United States Patent

[11] **3,610,529**

[72] Inventor **Robert Huber**
Zumikon, Switzerland

[21] Appl. No. **844,005**
[22] Filed **July 23, 1969**
[45] Patented **Oct. 5, 1971**
[73] Assignee **Societe Des Procedes D'Injection Sopromi**
Les Mureaux, France
[32] Priority **Aug. 28, 1968**
[33] **Switzerland**
[31] **12911/68**

[54] **ELECTROMAGNETIC FUEL INJECTION SPRAY VALVE**
11 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **239/96,** 239/533, 239/585
[51] **Int. Cl.** **F02m 47/00**
[50] **Field of Search** 239/86, 87, 88, 89, 90, 91, 92, 95, 96, 533, 585

[56] **References Cited**

UNITED STATES PATENTS

3,464,627	9/1969	Huber	239/96
3,481,542	12/1969	Huber	239/71

Primary Examiner—M. Henson Wood, Jr.
Assistant Examiner—Edwin D. Grant
Attorney—Spencer & Kaye

ABSTRACT: The nozzle valve needle is closed by a compression spring housed in a space that is separate from the space in which the pressure determines the opening and closing of the needle. In another embodiment, a piston is acted upon by the pressure in this latter space to close the needle.

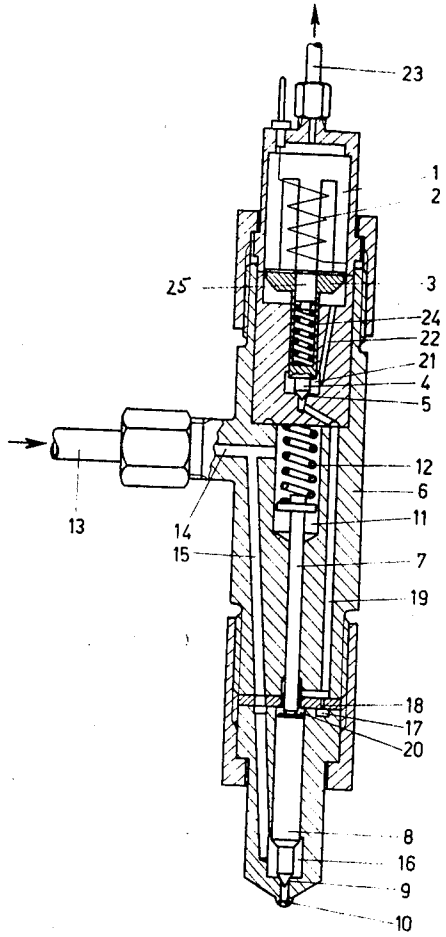
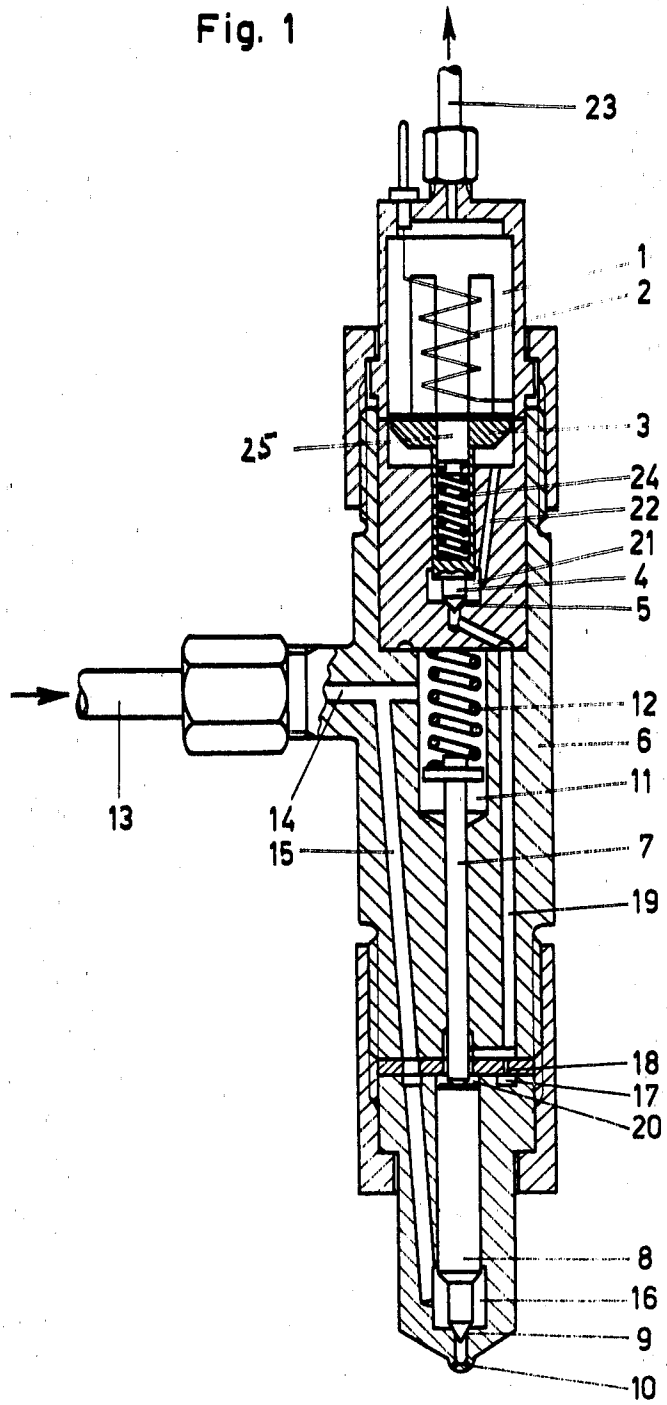
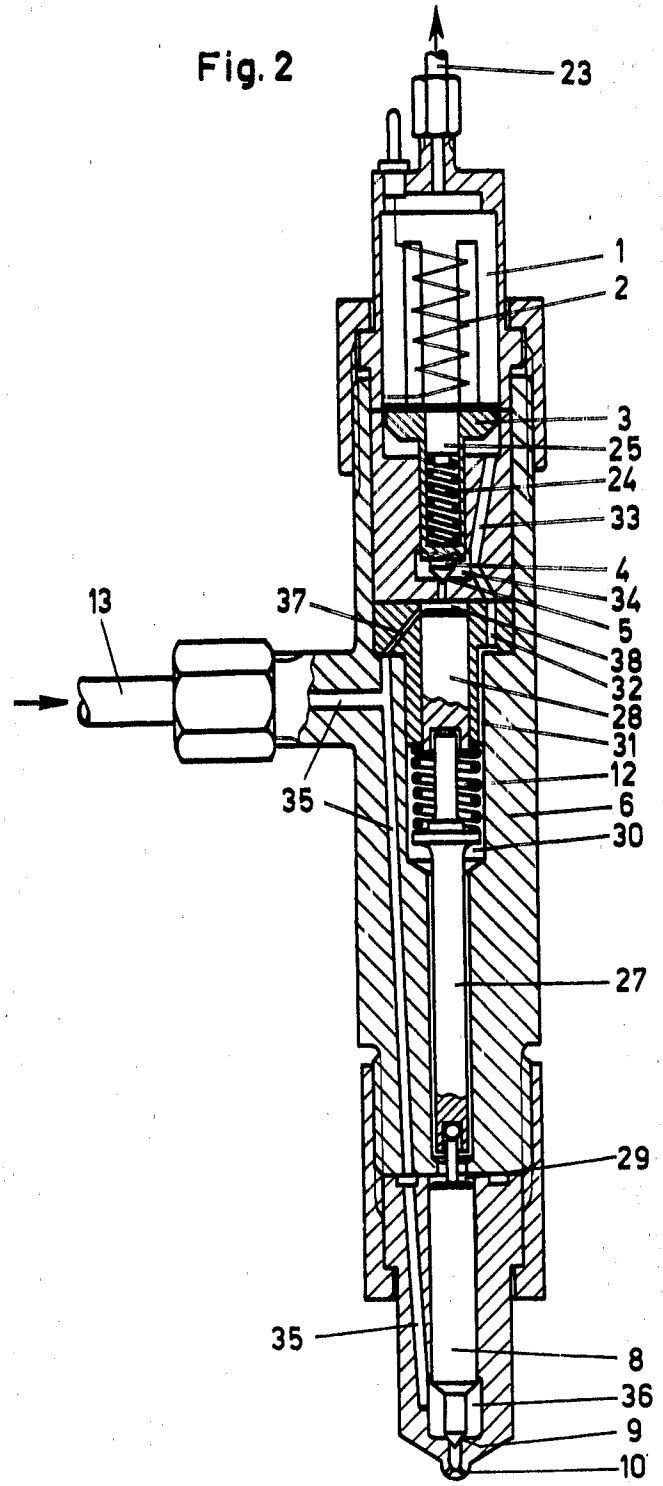


