

(19)



(11)

EP 1 767 774 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
10.01.2018 Bulletin 2018/02

(51) Int Cl.:
F02M 61/16 (2006.01) **F02M 65/00** (2006.01)
F02M 61/08 (2006.01) **F02M 61/18** (2006.01)

(21) Application number: **05020821.4**

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

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

Verfahren und Vorrichtung für die Erstellung einer Ventileinheit eines Injektors

Procédé et appareil pour la fabrication d'une soupape pour un injecteur

(84) Designated Contracting States:
DE FR IT

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

(73) Proprietor: **Continental Automotive GmbH**
30165 Hannover (DE)

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

(56) References cited:
EP-A- 0 282 463 DE-A1- 19 907 678
US-A1- 2003 230 133 US-B1- 6 920 690

EP 1 767 774 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

[0001] The invention relates to a method and an apparatus for manufacturing a valve group for an injector, according to the preamble of claims 1 and 4, respectively. 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. EP 0282463 discloses the preamble of claim 1. 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.

[0003] EP 0 282 463 A1 discloses a method and apparatus for matching a valve body with the relative needle of an injector valve for internal combustion engines. A measured value of a rate of flow is compared with a nominal reference value to check whether the percentage difference between the values falls within an acceptable range of variation. If this is not the case, the needle is replaced with another needle selected in dependence on the compared percentage difference, and the test is repeated until a suitable needle is found. A leakage test is then carried out by the admission of a test liquid under pressure into the body with a suitable needle kept in the closed position, and the measurement of the fall in pressure of the liquid supplied after a predetermined time interval.

[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 in such a way that it has one or more diameters of at least one cylindrical and/or at least one conical part of the cartridge recess. At least one cylindrical and/or at least one conical part of the respective needle for the cartridge is manufactured dependent on the one or, respectively, more diameters of the cylindrical and/or, respectively, the conical part of the cartridge recess. Finally, 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. The characteristic diameters are, for example, the one or more diameters of the at least one cylindrical and/or of the at least one conical part of the cartridge recess and, respectively, the respective needle. 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 diameters of the cylindrical and/or, respectively, conical part of the cartridge is or, respectively, are measured and the at least one diameter of the cylindrical and/or, respectively, conical part of the needle is manufactured dependent on the measured one or respectively more diameters of the cylindrical and/or, respectively, conical part of the cartridge. This enables that the cartridge and the at least one diameter of the cylindrical and/or, respectively, conical part 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 diameters of the cylindrical and/or, respectively, conical part and the step of manufacturing the at least one diameter of the cylindrical and/or, respectively, conical part of the needle dependent on the measured one or respectively more diameters of the cylindrical and/or, respectively, conical part may also be executed nearly simultaneously. According to the invention the method comprises a step of manufacturing the cartridge and the at least one diameter of the cylindrical and/or, respectively, conical part of the needle simultaneously. The tools for manufacturing the at least one diameter of the cylindrical and/or, respectively, conical part of the cartridge recess and the needle are mechanically coupled together in such a way that the tool for manufacturing the diameter of the cylindrical and/or, respectively, conical part of the needle follows the tool for manufacturing the cartridge. This enables manufacturing the at least one diameter of the cylindrical and/or, respectively, conical part of the needle dependent on the cartridge without measuring the one or more diameters of the cylindrical and/or, respectively, conical part of the cartridge. The mechanical following of the tool for manufacturing the at least one diameter of the cylindrical and/or, respectively, conical part of the needle en-

ables manufacturing the at least one diameter of the cylindrical and/or, respectively, conical part 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 the at least one characteristic geometry of the needle.

[0009] 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 diameter of a cylindrical and/or conical part. Exemplary embodiments of the invention are explained in the following with the aid of schematic drawings.

[0010] 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.

[0011] Elements of the same design and function that appear in the different illustrations are identified by the same reference character.

[0012] 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 be 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.

[0013] 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.

[0014] 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.

[0015] 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.

[0016] 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.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] 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.

