

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number:

0 234 642
B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication of the patent specification:
11.04.90

(51) Int. Cl. 4: **F02M 61/18, F02M 51/06**

(21) Application number: **87200212.6**

(22) Date of filing: **11.02.87**

(54) **Electromagnetically operated injector for internal combustion engines.**

(30) Priority: **18.02.86 IT 1944586**

(73) Proprietor: **WEBER S.r.l., Corso Marconi, 20,
I-10125 Torino(IT)**

(43) Date of publication of application:
02.09.87 Bulletin 87/36

(72) Inventor: **Facchin, Alessandro, Via L.B. Alberti 2,
I-56100 Pisa(IT)**
Inventor: **Manetti, Alberto, Via Calatafimi 22,
I-57013 Rosignano Solvay Livorno(IT)**

(45) Publication of the grant of the patent:
11.04.90 Bulletin 90/15

(74) Representative: **De Carli, Erberto et al, ING. BARZANO'
& ZANARDO MILANO S.p.A. Via Borgonuovo, 10,
I-20121 Milano(IT)**

(84) Designated Contracting States:
DE FR GB

(56) References cited:

DE-A- 3 012 416
DE-A- 3 415 905
DE-C- 285 330
FR-A- 529 508
FR-A- 779 909
FR-A- 1 408 212
FR-A- 2 447 471
GB-A- 2 136 500
GB-A- 2 144 178
US-A- 4 421 278
US-A- 4 487 369
US-A- 4 497 443
US-A- 4 520 962

EP 0 234 642 B1

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid (Art. 99(1) European patent convention).

Description

This invention relates to an electromagnetically operated injector for use in electronically controlled fuel injection systems, of the single or multiple injector type, for internal combustion engines.

This type of injector characteristically comprises a casing, a fuel inlet in said casing, fuel discharge elements terminating with an injection nozzle and comprising an at least partly ferromagnetic valve means for controlling the fuel flow through said discharge elements, and a solenoid contained in said casing and which, when energised, causes said valve means to open in opposition to resilient means, and thus allow the fuel to flow through said discharge elements.

One of the main characteristics to be considered in designing this type of electromagnetic injector is the shape of the jet leaving the bore in the injection nozzle. In this respect, this shape often differs according to the position of the injector on the engine.

Again, in certain applications, in order for example to reduce the pollutant percentage in the engine exhaust gas, an atomised conical spray can be desirable to facilitate the mixing of the petrol with the air drawn by the engine.

Various injectors have been known for some time which enable the desired atomised conical jet to be obtained, even at the low fuel pressures which exist in electromagnetic injection systems. The proposed injectors, while substantially attaining their object in the majority of cases, present various types of drawbacks which are summarised hereinafter.

In one type of known electromagnetic injector which has been available for many years, the conical jet is obtained by using a typical injector configuration for diesel engines with a precombustion chamber. The outlet of this conventional injector is shown in Fig. 1, and comprises a cylindrical pin element which, joined coaxially to the mobile valve element and contained in a bore provided in the fixed valve body, acts as a sizing means for the fuel discharge area, and terminates in a double reverberator cone the purpose of which is to widen the jet leaving the metering section.

However in more recent inventions (US-A 4 421 278 and US-A 4 497 443) the pin element is separated from the mobile valve element, and is joined with an interference fit to the fixed part of the valve body, leaving longitudinal passages for the fuel between the pin element and its seat in the fixed part of the valve body. All these injectors have certain common drawbacks such as the considerable manufacturing costs of the pin element because of its complicated profile, the difficulty of controlling the instantaneous annular flow metering cross-section of the electromagnetic injector, and the impossibility of obtaining, where necessary, a uniform fuel distribution within the internal volume of the jet cone.

Moreover, according to the type of petrol used and the conditions of the engine intake manifold, carbon or lead compounds tend to deposit on the pin, sometimes very rapidly, to cause considerable

reduction in fuel delivery, to the point where the engine could stop due to insufficient feed.

A different injector (GB-A 2 136 500) has a vortexing element in the form of a disc with oblique bores which, disposed immediately upstream of the valve means, causes the fuel to undergo a vortex movement before the fluid reaches the outlet bore.

However, in this type of injector, because of the vortex formation above the sealing seat, the discharge coefficient at said seat tends to reduce and therefore an increase in the stroke of travel of the mobile valve means is required in order to ensure that the flow does not become throttled at the passage area in the seat. This increases the time required by the mobile member to undergo its stroke of travel, leading to a higher speed of impact between said mobile member and the cooperating abutment element, with the consequent possibility that the mobile valve means rebounds to produce relative instability in fuel delivery. A further serious drawback of this injector is the fact that the fuel present between the vortexing element and the sealing seat is injected without the vortex effect at the commencement of each injection cycle. This volume of liquid, which is considerable percentage-wise at low delivery, creates difficulties in handling the flow because of the different discharge coefficients at the seat and at the injector discharge bore, and this gives rise in the jet to a considerable compact pre-spray in the shape of a cylindrical rod, which particularly under idling conditions causes increase in the pollutants emitted by the engine.

