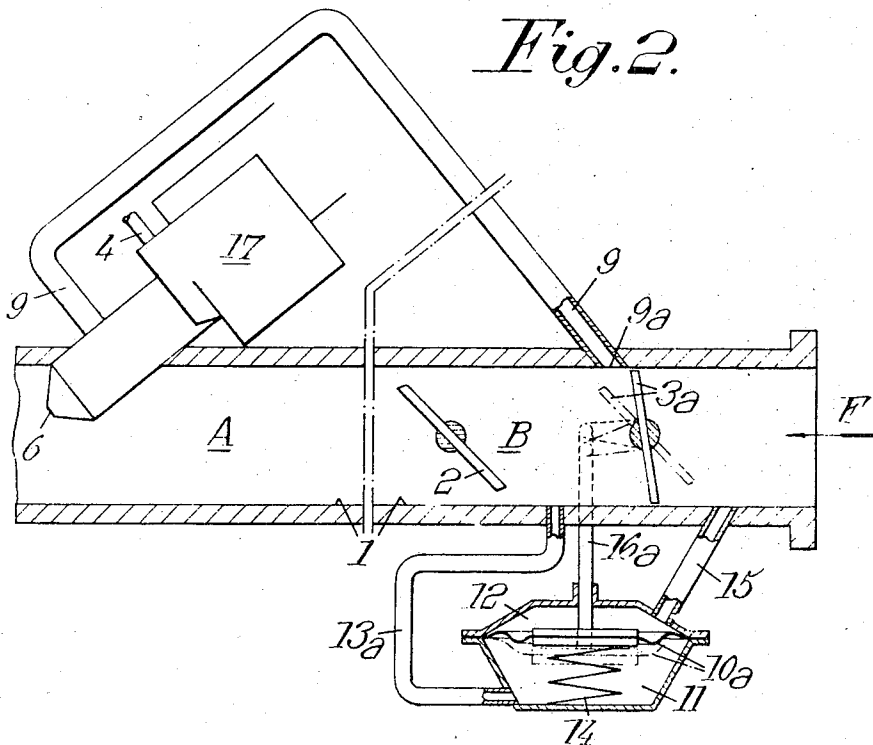


Fig. 2.



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INJECTION DEVICES FOR INTERNAL COMBUSTION ENGINES

This is a continuation of U.S. Pat. application Ser. No. 12,700, filed Feb. 19, 1970.

The invention relates to injection devices, for internal combustion engines, which comprise, on one hand, in their induction pipe, upstream of a main throttle member actuated by the driver, an auxiliary throttle member which opens automatically and progressively as the air-flow in the said pipe increases, on the other hand, a source of fuel under pressure connected to an injection orifice communicating with a zone of the said pipe situated downstream of the main throttle member and, on the other hand finally, a metering system sensitive to the position of the auxiliary throttle member and adapted to regulate the flow of injected fuel in such manner that the richness of the air-fuel mixture in the induction pipe is substantially constant, at least for certain conditions of operation of the motor, the said injection orifice being aligned with an auxiliary orifice which opens into the said zone of the induction pipe and the space comprised between the two orifices belonging to a chamber where the pressure is independent of that existing in the said zone of the induction pipe.

Such a device is described in U.S. Pat. application No. 47,631/67. It is to render the flow of fuel independent of the pressure existing in the zone in question of the induction pipe that the injection orifice does not open directly into this zone but into a chamber which is kept at atmospheric pressure by communicating with the atmosphere either directly or through the air intake of the induction pipe. It is known that this air intake is situated between an air filter, upstream of it, and the auxiliary throttle member, downstream of it. In this way, to the flow of air which is regulated by this throttle member there is added that which arrives by being provided from the said chamber. As the flow of fuel is adjusted to the single air-flow regulated by the auxiliary throttle member, there are produced undesirable variations of the richness of the air-fuel mixture which are particularly sensitive to the slowing of the motor and in general to very small air-flows.

It is an object of the invention, particularly, to remedy this drawback.

To this end, the injection device defined above is characterized by the fact that the said chamber communicates, at least when the auxiliary throttle member occupies a position corresponding to small air-flows, with the portion of the induction pipe limited by its two throttle members.

In this manner, it is as a whole that the air-flow is regulated by the auxiliary throttle member, due to which the richness of the mixture is rendered constant under the majority of operating conditions of the engine.

The invention will be better understood with the aid of the rest of the description which follows and from the accompanying drawing, which relate to two preferred embodiments given purely by way of illustrative but non-limiting example.