[0021] 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 diameters of at least one cylindrical and/or at least one conical part of the cartridge recess (10),
- manufacturing at least one cylindrical and/or at least one conical part of the respective needle (8) for the cartridge (4) dependent on the one or, respectively, more diameters of the cylindrical and/or, respectively, the conical part of the cartridge recess (10),
- assembling the cartridge (4) and the respective needle (8), the method being **characterized in that** it comprises a step of manufacturing the cartridge (4) and the cylindrical and/or, respectively, conical part of the needle (8) simultaneously, the tools for manufacturing the cylindrical and/or, respectively, conical parts of the cartridge (4) and, respectively, the needle (8) being mechanically coupled together in such a way that the tool for manufacturing the cylindrical and/or, respectively, conical part of the needle (8) follows the tool for manufacturing the cartridge (4).

2. Method in accordance with claim 1 comprising a step of measuring the one or, respectively, more diameters of the cylindrical and/or, respectively, conical part of the cartridge (4) and manufacturing the diameter of the cylindrical and/or, respectively, conical part of the needle (8) dependent on the measured one or respectively more diameters of the cylindrical and/or, respectively, conical part of the cartridge (4).
3. 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).
4. Apparatus for manufacturing a valve group (2) according to the method of claim 1 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 diameters of at least one cylindrical and/or at least one conical part of the cartridge

recess (10),
 - manufacturing at least one cylindrical and/or at least one conical part of the respective needle (8) for the cartridge (4) dependent on the one or, respectively, more diameters of the cylindrical and/or, respectively, the conical part of the cartridge recess (10),
 - assembling the cartridge (4) and the respective needle (8).

Patentansprüche

1. Verfahren zur Herstellung einer Ventilgruppe (2) mit einer Kartusche (4) mit einer Kartuschenvertiefung (10), in der eine Nadel (8) in axialer Richtung bewegbar angeordnet ist, wobei die Kartusche (4) und die Nadel (8) bei einer geschlossenen Stellung der Nadel (8) einen Fluidstrom durch eine Kartuschenöffnung (11) verhindern und ansonsten den Fluidstrom durch die Kartuschenöffnung (11) ermöglichen, wobei das Verfahren die folgenden Schritte aufweist:

- Herstellen der Kartuschenvertiefung (10) mit einem oder mehreren Durchmessern von mindestens einem zylinderförmigen und/oder mindestens einem konischen Teil der Kartuschenvertiefung (10),
- Herstellen mindestens eines zylinderförmigen und/oder mindestens eines konischen Teils der jeweiligen Nadel (8) für die Kartusche (4) in Abhängigkeit von dem einen oder bzw. den mehreren Durchmessern des zylinderförmigen und/oder bzw. des konischen Teils der Kartuschenvertiefung (10),
- Verbauen der Kartusche (4) und der jeweiligen Nadel (8), wobei das Verfahren **dadurch gekennzeichnet ist, dass** es einen Schritt der gleichzeitigen Herstellung der Kartusche (4) und des zylinderförmigen und/oder bzw. konischen Teils der Nadel (8) aufweist, wobei die Werkzeuge zur Herstellung des zylinderförmigen und/oder bzw. konischen Teils der Kartusche (4) und bzw. der Nadel (8) derart mechanisch miteinander gekoppelt werden, dass das Werkzeug zur Herstellung des zylinderförmigen und/oder bzw. konischen Teils der Nadel (8) dem Werkzeug für die Herstellung der Kartusche (4) folgt.

2. Verfahren nach Anspruch 1, das einen Schritt des Messens des einen oder bzw. der mehreren Durchmesser des zylinderförmigen und/oder bzw. konischen Teils der Kartusche (4) und des Herstellens des Durchmessers des zylinderförmigen und/oder bzw. konischen Teils der Nadel (8) in Abhängigkeit von dem gemessenen einen oder bzw. den gemessenen mehreren Durchmessern des zylinderförmigen

gen und/oder bzw. konischen Teils der Kartusche (4) aufweist.

3. Verfahren nach einem der vorhergehenden Ansprüche, das einen Schritt des Herstellens eines zylinderförmigen Teils (40) an einer Nadelspitze (13), das mit einer Kartuschenspitze (9) an der Kartuschenöffnung (11) zusammen als eine Einspritzdüse wirkt, aufweist, wobei der zylinderförmige Teil (40) aus der Kartuschenvertiefung (10) herausragt und einen Durchmesser (F_X) aufweist, der eine Funktion eines Durchmessers (X_T) der Kartuschenöffnung (11) ist.

