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(11) **EP 0 836 003 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
15.04.1998 Bulletin 1998/16

(51) Int. Cl.⁶: **F02M 47/02, F02M 61/14**

(21) Application number: **97117481.8**

(22) Date of filing: **09.10.1997**

(84) Designated Contracting States:
**AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC
NL PT SE**
Designated Extension States:
AL LT LV RO SI

(72) Inventor: **Carrara, Massimo**
8400 Winterthur (CH)

(74) Representative:
Jorio, Paolo, Dr. Ing. et al
Studio Torta S.r.l.,
Via Viotti, 9
10121 Torino (IT)

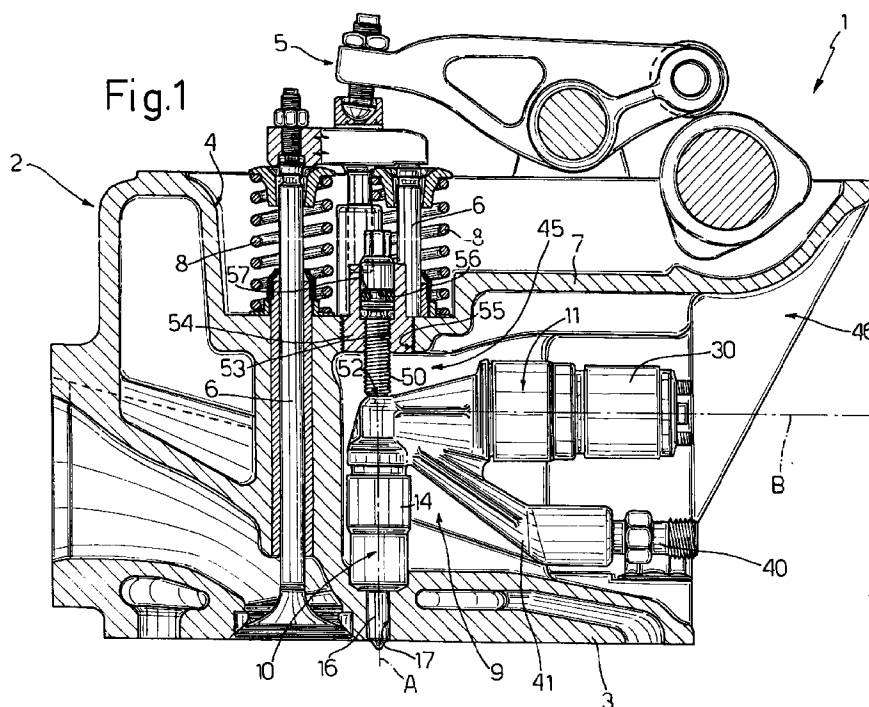
(30) Priority: **11.10.1996 IT TO960833**

(71) Applicant: **IVECO FIAT S.p.A.**
10156 Torino (IT)

(54) **Fuel injector for a heat engine and a heat engine provided with such an injector**

(57) An injector (9) for a heat engine (1) comprising a spray assembly (10) designed to be installed through a wall (3) of the engine delimiting a combustion chamber and provided with a movable needle (19), and a control assembly (11) provided with a solenoid valve

(30) for controlling the needle (19); the control assembly (11) extends in a transverse direction with respect to the spray assembly (10) below a bottom wall (7) of the tap-pet housing (4) of the engine.



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Description

The present invention relates to a fuel-injected heat engine, in particular but not exclusively of the compression-ignition (diesel) type used in commercial vehicles.

It is known that injectors for supplying fuel to heat engines comprise a spray assembly adapted to inject the fuel into a combustion chamber of an associated cylinder, and an electrohydraulic control assembly; these assemblies are normally coaxial to one another and integrated in a common casing of elongate tubular shape.

The injector is mounted in the engine cylinder head, preferably in a position coaxial to the associated cylinder, with the spray assembly arranged to pass through a wall of the cylinder head upwardly bounding the combustion chamber; the injector extends axially into the tappet housing between the valve springs and emerges at the top through cover of the housing itself.

The solution with a central injector coaxial to the associated cylinder is optimum for combustion but results in the use of four valves per cylinder (and the associated springs); therefore, the problems in respect of space requirements have proven to be particularly critical and give rise to substantial difficulties in the mounting and dismounting operations.

