



(11)

EP 3 385 533 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
29.07.2020 Bulletin 2020/31

(51) Int Cl.:
F02M 59/36 ^(2006.01)

(21) Application number: **18165539.0**

(22) Date of filing: **03.04.2018**

(54) **PIEZO CONTROLLED INLET VALVE**

PIEZOGESTEUEERTES EINLASSVENTIL

SOUPAPE D'ADMISSION À COMMANDE PIÉZOÉLECTRIQUE

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

(30) Priority: **04.04.2017 GB 201705399**

(43) Date of publication of application:
10.10.2018 Bulletin 2018/41

(73) Proprietor: **Delphi Technologies IP Limited
Saint Michael (BB)**

(72) Inventors:
• **MACLANE, Stephen, Joseph
Gillingham, Kent ME8 0RU (GB)**

• **HUTCHINS, Stephen
Gillingham, Kent ME8 0RU (GB)**

(74) Representative: **Delphi France SAS
c/o Delphi Technologies
Campus Saint Christophe
Bâtiment Galilée 2
10, avenue de l'Entreprise
95863 Cergy Pontoise Cedex (FR)**

(56) References cited:
**DE-A1-102008 018 018 DE-A1-102012 210 087
DE-A1-102012 218 552**

EP 3 385 533 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

TECHNICAL FIELD

[0001] The present invention relates to an inlet valve assembly of a high pressure fuel pump, said assembly having a piezo-controlled direct acting valve member.

BACKGROUND OF THE INVENTION

[0002] A direct injection equipment comprises a high pressure pump in which fuel received from a low pressure tank is pressurised prior to be delivered to a common rail and to injectors. The fuel in pressurised in a compression chamber which inlet is controlled by an inlet valve member that opens or closes under the influence of pressure difference between the upstream inlet conduit and said downstream compression chamber. Digital inlet valve (DIV) are added to limit the fuel entry in the compression chamber to the necessary volume demanded to be pressurised by the engine. A solenoid actuator may be added so that a magnetic armature cooperates with the valve member either to fully control the operation of the valve member or simply to speed-up the opening or to retard the closing, the valve member remaining generally passive. Such electro-valve, as disclosed in DE102012218552A1, are structurally large, complex and difficult to pilot.

SUMMARY OF THE INVENTION

[0003] Accordingly, it is an object of the present invention to resolve the above mentioned problems in providing a pumping head of a fuel injection equipment high pressure pump, said pumping head comprising a body provided with a main bore extending along a main axis from a lower opening to an upper end partially defining a compression chamber wherein are arranged an outlet opening and an inlet opening forming an axial guiding bore extending through said body from a seat face surrounding the inlet opening in the bore to a top face of the body.

[0004] Advantageously, the pumping head further comprises an inlet valve assembly controlling said inlet opening comprising an inlet valve body fixed atop the pumping head body thus defining an inner space, an inlet valve member having a head member defining a closing face cooperating with said seat face and, a stem member axially guided in said guiding bore and extending from said head member to an upper end protruding in said inner space and, a piezoceramic actuator fixed in said body and to said stem upper end.

[0005] Also, said piezoceramic actuator is a disc-like member provided with a central orifice, the outer edge of said disc-like member being fixed in the inlet valve body and, the stem upper end being fixed into the central orifice, so that when energized the disc deforms and centrally balloons, the outer edge of the disc remaining

pinched.

[0006] The pumping head further comprises a stem upper end cap member arranged atop the stem upper end and inside the central orifice of the piezoceramic member. It also comprises a flexible sealing membrane arranged in the inlet body inner space and preventing, in use, fuel to contact the piezoceramic disc.

[0007] Also, said membrane has an outer edge pinched between a face of the inlet valve body and the outer edge of the piezoceramic disc and, a central opening pinched between the stem upper end cap member and the piezoceramic disc.

[0008] Also, the inlet valve body comprises an annular member fixed on the pumping head body and defining the peripheral wall of the inner space and, a valve body cap member fixed on said annular member and closing said inner space.

[0009] Also, the disc membrane is arranged so its outer edge is against a top annular face of the annular member and the outer edge of said piezoceramic disc-like member, the valve body cap member covering the piezoceramic disc and being firmly tightened to the body annular member, thus pinching the piezoceramic disc and the membrane between the cover and the annular body member.