4. Vorrichtung zur Herstellung einer Ventilgruppe (2) gemäß dem Verfahren von Anspruch 1 mit einer Kartusche (4) mit einer Kartuschenvertiefung (10), in der eine jeweilige Nadel (8) in axialer Richtung bewegbar angeordnet ist, wobei die Kartusche (4) und die jeweilige Nadel (8) bei einer geschlossenen Stellung der jeweiligen Nadel (8) einen Fluidstrom durch eine Kartuschenöffnung (11) verhindern und ansonsten den Fluidstrom durch die Kartuschenöffnung (11) ermöglichen, wobei die Vorrichtung zu Folgendem betreibbar ist:

- Herstellen der Kartuschenvertiefung (10) mit einem oder mehreren Durchmessern von mindestens einem zylinderförmigen und/oder mindestens einem konischen Teil der Kartuschenvertiefung (10),
- Herstellen mindestens eines zylinderförmigen und/oder mindestens eines konischen Teils der jeweiligen Nadel (8) für die Kartusche (4) in Abhängigkeit von dem einen oder bzw. den mehreren Durchmessern des zylinderförmigen und/oder bzw. des konischen Teils der Kartuschenvertiefung (10),
- Verbauen der Kartusche (4) und der jeweiligen Nadel (8).

Revendications

1. Procédé pour la fabrication d'un groupe de soupapes (2) ayant une cartouche (4) avec un renforcement de cartouche (10) dans lequel une aiguille (8) est disposée de manière à pouvoir être déplacée dans une direction axiale, la cartouche (4) et l'aiguille (8) empêchant un écoulement de fluide à travers une ouverture de cartouche (11) dans une position fermée de l'aiguille (8) et dans le cas contraire, permettant l'écoulement de fluide à travers l'ouverture de cartouche (11), le procédé comprenant les étapes suivantes :

- fabrication du renforcement de cartouche (10) ayant un ou plusieurs diamètres d'au moins une

partie cylindrique et/ou d'au moins une partie conique du renforcement de cartouche (10),
 - fabrication d'au moins une partie cylindrique et/ou d'au moins une partie conique de l'aiguille (8) respective pour la cartouche (4) en fonction du ou, respectivement des diamètres de la partie cylindrique et/ou, respectivement, de la partie conique du renforcement de cartouche (10),
 - assemblage de la cartouche (4) et de l'aiguille (8) respective,

5

10

le procédé étant **caractérisé en ce qu'il** comprend une étape de fabrication simultanée de la cartouche (4) et de la partie cylindrique et/ou, respectivement, de la partie conique de l'aiguille (8), les outils de fabrication de la partie cylindrique et/ou, respectivement, des parties coniques de la cartouche (4) et, respectivement, de l'aiguille (8) étant accouplés mécaniquement l'un à l'autre de telle sorte que l'outil de fabrication de la partie cylindrique et/ou, respectivement, de la partie conique de l'aiguille (8) suive l'outil de fabrication de la cartouche (4).

15

20

2. Procédé selon la revendication 1, comprenant une étape de mesure du ou, respectivement des, diamètres de la partie cylindrique et/ou, respectivement, de la partie conique de la cartouche (4) et de fabrication du diamètre de la partie cylindrique et/ou, respectivement, de la partie conique de l'aiguille (8) en fonction du ou, respectivement, des diamètres mesurés de la partie cylindrique et/ou, respectivement, de la partie conique de la cartouche (4).

25

30

3. Procédé selon l'une des revendications précédentes, comprenant une étape de fabrication d'une partie cylindrique (40) au niveau d'une pointe d'aiguille (13) qui coopère en tant que buse d'injection avec une pointe de cartouche (9) au niveau de l'ouverture de cartouche (11), la partie cylindrique (40) dépassant du renforcement de cartouche (10) et ayant un diamètre (F_X) qui est fonction d'un diamètre (X_T) de l'ouverture de cartouche (11).

35

40

4. Appareil de fabrication d'un groupe de soupapes (2) selon le procédé de la revendication 1, ayant une cartouche (4) avec un renforcement de cartouche (10) dans lequel une aiguille (8) respective est disposée de manière à pouvoir être déplacée dans la direction axiale, la cartouche (4) et l'aiguille (8) respective empêchant un écoulement de fluide à travers une ouverture de cartouche (11) dans une position fermée de l'aiguille (8) respective, et dans le cas contraire, permettant l'écoulement de fluide à travers l'ouverture de cartouche (11), l'appareil étant apte à :

45

50

55

- fabriquer le renforcement de cartouche (10) ayant un ou plusieurs diamètres d'au moins une partie cylindrique et/ou d'au moins une partie

conique du renforcement de cartouche (10),
 - fabriquer au moins une partie cylindrique et/ou au moins une partie conique de l'aiguille (8) respective pour la cartouche (4) en fonction du ou, respectivement, des diamètres de la partie cylindrique et/ou respectivement, de la partie conique du renforcement de cartouche (10),
 - assembler la cartouche (4) et l'aiguille (8) respective.