Further injectors, proposed in US-A 4 487 369 and US 4 520 962, have downstream of the valve means a helically grooved element press-fitted into the injection nozzle body.

These injectors also have certain drawbacks, of which the main ones are as follows:

The difficulty in accommodating the fuel delivery times due to the scatter which the working cross-section at the helical grooves shows in the case of a large production series. This drawback is particularly harmful in multipoint injection systems, in which the fuel delivery scatter between the various injectors must be kept within very narrow limits.

The volume of liquid contained between the helically grooved element and the injector outlet bore (US-A 4 520 962) means that when the engine is cold there is a harmful pre-spray in the shape of a cylindrical rod.

The fuel contained within the helical grooves and the chambers housing the grooved element tend, when the engine is hot, to evaporate during the time between one injection and the next. This means that there is an uncontrolled delivery increase, in particular under idling conditions, which is a function of the temperature attained by the injector, the injection frequency and the fuel quantity injected.

In a recent injector (GB-A 2 144 178) jet atomisation is obtained by positioning downstream of the injection nozzle discharge bore a shield-shaped element against which the jet strikes, to undergo breakdown. This system, which had been formerly used in diesel injection, is however very difficult to handle

when used in mass-production, from the point of view of directing the broken-down jet into the engine intake duct and obtaining uniformity in the degree of atomisation because of the extreme sensitivity of these two parameters to the dynamics of the impact between the rod-shaped cylindrical jet leaving the injector and the shield-shaped element on which it is broken down.

From FR-A 1 408 212 there is known an electromagnetically operated injector in which a turbulence chamber is provided encircling the movable valve element immediately upstream of the valve seat. On opening the valve, the turbulence created in the turbulence chamber causes the fuel to pass through the terminal bore of the injection nozzle in form of a thin film adhering to the wall of the bore and involving a central air core. In an alternative embodiment, the valve element has a pin-like projection entering the terminal bore of the injection nozzle and leaving an annular space therewith, so as to mechanically create such a film with inner air core. Therefore, an atomised conical spray with fuel particles finely distributed through the cross section of the spray is not obtained.

FR-A 529 508 discloses an injector in which the movable valve element is provided with grooves near the sealing portion such as to reduce the fuel path from the periphery of the valve element to the injection nozzle, while maintaining a sufficiently large resting surface of the valve element on the valve seat. The grooves could also be provided in the valve seat. However, owing to the conical valve seat and the large sealing surface required, the fuel is caused to flow along the conical surface toward the injection nozzle to converge at the nozzle axis when the valve is opened, and on leaving the injection nozzle the fuel forms a jet having a fan configuration owing to a thin flat window provided at the exit of the nozzle. A distribution in the form of a cone with uniformly distributed fuel particles is therefore not provided.

Finally, DE-A 3 012 416 discloses an electromagnetically operated injector in which the movable valve element has a pin-like projection entering a chamber provided between the valve seat and the injection nozzle or a plurality of injection nozzles. Such an arrangement, in which the nozzles have a capillary configuration chosen so as to cause a pressure drop which is not higher than 10% of the pressure drop in the chamber and the capillary nozzles, has the purpose of preventing harmful gases to enter the injector. The provision of the pin-like projection involves higher costs and there is no improved outlet jet with respect to other known injectors.

The object of the present invention is therefore to obtain, in a simple manner and under low production costs, an electromagnetic injector which creates an atomised conical jet and which obviates the drawbacks of the known art.

In particular, an electromagnetic conical jet injector is required which:

has no additional mechanical element with respect to an injector in which the jet is of the cylindrical rod type;

enables the conical jet to be formed by hydraulic action;

leads to no increase in the fuel volume contained downstream of the valve means;

5 has its cone formation means disposed at the terminal section of the injection nozzle;

allows easy control of the effective fuel discharge cross-section of the injection nozzle;

10 has the terminal bore of its injection nozzle completely free of reverberation pins or helically grooved inserts;

has considerable jet direction uniformity;

allows the fuel to also undergo distribution within the conical spray.