In other known solutions, the coaxial arrangement of the injector is dispensed with and the valves are disposed on an inclined axis; however, these solutions, which are more advantageous with regard to space requirements, are disadvantageous with respect to combustion.

Another disadvantage arises from the fact that an oil seal has to be provided between the injector and the tappet cover and, optionally, a water seal between the cooling chamber of the cylinder head and the injector seating.

Furthermore, the fastening of the injector in its seating is generally complicated and inconvenient.

The object of the present invention is to devise a fuel injector for a heat engine, which makes it possible to eliminate the disadvantages of the aforementioned known injectors.

This object is achieved by the present invention in that it relates to a fuel injector for a heat engine, the injector comprising a spray assembly extending along an axis and provided with end nozzle means and with shut-off means which are associated with said nozzle means and which can move along said axis, and an electrohydraulic control assembly for said shut-off means, characterised in that said control assembly extends transversely with respect to said axis of said spray assembly.

The present invention also relates to a fuel-injected heat engine provided with at least one cylinder and with a cylinder head accommodating at least one injector associated with said cylinder, the injector comprising a spray assembly extending along an axis and provided

with end nozzle means and with shut-off means which are associated with said nozzle means and which can move along said axis, and an electrohydraulic control assembly for said shut-off means, characterised in that said control assembly extends transversely with respect to said axis of said spray assembly.

With a view to a better understanding of the present invention a preferred embodiment will be described non-restrictively by way of example below, with reference to the accompanying drawings, in which:

Figure 1 is a partial section of a heat engine provided with an injector in accordance with the present invention, and

Figure 2 is a view in elevation and in partial section, on an enlarged scale, of the injector in Figure 1.

With reference to Figure 1, the reference numeral 1 generally denotes a heat engine, only part of which is illustrated.

The engine 1 comprises a cylinder head 2, suitably made of a light alloy, which has a lower wall 3 upwardly bounding the combustion chamber (not shown) of the cylinders (also not shown), and defines upwardly a tappet housing 4 in which is accommodated a valve-control assembly 5 of known type. The engine 1 comprises four valves 6 per cylinder, two of which are shown in Figure 1.

The tappet housing 4 is closed upwardly by a cover (not shown) and is bounded downwardly by a substantially horizontal intermediate bottom wall 7 of the cylinder head 2, which forms a support for the valve springs 8.

The engine 1 also comprises an injector 9 for each cylinder.

Each cylinder 9 (Figure 2) comprises a spray assembly 10 and a control assembly 11.

The spray assembly 10 has a vertical axis coincident with the axis of the associated cylinder and comprises a tubular casing 14 which is made of a number of parts to facilitate assembly and machining, and which is provided with an axial cavity 15. The casing 14 has a lower end portion 16 of reduced diameter, which is mounted in a seating 17 passing through the wall 3 and which is provided end nozzles 18 communicating with the associated combustion chamber.

The spray assembly 10 further comprises a needle-type shut-off member 19 (hereinafter designated "needle 19") which slides in the cavity 15 and which is intended to co-operate with the nozzles 18 in a fluidtight manner, and a piston 22 sliding fluidtightly in a pressure chamber 23 defining an upper end portion of the cavity 15. The piston 22 and the needle 19 are provided with respective stems 24, 25 intended to co-operate with one another end on.

The needle 19 is urged downwards, i.e. towards the closed position, under the action of the piston 22 subjected to the pressure in the chamber 23 and of a spring

26 accommodated in the cavity 15 of the casing 14 coaxially to the stems 24, 25.

The needle 19 is provided with an intermediate annular thrust surface 27 of smaller area than the section of the piston 22, which faces downwards into a second pressure chamber 28 provided in the casing 14.

According to the present invention, the control assembly 11 extends transversely with respect to the axis A of the spray assembly 10.

In particular, the assembly 11 comprises a solenoid valve 30 of known type and which, therefore, will not be described in detail. The solenoid valve comprises an elongate outer body 31 extending integrally from an upper portion of the casing 14 and provided with an axial cavity 32 having an axis B orthogonal to the axis A, and a moving element 33 sliding axially in the cavity 32.

The cavity 32 communicates at one of its ends with the pressure chamber 23 through a passage 34 which is of narrow diameter and which is intended to be connected at its opposite end to a fuel-recirculating passage 34 (not shown) through a connector 35.

The moving element 33 comprises a ball-type shut-off member 36 intended to co-operate in a fluidtight manner with a tapered seating 37 leading into the passage 34 so as to isolate from the latter the cavity 34 and, therefore, the connector 35.

Finally, the injector 9 comprises a connector 40 for the inlet of fuel under high pressure. The connector 40 is secured to a lower extension 41 of the body 31 of the solenoid valve 30 and communicates with a feed passage 42 provided in the extension 41 itself and extending along an axis C which is inclined with respect to the axes A and B, towards the connection zone of the body 31 with the solenoid valve 30 and the casing 14. The passage 42 is connected to the pressure chamber 23 by a passage 43 of narrow diameter, and to the second pressure chamber 28 by a passage 44.

Owing to its special geometry, the injector 9 can be wholly accommodated in an intermediate chamber 45 of the cylinder head 2 situated between the lower wall 3 and the bottom wall 7 of the tappet housing 4. The chamber 45 communicates with the exterior of the engine through a lateral opening 46 in the cylinder head 2, which enables the injector 9 to be installed and the feed and recirculation pipes to pass therethrough, as well as a control cable (not shown) for the solenoid valve 30.

The injector 9 is secured in its installation position by a setscrew 50 with an axis A, which screw is installed through the bottom wall 7 of the tappet housing 4 and which acts at one of its ends against an upper bearing surface 52 of the casing 14 disposed transversal to the axis A and intersected by this latter. The screw 50 is screwed into an axial hole 53 of a bush 54 which, in turn, is screwed into a through-hole in the wall 7.

The bush 54, which is suitably made of steel, is interposed between the screw 50 and the wall 7 (of light alloy) so as to obviate damage to the latter as a result of

repeatedly screwing and unscrewing the screw 50 for maintenance operations.

The diameter of the hole 55 makes it possible to machine the injector seating 17 in the wall 3 of the cylinder head 2.

The screw 54 advantageously has an annular seating 56 for a sealing ring 57 which co-operates with the bush 54 so as to prevent any leakage of oil from the tappet housing 4.

The mode of operation of the injector 9, which is known per se, is as follows.

The needle 19 is held in the closed position by the spring 26 and by the hydraulic pressure acting on the piston 22, which prevail over the hydraulic pressure acting on the surface 27 of the needle 19. When the solenoid valve 30 is energised, the first pressure chamber 23 is connected to the recirculation passage; therefore, the piston 22 is free to move upwards so as to enable the needle 19 to open under the action of the hydraulic pressure prevailing in the second pressure chamber 28 on the surface 27, which action prevails over the elastic reaction of the spring 26.

When the solenoid valve 30 is de-energised, the pressure in the first chamber 23 increases again to the feed value and the resultant force exerted by the piston 22, added to that of the spring 26, overcomes the hydraulic force acting on the needle 19, thereby inducing the closure of the latter.

The numerous advantages achieved with the present invention are evident from a study of the features of the engine 1 and, in particular, of the injector 9 designed in accordance therewith.

Firstly, as a result of the transverse arrangement of the control assembly 11 with respect to the spray assembly 10 of the injector 9, the introduction of the injector 9 itself into the tappet housing 4 is obviated but allows an arrangement of the spray assembly 10 coaxial to the respective cylinder. This makes it possible to effect savings in the mounting and dismounting times, and to facilitate the connection of the pipes and the cable to the injector.

Furthermore, the fastening of the injector 9 itself is facilitated, since by means of the screw 50 or another equivalent member it is possible to apply a purely axial force on the spray assembly 10.

The screw 50 can be actuated from the tappet housing 4 by means of a conventional implement.

The arrangement of the control assembly 11 in the chamber 45 makes it possible to reduce the thermal stress on the assembly 11 itself. Any loss of fuel does not contaminate the engine oil. The passages inside the injector are of shorter length and, therefore, the pressure losses are reduced. Moreover, as the drilling lengths are less, the diameter of the spray assembly can be reduced. Finally, the dimensions of the moving elements inside the injector 9 are reduced.

Finally, it is evident that the engine 1 and the injector 9 can be subject to modifications and variants which

do not depart from the scope of protection defined by the claims.

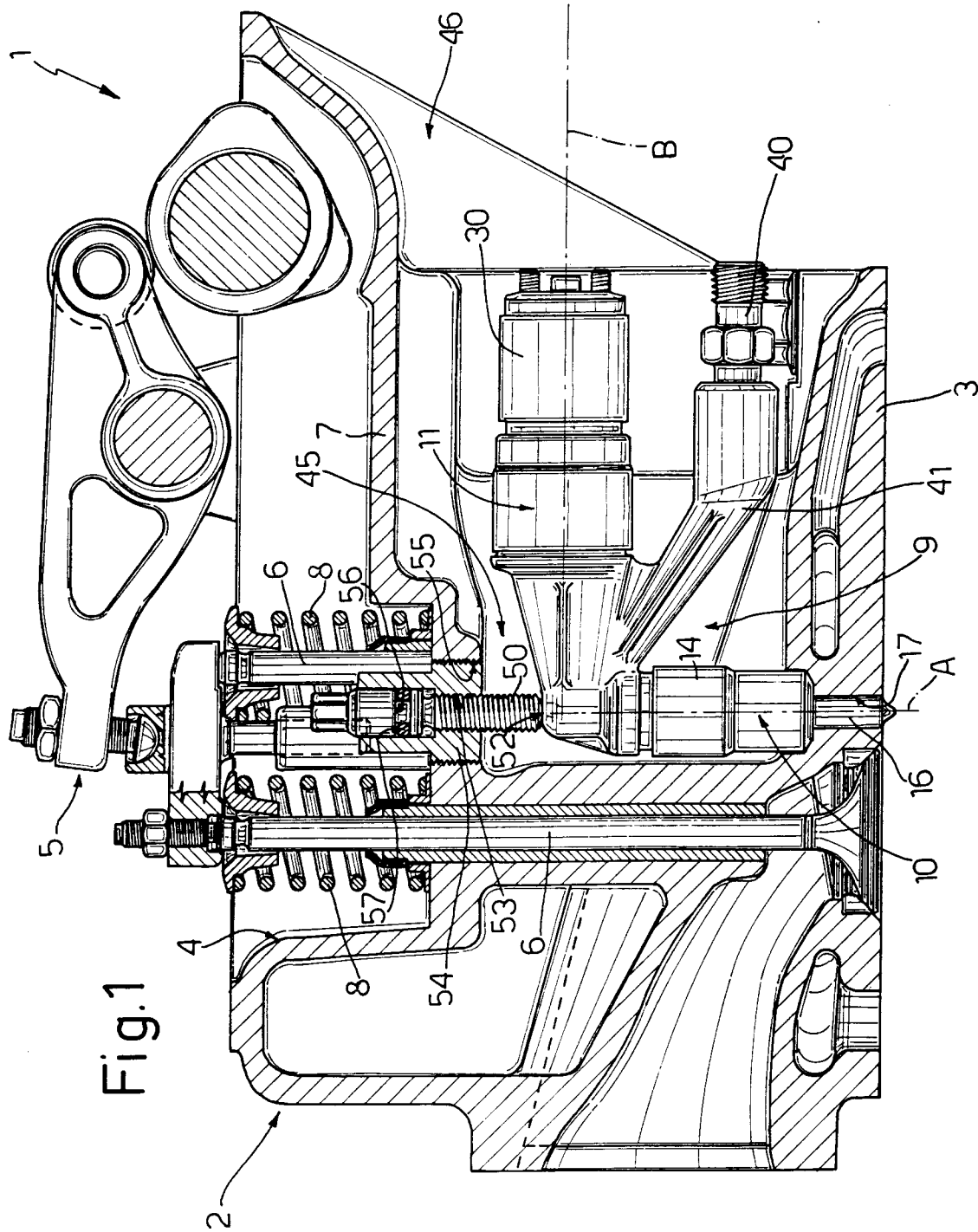
In particular, the control assembly 11 can extend in a direction which is transverse but not orthogonal to the axis A of the spray assembly 10. Moreover, the injector 9 can be secured in the cylinder head 2 by means of a conventional clamping bracket instead of the screw 50.

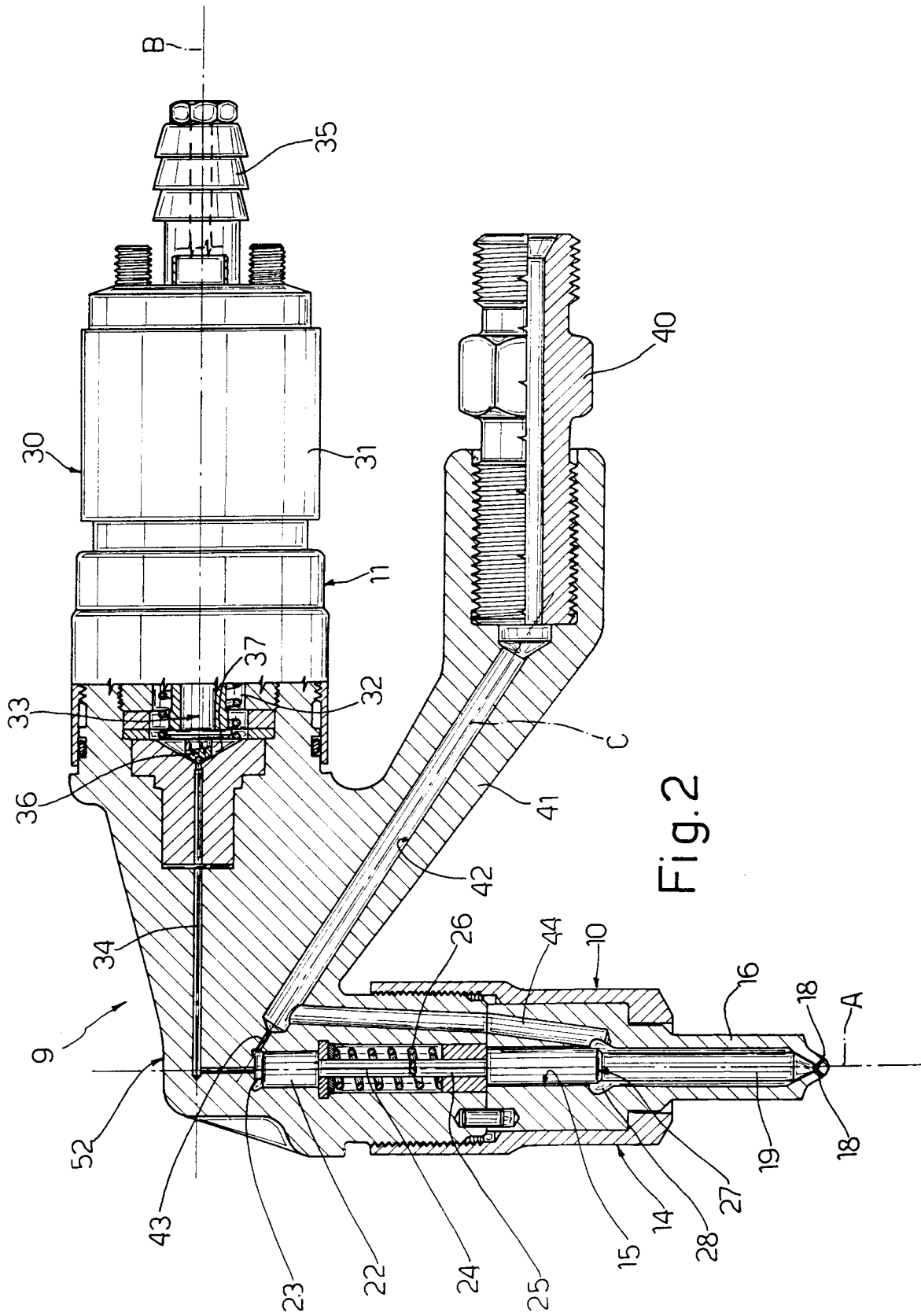
Claims

1. A fuel injector (9) for a heat engine (1),
the injector (9) comprising a spray assembly (10)
extending along an axis (A) and provided with end
nozzle means (18) and with shut-off means (19)
which are associated with said nozzle means (18)
and which can move along said axis (A), and an
electrohydraulic control assembly (11) for said shut-
off means (19), characterised in that said control
assembly (11) extends transversely with respect to
said axis (A) of said spray assembly (10). 15
2. An injector according to claim 1, characterised in
that said control assembly (11) has an axis (B)
orthogonal to said axis (A) of said spray assembly
(10). 20
3. An injector according to claim 1 or 2, characterised
in that said spray assembly (10) comprises a casing
(14) provided with a bearing surface (52) opposite
said nozzle means (18), disposed transversely to
said axis (A) and intersected by the axis (A) itself. 25
4. A fuel-injected heat engine (1) provided with at
least one cylinder and with a cylinder head (2)
accommodating at least one injector (9) associated
with said cylinder, the injector (9) extending along
an axis (A) and provided with end nozzle means
(18) and with shut-off means (19) which are associ-
ated with said nozzle means (18) and which can
move along said axis (A), and an electrohydraulic
control assembly (11) for said shut-off means (19),
characterised in that said control assembly (11)
extends transversely with respect to said axis (A) of
said spray assembly (10). 30
5. An engine according to claim 4, characterised in
that said cylinder head (2) comprises a lower wall
(3) delimiting said cylinder and it defines upwardly a
tappet housing (4) having a bottom wall (7); said
cylinder head (2) having at least one intermediate
chamber (45) situated between said bottom wall (7)
of said tappet housing (4) and said lower wall (3),
said injector (9) being accommodated in said inter-
mediate chamber (45). 35
6. An engine according to claim 5, characterised in
that said cylinder head (2) has at least one lateral
opening (46) communicating with said intermediate
chamber (45). 40

chamber (45).

7. An engine according to any one of claims 4 to 6,
characterised in that said spray assembly (10) com-
prises a casing (14) provided with a bearing surface
(52) opposite said nozzle means (18) and disposed
transversely to said axis (A) and intersected by the
axis (52) itself. 45
8. An engine according to claim 7, characterised by
comprising means (50) for locking said injector (9),
which are associated with said bottom wall (7) of
said tappet housing (4) and which co-operate with
said bearing surface (52) of said injector (9). 50
9. An engine according to claim 8, characterised in
that said locking means comprise a setscrew (5)
arranged to pass through said bottom wall (7) of
said tappet housing (4). 10. An engine according to
claim 4, characterised in that said control assembly
(11) has an axis (B) which is orthogonal with
respect to said axis (A) of said spray assembly (10). 55







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EUROPEAN SEARCH REPORT

Application Number
EP 97 11 7481

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.6)
X	DE 43 32 119 A (BOSCH GMBH ROBERT) 23 March 1995 * column 3, line 9 - column 5, line 30; figure 1 *	1,2,4,10	F02M47/02 F02M61/14
X	FR 2 145 081 A (AUTOMOBILES PEUGEOT) 16 February 1973 * page 2, line 24 - page 3, line 19; figure *	1,2,4,10	
X	EP 0 196 265 A (STANADYNE INC) 1 October 1986 * page 4, line 19 - page 11, line 22; figure 1 *	1,2,4,10	
X	FR 2 636 675 A (USUI KOKUSAI SANGYO KK ;KANESAKA GIJUTSU KENKYUSHO KK (JP)) 23 March 1990 * page 6, line 30 - page 8, line 25; figure 1 *	1,2,4,10	
X	EP 0 228 578 A (GANSER MARCO ALFREDO) 15 July 1987 * page 17, last paragraph - page 22, paragraph 3; figures 4,5 *	1,2,4,10	TECHNICAL FIELDS SEARCHED (Int.Cl.6) F02M
X	PATENT ABSTRACTS OF JAPAN vol. 012, no. 182 (M-702), 27 May 1988 & JP 62 291462 A (TOYOTA MOTOR CORP), 18 December 1987, * abstract *	1,2,4,10	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 8 January 1998	Examiner Hakhverdi, M
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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