[0010] The pumping head further comprises electrical wires connected to the piezoceramic disc and extending outside the inlet valve body so that, in use, command signals may be sent from a command unit to said piezoceramic actuator.

[0011] The invention also extends to a high pressure fuel pump comprising a cambox and a pumping head as described above and wherein, in use, a camshaft rotates in the cambox imparting reciprocal displacements to a plunger guided in the main bore and varying the volume of the compression chamber.

[0012] It also extend to a fuel injection equipment comprising a high pressure pump as here above mentioned and a command unit connected to the inlet valve piezoceramic disc and adapted to send command signal for operating the inlet valve member.

[0013] The invention also extends to a method of controlling such fuel injection equipment, the method comprising the step of:

- energizing the piezoceramic disc so that the piezoceramic disc deforms forcing the inlet valve member to open.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The present invention is now described by way of example with reference to the accompanying drawing in which figure 1 is an axial section of a pumping head of a HP pump as per the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] A fuel injection equipment comprises a high pressure pump 10 that receives fuel at low pressure, pressurises it and delivers it to a common rail. The pump 10 has a pumping head 12 fixed on a cambox, not shown, the head 12 having a body 14 provided with a blind bore 16 which extends along a pumping axis X and in which, in use, reciprocates a plunger, not shown, that cooperates with a camshaft rotating in the cambox. Said bore 16 is open at a lower end of the head 12 to enable the plunger to extend in the cambox and, at the upper blind end, said bore 16 partially defines a compression chamber 18 in which radially opens an outlet channel 20 controlled by an outlet check valve 22 and, axially opens an inlet valve guiding bore 24 controlled by an inlet valve assembly 26. In the example embodiment of the figure, the inlet valve guiding bore 24 is coaxial to the bore 16 and it upwardly extends from a lower end opening in the blind end of the bore 16, said lower opening being surrounded by a seat face 28 defined on said end face of the bore to, an upper end opening on a top face 30 of the head body. From said pumping head top face 30 upwardly protrudes a cylindrical wall 32 having a right-angled triangle wall section defining an cylindrical outer face 34 and, a frustoconical inner face 36 downwardly pointing toward the head body 14, said cylindrical wall 32 axially extending about the pumping axis X. The pumping head top face 30 further comprises a conical member 38 axially upwardly protruding in the middle of said cylindrical wall 32, the inlet valve guiding bore 24 axially extending in said conical member 38 and opening at the top of it. The pumping head body 14 is further provided with a fuel inlet channel 40 drilled in said conical member 38 and extending from the top face 30 of the pumping head, in an area close to the base of said conical member 38, to an annular chamber defined in the inlet valve guiding bore 24 above said seat face 28.

[0016] The inlet valve assembly 26 has a body 42 comprising a main member 44 and a cap member 46, said main member 44 having a base 48, fixed on the top face 30 of the pumping head body and, an annular tubular portion 50 axially protruding from said base 48 and adjusted onto the outer face 34 of the cylindrical wall. Said tubular portion 40 is covered by the cap member 46 having a transverse wall 52 closing the inlet body tubular portion 50 and a peripheral wall 54 internally threaded and complementary engaged and tightened onto a male thread provided on the outer face of the inlet body tubular portion 50. As visible on the figure, the inlet valve body 42 and the top face 30 of the pumping head together define an inner space S in which opens the inlet valve guiding bore 24 and the fuel inlet channel 40.

[0017] Said inlet valve assembly 26 further comprises a poppet inlet valve member 56 having a stem 58 axially guided in the guiding bore 24 and extending between an upper end 60 protruding in the inner space S and a lower end protruding in the compression chamber 18, said low-

er end enlarging to form a head member 62 defining a closing face adapted to cooperate with the seat face 28 to seal said blind end of the bore.

