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[54] **INJECTION VALVE FOR INTERNAL-COMBUSTION ENGINES**
3 Claims, 2 Drawing Figs.

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[56] **References Cited**
UNITED STATES PATENTS

1,735,718	11/1929	Attendu	239/533
3,373,943	3/1968	Roosa	239/533
3,451,626	6/1969	Roosa	239/533

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ABSTRACT: An internal-combustion engine fuel injection valve is so constructed that the fuel cools the valve needle and the unseating pressure and the stroke of the needle are independently adjustable.

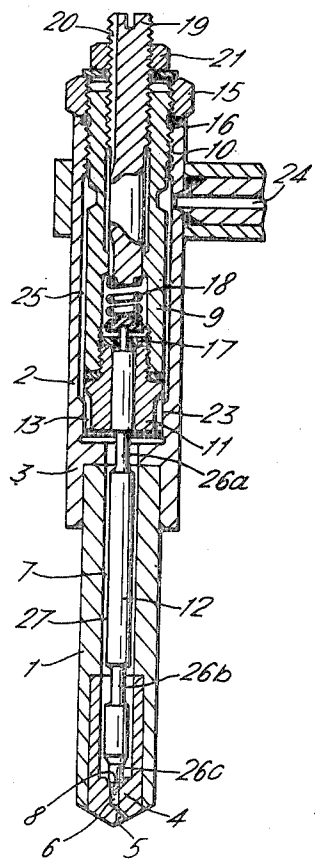


Fig. 1.

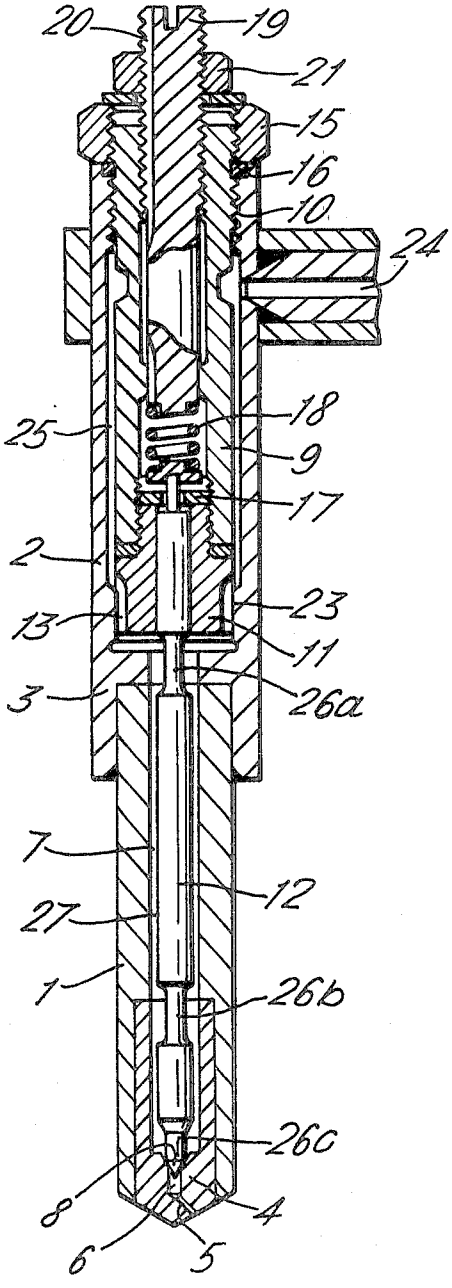
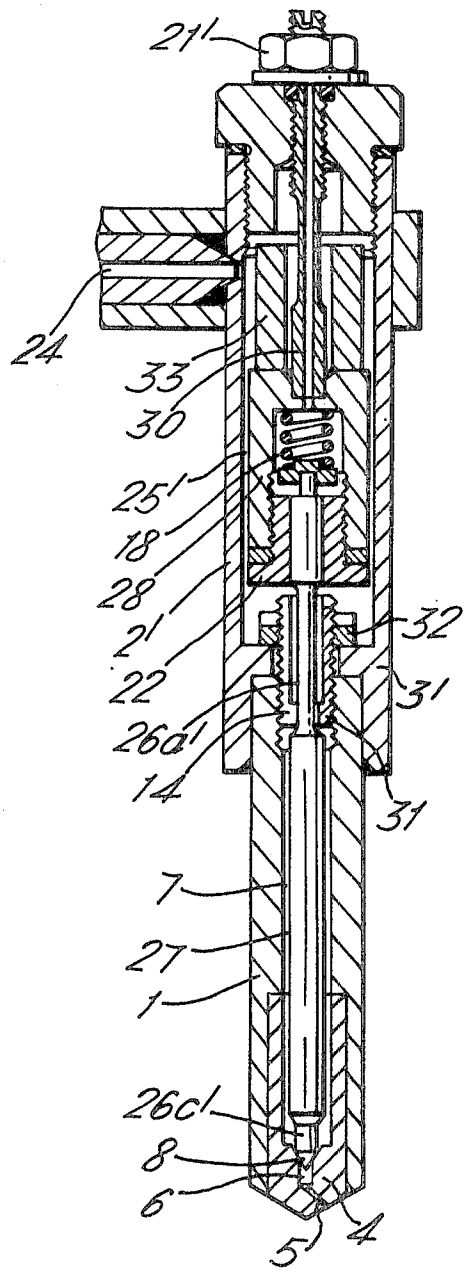


