(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 361 359 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **89117661.2**

(51) Int. Cl.5: **F02M 61/18 , F02M 69/04**

(22) Date of filing: **25.09.89**

(30) Priority: **27.09.88 IT 5342188 U**

(43) Date of publication of application:
04.04.90 Bulletin 90/14

(84) Designated Contracting States:
DE ES FR GB SE

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(54) A multi-nozzle injector for an internal combustion engine.

(57) A multi-nozzle injector with orientated jets, in particular for an internal combustion engine of the type having one or more inlet valves for each cylinder, supplied by one or more ducts in which the valve means for the injection and metering of the fuel comprise an axially movable shutter member (18), a valve seat (19) cooperating in a fluid-tight manner with the shutter member (18) and at least one pair of nozzles (20) hydraulically connected with the valve seat through a common calibrated duct (21) adapted to meter the flow of fuel passing from the said valve seat (19) towards the said nozzles (20), in which the valve seat (19) and the calibrated duct (21) are formed in an insert element (30) defining an end wall of a hollow body (12) of the said injector housing the shutter, and in which the nozzles (20) are formed in an insert (32) fixedly inserted into the interior of a recess in the insert element (30).

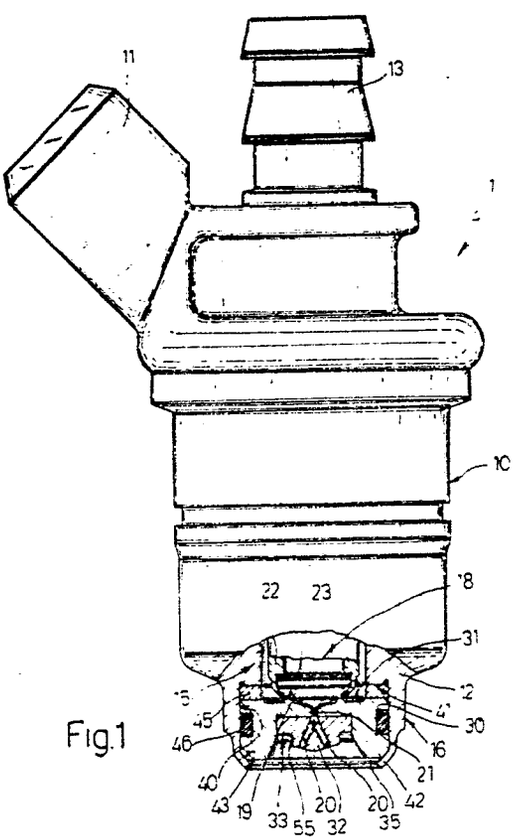

Fig.1

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A MULTI-NOZZLE INJECTOR FOR AN INTERNAL COMBUSTION ENGINE

The present invention relates to a multi-nozzle injector with orientated jets, in particular for an internal combustion engine of the type having two inlet valves for each cylinder, adapted to be disposed straddling two or more different adjacent inlet ducts of a heat engine for injecting fuel simultaneously into them.

Injectors of the type described have the purpose of optimising the ratio of the mixture (that is the ratio between the flow rate by weight of inlet air and flow rate by weight of fuel) in the various operating conditions of the engine, and are known from US Patent 2,995,123; they allow a high specific power to be obtained with reduced fuel consumption and low emission of pollutants, but also have several disadvantages, among which are a certain constructional complexity, manufacturing difficulty in forming the injection nozzles, and the necessity of changing the entire body of the injector for mounting on different engines, due to the necessity of modifying the dimensions and orientation of the nozzles, which are typical for each particular engine model, that is for each possible combination between cylinder capacity and specific power of the engine.

The object of the invention is that of providing a multi- nozzle injector of the type specified above, which will be of particularly simple construction and relatively economical to produce.

The said object is achieved by the invention which relates to a multi-nozzle injector for an internal combustion engine comprising a hollow body provided with a supply connector for fuel under pressure and valve means for the injection and metering of the fuel, including a shutter member movable axially within the hollow body and a valve seat cooperating in a fluid-tight manner with the shutter member, characterised by the fact that the valve means further include at least one pair of nozzles hydraulically connected with the valve seat through a common calibrated duct able to meter the flow of fuel passing from the said valve seat towards the said nozzles.

Further objects and advantages of the invention will become apparent from the following description of a non-limitative embodiment thereof, with reference to the attached drawings, in which:

Figure 1 is a partially sectioned side view of an injector formed according to the invention;

Figure 2 is a sectioned view on an enlarged scale of a detail of the injector of Figure 1; and

Figure 3 illustrates an example of the application of the injector of the invention.