[0018] The upper end 60 of the stem is covered by a cap member 46 defining a closed cylindrical portion 66 wherein said stem upper end 60 is inserted and, a crimping annular member 68 enabling to crimp said cap member 46 on the stem. The stem upper end 60 covered by said closed portion 66 of the cap are inserted in an orifice 70 centrally provided in a disc-like piezoceramic member 72 that transversally extends parallel to the transverse wall 52 of the cap toward an outer circular edge 74 that is between said body cap member 46 and the inlet body tubular portion 50. Moreover, a sealing flexible membrane 76 adapted to prevent fuel contact to the piezoceramic disc 72 is arranged in the inner space S, lying against the under face of said disc member 72, the membrane 76 having a peripheral area sandwiched between the disc member 72 and the inlet body tubular portion 50. Centrally, the membrane 76 is holed and fixed to the crimping annular member 68.

[0019] Not shown, the pumping head 12 and the inlet valve assembly 26 further comprise a fuel inlet conduit opening in the inner space S and enabling, in use, fuel to flow from a low pressure tank and to fill said inner space S and, electrical connection means, such as cables, wires and connectors, enabling to electrically connect said piezoceramic disc member 72 to an external command unit that will deliver relevant electrical command signals.

[0020] The operation of said pumping head 12 is now described focusing mainly on the moves of the inlet valve member.

[0021] In a first step the piezoceramic disc 72 is not energised, it does not receive electrical signals, and it remains in a neutral planar position. In said neutral position the inlet valve member is upwardly pulled sealing the fluid communication between the inlet channel and the compression chamber 18.

[0022] In a subsequent second step, the piezoceramic disc 72 is energized and, upon receiving such electrical signal, the disc deforms and centrally balloons, the outer edge 74 of the disc remaining pinched. As the disc 72 balloons, the disc central area downwardly moves pushing the inlet valve member 56 in an open position where the closing face of the head lifts away from the seat face 28 of the bore, enabling fuel passage in and out the compression chamber.

[0023] Thanks to said piezoceramic actuation of the inlet valve member, the opening and closing of the inlet is directly controlled, therefore, the inlet valve member can be opened or closed, earlier or later than it would naturally do under the sole influence of the pressure differences in the inner space S and in the compression chamber 18, this to optimise the filling of the compression chamber to the necessary quantity demanded by an engine.

LIST OF REFERENCES

[0024]

X	pumping axis	5
S	inner space	
10	high pressure pump	
12	pumping head	
14	body of the pumping head	10
16	bore	
18	compression chamber	
20	outlet channel	
22	outlet valve	
24	inlet valve guiding bore	15
26	inlet valve assembly	
28	seat face	
30	top face of the pumping head	
32	cylindrical wall	
34	outer face	20
36	inner face	
38	conical member	
40	inlet channel	
42	inlet valve body	
44	main member of the inlet valve body	25
46	body cap member	
48	body base of the main member	
50	body tubular portion	
52	transverse wall of the cap	
54	peripheral wall of the cap	30
56	inlet valve member	
58	stem	
60	upper end of the stem	
62	inlet valve head	
64	cap member	35
66	closed portion	
68	crimping annular member	
70	orifice	
72	piezoceramic disc	
74	outer edge	40
76	membrane	

Claims

1. Pumping head (12) of a fuel injection equipment high pressure pump (10), said pumping head (12) comprising a body (14) provided with a main bore (16) extending along a main axis (X) from a lower opening to an upper end partially defining a compression chamber (18) wherein are arranged an outlet opening and an inlet opening forming an axial guiding bore (24) extending through said body (14) from a seat face (28) surrounding the inlet opening in the bore to a top face (30) of the body and wherein, the pumping head (12) further comprising an inlet valve assembly (26) controlling said inlet opening and comprising an inlet valve body (42) fixed atop

the pumping head body thus defining an inner space (S), an inlet valve member (56) having a head member (62) defining a closing face cooperating with said seat face (28) and, a stem member (58) axially guided in said guiding bore (24) and extending from said head member (62) to an upper end (60) protruding in said inner space (S) and, a piezoceramic actuator (72) fixed in said body (42) and to said stem upper end (60), **characterized in that** said piezoceramic actuator (72) is a disc-like member provided with a central orifice (70), the outer edge (74) of said disc-like member being fixed in the inlet valve body (42) and, the stem upper end (60) being fixed into the central orifice (70) so that when energized the disc deforms and centrally balloons, the outer edge (74) of the disc remaining pinched.