FIG 1

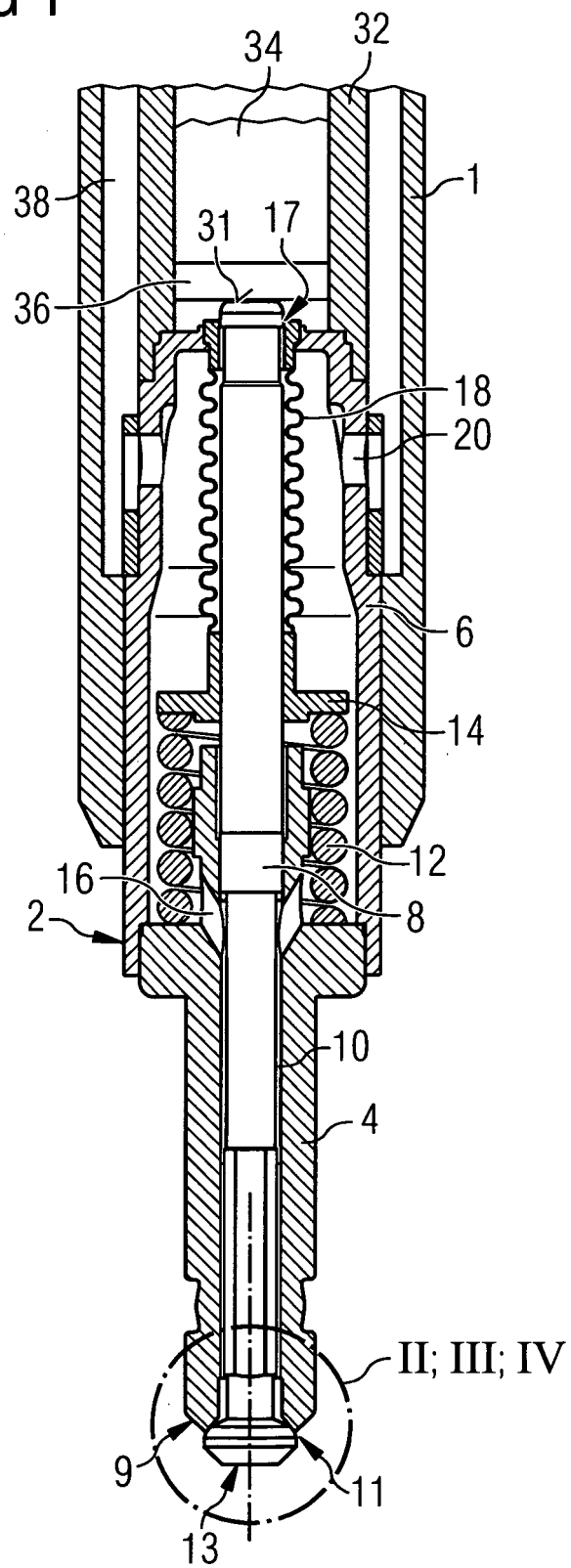


FIG 2

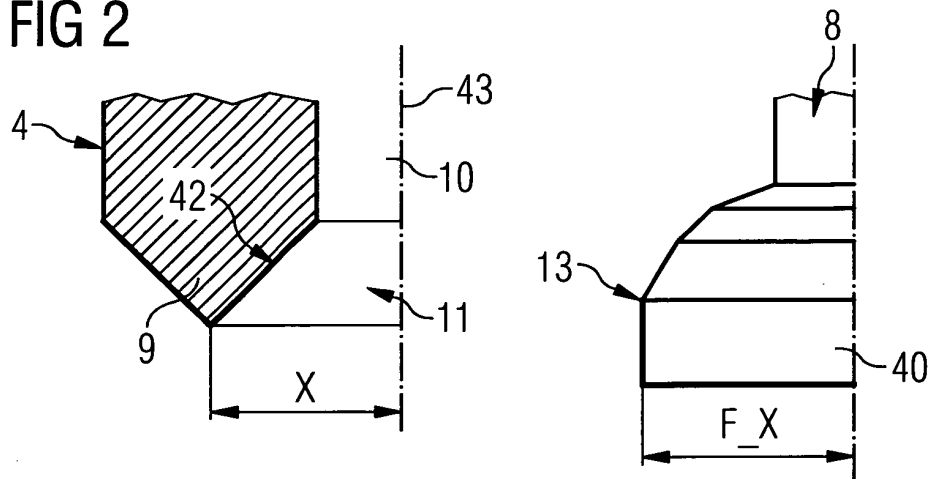


FIG 3

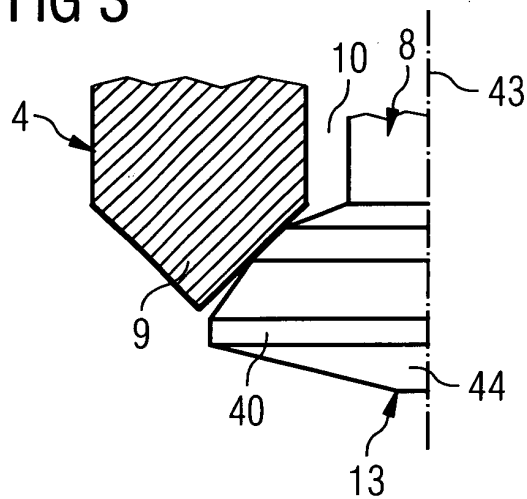


FIG 4

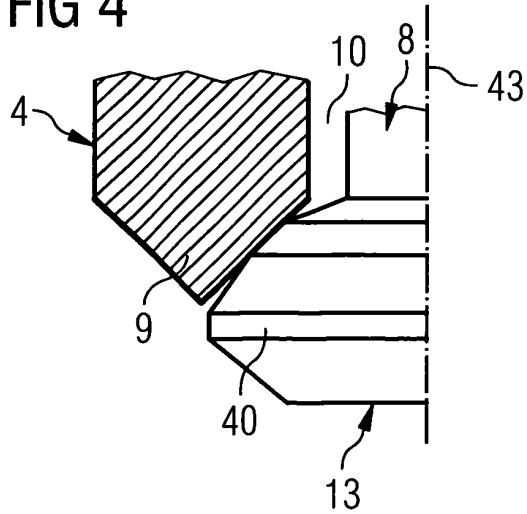


FIG 5

