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[54] FUEL INJECTION DEVICE

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[58] **Field of Search** 239/533, 88, 90, 453

[56] **References Cited**

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[57] **ABSTRACT**

A fuel injection device, especially for diesel engines, in which the fuel injection plunger is reciprocable in a guiding body one end portion of which forms a spring chamber for the spring which controls the valve member in the nozzle body which latter is connected to that end portion of the guiding body which forms said spring chamber.

10 Claims, 2 Drawing Figures

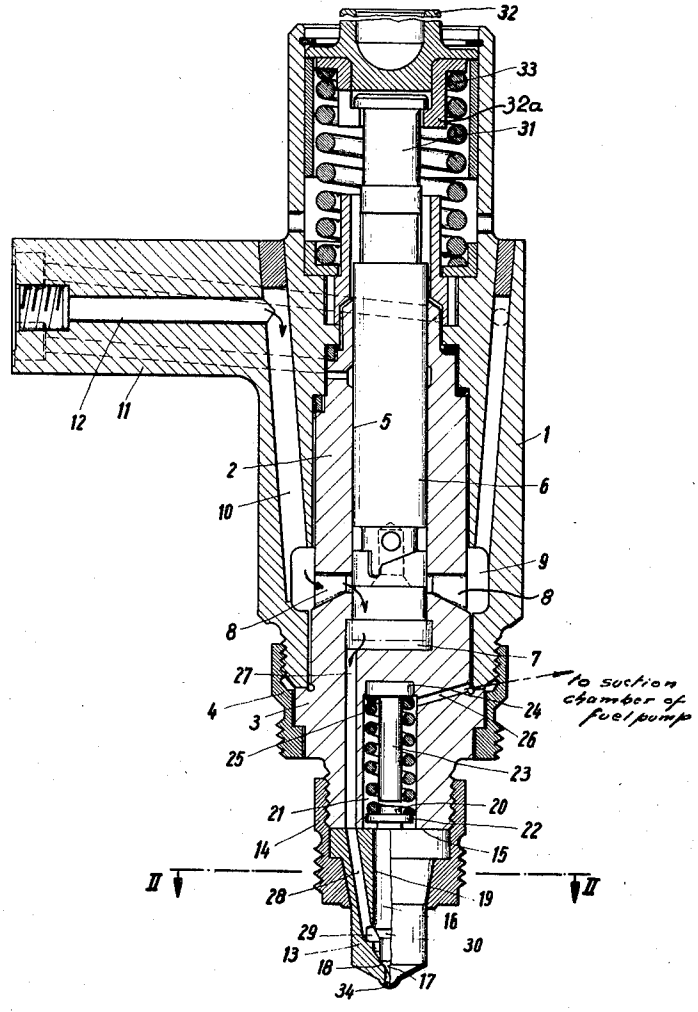

Fig. 1

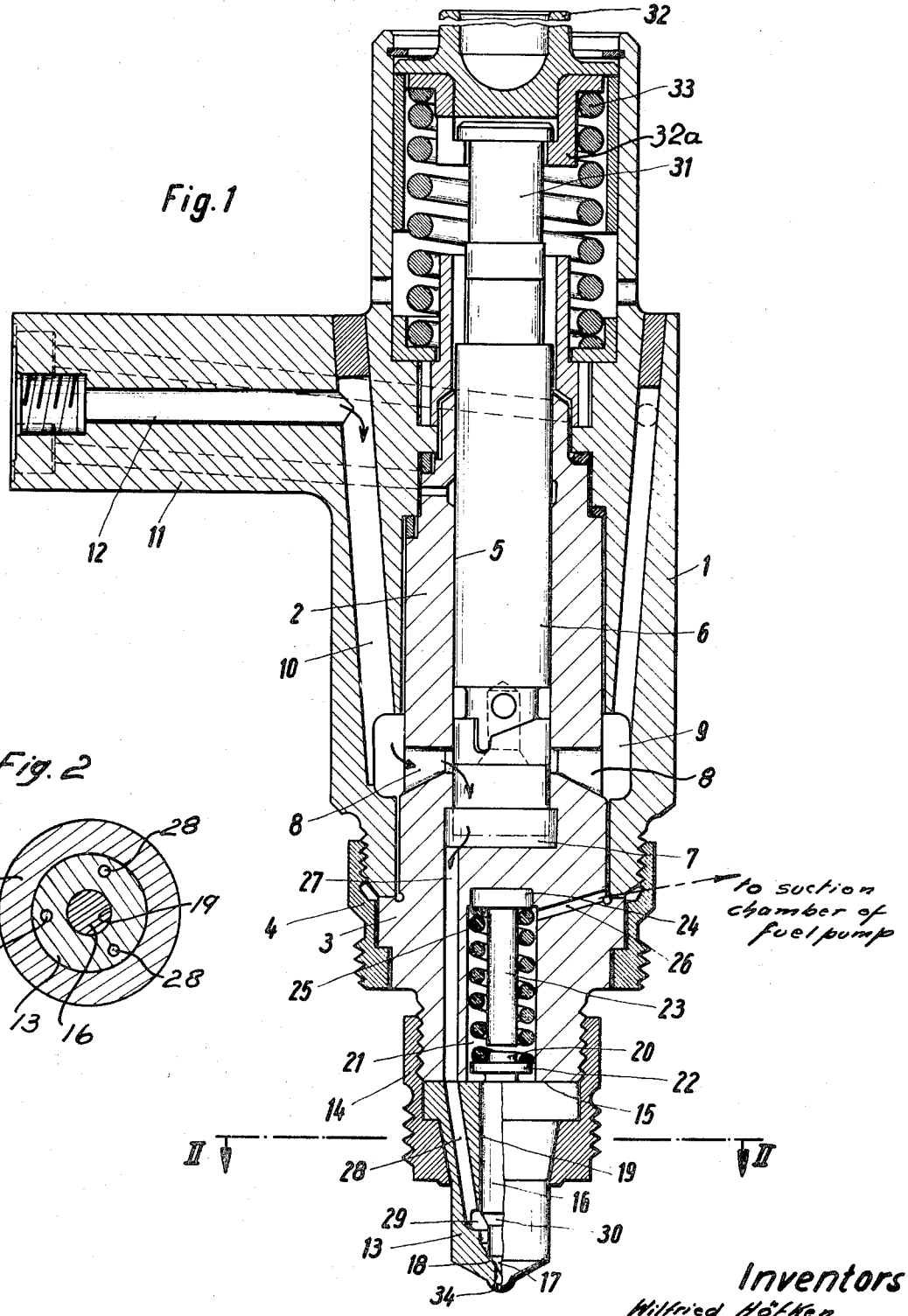

Fig. 2

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FUEL INJECTION DEVICE

The present invention relates to a fuel injection device, especially for fuel pump equipped diesel engines, in which the pump comprises a plunger reciprocable in a guiding body and is structurally united with a fuel nozzle head while an injection valve is provided in the fuel conveying path of the nozzle head, the spring of the injection valve which biases the valve closing element in closing direction being arranged in a spring housing.

Heretofore known fuel injection devices of the above-mentioned general type are respectively associated with a cylinder of the internal combustion engine and, in most instances, are connected to the respective cylinder head while the pump is controlled by the cam shaft of the internal combustion engine through the intervention of a rocker or the like. In view of the structural combination of pump and nozzle it is possible to provide a relatively small number of connecting elements for the injection device which are subjected to the pump pressure. In addition to the precise control of the dynamic injection operation, this represents an essential requirement for fuel injection devices because during the injection process rather high hydraulic pressures occur which frequently exceed 1,000 atmospheres above atmospheric pressure. In this connection the difficulty is encountered so to design the high-pressure actuated parts and connections that they will be able to withstand over a long period of time the continuous pulsating pressures and will not permit even minor leakage.