Fig. 2.



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INJECTION VALVE FOR INTERNAL-COMBUSTION ENGINES

This invention relates to injection valves for internal-combustion engines.

In injection nozzles of the known type, the outside diameter must not be below a certain value, related to the length of the nozzle, since the bore for the fuel supply line must be provided in the body of the injection nozzle. The installation dimensions are therefore relatively great and no longer meet the requirements for an injection nozzle for small internal-combustion engines. Long injection valves of small cross section are already known. These injection valves have special bearing elements for the nozzle needle, the element at the tip serving at the same time as a valve seat. It has also been suggested to roll the nozzle body of sheet metal and to provide fuel supply lines in the form of slots in the wall. It is also known to make the valve body of threaded pipe sections. The guide elements for the nozzle needle are screwed in and sealed with thermosetting plastics. The insertion of a hollow plug or the use of spherical bearing surfaces is likewise known. A subsequent deformation of the nozzle body and/or of the bearings during the installation of the needle has also been suggested. In all these models the provision of special line bores for the fuel supply has been eliminated. The fuel is brought directly to the nozzle needle by means of recesses, slots, grooves and the like, and conducted directly between the nozzle needle and the nozzle body to the outlet port. For this reason, the needle is yieldingly mounted on its seat. If the pressure rises in the needle chamber, the needle is lifted from its seat and the fuel can issue through the injection orifice. Each of these constructions has a number of disadvantages which particularly include that the manufacturing costs are rather high. The cutting of the thread is difficult and cannot always be effected with the necessary pairing accuracy. The casting of synthetic resin or the use of plastic inserts are not satisfactory either. The plastic material cannot withstand the rapid temperature changes and the high pressure (approximately 200 atmospheres). Cracks and wear in the plastic parts are the result. This in turn causes inaccuracies in the guidance of the needle which lead to jamming and canting. Beyond that, irregularities appear during the injection which can lead to a breakdown of the nozzle. The fabrication techniques involving subsequent deformation of the valve body or of other parts of the injection valve do not give the desired results either, since the subsequent deformation can only be controlled to a limited extent and is not always uniform. Moreover, the temperatures occuring during the injection lead to further deformations which can cause jamming of the needle.

It is an object of the present invention to eliminate or mitigate the aforementioned disadvantages.

It is a more specific object of the invention to provide an injection valve the cross section of which is small and in which the needle is so guided that jamming of the needle by heating is avoided by corresponding cooling.