With reference to Figures 1 to 3, the reference numeral 1 indicates a multi-nozzle fuel injector for an internal combustion engine 2 of known type of which, for simplicity, only a cylinder 3 provided with a pair of inlet valves 4 and a part of the cylinder head 5 provided with a pair of ducts or adjacent inlet manifolds 6, supplying the valves 4 are illustrated in a schematic manner; in particular, the injector 1 is mounted symmetrically straddling the ducts 6 and is an electrically operated injector, that is to say it is of the known electromagnetically operated type. The injector 1 includes a casing 10 provided with an electrical connector pin 11 of known type, a hollow tubular body 12 provided at its upper end close to the pin 11 with a connector 13 for the supply of fuel 14 under pressure, for example petrol or diesel oil, and valve means for the injection and metering of fuel 14, generally indicated 15, housed within a terminal sleeve shaped lower end 16 of the hollow body 12; the valve means 6 include a shutter member 18 movable axially within the hollow body 12, in which is housed a substantially coaxial valve seat 19 cooperating in a fluid-tight manner with the shutter member 18, and a plurality of injection nozzles 20, two in the illustrated example, adapted to permit the ejection of jets of fuel 14 under pressure from the interior of the hollow body 12 when the shutter member 18 is spaced from the valve seat 19; in the example the shutter member 18 is normally maintained, in a known manner, for example by means of a spring not illustrated, in cooperation with the valve seat 19 in such a way as to maintain the hollow body 12 sealed in a fluid-tight manner whereby to prevent any escape of fuel from the nozzles 20; at predetermined instants the member 18 is spaced from the seat 19 by means of an electromagnet of known type, not illustrated for simplicity, supplied from the pin 11 and housed in the casing 10, by an amount such as to allow the fuel under pressure contained in the body 12 (and coming from the connector 13) to traverse the valve seat 19 and reach the nozzles 20. During this phase, the so called injection phase, it is known that the quantity of fuel injected into the ducts 6 and, therefore, the mixture ratio obtainable during the induction stroke of the engine 2, depends on the time for which the valve means 15 are open (that is the time during which the shutter 18 remains spaced from the seat 19) and on the flow cross-section thereby made available to the fuel; in known injectors this flow cross-section is usually determined by the diameter of the nozzles 20, which are constituted by holes having calibrated dimensions.

According to the invention, in the injector 1 the nozzles 20 are defined by simple holes formed without strict tolerances, having purely the purpose of guiding the fuel jet 14 during the injection, whilst the metering of the jet (or, in the case in question, the jets, there being more than one nozzle 20) is effected by a rectilinear calibrated duct 21 formed coaxially with the shutter 18, which is common for both nozzles 20 and hydraulically connects them with the interior of the valve seat 19. In the illustrated example the shutter 18 comprises a hollow stem 22 and a plate 23 fixed onto the tip of the stem 22 (for example by crimping) and adapted to cooperate frontally with the seat 19, which is of known type, defined by a depression 23 provided peripherally of a sealing edge 24 (Figure 2) against which the plate 23 is normally pressed.

According to a further characteristic of the invention, the valve seat 19 and the calibrated duct 21 are formed in a substantially cylindrical element 30 the upper face of which defines a bottom wall 31 of the hollow body 12. On the other hand, the nozzles 20 are formed in an insert 32 fixedly secured within the interior of a frontal recess 33 formed on a lower face 35 of the element 30, opposite the face 31 and the associated valve seat 19, and facing outwardly of the body 12; the calibrated duct 21 is formed in the element 30 in such a way as to open into the recess 33 in correspondence with a space 36 (Figure 2) where the two nozzles 20 are hydraulically connected; these latter are formed in such a way as to diverge from one another starting from the hydraulic connection region 36 between them, which is defined by respective common ends of the nozzles 20 themselves which mutually intersect.

The recess 33 in the element 30 comprises a cylindrical seat 38 within which the insert 32 is fixedly housed (for example by an interference fit), and a flared mouth 39 facing the outer surface 35 and defining a chamber into which the nozzles 20 open, in the non-limitative example illustrated they have a divergence angle substantially identical with the flare angle of the mouth or chamber 39, that is to say having a substantially frustoconical form with the same cone angle.