Fig. 1



Inventor:
Robert Huber
By Spencer & Kaye
Attorneys

Fig. 2



Inventor:
Robert Huber
By: Spencer & Kaye
Attorneys

Fig.3

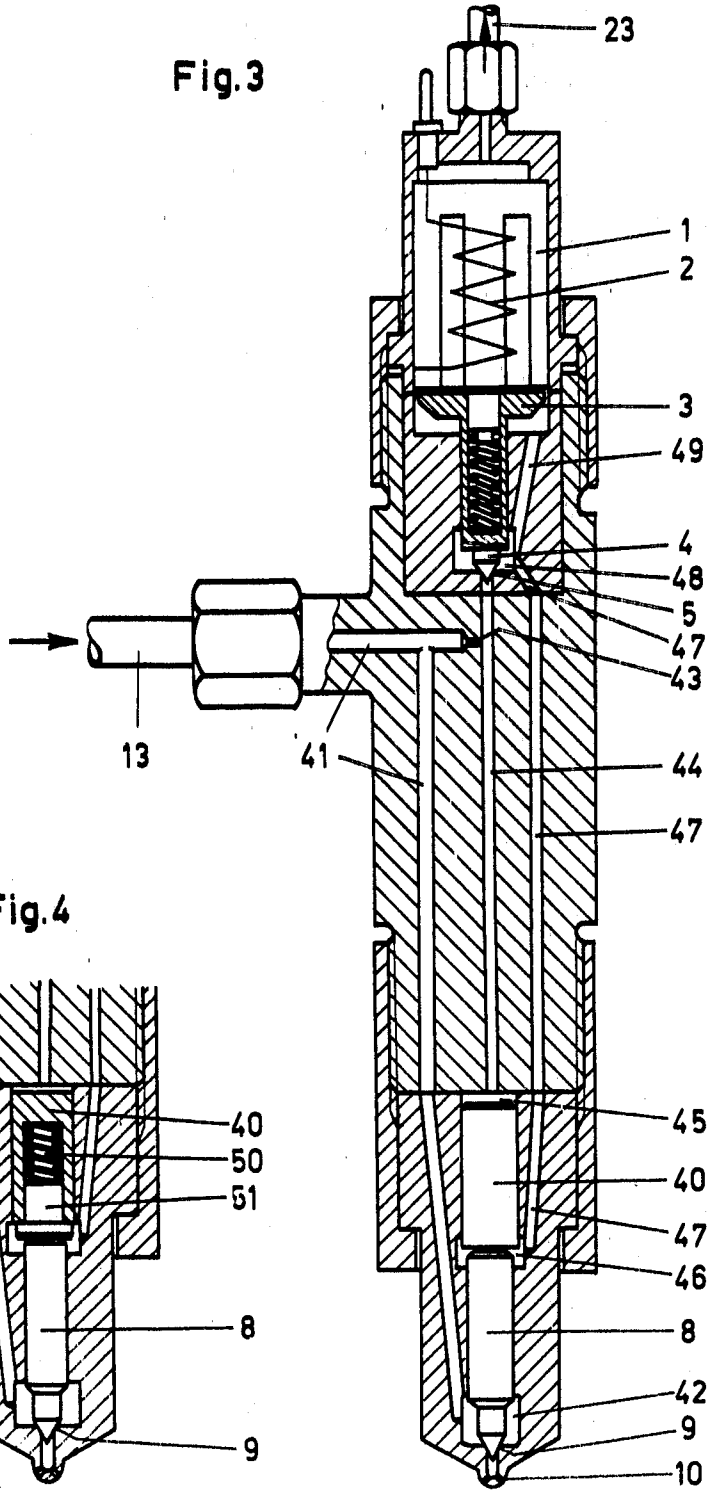


Fig.4

Inventor:
Robert Huber
By Spencer & Kaye
Attorneys

ELECTROMAGNETIC FUEL INJECTION SPRAY VALVE

BACKGROUND OF THE INVENTION

The invention relates to an electromagnetic fuel-injection spray valve for internal combustion engines, particularly diesel engines, including an electromagnetic metering valve at the upper end of the spray valve body, a spray nozzle, a needle valve arranged immediately upstream of the spray nozzle, and a nozzle valve needle incorporated by the needle valve and opened by the fall in the pressure acting on the needle, caused when the metering valve opens to establish a path to a fuel return line.

An injection valve of this kind is prior art, the quantity of the fuel injected being determined by the length of the current pulse fed to the electromagnetic metering valve.

A spring closes the nozzle valve needle after each injection. This spring is contained in a space the fuel pressure in which determines the opening and closing of the nozzle valve needle by the spring, the space being connected to a relief line. As a consequence of the additional volume required by this space to house the spring, the total volume is relatively large in which the fuel pressure must be reduced for each injection. This fact slows down the rise and fall of the fuel pressure in this space, and delays control of the engine, particularly at high r.p.m.

SUMMARY OF THE INVENTION

The purpose of the invention is to provide an electromagnetic fuel-injection spray valve of the aforesaid kind that avoids this disadvantage. In accordance with the invention, spring means to close the nozzle valve needle is housed in a space separate from that determining the opening and closing of the needle, or nozzle-valve-needle closing means is provided operated by the fuel pressure in the space determining opening and closing of the needle.

BRIEF DESCRIPTION OF THE DRAWINGS

Several embodiments of the invention will be described, with reference to the figures of the accompanying drawings, wherein:

FIGS. 1 2, and 3 are longitudinal sections of three different embodiments of the invention; and