15 This object is attained according to the invention by an electromagnetically operated injector for feeding fuel to an internal combustion engine, comprising a casing, a fuel inlet in said casing, fuel discharge elements terminating with an injection
20 nozzle and comprising an at least partly ferromagnetic valve means for controlling the fuel flow through said elements, and a solenoid contained in said casing order, when energised, to cause said valve means to open in opposition to resilient
25 means, wherein between the valve seat and the terminal bore of said injection nozzle, through which the fuel flows for its injection into the engine, there is provided an inner chamber, characterised in that in the surface of said terminal bore there are
30 formed one or more grooves which open into said inner chamber and are of gradually decreasing cross-section in the direction away from said inner chamber.

35 Obviously the number, shape and path of extension of said one or more grooves of decreasing cross-section can vary according to the particular spray characteristics required for any given case. Compared with the known art, an injector according to the present invention has the following advantages:

40 small cost increase over an injector with cylindrical rod jet;

no delivery drift with the injector hot;

absence of harmful pre-spray of rod type;

45 no variation in the discharge coefficient at the fuel passage area through the valve means;

ease of controlling the instantaneous throughput delivered by the injector for a mass-production run;

50 no delivery reduction with time due to carbon sediments or fuel lead residues depositing on jet reverberation elements;

no need for increase of the fuel passage area through the valve means, with relatively lesser possibility of rebound of the mobile assembly.

55 The structural and operational characteristics of the invention and its advantages over the known art will be more apparent from an examination of the description given hereinafter by way of example, with reference to the accompanying drawings in which:
60

Fig. 1 is a longitudinal section through the injection nozzle of an electromagnetic injector of conventional type;

65 Fig. 2 is diagrammatic section through an electro-

magnetic injector constructed in accordance with the principles of the present invention;

Fig. 3 is an enlarged view of that zone of the injection nozzle lying within the dashed-line portion of Fig. 2;

Fig. 4 is a plan view on the section line IV-IV of Fig. 3;

Fig. 5 is a perspective view of the injection nozzle of Figs. 3 and 4;

Figs. 6, 7 and 8 are views analogous to that Fig. 4, but showing other possible types and arrangements of the grooves;

Figs. 9 and 10 are partial sections through the nozzle zone showing two different possible groove extension paths.

With reference to Fig. 2, an electromagnetic injector of the type according to the invention comprises a central cylindrical core 10 of ferromagnetic material housed in a casing 11, also of ferromagnetic material, and extending outside the casing 11 to form a connector 10a for connecting the injector inlet to the fuel feed.

A ferromagnetic mobile armature 12 is coaxially associated with the core 10 to form a magnetic circuit together with the core 10 and casing 11.

The core 10 is at least partly surrounded by a coil 13 wound on a spool 14, and fed electrically in known manner under intermittent control by conductors 15 partly embedded in a plastics cap 16. The mobile armature 12, substantially of hollow cylindrical shape, carries a shut-off valve element 17 by way of a washer 18, and is guided by a tube 19 inserted into the core 10 but projecting from it. A spring 20 normally urges the shut-off valve element 17 against a valve seat defined by an upper surface of an injection nozzle 21, which is provided in known manner with a sized bore for fuel discharge. The spring 20 reacts against a dowel 22 inserted with an interference fit into the core 10 and open centrally to allow the fuel to pass. Between the nozzle 21 and casing 11 there is interposed an annular spacer 23, which substantially defines the stroke of the armature 12, which at the end facing the core 10 abuts against an annular abutment element 24, which is of impact-resistant material and at least partly amagnetic, and is mounted on the core 10 in such a manner as to project axially from the end of the core 10 to leave a small air gap between the armature 12 and core 10 when the armature is in its completely raised position, in which the shut-off valve element 17 opens the passage through the injection nozzle 21. The annular abutment element 24 ensures that there is no mechanical and/or hydraulic sticking, which would be prejudicial to instantaneous injector shut-off action. The hydraulic seal is provided by seal rings 25, 26 and 29. The fuel, fed through the dowel 22, reaches the bores 27 of the core 10 in known manner, and then the bores 28 in the armature 12, from which the fuel reaches the injection nozzle 21. When the coil 13 is de-energised, the armature 12 is in its lowered position in which the shut-off valve element 17 shuts off the fuel passage through the injection nozzle 21, whereas when the coil 13 is energised, the armature 12 is in its raised position in contact with

the annular abutment element 24, the shut-off valve element 17 opening the fuel passage through the injection nozzle 21. The terminal zone of the injection nozzle 21 is formed, as shown in Fig. 3, by a terminal bore 30 the surface of which is provided with one or more grooves 31 of substantially longitudinal extension, which open into an inner chamber 32 which is provided between the terminal bore 30 and the valve seat. Said one or more grooves 31 characteristically have a cross-section which gradually decreases in the direction away from the inner chamber 32, and can terminate either within the interior of the discharge bore 30 as shown in Fig. 3, or can open, at their end distant from the inner chamber 32, into the outer surface 33 of the injection nozzle 21 into which the fuel discharge bore 30 opens, as shown in Fig. 9.