Furthermore, fuel injection devices have become known according to which the nozzle and pump are structurally separated from each other and are connected with each other through the intervention of a fuel injection line. With such designs, however, a relatively high number of individual elements and connections is necessary which fact frequently leads to a premature wear and leakage.

It is, therefore, an object of the present invention so to design a fuel injection device of the above-mentioned general type that also after a long period of operation no leakage or practically no wear will occur.

It is another object of this invention to provide a fuel injection device as set forth in the preceding paragraph which will have a minimum of connections between the individual elements which are subjected to high pressure.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawing, in which:

FIG. 1 is a longitudinal section through a fuel injection device according to the present invention.

FIG. 2 represents a section taken along the line II—II of FIG. 1.

The fuel injection device according to the present invention, which comprises a plunger displaceable in a guiding body and structurally united with a fuel nozzle head in the fuel conveying passage of which there is provided an injection valve the closing member of which is spring-biased in closing direction, is characterized primarily in that the spring housing is formed by a recess in the guiding body and that the nozzle head is firmly connected to one end face of the guiding body. In this way there is required practically only one connection, namely the connection between the nozzle head and the guiding body which is subjected to the high injection or pump pressure so that leakage will be avoided even after a relatively long period of operation and that the wear is only very minor. This favorable situation is even further improved when the nozzle head is designed as a single integral piece and has a guiding bore for the valve closing member.