In the drawing:

FIGS. 1 and 2 show, partly in elevation and partly in section, these two embodiments of injection devices according to the invention.

As regards the injection device as a whole, it is advantageously established according to the disclosure of

the above-mentioned patent application, by making it comprise:

on one hand, in its induction pipe 1, upstream of a main throttle member (or butterfly valve) 2 actuated by the driver, an auxiliary throttle member 3 which is opened automatically and progressively as the flow of air in the pipe 1 increases (the direction of flow being diagrammatically shown by an arrow F); on the other hand, a source of liquid fuel under pressure (not shown) connected by a pipe 4 to an injection orifice 5 indicating with a zone A of the pipe 1 situated downstream of the main throttle member 2; and, on the other hand finally, a metering system (not shown) sensitive to the position of the auxiliary throttle member and adapted to regulate in such manner the flow of fuel injected by the orifice 5 that the richness of the air-fuel mixture is substantially constant, at least for certain conditions of operation of the engine.

In addition, the injection orifice 5 is aligned with an auxiliary orifice 6 which opens into the zone A of the pipe 1, the space comprised between the two orifices 5 and 6 belonging to a chamber 8 where the pressure is independent of that existing in the zone A, so that the flow of fuel through the orifice 5 is itself rendered independent of this latter pressure. The section of the orifice 6 is preferably greater than that of the orifice 5. The chamber 8 is connected indirectly to the atmosphere, in the manner specified below, by a passage 9 of which the section is distinctly greater than that of the orifice 6.

In the embodiment shown in FIG. 1, the auxiliary throttle member 3 is constituted by a casing capable of being transversely displaced with respect to the pipe 1 to be capable of closing it more or less. This casing is actuated by a pneumatic device comprising a diaphragm 10 separating the two chambers 11 and 12 from one another. An orifice 13, passing through the wall of the casing, places the chamber 11 in communication with the section B of the pipe 1 which is included between the throttle members 2 and 3. A spring 14 tends to push back the casing to the inside of the pipe 1, against the action of the reduced pressure transmitted into chamber 11 through the orifice 13. The chamber 12 is put at atmospheric pressure through a passage 15 which opens preferably into the intake of pipe 1, between an air filter (not shown) and the casing 3. Finally, the casing 3 bears a central shank 16 which slides in a guide 7 and which projects to the exterior to act on the said metering system.

The longitudinal position taken at each moment by the casing 3 and its shank 16 corresponds, of course, to the flow of air which circulates in the pipe 1 in the direction of the arrow F. The greater the flow, the more the shank 16 lifts, a substantially constant reduced pressure (or at the very least varying according to the characteristics of the spring 14) being established in the section B of the pipe 1.

It is clear that the casing 3 could be replaced by any one of the equivalent auxiliary throttle members well known by technicians. In particular, as shown in FIG. 2, this auxiliary throttle member could be constituted by a valve-flap 3a actuated by a diaphragm 10a separating two chambers 11 and 12 from one another similar to those denoted by the same reference numbers in FIG. 1, the orifice 13 is being placed by a passage 13a. The diaphragm 10a is coupled to the valve-flap 3a by a mechanism 16a constituted, for example,

by the assembly of a link-rod attached by one end to the diaphragm and, by the other, to a lever rigidly fixed to the valve-flap 3a. In this case, the greater the flow of air in the direction of the arrow F, the more the valve-flap 3a opens.

As regards the said metering system, it is advantageously made to comprise a member (not shown) driven in a continuous rotary movement and capable, by acting on the energizing of an electromagnet 17 which actuates a valve 18 cooperating with the injection orifice 5, to determine, over a fraction only of each of its turns, the opening of this valve, and this system is arranged in such manner that it increases the said fraction in proportion as the opening of the auxiliary throttle member 3 increases (that is to say, in the example shown in FIG. 1, the rise of the shank 16) and vice-versa. The electromagnet 17 acts on a shaft 19, rigidly fixed to the valve 18, against the action of a return spring 20. Various solutions, to constitute this metering system, have been described in the above-mentioned patent application as well as in U.S. Pat. Appln. Ser. No. 766,264 filed

Whatever the structure of this metering system, it adapts the flow of fuel to the air-flow which passes in the pipe 1 from one side to the other of the auxiliary throttle member 3 or 3a.

To avoid the air introduced into the pipe 1 through the orifice 6 provided from the chamber 8 from disturbing the metering of fuel, according to the invention, the chamber 8 is made to communicate, not directly with the atmosphere or with the air intake of the induction pipe 3a but with the section B of this pipe which is included between the two throttle members 2 and 3 or 3a. In other words, the passage 9 is connected, through one end, to the chamber 8 and, through the other end, to the section B.