2. Pumping head (12) as claimed in claim 1 further comprising a stem upper end cap member (64) arranged atop the stem upper end (60) and inside the central orifice (70) of the piezoceramic member.
3. Pumping head (12) as claimed in claim 2 further comprising a flexible sealing membrane (76) arranged in the inlet body inner space (S) and preventing, in use, fuel to contact the piezoceramic disc (72).
4. Pumping head (12) as claimed in claim 3 wherein said membrane (76) has an outer edge pinched between a face of the inlet valve body (42) and the outer edge of the piezoceramic disc (72) and, a central opening pinched between the stem upper end cap member (64) and the piezoceramic disc (72).
5. Pumping head (12) as claimed in any one of the preceding claims wherein the inlet valve body (42) comprises an annular member (44) fixed on the pumping head body and defining the peripheral wall of the inner space (S) and, a valve body cap member (46) fixed on said annular member (44) and closing said inner space (S).
6. Pumping head (12) as claimed in the combination of claims 4 and 5 wherein the disc membrane (76) is arranged so its outer edge is against a top annular face of the annular member (44) and the outer edge of said piezoceramic disc-like member (72), the valve body cap member (46) covering the piezoceramic disc (72) and being firmly tightened to the body annular member (44), thus pinching the piezoceramic disc and the membrane between the cover and the annular body member.
7. Pumping head (12) as claimed in any one of the preceding claims further comprising electrical wires connected to the piezoceramic disc (72) and extending outside the inlet valve body (42) so that, in use, command signals may be sent from a command unit

to said piezoceramic actuator.

8. High pressure fuel pump (10) comprising a cambox and a pumping head (12) as claimed in any of the preceding claims and wherein, in use, a camshaft rotates in the cambox imparting reciprocal displacements to a plunger guided in the main bore (16) and varying the volume of the compression chamber (18).
9. Fuel injection equipment comprising a high pressure pump (10) as claimed in claim 8 and a command unit connected to the inlet valve piezoceramic disc (72) and adapted to send command signal for operating the inlet valve member (56).
10. Method of controlling a fuel injection equipment as claimed in claim 9, the method comprising the step of:
 - energizing the piezoceramic disc (72) so that the piezoceramic disc deforms forcing the inlet valve member (56) to open.

Patentansprüche

1. Pumpkopf (12) einer Hochdruckpumpe (10) einer Kraftstoffeinspritzvorrichtung, wobei der Pumpkopf (12) einen Körper (14) aufweist, der mit einer Hauptbohrung (16) vorgesehen ist, die sich entlang einer Hauptachse (X) von einer unteren Öffnung zu einem oberen Ende erstreckt, teilweise eine Kompressionskammer (18) definierend, in der eine Auslassöffnung und eine Einlassöffnung angeordnet sind, die eine axiale Führungsbohrung (24) bilden, die sich durch den Körper (14) von einer Sitzfläche (28), die die Einlassöffnung in der Bohrung umgibt, zu einer Oberseite (30) des Körpers erstreckt, und wobei der Pumpkopf (12) weiter aufweist eine Einlassventilanordnung (26), die die Einlassöffnung steuert und einen Einlassventilkörper (42) aufweist, der auf dem Körper des Pumpkopfs befestigt ist, wodurch ein Innenraum (S) definiert wird, ein Einlassventilelement (56) mit einem Kopfelement (62), das eine mit der Sitzfläche (28) zusammenwirkende Schließfläche definiert, und ein Schaftelement (58), das in der Führungsbohrung (24) axial geführt ist und sich von dem Kopfelement (62) zu einem oberen Ende (60) erstreckt, in den Innenraum (S) hineinragend, und einen piezokeramischen Aktuator (72), der in dem Körper (42) und an dem oberen Ende (60) des Schafts befestigt ist, **dadurch gekennzeichnet, dass** der piezokeramische Aktuator (72) ein scheibenartiges Element ist, das mit einer zentralen Öffnung (70) vorgesehen ist, wobei der Außenrand (74) des scheibenartigen Elements in dem Einlassventilkörper (42) befestigt ist und das obere Ende (60) des

Schafts in der zentralen Öffnung (70) befestigt ist, so dass sich bei einem Zuführen von Energie die Scheibe verformt und sich zentral ausdehnt, wobei der Außenrand (74) der Scheibe eingeklemmt bleibt.