The spring housing may in a simple manner be formed by a blind bore the axis of which constitutes an extension of the axis of the plunger. Similarly, also the plunger guiding means may be formed by a blind bore in the guiding body so that a conduit connection between the guiding means for the plunger or the cylinder chamber of the plunger with the spring housing is avoided and a proper working of the valve will be assured.

In order in particular in this instance to establish a connection between the cylinder chamber associated with the plunger on one hand and the nozzle head on the other hand, it is advantageous to provide a passage from said cylinder chamber to the nozzle head which passage extends in spaced relationship to and adjacent the spring housing. The passage expediently leads into the end face of the guiding body so that the connection of this passage with a corresponding passage provided in the nozzle head can be effected in a simple manner by engagement of the nozzle head with the guiding body.

For purposes of relieving the pressure of the valve-closing member by the leakage fuel, a venting passage is provided in the spring housing which passage communicates with the suction chamber of the pump. The nozzle head may be connected to the guiding body in a simple manner by a capscrew or box nut.

According to a further feature of the invention, a shank is provided in the spring housing while a valve spring in the form of a coil spring extends around said shank. The free end face of the shank forms an abutment for the valve closing member so that a simple arrangement for limiting the movement of the valve closing member is obtained.

Referring now to the drawings in detail, the injection device illustrated therein comprises a housing 1 having inserted therein a guiding body 2 with stepwise varying diameter. This guiding body 2 protrudes beyond one end of the housing 1 and at the corresponding end face of the housing 1 is provided with a collar 3 engaging the said end face of housing 1. By means of the collar 3 forming part of the guiding body 2, the latter is by means of a box nut 4 clamped against the adjacent end face of housing 1. A plunger 6 is displaceably mounted in a guiding bore 5 provided in and arranged coaxially with regard to the guiding body 2. The guiding bore 5 has one end portion, namely the one adjacent the box nut 4, slightly widened in diameter to provide a cylinder chamber 7. The guiding body 2 is provided with two radial openings 8 offset with regard to each other by 180°, said radial openings 8 being surrounded by and communicating with an annular passage 9 provided on the inside of the housing 1. At least one longitudinal bore 10 provided in the housing 1 leads into said annular passage 9 and communicates with a transverse bore 12 provided in an extension 11 of said housing. The extension 11 serves for connecting the injection device to a fuel line and, if desired, for connecting the injection device, for instance, to a cylinder head.

Connected to that end of the guiding body 2 which protrudes beyond the box nut 4 is a nozzle head 13 with a box nut 14 which is screwed onto the thread provided at the adjacent end of the guiding body 2 and thus clamps the nozzle head 13 firmly against the end face 15 of the guiding body 2.

A valve having its closing member formed by a valve needle 16 is provided in the nozzle head 13. The conical end 17 of the valve needle 16 has in the nozzle head 13 associated therewith a corresponding conical valve seat 18. The cylindrical part of the valve needle 16 is displaceably mounted in a longitudinal bore 19 of the nozzle head 13 while the valve needle 16 is provided with a shank 20 protruding beyond that end face of the nozzle head 13 which faces toward the guiding body 2. Shank 20 which extends into a blind bore 21 of the guiding body 2 has a flange 22 arranged in spaced relationship to the free end face of the shank 20. Opposite the shank 20 and of the same diameter as the latter is a further shank 23 which by means of a head 24 is connected to the bottom of the blind bore 21 in any convenient manner. Around the shanks 21 and 23 the axes of which are in alignment with each other there extends a coil spring which forms a valve spring 25. The outer diameter of spring 25 is only slightly less than the inner diameter of the blind bore 21 serving as spring housing. From the inner end of the blind bore 21 there extends a transverse passage 26 forming a venting passage. From the end face of the cylinder chamber 7, in the guiding body 2 there extends one or more bores 27 to the end face 15 of the guiding body 2, said bore or

bores 27 being eccentrically located with regard to the axis of the guiding body 2 but extending parallel to said axis. This bore or bores 27 are arranged in spaced relationship to the blind bore 21. From that end face of the nozzle head 13 which engages the end face 15 of the guiding body 2 there extends one or more bores 28 which are in communication with the bore or bores 27. The bore or bores 28 lead to an annular passage 29 in the nozzle head 13 which passage 29 is located above the valve seat 18. Within the area of said passage 29, the valve needle 16 has a conical section 30. That end 31 of the plunger 6 which faces away from the nozzle head 13 and forms a shank is connected to a coupling 32, 32*a* protruding from the housing 1. This coupling serves for establishing a driving connection of the fuel injection device, for instance, with a rocker driven by the cam shaft of the motor. The plunger 6 is spring-biased by a pressure spring 33 so as to be urged to its starting position shown in the drawing.