FIG. 4 is a modification of the embodiment shown in FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to FIG. 1, the electromagnetic part of the valve comprises in a known manner a core 1 having a winding 2 and a movable armature 3, which is rigidly connected to the needle 4 of a metering valve. The needle cooperates with the valve seat 5. A compression spring 24 presses the armature downwards, seating the metering needle 4 on its seat 5. The upper end of the spring 24 presses against a stop 25 slidably held in the armature 3 and pressed against the core 1. A rod 7 is sealingly held in the valve body 6 free to slide axially. Joined to the lower end of the rod 7 is a nozzle valve needle 8, which cooperates with the valve seat 9 and forms the actual injection spray valve controlling the flow of fuel to the spray nozzle 10. A compression spring 12, located in a chamber 11, presses on the rod 7 and hence on the nozzle valve needle 8 to keep the injection spray valve closed.

The fuel, delivered by a high-pressure supply pump, flows through the line 13 and the bores 14 and 15 to be delivered simultaneously to the chamber 11 and the space 16 just upstream of the seat 9.

The bore 15 is connected to an annular space 17, which a throttling bore 18 connects to bores 19 that form a relief line connecting a space 20 above the nozzle valve needle 8 with the valve seat 5 of the metering valve 4 and 5. When the latter is open the space 20 communicates with a space 21 that a bore 22 connects with a return line 23, in which the fuel is at approximately atmospheric pressure. The fuel flows through bores (not shown) in the core 1 to the return line 23. The injection spray valve operates in the following manner. The fuel delivered under pressure by the line 13 flows through the bores 14 and 15 to fill the spaces 11, 16, and 17, and through the throttling bore 18 into the relief line 19 and the space 20. When a current pulse energizes the winding 2, the armature 3 and its metering needle 4 are raised, the pressure in the relief line 19 and the space 20 consequently falling. Since the cross-sectional area of the nozzle valve needle 8 is greater than that of the rod 7, the needle 8 is raised from its seat 9 and fuel sprayed from the spray nozzle 10 into the cylinder, not shown. As soon as the flow of current in the winding 2 stops, the metering needle 4 closes. The spring 12 presses the nozzle valve needle 8 back onto its seat 9, and at the same time the pressure in the relief line 19 and the space 20 rises.

