

# United States Patent

Krauss et al.

[15] 3,690,566

[45] Sept. 12, 1972

## [54] FUEL INJECTION VALVE

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[22] Filed: **Sept. 3, 1971**

[21] Appl. No.: **177,551**

## [30] Foreign Application Priority Data

Sept. 28, 1970 Germany.....P 20 47 588.1

[52] U.S. Cl.....**239/453, 239/533**

[51] Int. Cl. ....**B05b 1/32**

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

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## ABSTRACT

In a fuel injection valve, in order to ensure alignment of the movable valve member with the longitudinal axis of the fuel injection valve, the length of a compression spring surrounding the movable valve member and urging the latter into a closed position, is substantially greater than the length of the movable valve member when the latter is in its closed position.

**6 Claims, 2 Drawing Figures**

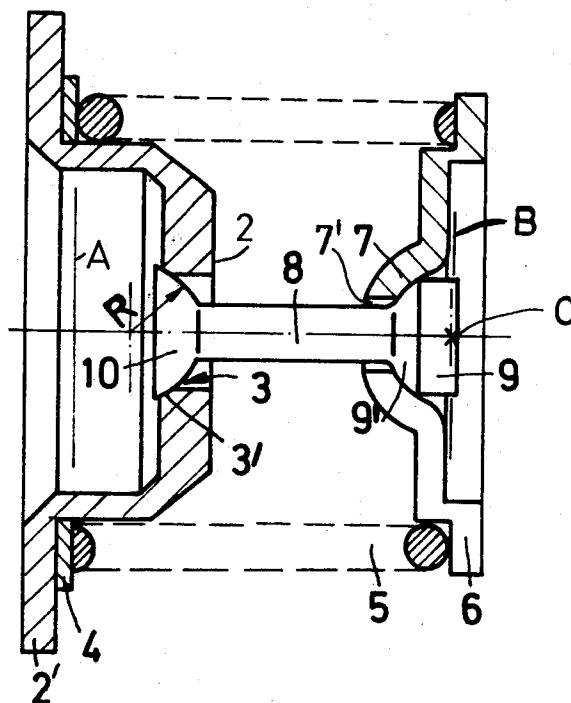


Fig. 1

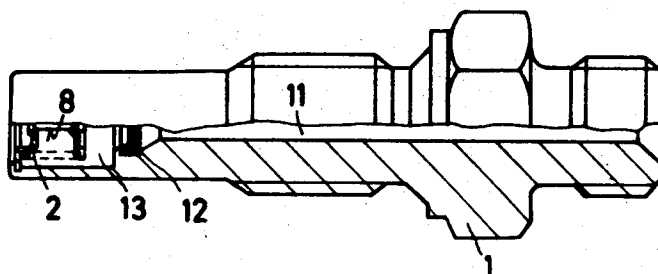
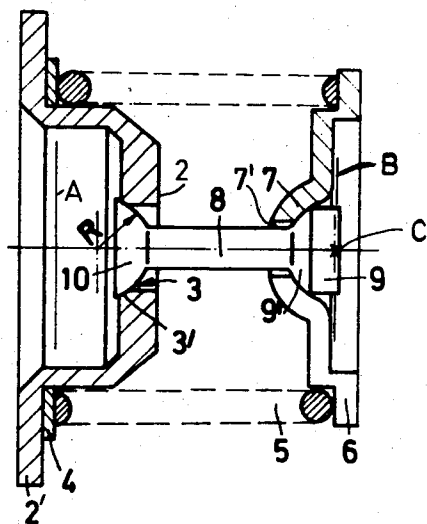


Fig. 2



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## FUEL INJECTION VALVE

This invention relates to a fuel injection valve of the type having a movable valve member which is reciprocally suspended between a spring seat disc and a valve seat and which executes an opening movement against the force of a compression spring.

For ensuring a satisfactory fuel injection in an internal combustion engine, the movable valve member of such a fuel injection valve has to be centered at least prior to the beginning of each injection step. In a known fuel injection valve of the aforeoutlined type (such as disclosed in German Patent No. 968,172) there is provided a movable valve member which has a spherical work face drawn against a conforming spherical valve seat by means of the closing spring. When the movable valve member is seated, the center of its spherical work face coincides with the center of the spherical valve seat. Thus, in such a structure the possibility exists that the movable valve member is drawn into its seat in a direction which is not parallel with its longitudinal axis. Such an occurrence has a disadvantageous effect on the shape and direction of the fuel jet emanating from the nozzle opening at the downstream end of the fuel injection valve.