When the plunger 6 is pressed downwardly against the thrust of spring 33, through the intervention of the coupling member 32, the oil which entered the cylinder chamber through the passages 12, 10, 9, 8 is after the openings 8 have been closed displaced by the piston 6 and pressed through bores 27, 28 into the annular passage 29. In view of the pressure in the annular passage 29, the valve needle 16 is lifted against the thrust of spring 25 so that the valve opens, the fuel passes through the nozzle openings 34 at the end of the nozzle head 13 into the combustion chamber of the respective internal combustion engine.

Since the spring housing 21 is provided directly in the guiding body 2 and inasmuch as the nozzle head 13 is designed as a single integral piece, there is practically only the connection between the parts 13, 2 which is subjected to the high pump or injection pressure. This connection can easily be kept tight because only in the small bores 27, 28 there occurs the high-injection pressure.

It is, of course, to be understood that the present invention is, by no means, limited to the showing in the drawing but also comprises any modifications within the scope of the appended claims.

We claim:

1. A fuel injection device, especially for fuel pump equipped diesel engines, which includes: housing means having first conduit means therein for connection with a source of fuel, a guiding body arranged within said housing means and provided with second conduit means for connection with said first conduit means, said second conduit means leading to one end face of said guiding body, control plunger means reciprocable in said guiding body and operable to control communication between said first and second conduit means and to exert pressure on fuel in said second conduit means, said guiding body also having recess means at said one end face thereof, unitary nozzle head means connected to said guiding body directly against the end face thereof and provided with a nozzle opening and with third conduit means communicating with said second conduit means and leading to said nozzle opening, control valve means reciprocable in said unitary nozzle head means which is an integral piece from the high-pressure side of the pump to the end face and adapted for controlling fluid communication between said third conduit means and said nozzle opening, and spring means within said recess means and normally causing said control valve means to close said nozzle opening to thereby interrupt fluid communication between said third conduit means and said nozzle opening, said control valve means being operable in response to a fluid pressure exceeding the thrust of said spring means to relieve said nozzle opening to thereby establish communication between said third conduit means and said nozzle opening.

2. A device according to claim 1, in which said recess means is formed by a blind bore.

3. A device according to claim 1, in which the axis of said recess means is substantially an extension of the axis of said control plunger means.

4. A device according to claim 1, in which said guiding body comprises a blind bore having said control plunger means reciprocable therein and guiding the same.

5. A device according to claim 4, in which said blind bore for said control plunger means ends in a chamber communicating with said second conduit means.

6. A device according to claim 1, in which said second conduit means from the recess means for the plunger means in said guiding body extend to open into the engagement end face of said guiding body for said nozzle head means.

7. A device according to claim 1, in which a box nut secures said nozzle head means to said guiding body, whereby thread means of said guiding body for said box nut are provided preferably directly adjoining the engagement end surface for said nozzle head means.

8. A fuel injection device, especially for fuel pump equipped diesel engines, which includes: housing means having first conduit means therein for connection with a source of fuel, a guiding body arranged within said housing means and provided with second conduit means for connection with said first conduit means, said second conduit means leading to one end face of said guiding body, control plunger means reciprocable in said guiding body and operable to control communication between said first and second conduit means and to exert pressure on fuel in said second conduit means, said guiding body also having recess means at said one end face thereof, nozzle head means connected to said guiding body and provided with a nozzle opening and with third conduit means communicating with said second conduit means and leading to said nozzle opening, control valve means reciprocable in said nozzle head means for controlling fluid communication between said third conduit means and said nozzle opening, and spring means within said recess means and normally causing said control valve means to close said nozzle opening to thereby interrupt fluid communication between said third conduit means and said nozzle opening, said control valve means being operable in response to a fluid pressure exceeding the thrust of said spring means to relieve said nozzle opening to thereby establish communication between said third conduit means and said nozzle opening, said venting means being connectable to the suction side of a fuel pump for connection with said fuel injection device.

9. A device according to claim 8, which includes nut means connecting said nozzle body means to said guiding body.

10. A device according to claim 8, which includes abutment means arranged in said recess means for limiting the nozzle opening relieving stroke of said control valve means, said abutment means including a shank having said spring means in the form of a coil spring extending around said shank.

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