The sleeve-like end 16 housing the valve means 15 includes a seat 40 for sealingly receiving the element 30 provided with an axial shoulder 41 and a plastically deformable peripheral rim 42 which is clenched against a bevelled front edge 43 of the element 30 to retain this latter in position against the axial shoulder 41 with the interposition, between the shoulder 41 and the element 30, of a spacer ring 45 of known type, preferably of calibrated thickness, that is having a predetermined highly precise dimension. Within the seat 40 the seal between the end 16 and the element 30 is guaranteed by an O-ring seal 46 snap-engaged within an annular seat or groove 47 formed on the lateral surface of the element 30. The insert 32 preferably has cylindrical symmetry and includes a first cylindrical abutment 50 of greater diameter, adapted to be inserted coaxially within the seat 38 to ensure fixing of the insert 32 to the element 30, and a second cylindrical abutment 51, of smaller diameter, projecting axially from the first abutment 50 into the mouth or chamber 39 and terminating with a conical frontal surface 52 in correspondence with which the nozzles 20 open into the chamber 39; on the other hand, the hydraulic connection space 36 between the nozzles 20 and the calibrated duct 21 is formed in correspondence with a flat surface 53 opposite the surface 52 and frontally delimiting the abutment 50, which is adapted to contact against the bottom of the seat 38. The cylindrical abutment 51 finally has a lateral milling 55 for precise angular reference with respect to the holes 20.

From what has been described the advantages associated with the invention are evident; the function of regulation of the rate of flow of fuel to be injected, rather than being performed directly by the nozzles 20 or, as in other known constructions, by the opening left free between the seat 19 and the shutter 18 when this latter is actuated in a known way by the said known and not illustrated electromagnet, is performed by an independent element which can be made easily (being rectilinear and coaxial with the shutter 18) such as the calibrated duct 21; the fact that this is formed, rather than directly in the body of the injector, on an insert element which is easily mounted and replaced, then permits, on the one hand the calibrated duct 21 to be formed even more easily, and on the other to adapt the same injector 1 to engines requiring different fuel/air mixture ratios simply by substituting the element 30 with another of identical external dimensions in such a way as perfectly to adapt to the seat 40, but having a calibrated hole 21 of different diameter. A further constructional advantage finally derives from the fact that the inclined nozzles 20, rather than being formed in the said element provided with the calibrated hole 21, are also formed on a separate insert, that is the insert 32, which is then fixed within the element 30; this on the one hand facilitates the production of the nozzles 20, which can be made as through holes, rather than as blind holes, and on the other hand further increases the flexibility of the structure of the injector 1; it is in fact evident that if it is desired to serve different engines, in which the fuel 14 must be injected in different directions, the same injector 1 can still be used, simply by substituting the insert 32 with another identical apart from the position and in-

clination of the holes 20.

Finally it is clear from what has been described that variations and modifications can be introduced without by this departing from the ambit of the invention: for example the manner of fixing of the element 30 and the insert 32 can be of any different form, and the nozzles 20 can be present in any number and in any configuration, for example asymmetric, with a hole 20 disposed axially of the duct 21 and one or more holes 20 formed at an angle on one side of the first, according to the configuration of the induction ducts 6 of the engine 2 on which the injector 1 is to be mounted.

Claims

1. A multi-nozzle injector with orientated jets for an internal combustion engine, comprising a hollow body provided with an inlet connector for fuel under pressure and valve means for injection and metering of the fuel including a shutter member movable axially within the hollow body, and a valve seat cooperating in a fluid-tight manner with the valve shutter, characterised by the fact that the valve means further include at least one pair of nozzles hydraulically connected with the valve seat through a common calibrated duct adapted to meter the flow of fuel passing through the said valve seat towards the said nozzles.

2. An injector according to Claim 1, characterised by the fact that the said valve seat and the said calibrated duct are formed in an insert element defining a bottom wall of the said hollow body.

3. An injector according to Claim 2, characterised by the fact that the said nozzles are formed as through holes passing through an insert fitted securely within the interior of a frontal recess formed in an outer surface of the insert element, opposite the said valve seat; the said calibrated duct opening into the said frontal recess in correspondence with a hydraulic connection space between the nozzles.

4. An injector according to Claim 3, characterised by the fact that the said frontal recess of the insert element includes a cylindrical bottom seat within which the said insert is housed, and a mouth flared towards the said outer surface and defining a chamber into which the said nozzles open.

5. An injector according to Claim 3 or Claim 4, characterised by the fact that the said nozzles are formed in such a way as to diverge from one another starting from the said hydraulic connection space between them, which is defined by respective common mutually intersecting ends of the said nozzles.