The grooves 31 of decreasing cross-section cause the formation, within the liquid mass leaving the injector at the moment the valve means 17 open, of fluid fillets of preferential path which by virtue of the proximity of the grooves 31 to the outlet surface 33, cause the fuel injection jets to open out and to break down into droplets of very small size.

The injection cone angle and the fuel distribution over the cross-section transverse to the jet axis depend on the dimensional characteristics and number of the grooves 31 of decreasing cross-section.

In a mass-production run, discharge coefficient uniformity of the fuel discharge bore in the injection nozzle 21 can be maintained by controlling the dimension H (figure 3) at which the grooves 31 are positioned with respect to the outer surface 33 of the nozzle 21 into which the discharge bore 30 opens.

Figs. 3, 4, 5 and 6 show grooves 31 of substantially triangular cross-section. Other shapes can be used without appreciable change in their functional performance. For example, the groove or grooves 31 can be of substantially rectangular or semi-circular cross-section, as shown in Figs. 7 and 8, respectively. Figs. 3, 4, 5, 7, 8 and 9 show grooves 31 of substantially rectilinear extension, with their longitudinal axis coplanar with the axis of the fuel discharge bore 30 in the injection nozzle. These grooves can however be made with their axis oblique to the axis of the nozzle discharge bore 30 (Fig. 6) in order to create in the fluid mass a tangential component which favours the formation of the atomised conical spray. Likewise, the grooves 31 can be of curved extension, for example as shown in Fig. 10. An even number or odd number of grooves 31 can be provided, and they are preferably distributed angularly equidistant on the surface of the terminal bore 30 of the injection nozzle.

Claims

1. An electromagnetically operated injector for feeding fuel to an internal combustion engine, comprising a casing (11), a fuel inlet in said casing (11), fuel discharge elements terminating with an injection nozzle (21), and comprising an at least partly ferromagnetic valve means (17) for controlling the fuel flow through said elements, and a solenoid (13) con-

tained in said casing (11) in order, when energised, to cause said valve means (17) to open in opposition to resilient means (20), wherein between the valve seat and the terminal bore (30) of said injection nozzle (21), through which the fuel flows for its injection into the engine, there is provided an inner chamber (32), characterised in that in the surface of said terminal bore (30) there are formed one or more grooves (31) which open into said inner chamber (32) and are of gradually decreasing cross-section in the direction away from said inner chamber (32).

2. An injector as claimed in claim 1, characterised in that said grooves (31) of decreasing cross-section are distributed angularly equidistant on the surface of said terminal bore (30) of the injection nozzle (21).

3. An injector as claimed in claim 1, characterised in that said one or more grooves (31) of decreasing cross-section are of substantially rectilinear extension, and the axis of each of said grooves (31) is coplanar with the axis of said terminal bore (30) of the injection nozzle (21).

4. An injector as claimed in claim 1, characterised in that said one or more grooves (31) of decreasing cross-section are of substantially rectilinear extension, and the axis of each of said grooves (31) lies in a plane which is oblique to the axis of said terminal bore (30) of the injection nozzle (21).

5. An injector as claimed in claim 1, characterised in that said one or more grooves (31) of decreasing cross-section are of curved extension.

6. An injector as claimed in one of claims 2, 3, 4 or 5, characterised in that at their end further from said inner chamber (32) said one or more grooves (31) of decreasing cross-section terminate at the surface which defines said terminal bore (30) of the injection nozzle (21).

7. An injector as claimed in one of claims 2, 3, 4 or 5, characterised in that at their end further from said inner chamber (32), said one or more grooves (31) of decreasing cross-section open into the outer surface (33) of the injection nozzle (21) into which said terminal bore (30) opens.

8. An injector as claimed in claim 6 or 7, characterised in that said one or more grooves (31) of decreasing cross-section are of substantially triangular cross-section.

9. An injector as claimed in claim 6 or 7, characterised in that said one or more grooves (31) of decreasing cross-section are of substantially rectangular cross-section.

10. An injector as claimed in claim 6 or 7, characterised in that said one or more grooves (31) of decreasing cross-section are of substantially semi-circular cross-section.

11. An injector as claimed in any one of the preceding claims, characterised in that said one or more grooves (31) of decreasing cross-section are provided in an odd number.