It is clear that, due to the invention, the total air-flow admitted to the engine is in direct relationship with the position of the auxiliary throttle member 3 or 3a and, consequently, with the flow of fuel introduced through the orifice 5. Moreover, given that the pressure transmitted into the chamber 8 and existing at the outlet of the injection orifice 5 is appreciably constant and independent of the reduced pressure existing in the portion A of the pipe, variations in the flow of fuel are rendered practically independent of any parameter other than the overall air-flow, at least under the majority of operating conditions of the engine.

In the case where the auxiliary throttle member is constituted by a valve-flap or butterfly-valve 3a, as is indicated in FIG. 2, it may be advantageous to place the orifice 9a through which the passage 9 can open into the section B in such a way that it passes from downstream to upstream of the valve-flap 3a when the latter passes from the closed position (shown by a full line in FIG. 2) to an open position (shown in mixed line). This arrangement enables the obtaining with certainty, at the level of the orifice 9a of a pressure greater at any moment than the pressure existing at the other end of the passage 9, that is to say in the chamber 8 (see FIG. 1). In fact, when the valve-flap 3a is sufficiently opened, the orifice 9a is situated upstream of the section B of the pipe 1, in which section the pressure is always less than that which exists in the portion of the pipe 1 situated upstream of the auxiliary throttle member 3a. It is noted that, for this position of the auxiliary throttle member, the whole of the air-flow admitted to

the engine no longer passes into the section B of the pipe 1, but this has little importance since, when the auxiliary throttle member 3a is open, this corresponds to a strong air-flow in the pipe 1 and, under these conditions, the additional air-flow through the passage 9 becomes negligible.

As is evident, and as is already clear from the above, the invention is by no means limited to that of its methods of application nor to those embodiments of its various parts, which have been more particularly described; it embraces, on the contrary, all variations of them.

What I claim is:

1. In an injection system for use in an internal combustion engine including in the induction pipe of the engine, a main throttle member actuated by the driver, an auxiliary throttle member positioned upstream of said main throttle member, spring biasing means normally urging said auxiliary throttle member closed and automatically and progressively, in proportion to the air-flow past said auxiliary throttle member in said pipe, allowing the opening of said auxiliary throttle member to increase against the spring bias, an injection orifice communicating with a zone of said induction pipe situated downstream of said main throttle member, a source of fuel under pressure connected to said injection orifice, a metering system disposed between the fuel source and the injection orifice and sensitive to the position of the auxiliary throttle member and comprising regulating means for the flow of fuel through said injection orifice so that the richness of the air-fuel mixture passing into the induction pipe downstream of said injection orifice is substantially constant, at least under certain conditions of operation of the engine, an auxiliary orifice opening into said zone and aligned with and separated by a space from said injection orifice, said space forming part of a chamber wherein the pressure is substantially independent of that existing in said zone and a passage communicating said chamber with an upstream portion of said induction pipe the improvement comprising the passage communicating said chamber with that portion of the induction pipe bounded on the downstream side by the upstream side of the main throttle member and on the upstream side by the auxiliary throttle member such that when the force exerted by said spring means on said auxiliary throttle member is nearly closing said auxiliary throttle member due to slight airflow passing through said induction pipe which under such circumstances, is exerted only a relatively small counter-balancing force on the auxiliary throttle member, said passage lies on the downstream side of said auxiliary throttle member so that the auxiliary throttle member will be exposed to the total air flowing through the induction pipe even though when greater air flows are present in said induction pipe and a greater counter-balancing force is imposed on said auxiliary throttle member forcing it to a greater opening against the influence of said spring means, the passage may lie on the upstream side of said auxiliary throttle member whereupon a portion of the total air flow may be diverted through said passage before reaching the auxiliary throttle member so that for at least conditions of slight air flow the sensitivity of the metering system and its correlation with the auxiliary throttle member is preserved.

2. An injection system according to claim 1, wherein the auxiliary throttle member is a butterfly valve and said passage has its inlet into the induction pipe situated to pass from downstream to upstream of the butterfly valve when the degree of rotation and therefore opening of said butterfly valve increases beyond a predetermined limit.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,826,233 Dated July 30, 1974

Inventor(s) ANDRE LOUIS MENNESSON

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On Title Page insert:

"FOREIGN APPLICATION PRIORITY DATA

February 25, 1969 France 69 04748"

Signed and sealed this 3rd day of December 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents