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

(11) EP 1 767 774 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
28.03.2007 Bulletin 2007/13

(51) Int Cl.:
F02M 61/16 *(2006.01)* ***F02M 65/00*** *(2006.01)*
F02M 61/08 *(2006.01)*

(21) Application number: **05020821.4**

(22) Date of filing: **23.09.2005**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

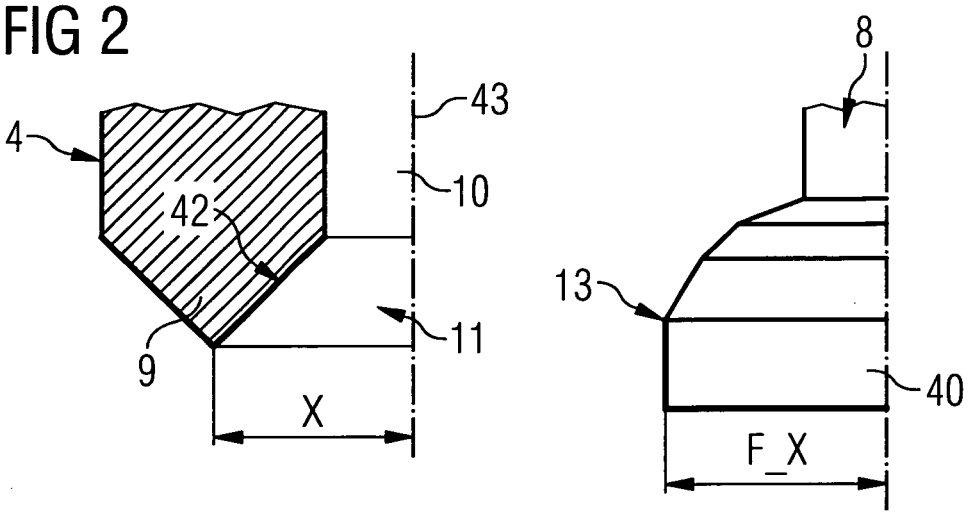
(71) Applicant: **SIEMENS AKTIENGESELLSCHAFT**
80333 München (DE)

(72) Inventors:
- **Gestri, Luca**
  56023 S. Lorenzo alle Corti (PI) (IT)
- **Mureddu, Annamaria**
  57017 Livorno (IT)

(54) Method and apparatus for manufacturing a valve group for an injector

(57) A valve group (2) has a cartridge (4) with a cartridge recess (10). A needle (8) is arranged in the cartridge recess (10) movable in axial direction. The cartridge (4) and the needle (8) prevent a fluid flow through an cartridge opening (11) in a closed position of the needle (8) and otherwise enable the fluid flow through the cartridge opening (11). The cartridge recess (10) has one or more characteristic diameters. At least one characteristic geometry of the respective needle (8) for the cartridge (4) is manufactured dependent on the one or respectively more characteristic diameters of the cartridge recess (10).

FIG 2



EP 1 767 774 A1

Description

[0001] The invention relates to a method and an apparatus for manufacturing a valve group for an injector, the valve group having a cartridge with a cartridge recess in which a needle is arranged moveable in axial direction. The cartridge and the needle prevent a fluid flow through a cartridge opening in a closed position of the needle and otherwise enable the fluid flow through the cartridge opening.

[0002] The injector comprising the valve group may be used for dosing fluid into a combustion chamber of an internal combustion engine. To ensure a high engine power while having a good environmental compatibility one has to ensure an accurate dosing of the fluid by the injector.

[0003] DE 199 07 678 A1 discloses a method for manufacturing control edges of a valve of a fluid injector for an internal combustion engine. The control edges are manufactured simultaneously by the same tool.

[0004] The object of the invention is to create a method and an apparatus for manufacturing a valve group for an injector, the valve group enabling simply an accurate dosing of fluid.

[0005] The object of the invention is achieved by the independent claims. Advantageous embodiments of the invention are given in the sub-claims.

[0006] The invention is distinguished by a method and an apparatus for manufacturing a valve group for an injector. The valve group has a cartridge with a cartridge recess in which a needle is arranged moveable in axial direction. The cartridge and the needle prevent a fluid flow through a cartridge opening in a closed position of the needle and otherwise enable the fluid flow through the cartridge opening. The cartridge recess is manufactured comprising one or more characteristic diameters. At least one characteristic geometry of the respective needle for the cartridge is manufactured dependent on the one or respectively more characteristic diameters of the cartridge recess. Further, the cartridge and the respective needle are assembled.

[0007] If some dimensions of the valve group deviate from their given dimensions this may lead to an increased coking of the valve group in the area of the cartridge opening. The dimensions may comprise the one or more characteristic diameters of the cartridge. Already very small deviations from the given dimensions may lead to an inaccurate dosing of the fluid by the injector comprising the valve group. So it is very important that deviations of given dimensions of the valve group are as small as possible. The deviations may occur while manufacturing the valve group. Manufacturing at least one characteristic geometry of the needle dependent on the one or more characteristic diameters of the cartridge contributes to a very precise fit of the needle to the cartridge despite the deviations. The at least one characteristic geometry of the needle may be for example a diameter of the needle at a given axial length of the needle. This contributes to an accurate dosing of fluid by the injector comprising the valve group.

[0008] In an advantageous embodiment of the method the one or more characteristic diameters of the cartridge is or respectively are measured and the at least one characteristic geometry of the needle is manufactured dependent on the measured one or respectively more characteristic diameters of the cartridge. This enables that the cartridge and the at least one characteristic geometry of the needle are manufactured at different times or different places which may contribute to low cost production of the valve group. The step of measuring the one or more characteristic diameters and the step of manufacturing the at least one characteristic geometry of the needle dependent on the measured one or respectively more characteristic diameters may also be executed nearly simultaneously.

[0009] In a further advantageous embodiment the method comprises a step of manufacturing the cartridge and the at least one characteristic geometry of the needle simultaneously. The tool for manufacturing the at least one characteristic geometry of the needle mechanically follows the tool for manufacturing the cartridge. This enables manufacturing the at least one characteristic geometry of the needle dependent on the cartridge without measuring the one or more characteristic diameters of the cartridge. The mechanical following of the tool for manufacturing the at least one characteristic geometry of the needle enables manufacturing the at least one characteristic geometry of the needle dependent on the cartridge without any electronic or software for measuring the cartridge. Mechanical following means in this context that the tools are coupled mechanically and the tool for manufacturing the cartridge leads the movement of the tool for manufacturing for manufacturing the at least one characteristic geometry of the needle.

[0010] In a further advantageous embodiment of the method a cylindrical part of the needle tip is manufactured which works together as an injection nozzle with a cartridge tip at the cartridge opening. The cylindrical part sticking out of the cartridge recess and having a diameter which is a function of a diameter of the cartridge opening. The cylindrical part enables simply a very precise manufacturing of the needle depending on the characteristic diameters.

[0011] Exemplary embodiments of the invention are explained in the following with the aid of schematic drawings.

[0012] These are as follows:

Figure 1 a valve group for an injector,

Figure 2 a detailed view of a cartridge tip and a first embodiment of a needle tip of the valve group,

Figure 3 a detailed view of the cartridge tip and a second embodiment of the needle tip,

Figure 4 a detailed view of the cartridge tip and a third embodiment of the needle tip,

Figure 5 a flow chart of a first method for manufacturing the valve group,

Figure 6 a flow chart of a second method for manufacturing the valve group.

[0013] Elements of the same design and function that appear in the different illustrations are identified by the same reference character.

[0014] A fluid injector (figure 1) comprises an injector housing 1 and a valve group 2. The valve group 2 comprises a cartridge 4, a valve cap 6 and a needle 8. The injector may be used to inject fluid to a combustion chamber of an internal combustion engine. The injector may is connected to a high pressure fuel chamber, for example a common rail, of an internal combustion engine, where fuel is stored under high pressure, for example under the pressure of about 200 Bar.

[0015] The cartridge 4 comprises a cartridge recess 10. At one axial end facing away from the valve cap 6 the cartridge 4 comprises a cartridge tip 9. The cartridge recess 10 comprises a cartridge opening 11. Further, the cartridge 4 comprises two boreholes 16. In an alternative embodiment the cartridge 4 may comprise only one or more boreholes 16.

[0016] The cartridge 4 takes in the needle 8 movable in axial direction. The needle 8 comprises a needle tip 13 facing away from the valve cap 6. The needle 8 further comprises an end face 15 facing away from the needle tip 13.

[0017] A spring 12 is arranged between the cartridge 4 and a spring washer 14. The spring washer 14 forms a first spring rest for the spring 12. A second spring rest is formed preferably at one axial end of the cartridge 4 facing away from the cartridge tip 9. The spring washer 14 is fixed to the needle 8. The spring 12 forces the needle 8 via the spring washer 14 in order to press the needle tip 13 against the cartridge opening 11.

[0018] The valve cap 6 comprises a control recess 17 facing away from the cartridge 4. Bellows 18 prevent leaking of the fluid through the control recess 17 of the valve cap 6. The end face 15 of the needle 8 protrudes in an actor housing 32. An actor 34 is arranged in the actor housing 32 and comprises a ground plate 36. Via the ground plate 36 the actor 34 affects the needle 8 at the end face 31 of the needle 8.

[0019] The needle 8 prevents in a closed position of the needle 8 a fluid flow through the cartridge opening 11. In the closed position of the needle 8 the needle tip 13 is pressed to the cartridge recess 10 from the outside of the cartridge recess 10 covering it sealing up the cartridge recess 10. So the needle 8 prevents the fluid flow through the cartridge opening 11. Apart from the closed position the needle tip 13 is moved away from the cartridge opening 11. So the cartridge opening 11 and the needle 8 form an injection nozzle. The fluid may flow through the volume between the injector housing 1 and the actor housing 5. The fluid may enter the valve group 2 through a fluid recess 20 of the valve cap 6. Then the fluid flows to the cartridge opening 11 and apart from the closed position of the needle 8 the fluid is injected to the combustion chamber of the internal combustion engine. The axial position of the needle 8 depends on a force balance. A first force is affected by the spring 12 in closing direction of the needle 8 and a second force is affected by the actor 34 in opening direction of the needle 8. Further forces on the needle 8 are affected by the fluid in the valve group 2.

[0020] The cartridge opening 11 comprises a conical part 42 (figure 2) of the cartridge 4 facing an axis 43 of the cartridge 4. The diameter of the conical part 42 increases away from the valve cap 6. For example an inner diameter and an outer diameter X of the conical part 42 may be called characteristic diameters of the cartridge 4. At an alternative embodiment of the cartridge 4 there also may be more or less characteristic diameters of the cartridge 4, for example: if the cartridge opening 11 comprises a second conical part and/or a cylindrical part, one diameter of the conical part and/or respectively the diameter of the cylindrical part of the cartridge opening 11 may be called characteristic diameter of the cartridge 4. The outer diameter X of the conical part 42 in cooperation with the needle tip 13 is very important for an accurate dosing of the fluid and for avoiding coking. The coking may results at a high temperature by not completely burned fluid and/or dirt in the fluid. The needle tip 13 comprises a cylindrical part 40 which comprises a diameter F X. A characteristic geometry of the needle 8 may comprise the cylindrical part 40 of the needle 8.

[0021] The needle tip 9 could also comprise a conical part 44 (Figure 3). The conical part 44 borders the cylindrical part 40. Alternatively the conical 44 part of the needle tip 13 may include different cone angles with the axis of the needle 8 (Figure 4). The characteristic geometry of the needle 8 may comprise the conical part 44 of the needle 8. The characteristic geometry of the needle 8 may also comprise a further part of the needle 8 which is relevant for reducing the coking at the cartridge tip 9 and/or the needle tip 13.

[0022] To ensure a very good fit between the cartridge tip 9 and the needle tip 13 the valve group 2 is preferably manufactured by the following steps. In a first step S1 (figure 5), the cartridge 4 and the needle 8 are assembled to the tools which are operable to manufacture the cartridge 4 and respectively the needle 8. In a second step S2 the cartridge 4 and, in particular, one or more characteristic diameters of the cartridge 4 are manufactured. In a third step S3, the one or more characteristic diameters of the cartridge 4 are measured. In a fourth step S4 at least one characteristic geometry of the needle 8 is manufactured dependent on the cartridge 4, in particular dependent on the characteristic diameters. In a step S5 the needle 8 and the cartridge 4 are assembled together.

So some deviations of the one or more measured characteristic diameters which occur while manufacturing the cartridge 4 are transferred to the at least one characteristic geometry of the respective needle 8. This contributes to a very precise fit of the needle 8 to the cartridge 4 despite the deviations.

[0023] Alternatively the second step S2, the third step S3 and the fourth step S4 are substituted by a sixth and a seventh step S6, S7. In the sixth step S6 the tools for manufacturing the cartridge 4 or respectively the at least one characteristic geometry of the needle 8 are mechanically coupled together in a way that the tool for manufacturing the at least one characteristic geometry of the needle 8 can follow the tool for manufacturing the cartridge 4. In the seventh step S7 the one or more characteristic diameters of the cartridge 4 are manufactured simultaneously with the characteristic geometry of the needle 8 comprising the diameter F_X.

Claims

1. Method for manufacturing a valve group (2) having a cartridge (4) with a cartridge recess (10) in which a needle (8) is arranged movable in axial direction, the cartridge (4) and the needle (8) preventing a fluid flow through a cartridge opening (11) in a closed position of the needle (8) and otherwise enabling the fluid flow through the cartridge opening (11), the method comprising the steps of:

   - manufacturing the cartridge recess (10) having one or more characteristic diameters,
   - manufacturing at least one characteristic geometry of the respective needle (8) for the cartridge (4) dependent on the one or respectively more characteristic diameters of the cartridge recess (10),
   - assembling the cartridge (4) and the respective needle (8).

2. Method in accordance with claim 1 comprising a step of measuring the one or more characteristic diameters of the cartridge (4) and manufacturing the at least one characteristic geometry of the needle (8) dependent on the measured one or respectively more characteristic diameters of the cartridge (4).

3. Method in accordance with claim 1 comprising a step of manufacturing the cartridge (4) and the at least one characteristic geometry of the needle (8) simultaneously, the tool for manufacturing the at least one characteristic geometry of the needle (8) mechanically following the tool for manufacturing the cartridge (4).

4. Method in accordance with one of the preceding claims comprising a step of manufacturing a cylindrical part (40) at a needle tip (13) which works together as an injection nozzle with a cartridge tip (9) at the cartridge opening (11), the cylindrical part (40) sticking out the cartridge recess (10) and having a diameter (F_X) which is a function of a diameter (X_T) of the cartridge opening (11).

5. Apparatus for manufacturing a valve group (2) having a cartridge (4) with a cartridge recess (10) in which a respective needle (8) is arranged movable in axial direction, the cartridge (4) and the respective needle (8) preventing a fluid flow through an cartridge opening (11) in a closed position of the respective needle (8) and otherwise enabling the fluid flow through the cartridge opening (11), the apparatus is operable to:

   - manufacturing the cartridge recess (10) having one or more characteristic diameters,
   - manufacturing at least one characteristic geometry of the respective needle (8) dependent on the one or respectively more characteristic diameters of the cartridge recess (10)
   - assembling the cartridge (4) and the respective needle (8).

FIG 1

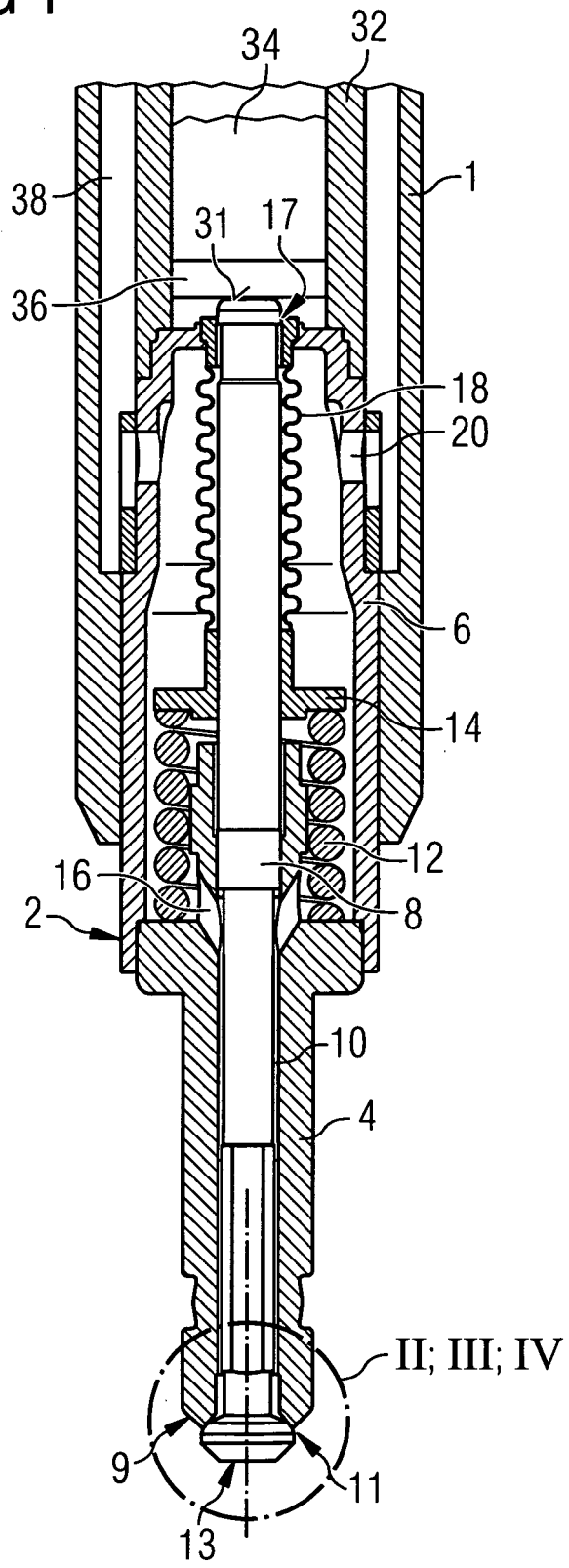


FIG 2

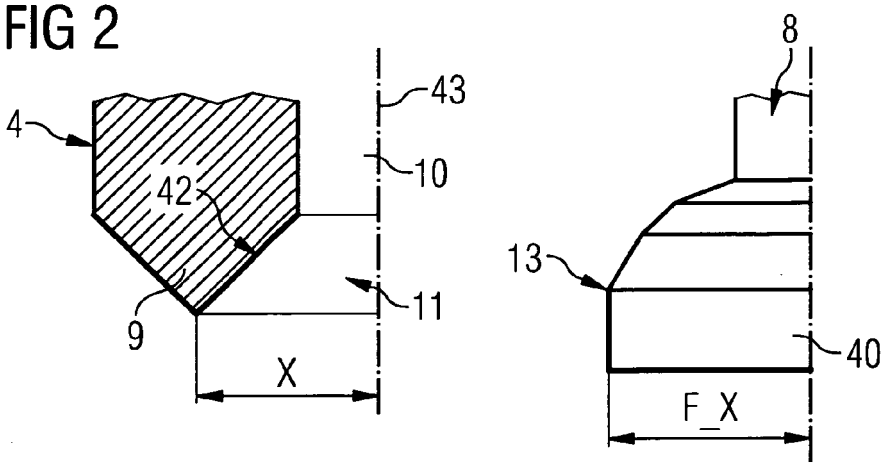


FIG 3

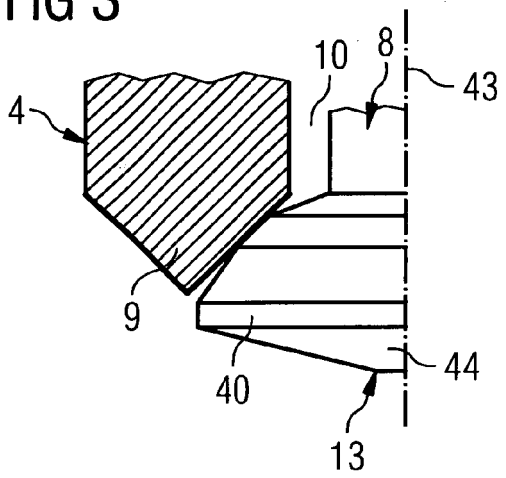


FIG 4

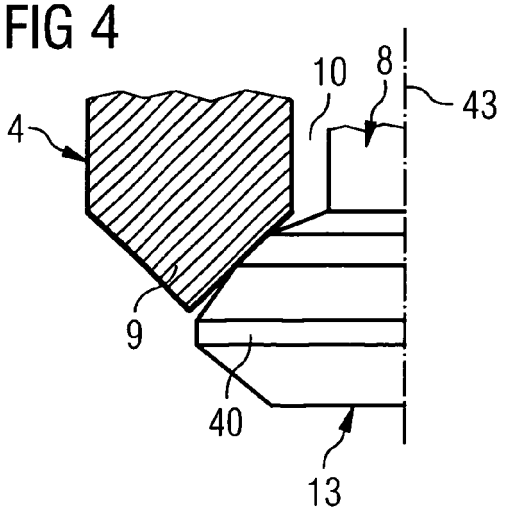


FIG 5

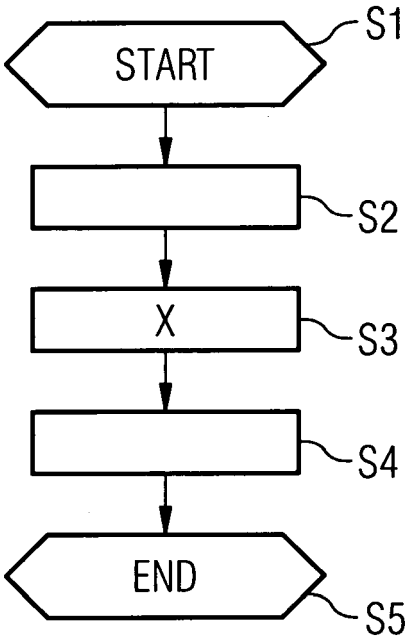
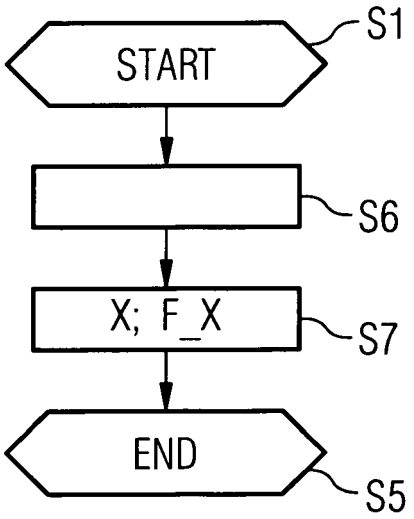


FIG 6



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 02 0821

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	EP 0 282 463 A (WEBER S.R.L) 14 September 1988 (1988-09-14) * page 3, line 36 - line 61 * * claim 1 * * figures *	1,2,5 3,4	F02M61/16 F02M65/00 F02M61/08
D,Y	DE 199 07 678 A1 (HYDRAULIK-RING GMBH) 24 August 2000 (2000-08-24) * the whole document *	3,4	
A	US 6 920 690 B1 (IMOEHL WILLIAM JAMES) 26 July 2005 (2005-07-26) * the whole document *	1	
A	US 2003/230133 A1 (FATH ANDREAS ET AL) 18 December 2003 (2003-12-18) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (IPC)

F02M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	27 February 2006	Louchet, N

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 02 0821

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

27-02-2006

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0282463 A	14-09-1988	IT 1226476 B	16-01-1991
DE 19907678 A1	24-08-2000	FR 2789926 A1	25-08-2000
		IT RM20000084 A1	21-08-2001
		US 6371382 B1	16-04-2002
US 6920690 B1	26-07-2005	NONE	
US 2003230133 A1	18-12-2003	DE 10226397 A1	05-02-2004

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE 19907678 A1 **[0003]**