Patentansprüche

1. Elektromagnetischer Injektor zur Zufuhr von Kraftstoff in eine Brennkraftmaschine, welcher ein

Gehäuse (11), einen Kraftstoffeinfuß in das Gehäuse (11), Elemente zum Ausbringen von Kraftstoff, welche in einer Einspritzdüse (21) enden, wenigstens teilweise ferromagnetische Ventilmittel (17) zur Steuerung des Kraftstoffflusses durch die Elemente und ein im Gehäuse (11) aufgenommenes Solenoid (13) aufweist, welches bei einer Erregung ein Öffnen der Ventilmittel (17) gegen elastische Mittel (20) bewirkt, wobei zwischen dem Ventilsitz und der Endöffnung (30) der Einspritzdüse (21), durch welche der Kraftstoff für eine Einspritzung in den Motor strömt, eine Innenkammer (32) vorgesehen ist, dadurch gekennzeichnet, daß in der Oberfläche der Endbohrung (30) eine oder mehrere Nut(en) (31) ausgebildet ist (sind), welche in die Innenkammer (32) münden und in Richtung von der Innenkammer (32) weg einen zunehmend verringerten Querschnitt aufweisen.

2. Injektor nach Anspruch 1, dadurch gekennzeichnet, daß die Nuten (31) mit abnehmendem Querschnitt in äquidistanten Winkeln über die Oberfläche der Endbohrung (30) der Einspritzdüse (21) verteilt angeordnet sind.

3. Injektor nach Anspruch 1, dadurch gekennzeichnet, daß die Nut(en) (31) mit abnehmendem Querschnitt eine im wesentlichen geradlinige Ausdehnung aufweist(en) und daß die Achse jeder der Nuten (31) koplanar mit der Achse der Endbohrung (30) der Einspritzdüse (21) ist.

4. Injektor nach Anspruch 1, dadurch gekennzeichnet, daß die Nut(en) (31) mit abnehmendem Querschnitt eine im wesentlichen geradlinige Ausdehnung aufweist(en) und daß die Achse jeder der Nuten (31) in einer Ebene liegt, welche zur Achse der Endbohrung (30) der Einspritzdüse (21) geneigt verläuft.

5. Injektor nach Anspruch 1, dadurch gekennzeichnet, daß die Nut(en) (31) mit abnehmendem Querschnitt eine gekrümmte Ausdehnung aufweist(en).

6. Injektor nach einem der Ansprüche 2, 3, 4 oder 5, dadurch gekennzeichnet, daß die Nut(en) (31) mit abnehmendem Querschnitt an ihrem der Innenkammer (32) abgewandten Ende an der Oberfläche, welche die Endbohrung (30) der Einspritzdüse (21) definiert, endet(n).

7. Injektor nach einem der Ansprüche 2, 3, 4 oder 5, dadurch gekennzeichnet, daß die Nut(en) (31) mit abnehmendem Querschnitt an ihrem der Innenkammer (32) abgewandten Ende in die Außenfläche (33) der Einspritzdüse (21), in welche die Endbohrung (30) mündet, mündet(n).

8. Injektor nach Anspruch 6 oder 7, dadurch gekennzeichnet, daß die Nut(en) (31) mit abnehmendem Querschnitt einen im wesentlichen dreieckigen Querschnitt aufweist(en).

9. Injektor nach einem der Ansprüche 6 oder 7, dadurch gekennzeichnet, daß die Nut(en) (31) mit abnehmendem Querschnitt einen im wesentlichen rechteckigen Querschnitt aufweist(en).

10. Injektor nach Anspruch 6 oder 7, dadurch gekennzeichnet, daß die Nut(en) (31) mit abnehmendem Querschnitt einen im wesentlichen halbkreisförmigen Querschnitt aufweist(en).

11. Injektor nach einem der vorangehenden An-

sprünge, dadurch gekennzeichnet, daß die Nut(en) (31) mit abnehmendem Querschnitt in einer ungeraden Anzahl vorgesehen ist (sind).

Revendications

1. Injecteur électromagnétique pour l'alimentation en carburant d'un moteur à combustion interne, comprenant un boîtier (11), une admission de carburant dans le boîtier (11), des éléments d'évacuation de carburant qui se terminent par une buse d'injection (21), et comprenant un obturateur (17) au moins partiellement ferromagnétique pour commander l'écoulement du carburant à travers ces éléments, et un solénoïde (13) contenu dans le boîtier (11) afin, lorsqu'il est excité, d'engendrer l'ouverture de l'obturateur (17) à l'encontre d'un moyen élastique (20), une chambre intérieure (32) étant prévue entre le siège de valve et l'alésage terminal (30) de la buse d'injection (21), par lequel le carburant s'écoule pour être injecté dans le moteur, caractérisé en ce qu'une ou plusieurs rainures (31), qui s'ouvrent dans la chambre intérieure (32) et qui sont de section progressivement décroissante en éloignement de la chambre intérieure (32), sont formées dans la surface de l'alésage terminal (30).

2. Injecteur selon la revendication 1, caractérisé en ce que les rainures (31) de section décroissante sont réparties de manière angulairement équidistante sur la surface de l'alésage terminal (30) de la buse d'injection (21).

3. Injecteur selon la revendication 1, caractérisé en ce que la ou les rainures (31) de section décroissante s'étendent de manière sensiblement rectiligne, et en ce que l'axe de chacune des rainures (31) est coplanaire avec l'axe de l'alésage terminal (30) de la buse d'injection (21).

4. Injecteur selon la revendication 1, caractérisé en ce que la ou les rainures (31) de section décroissante s'étendent de manière sensiblement rectiligne, et en ce que l'axe de chacune des rainures (31) se situe dans un plan qui est incliné par rapport à l'axe de l'alésage terminal (30) de la buse d'injection (21).

5. Injecteur selon la revendication 1, caractérisé en ce que la ou les rainures (31) de section décroissante s'étendent de manière courbe.

6. Injecteur selon l'une des revendications 2, 3, 4 ou 5, caractérisé en ce qu'à leur extrémité éloignée de la chambre intérieure (32), la ou les rainures (31) de section décroissante se terminent sur la surface qui définit l'alésage terminal (30) de la buse d'injection (21).

7. Injecteur selon l'une des revendications 2, 3, 4 ou 5, caractérisé en ce qu'à leur extrémité éloignée de la chambre intérieure (32), la ou les rainures (31) de section décroissante s'ouvrent dans la surface extérieure (33) de la buse d'injection (21) dans laquelle s'ouvre l'alésage terminal (30).

8. Injecteur selon la revendication 6 ou 7, caractérisé en ce que la ou les rainures (31) de section décroissante sont de section sensiblement triangulaire.

9. Injecteur selon la revendication 6 ou 7, caractérisé en ce que la ou les rainures (31) de section dé-

croissante sont de section sensiblement rectangulaire.

10. Injecteur selon la revendication 6 ou 7, caractérisé en ce que la ou les rainures (31) de section décroissante sont de section sensiblement semi-circulaire.

11. Injecteur selon l'une quelconque des revendications précédentes, caractérisé en ce que la ou les rainures (31) de section décroissante sont prévues en nombre impair.

5

10

15

20

25

30

35

40

45

50

55

60

65

Fig.2

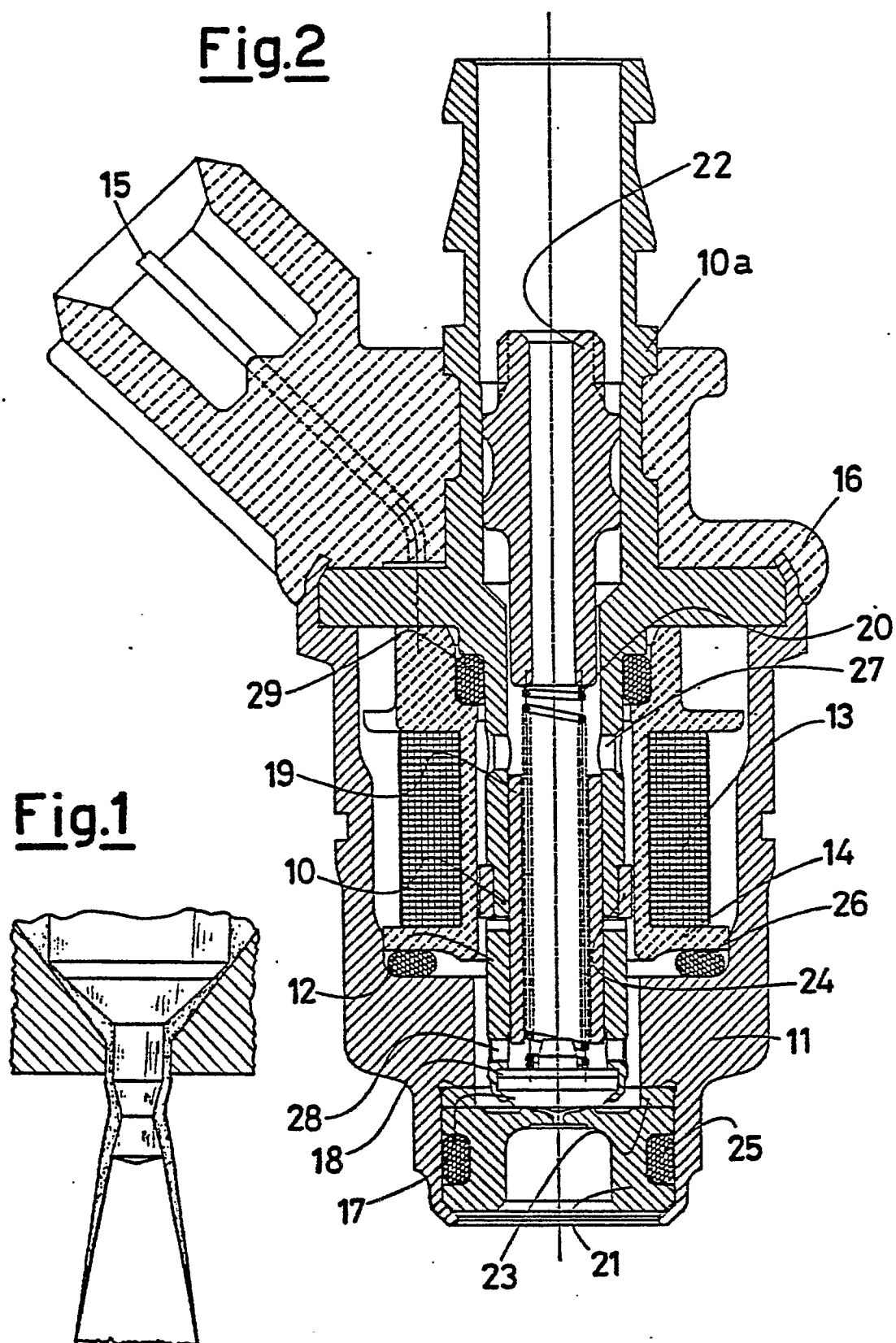


Fig.3

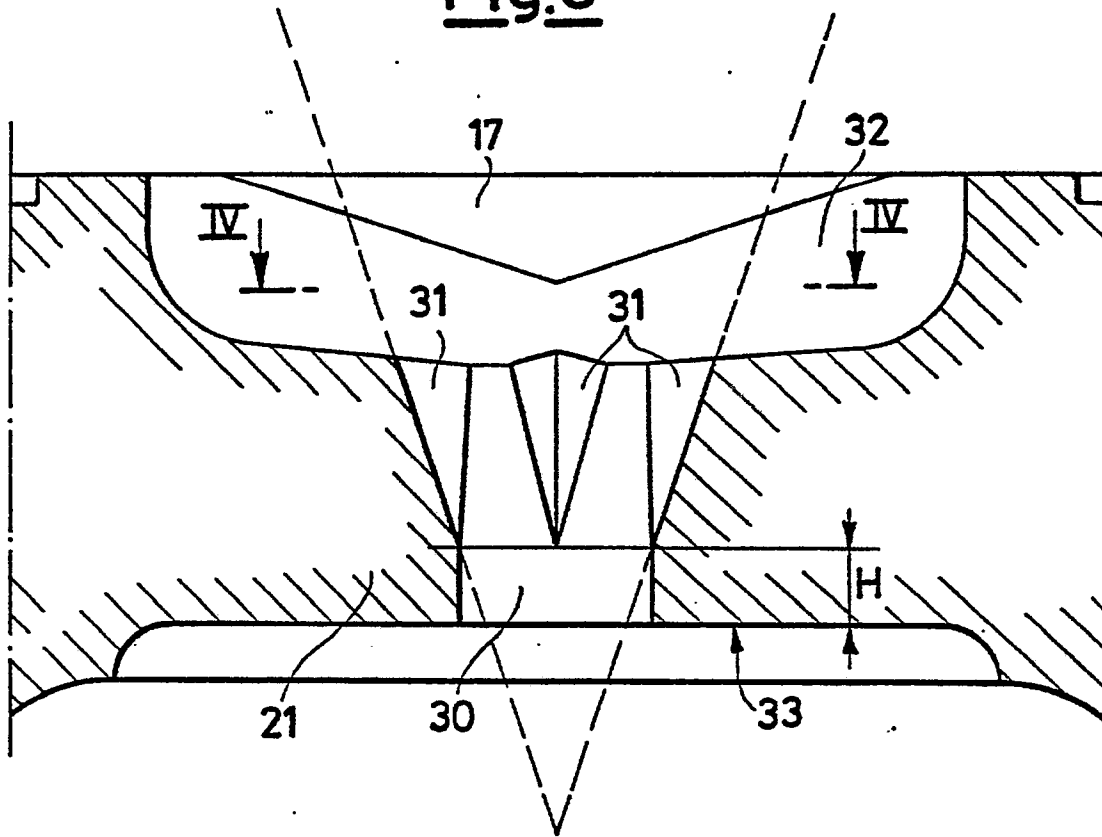


Fig.4

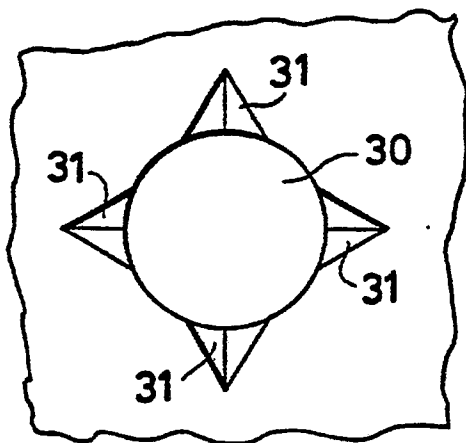
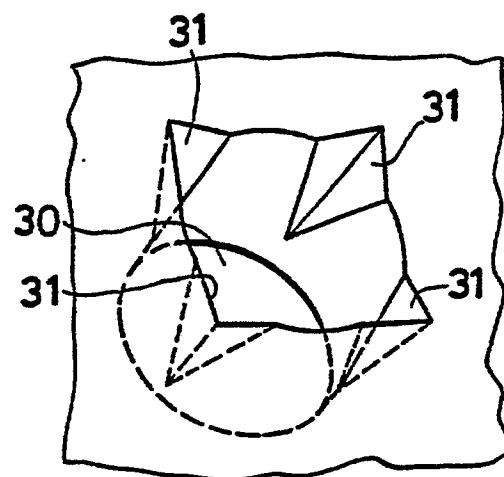


Fig.5



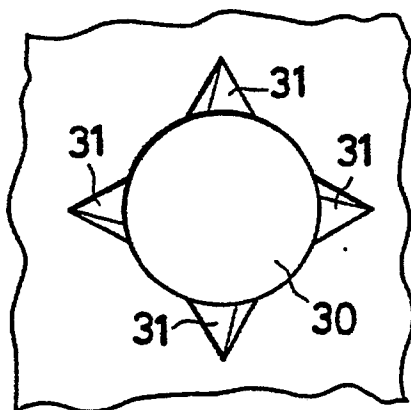


Fig. 6

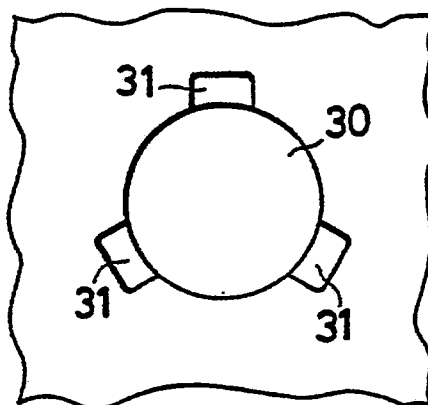


Fig. 7

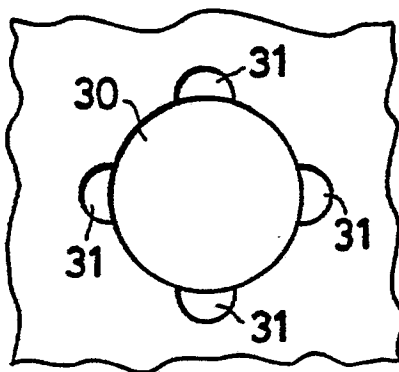


Fig. 8

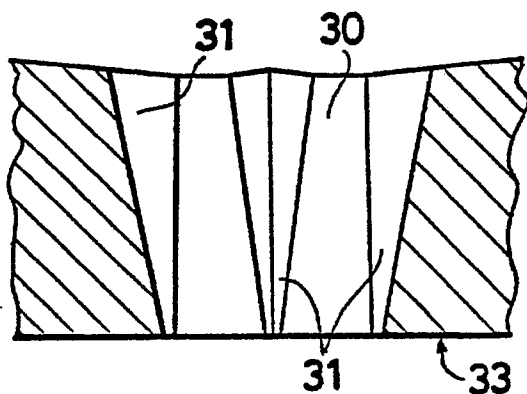


Fig. 9

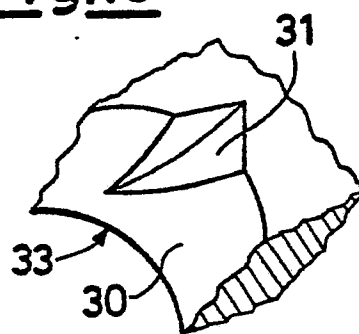


Fig. 10