6. An injector according to any of Claims from 2 to 5, characterised by the fact that the said hollow body has a terminal end housing the said valve means and comprising a fluid-tight housing for the insert element provided with an axial bottom shoulder and a plastically deformable peripheral edge which is clenched against a bevelled front edge of the said insert element to retain this latter against the said axial shoulder, with the interposition of a spacer ring between the shoulder and the insert element.

7. An injector according to any preceding Claim, characterised by the fact that it is an electrically operated injector.

8. An injector according to any preceding Claim, characterised by the fact that the relative position between the body and the nozzles is determined with precision by means of a lateral reference milling.

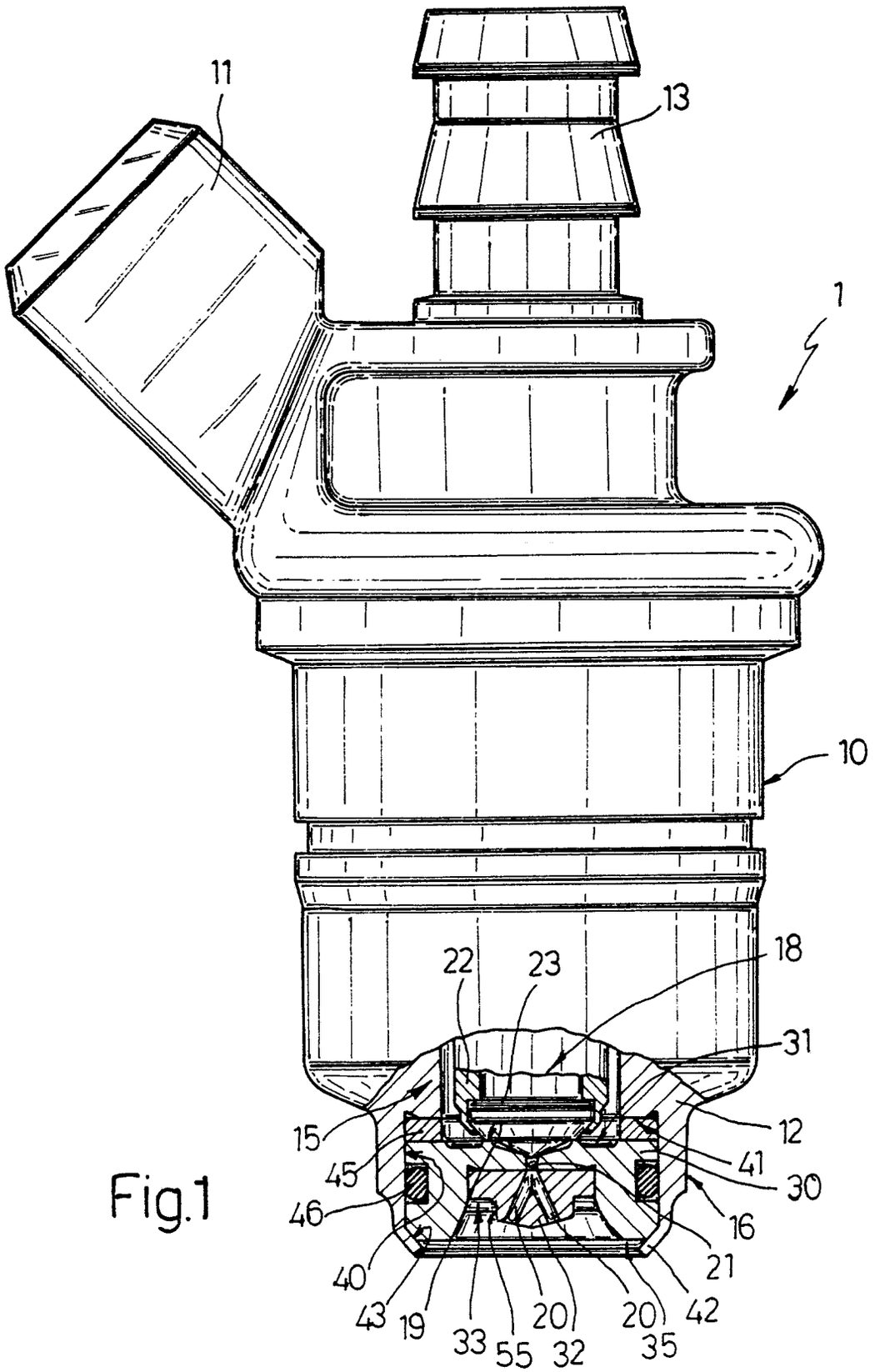
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Fig.1