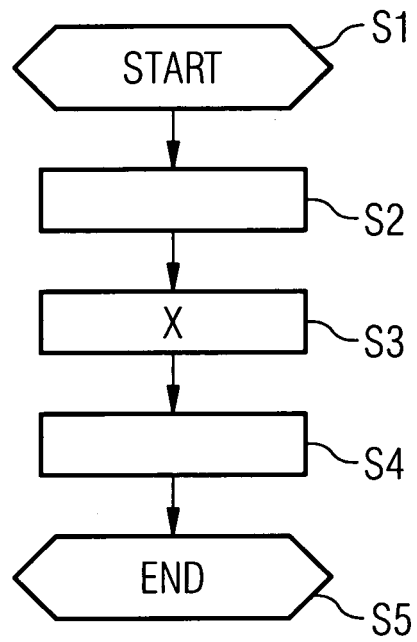
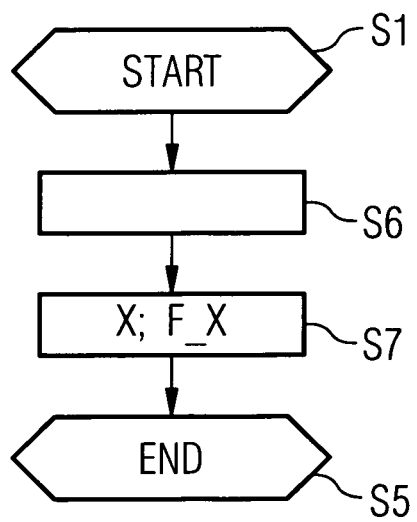


FIG 6



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

- EP 0282463 A [0002]
- DE 19907678 A1 [0002]
- EP 0282463 A1 [0003]