2. Pumpkopf (12) gemäß Anspruch 1, der weiter ein Kappenelement (64) des oberen Endes des Schafts aufweist, das auf dem oberen Ende (60) des Schafts und innerhalb der zentralen Öffnung (70) des piezokeramischen Elements angeordnet ist.
3. Pumpkopf (12) gemäß Anspruch 2, der weiter eine flexible Dichtungsmembran (76) aufweist, die in dem Innenraum (S) des Einlasskörpers angeordnet ist und bei Verwendung verhindert, dass Kraftstoff die piezokeramische Scheibe (72) kontaktiert.
4. Pumpkopf (12) gemäß Anspruch 3, wobei die Membran (76) einen Außenrand hat, der zwischen einer Fläche des Einlassventilkörpers (42) und dem Außenrand der piezokeramischen Scheibe (72) eingeklemmt ist, und zentrale Öffnung, die zwischen dem Kappenelement (64) des oberen Endes des Schafts und der piezokeramischen Scheibe (72) eingeklemmt ist.
5. Pumpkopf (12) gemäß einem der vorhergehenden Ansprüche, wobei der Einlassventilkörper (42) ein ringförmiges Element (44) aufweist, das an dem Körper des Pumpkopfs befestigt ist und die Umfangswand des Innenraums (S) definiert, und ein Ventilkörperkappenelement (46), das an dem ringförmigen Element (44) befestigt ist und den Innenraum (S) schließt.
6. Pumpkopf (12) gemäß der Kombination der Ansprüche 4 und 5, wobei die Scheibenmembran (76) so angeordnet ist, dass ihr Außenrand gegen eine obere ringförmige Fläche des Ringelements (44) und den Außenrand des piezokeramischen, scheibenartigen Elements (72) liegt, wobei das Ventilkörperkappenelement (46) die piezokeramische Scheibe (72) bedeckt und fest mit dem ringförmigen Körperelement (44) befestigt ist, wodurch die piezokeramische Scheibe und die Membran zwischen der Abdeckung und dem ringförmigen Körperelement eingeklemmt sind.
7. Pumpkopf (12) gemäß einem der vorhergehenden Ansprüche, der weiter elektrische Drähte aufweist, die mit der piezokeramischen Scheibe (72) verbunden sind und sich außerhalb des Einlassventilkörpers (42) erstrecken, so dass bei Verwendung Befehlssignale von einer Befehlseinheit an den piezokeramischen Aktuator gesendet werden können.
8. Hochdruckkraftstoffpumpe (10), die eine Nockenbox und einen Pumpkopf (12) gemäß einem der vorher-

gehenden Ansprüche aufweist, und wobei bei Verwendung eine Nockenwelle in der Nockenbox rotiert, um Hin- und Her-Verschiebungen auf einen Kolben auszuüben, der in der Hauptbohrung (16) geführt wird, und das Volumen der Kompressionskammer (18) zu variieren.

9. Kraftstoffeinspritzvorrichtung, die eine Hochdruckpumpe (10) gemäß Anspruch 8 und eine Befehls-einheit aufweist, die mit der piezokeramischen Scheibe (72) des Einlassventils verbunden ist und ausgebildet ist zum Senden eines Befehlssignals zum Betreiben des Einlassventilelements (56).

10. Verfahren zum Steuern einer Kraftstoffeinspritzvorrichtung gemäß Anspruch 9, wobei das Verfahren den Schritt aufweist:

- Zuführen von Energie zu der piezokeramischen Scheibe (72), so dass sich die piezokeramische Scheibe verformt und das Einlassventilelement (56) zum Öffnen zwingt.

Revendications

1. Tête de pompage (12) d'une pompe à haute pression d'un équipement d'injection de carburant (10), ladite tête de pompage (12) comprenant un corps (14) doté d'un perçage principal (16) s'étendant le long d'un axe principal (X) depuis une ouverture inférieure jusqu'à une extrémité supérieure définissant partiellement une chambre de compression (18), dans laquelle sont agencées une ouverture d'échappement et une ouverture d'admission formant un perçage de guidage axial (24) s'étendant à travers ledit corps (14) depuis une face de siège (28) entourant l'ouverture d'admission dans le perçage jusqu'à une face supérieure (30) du corps et dans laquelle la tête de pompage (12) comprend en outre un assemblage de soupape d'admission (26) commandant ladite ouverture d'admission et comprenant un corps de soupape d'admission (42) fixé au sommet du corps de tête de pompage définissant ainsi un espace intérieur (S), un élément de soupape d'admission (56) ayant un élément de tête (62) définissant une face de fermeture coopérant avec ladite face de siège (28) et un élément de tige (58) guidé axialement dans ledit perçage de guidage (24) et s'étendant depuis ledit élément de tête (62) jusqu'à une extrémité supérieure (60) se projetant dans ledit espace intérieur (S), et un actionneur piézocéramique (72) fixé audit corps (42) et à ladite extrémité supérieure de tige (60),
caractérisée en ce que
ledit actionneur piézocéramique (72) est un élément similaire à un disque avec un orifice central (70), le bord extérieur (74) dudit élément similaire à un dis-

que étant fixé dans le corps de soupape d'admission (42) et l'extrémité supérieure de tige (60) étant fixée jusque dans l'orifice central (70) de sorte que, quand il est actionné, le disque se déforme et gonfle centralement, le bord extérieur (74) du disque restant pincé.

2. Tête de pompage (12) selon la revendication 1, comprenant en outre un élément de capuchon d'extrémité supérieure de tige (64) agencé au sommet de l'extrémité supérieure de tige (60) et à l'intérieur de l'orifice central (70) de l'élément piézocéramique.

3. Tête de pompage (12) selon la revendication 2, comprenant en outre une membrane d'étanchéité flexible (76) agencée dans l'espace intérieur de corps d'admission (S) et empêchant, en utilisation, un carburant d'entrer en contact avec le disque piézocéramique (72).

4. Tête de pompage (12) selon la revendication 3, dans laquelle ladite membrane (76) a un bord extérieur pincé entre une face du corps de soupape d'admission (42) et le bord extérieur du disque piézocéramique (72), et une ouverture centrale pincée entre l'élément de capuchon d'extrémité supérieure de tige (64) et le disque piézocéramique (72).

5. Tête de pompage (12) selon l'une quelconque des revendications précédentes, dans laquelle le corps de soupape d'admission (42) comprend un élément annulaire (44) fixé sur le corps de tête de pompage et définissant la paroi périphérique de l'espace intérieur (S), et un élément de capuchon de corps de soupape (46) fixé sur ledit élément annulaire (44) et fermant ledit espace intérieur (S).

6. Tête de pompage (12) selon la revendication 4 combinée à la revendication 5, dans laquelle la membrane de disque (76) est agencée de sorte que son bord extérieur est contre une face annulaire supérieure de l'élément annulaire (44) et le bord extérieur dudit élément similaire un disque piézocéramique (72), l'élément de capuchon de corps de soupape (46) couvrant le disque piézocéramique (72) et étant fermement serré à l'élément annulaire de corps (44), pinçant ainsi le disque piézocéramique et la membrane entre la couverture et l'élément de corps annulaire.

7. Tête de pompage (12) selon l'une quelconque des revendications précédentes, comprenant en outre des fils électriques connectés au disque piézocéramique (72) et s'étendant à l'extérieur du corps de soupape d'admission (42) de sorte que, en utilisation, des signaux de commande peuvent être envoyés depuis une unité de commande audit actionneur piézocéramique.

8. Pompe à carburant à haute pression (10) comprenant un carter à came et une tête de pompage (12) selon l'une quelconque des revendications précédentes, et dans laquelle, en utilisation, un arbre à came tourne dans le carter à came, imposant des déplacements de va-et-vient à un piston guidé dans le perçage principal (16) et faisant varier le volume de la chambre de compression (18). 5
9. Équipement d'injection de carburant comprenant une pompe à haute pression (10) selon la revendication 8 et une unité de commande connectée au disque piézocéramique de soupape d'admission (72) et adaptée pour envoyer un signal de commande pour faire fonctionner l'élément de soupape d'admission (56). 10 15
10. Procédé de commande d'un équipement d'injection de carburant selon la revendication 9, le procédé comprenant l'étape consistant à : 20
- exciter le disque piézocéramique (72) de sorte que le disque piézocéramique se déforme en forçant l'élément de soupape d'admission (56) à s'ouvrir. 25

30

35

40

45

50

55

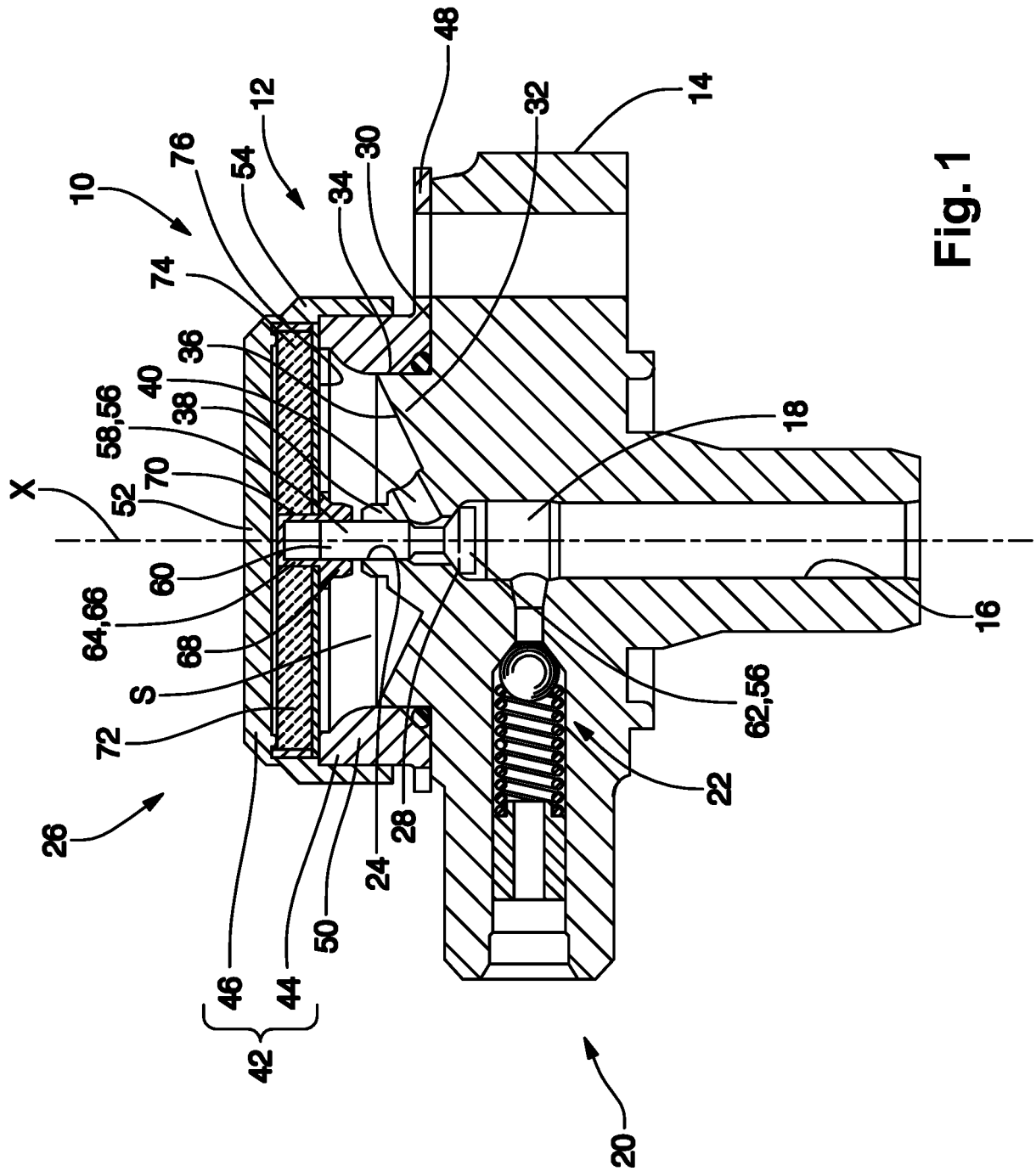


Fig. 1

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 102012218552 A1 [0002]