It is an object of the invention to provide an improved fuel injection valve of the aforeoutlined type in which the movable valve member assumes a position in which its axis is aligned or axially parallel with the longitudinal axis of the fuel injection valve as early as the moment it is seated in its valve seat.

Briefly stated, according to the invention, in a closed position of the valve the length of the movable valve member between the valve seat and the valve seat disc suspension is smaller than the length of the closing spring between its points of engagement. This support of the movable valve member results in self-stabilizing forces which affect the movable valve member and which prevent shifts of the spring from its central axis and thus result in a self-centering of the spring and the movable valve member.

The invention will be better understood as well as further objects and advantages become more apparent from the ensuing specification of a preferred, although exemplary embodiment taken in conjunction with the drawing wherein:

FIG. 1 is an axial longitudinal section of a fuel injection valve incorporating the preferred embodiment and

FIG. 2 is an axial sectional view on an enlarged scale of those components of the fuel injection valve shown in FIG. 1 which constitute the preferred embodiment.

Turning now to the Figures, in a nozzle holder 1 there is positioned a cup-shaped nozzle body 2 in which there is provided a nozzle opening 3 surrounded by a valve seat 3'. One frontal terminal face of a closing spring 5 engages a circular flange 2' of the nozzle body 2 with the interposition of a setting disc 4 (FIG. 2). The other frontal terminal face of the closing spring 5 is in engagement with a spring seat disc 6. The latter has a spherically formed middle portion 7 in which there is provided an opening 7' traversed by a movable valve member 8. The latter includes an enlargement 9 provided with a spherical portion 9' which is in engagement with the concave side of the spherical portion 7. The movable valve member 8 has at its terminus adjacent the nozzle body 2, a hemispherical valve head

10, which, together with the valve seat 3' constitutes the valve proper. It is noted that the valve seat 3' is spaced from the plane of engagement A of the springs in an upstream direction and the distance between plane A and seat 3' is at least R which is the radius of head 10. As clearly seen in FIG. 2, the length of the movable valve member 8 is substantially shorter than the length of the spring 5 when the member 8 is seated. As a result, as soon as the spring 5 and the movable valve member 8 assumes a position in which the longitudinal axis of the spring or the movable valve member is not aligned (or not parallel) with the longitudinal axis of the fuel injection valve, the bias of the spring is increased. This augmented bias has a centering effect on the misaligned movable valve member 8. It may be further observed that the plane of engagement B between the frontal terminal face of the spring 5 and the spring seat disc 6 contains the center C of the spherical portion 9' of enlargement 9. By virtue of this feature, the movable valve member 8 remains centered even if the spring seat disc 6 assumes an oblique position.

The fuel delivered by a fuel injection pump (not shown) is admitted in the nozzle holder 1 through a bore 11 and a filter 12 into a pressure chamber 13 which is bounded in the direction of injection by the nozzle body 2.

As soon as the pressure of the fuel introduced into the fuel injection valve has reached a predetermined value, the fuel injection valve opens, that is, the movable valve member 8 is lifted off its valve seat 3' against the force of the spring 5 in the direction of injection, thus unblocking the injection nozzle opening 3.

What is claimed is:

1. In a fuel injection valve of the type including channel means for admitting fuel under pressure and valved nozzle means to inject said fuel, the improvement comprising,

A. a movable valve member having

1. a valve head at one end,
2. a securing means at the other end,

B. a valve seat cooperating with the valve head of said movable valve member,

C. a coil spring surrounding said movable valve member and having

1. a first frontal terminal face at one end,
2. a second frontal terminal face at the other end,

D. stationary flange means for engaging said first frontal terminal face of said spring and

E. a movable spring seat disc having

1. securing means cooperating with the securing means of said movable valve member for attaching the latter to said spring seat disc,
2. flange means for engaging said second frontal terminal face of said spring, said spring urging said valve head towards said valve seat, the distance between said first and second frontal terminal faces of said spring being greater than the length of said movable valve member measured between said valve seat and said securing means of the spring seat disc when said valve head is seated in said valve seat.

2. An improvement as defined in claim 1, wherein the securing means of the movable valve member is formed of an enlargement having a spherical portion in

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engagement with a complementary spherical portion of said securing means forming part of said spring seat disc.

3. An improvement as defined in claim 1, wherein said valve seat has a spherical configuration.

4. An improvement as defined in claim 1, wherein said valve seat is at a distance from said first frontal terminal face of said spring in an upstream direction.

5. An improvement as defined in claim 4, wherein

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said valve head has a spherical portion cooperating with said valve seat, said distance being at least as great as the radius of the spherical portion of said valve head.

6. An improvement as defined in claim 2, wherein the center of the spherical portion of said enlargement is contained in the plane of said second frontal terminal face of said spring.

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