Injection valves according to the invention preferably comprise a nozzle holder housing consisting of two tubular parts and provided at one end with a nozzle injector. The nozzle injector has one or more nozzle bores which communicate with a collecting bore, the collecting bore being sealed by the nozzle needle point from the rest of the nozzle chamber. Into the other end of the nozzle holder housing is screwed a pipe section which has at the bottom end a guide bushing for the nozzle needle and at the upper end a threaded pin. Inside the chamber thus formed is arranged a compression spring and an apertured plate which limits the path of the nozzle needle. The pipe section is of a diameter sufficiently smaller than that of the nozzle holder housing that an annulus is formed which is in communication with the nozzle chamber through recesses in the guide bushing. The fuel enters the annulus through a feed bore and flows through the guide bushing recesses into the nozzle chamber. The nozzle needle is constantly wetted and cooled by the flow of the fuel. If the opening pressure is exceeded, the needle is lifted from its seat and the fuel is injected through the collecting bore and the nozzle bores into the combustion chamber. The guide bushing is removably mounted in the conduit section by screwing or any other suitable type of fastening. In order to achieve alignment of the nozzle needle guide with the seating surface of the nozzle needle in the nozzle injector and with respect to the guide faces, the thread of the pipe section has sufficient play. The sealing of the annulus and of the thread is effected by a resilient annular seal, for example, a rubber or plastic gasket. In order to compensate any existing offset, the nozzle needle is provided on its shaft with several recesses or constrictions which result in a lower bending stiffness, permitting the needle to bend. Setting of the needle stroke is effected by turning the pipe section. After the setting, the pipe section is locked by a check nut. Setting of the opening pressure is effected by adjusting the threaded pin and locking by a check nut. The setting of the opening pressure and of the needle stroke are independent of and without influence on each other. The threaded pin is provided with a groove through which any oil leaking into the spring pocket can flow off.

Another preferred construction according to the invention involves the arrangement of a spring pocket instead of the pipe section. The spring pocket, supporting a filler member above it, is suspended from an elastic member. The elasticity of the elastic member is based on the same principle as the elasticity of the needle, viz, the provision of at least one recess or constriction to lower the bending stiffness of the member. The spring pocket is closed at its bottom end by the guide bushing so that a closed chamber is formed. An adjusting screw with a check nut is provided to limit the stroke. The setting of the opening pressure is effected by adjusting the elastic member. The fuel enters the annulus through the feed bore and flows through grooves provided in the adjusting screw into the nozzle chamber. The alignment of the nozzle needle guide to compensate for any offset is effected by bending of the elastic member.

Among the advantages of the injection valves of the invention are better accommodation of the valves in the cylinder head of an internal-combustion engine and more economical manufacture, compared to the presently used injection valves. The customary transmission plungers between the nozzle needle and the compression spring are no longer required. The moving mass is thus greatly reduced and the inertia and the surface pressure on the sealing surface between the nozzle needle and the nozzle point are reduced. A number of parts can be made from commercial pipes, which reduces the material and manufacturing expenditures. The setting of the needle stroke and of the opening pressure is effected in a simple manner without the two setting procedures influencing each other. Due to the elimination of fuel feed bores in the walls of the nozzle holder, the cross section of the injection valve is reduced. The guidance of the needle is improved by the elastic pipe section and/or by the elastic suspension. The constant wetting of the nozzle needle by the fuel results in a good cooling effect, so that jamming of the needle by heat deformation is avoided. Instead of a metallic guide bushing for the nozzle needle there can be used one of a rubber or plastic or an elastic member, for example, a diaphragm.

The invention will be described more fully below by reference to specific embodiments, as illustrated in the drawings, in which:

FIG. 1 is a longitudinal cross section of an injection valve according to the invention; and

FIG. 2 is a like view of another injection valve according to the invention.

A nozzle holder housing 3 consists of two tubular parts 1, 2 and is provided at one end with a nozzle tip 4. In the nozzle tip 4 are provided one or more nozzle bores 5 which open into a collecting bore 6. The collecting bore 6 is sealed by the nozzle needle point 8 from the rest of the nozzle chamber 7. Into the other end of the nozzle holder housing 3 is screwed a pipe section 9 (FIG. 1) which is provided at its bottom end with a guide bushing 11 and which carries at its upper end a threaded pin 19. Inside the chamber thus formed is arranged a compres-