In the embodiment shown in FIG. 2, a piston 28 is arranged above a rod 27, which corresponds to the rod 7 in FIG. 1. The rod 27 is arranged with lateral play in the valve body 6. The space 29 above the injection spray needle 8 is connected to a space 30, which a passage 31 and a bore 32 connect to a space 34, and which a bore 33 and passages in the core 1 connect to the return line 23, so that an approximately atmospheric pressure is present in all of these spaces and connecting bores and passages.

Fuel delivered under high pressure by the line 3 flows through the bores 35 into the space 36 and through the throttling bore 37 into the space 38 above the piston 28. When the winding 2 is energized, the metering needle 4 is raised, causing the high pressure in the space 38 to fall. As a consequence of the high pressure in the space 36, the injection spray needle 8 is raised from its seat 9, and fuel sprays from the spray nozzle 10 into the cylinder, not shown. The space 38, which must be relieved of its pressure for each injection, has in this embodiment a very small volume. As soon as the metering needle 4 is again seated, the spring 12 reseats the needle 8, and the pressure in the space 38 rises.

In the embodiment shown in FIG. 1, the spring 12 is the only means for closing the needle 8, whereas in the embodiment shown in FIG. 2 the spring 12 can be eliminates or can be weak, provided that the piston 28 has a somewhat larger diameter than does the shaft of the needle 8, so that the downward closing force acting on the piston 28 is greater than the upward force acting on the needle 8.

In the embodiment shown in FIG. 3 is closing spring 12 is also not essential. A piston 40, having a larger cross section than does injection spray needle 8, is arranged immediately above the needle 8. The fuel delivered at high pressure by the line 13 flows through the bores 41 to the space 42 and through the throttling bore 43 and the bore 44 into the space 45.

In contrast to the first embodiment, the space 46 between the piston 40 and the injection spray needle 8 is connected at all times to a space 48 by the bores 47 and to the return line 23 by a bore 49 and the passages (not shown) in the core 1. As a consequence of the greater cross sectional surface area of the piston 40, the latter exerts a closing force on the needle 8. As soon, however, as the energized winding 2 opens the metering valve 4 and 5, the pressure in the space 45 falls; and the injection spray needle 8, because of the unchanged pressure in the space 42, is raised, and fuel is sprayed from the nozzle 10. When the metering valve 4 and 5 closes, the pressure in the space 45 immediately rises, and the piston 40 presses the needle 8 back onto its seat 9.

In order to keep the needle 8 seated when the fuel pressure is absent (engine shut off) there can be incorporated in the piston 40, as shown in FIG. 4, a weak spring 50, which presses against the needle 8 by means of an auxiliary piston 51.

In the three embodiments the spaces 20, 38, and 45, the relative pressure in which determines the opening and closing of the injection spray valve, are connected by the calibrated throttling bores 18, 37, and 43 to the fuel supply line 13 and are connected directly, or by the bores 19 and 44, with the electromagnetically controlled metering valve 4 and 5. The dimensions of the calibrated cross section and of the cross section exposed by the valve fundamentally influence the manner

in which the spray valve 8 and 9 opens and closes. If the calibrated inlet is made relatively large as compared to the cross section controlled by the valve, for example, the needle 8 opens relatively slowly, since the fuel that must be pushed away by the needle 8 (FIG. 1), or by the piston 28 or 40 (FIGS. 2 and 3), cannot quickly escape. But the valve closes quickly because of the large inlet cross section.

On the other hand, if the inlet cross section is small and the valve cross section large, the valve opens quickly but closes much more slowly.

By suitable choice of the cross sections through which the fuel flows, the fuel injection spray valve can be adapted to the engine.