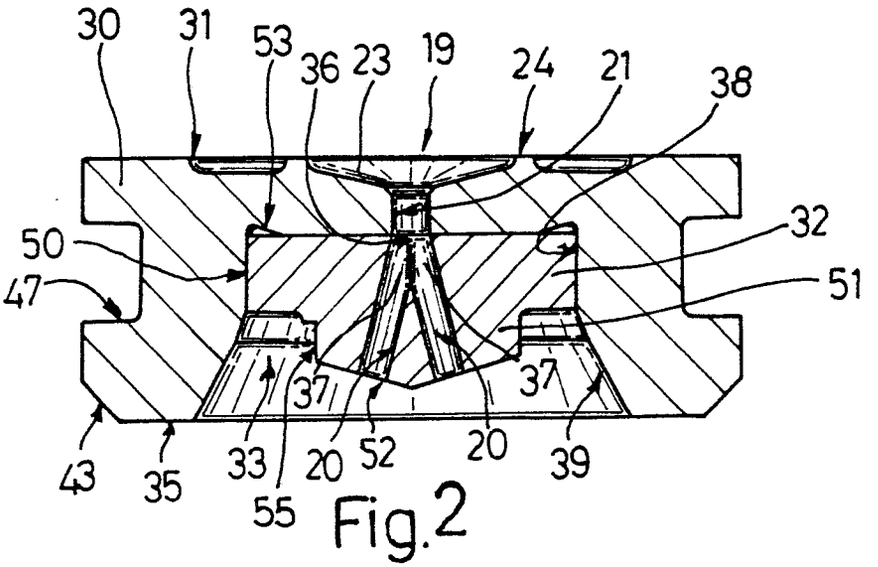
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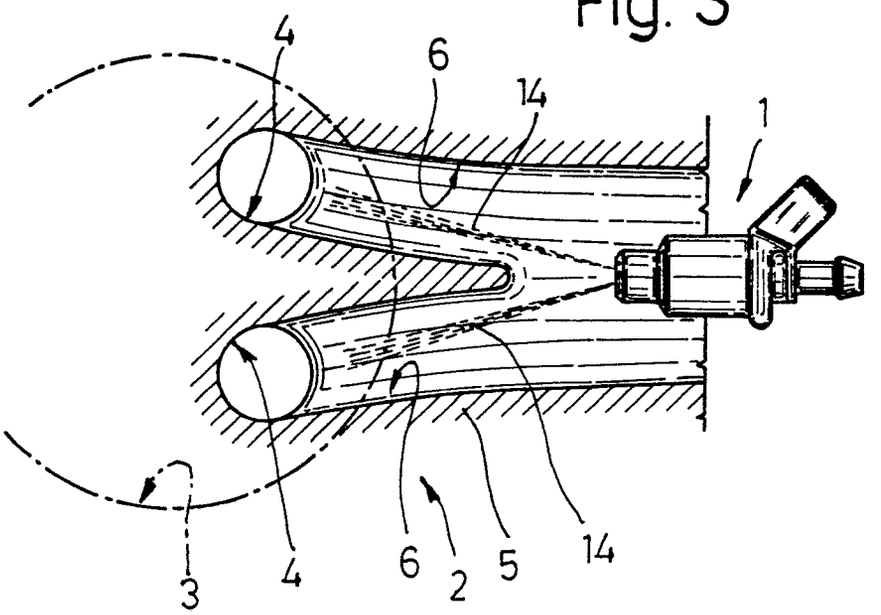
Fig.2

Fig. 3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EUROPEAN SEARCH REPORT

Application Number

EP 89 11 7661

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US-A-4657189 (IWATA) * the whole document *	1, 2, 7	F02M61/18 F02M69/04
A		3, 4, 6	

X	EP-A-257475 (NIPPONDENSO) * column 4, line 30 - column 6, line 42; figures 1-3 *	1, 7	
Y		2, 3, 5	

Y	EP-A-242978 (GENERAL MOTORS CORPORATION) * column 5, line 17 - column 7, line 29; figures 1-5 *	2, 3, 5	
A		7	

Y	DE-A-3229716 (ROBERT BOSCH GMBH) * page 6, line 13 - page 7, line 13; figures 2, 3 *	2, 3	
A		6, 7	

A	FR-A-2355175 (THE BENDIX CORPORATION) * page 12, line 27 - page 15, line 25; figures 2-4 *	1-3, 6, 7	
	-----		TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F02M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	02 JANUARY 1990	HAKHVERDI M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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