sion spring 18 and an apertured plate 17 which limits the path of the nozzle needle 12. The pipe section 9 is of substantially lesser diameter than the nozzle holder housing 3 so that an annulus 25 is formed which is in communication with the nozzle chamber 7 through grooves 13 in the guide bushing 11. The guide bushing 11 is secured in the pipe section 9 by screwing or any other suitable fastening method. The thread 10 of the pipe section 9 has sufficient play to permit alignment or centering of the nozzle holder housing 3. In order to compensate for any existing stagger, the nozzle needle 12 is provided on its shaft with several recesses or constrictions 26 which permit elastic bending of the needle 12 to effect the compensation. The annulus 25 and the thread 10 are sealed by a resilient annular seal 16, which can consist, for example, of a rubber or a plastic. The needle stroke is set by turning the pipe section 9. After the setting, the pipe section 9 is locked by a check nut. The initial stress of the compression spring 18 is regulated by a check nut. The initial stress of the compression spring 18 is regulated by turning the threaded pin 19. This initial stress corresponds to the opening pressure of the injection valve. In order to prevent unintentional changing of the opening pressure, the threaded pin is locked in place by a check nut 21. The threaded pin 19 is provided with a groove 20 through which the oil leaking into the spring pocket can flow off. The fuel enters the annulus 25 through the feed bore 24 and flows through the grooves 13, 14 into the nozzle chamber 7. The fuel line thus formed has at the same time the function of a cooling line. The fuel itself serves as a coolant. If the opening pressure is exceeded, the nozzle needle 12 is lifted from its seat in the nozzle tip 14 and the fuel is injected through the collecting bore 6 and the nozzle bores 5 into the combustion chamber of the internal-combustion engine.

The injection valve of FIG. 2 operates in the same manner as that of FIG. 1. Reference numerals in FIG. 2 identical to those in FIG. 1 denote identical elements. Reference numerals differing by the addition of a prime sign denote structurally and functionally analogous elements. In the injection valve of FIG. 2, a spring pocket 28 is suspended from an elastic member 30 and supports a filter element 33. The lower end of the spring pocket 29 is terminated by a guide bushing 32. The setting of the opening pressure is effected by shifting the elastic member 30. For this purpose, for the setting of the needle stroke is provided a separate adjusting screw 31 with a check nut 32. In other respects, the injection valve of FIG. 2 is essentially like that of FIG. 1.

What is claimed is:

1. An injection valve for an internal-combustion engine, comprising a housing, one end of the housing forming a nozzle and having defined therethrough at least one passage, a nozzle needle seat defined at the interior of said end of the housing, a tubular member received in the housing and having formed in the end facing the end of the housing a compartment, a bushing abutting against the tubular member and closing the compartment, a compression spring mounted in the compartment, a nozzle needle extending at one end into the compartment, said nozzle needle passing through the bushing and having a tip shaped to seat on said nozzle needle seat to seal said passage, said spring being positioned relative to the needle to urge the needle downwards so that the tip of the needle is seated on said seat, conduit means for feeding fuel into the upper part of the housing, passage means communicating between the upper part of the housing and the nozzle, said passage means including an annular space between the housing and the tip and adjacent portions of the needle, means for adjusting the pressure with which the needle tip is urged against the seat by the spring, and means for adjusting independently of said pressure the distance away from the seat the needle may be urged by pressure counter to the spring, said nozzle being adapted to be received into a combustion chamber of an internal-combustion engine wherein when the pressure in the chamber exceeds the pressure under which the needle tip is seated, the needle tip unseats to permit the injection of fuel into the chamber.

2. Injection valve according to claim 1, in which the tubular member is axially adjustably received in the housing, means are provided on the bushing for preventing axial movement of the needle relative to the bushing away from said seat, said tubular member and said preventing means together comprising the distance-adjusting means, and a pin is adjustably axially mounted in the tubular member with an end thereof bearing against the spring, said pin comprising said pressure-adjusting means.

3. Injection valve according to claim 1, further comprising a pin axially adjustably suspended in the housing, said tubular member being suspended from the pin, said pin comprising the pressure-adjusting means, and a sleeve axially adjustably mounted in the housing, an abutment formed on the pin, said sleeve abutting against said abutment, said sleeve together with said abutment comprising said distance-adjusting means.

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