Although the preferred embodiments of the invention have been described, the scope of, and the breadth of protection afforded to, the invention are limited solely by the appended claims.

I claim:

1. An electromagnetic fuel-injection spray valve for internal combustion engines, particularly diesel engines, including an electromagnetic metering valve (4,5) at the upper end of the spray valve body (16), a spray nozzle (10), a needle valve (8,9) arranged immediately upstream of said spray nozzle, a nozzle valve needle (8) incorporated by said needle valve and opened by the fall in the pressure acting on said needle, caused when said metering valve opens to establish a path to a fuel return line (23), and wherein the improvement comprises a first space (20,38,45) in which the fuel pressure determines the opening and closing of said nozzle valve needle, and means operatively associated with said nozzle valve needle for aiding the closing of said nozzle valve needle in response to the closing of the metering valve.

2. The injection spray valve as defined in claim 1, wherein said first space is provided with an inlet passage for the inflow of fuel thereto and is connected to said metering valve to form part of the path to the fuel return line, and the cross section of the fuel flowing into said first space via said inlet passage is smaller than that of the fuel flowing thereout vial said return line path, for obtaining a quick opening and a slow closing of said nozzle valve needle.

3. The injection spray valve as defined in claim 1, wherein said first space is provided with an inlet passage for the inflow of fuel thereto and is connected to said metering valve to form part of the path to the fuel return line, and the cross section of the fuel flowing into said first space via said inlet passage is greater than that of the fuel flowing thereout via said return line path, for obtaining a slow opening and a quick closing of said nozzle valve needle.

4. The injection spray valve as defined in claim 1, wherein said means operatively associated with said nozzle valve needle comprise: a second space separate from said first space, and spring means contained within said second space for aiding the closing of said nozzle valve needle.

5. The injection spray valve as defined in claim 4, wherein said nozzle valve needle is closed by said spring means, said second space (11) is under fuel pressure at all times, and said first space is located at the rear end of said nozzle valve needle, and further including a rod (7) sealingly arranged in the spray valve body (6) and free to slide axially for transmitting the force of said spring means to said nozzle valve needle.

6. The injection spray valve as defined in claim 4, wherein said nozzle valve needle is closed by said spring means, said second space (30) is relieved of fuel pressure at all times, and said first space (38) is in direct communication with said metering valve at all times, and further including a rod (27) free to move axially for transmitting the force of said spring means to said nozzle valve needle, and a piston (28) connected to said rod to move therewith, one end of said piston defining one side of said first space.

7. The injection spray valve as defined in claim 4, wherein said nozzle valve needle is in part closed by said spring means, said second space (30) is relieved of fuel pressure at all times, and said first space (38) is in direct communication with said metering valve at all times, and further including a rod (27) free to move axially for transmitting the force of said spring means to said nozzle valve needle, and a piston (28) connected to said rod to move therewith, said piston having a larger diameter than does the shaft of said nozzle valve needle to help to close the latter, and one end of said piston defining one side of said first space.

8. An electromagnetic fuel-injection spray valve as defined in claim 1 wherein said means operatively associated with said nozzle valve needle comprised closing means operated by the pressure in said first space for closing said nozzle valve needle.

9. The injection spray valve as defined in claim 8, wherein said nozzle valve needle is closed by said closing means and said closing means is a piston (28) of which one end defines one side of said first space, and said first space is in direct communication with said metering valve at all times, and further including a rod (27) free to move axially for transmitting the pressure within said first space acting on said piston to said nozzle valve needle to close the latter.

10. The injection spray valve as defined in claim 8, wherein said nozzle valve needle is closed by said closing means and the latter is an operating piston (40) of which one end defines one side of said first space (45), said operating piston having a cross section greater than does said nozzle valve needle and acting directly on the latter, whereby the fuel pressure in said first space determines the closing of said nozzle valve needle.

11. The injection spray valve as defined in claim 10, including an auxiliary piston (51) arranged within said operating piston for acting on said nozzle valve needle, and a compression spring (50) pressing on said auxiliary piston to keep said nozzle valve needle closed when the fuel pressure is absent.