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

(11) EP 1 467 088 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.10.2004 Bulletin 2004/42

(51) Int Cl.7: F02M 61/20, F02M 51/06

(21) Application number: 03008497.4

(22) Date of filing: 11.04.2003

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

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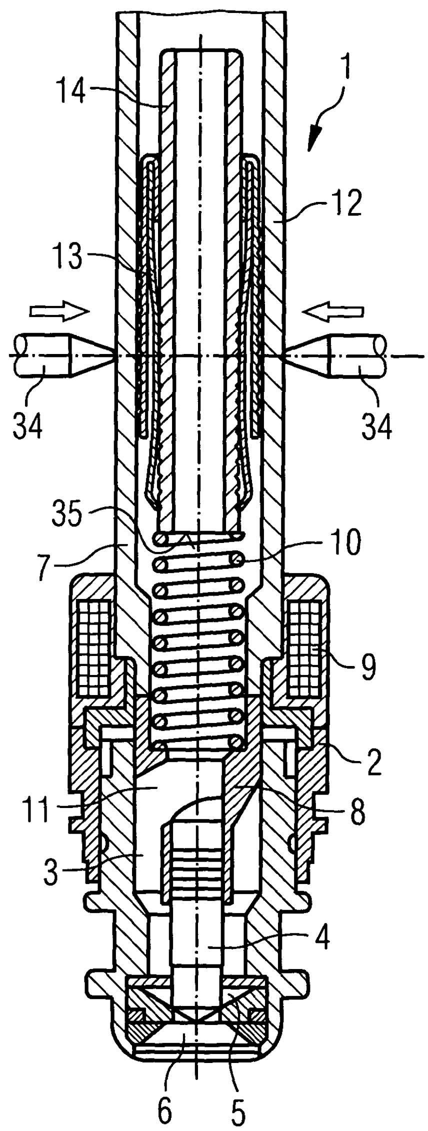
(54) Injection valve with a spring pretension adjusting tube

(57) The invention describes an injection valve (1) with a valve closing element (4) that is biased by a spring (10) against a valve seat (5). The spring (10) is preloaded by an adjusting tube (14) that is arranged within an inlet tube (7) and connected to the inlet tube (7). The invention proposes a retaining element (12,13) that is fixed with the inlet tube (7) and that retains the adjusting tube (14). The retaining element (12,13) blocks a movement of the adjusting tube (14) of the spring (10) and enables an incremental movement of the adjusting tube (14) towards the spring (10). The injection valve (1) shows the advantage that the tension of the spring (10) can be precisely adjusted.

FIG 1



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Description

[0001] The invention relates to an injection valve with a closing member that is dedicated to a valve seat. The closing member is stressed towards the valve seat by means of a spring. The spring abuts on an adjusting tube that is used for adjusting the preload of the spring. For a precise function of the injection valve, the spring has to push the valve closing element towards the valve seat with a predetermined preload. For adjusting the preload of the spring, the adjusting tube is pushed closer to the closing element until a favored function of the injection valve is achieved. At this position the adjusting tube is fixed. After fixing the adjusting tube, the function of the injection valve is ascertained again. If the injection function of the injection valve deviates from a desired function, the injection valve cannot be used since the preload of the spring cannot be adjusted to attain the desired function of the injection valve. The faulty injection valve has to be separated out.

[0002] US Patent 5,967,419 describes a fuel injector with a valve, with a valve seat, with a valve closing element that is dedicated to the valve seat. The valve closing element is connected to an armature. The armature is preloaded towards the valve seat by means of a spring. The spring is arranged in a tube adjacent to a spring pin that is arranged within the tube, as well. The spring pin is press-fit within the tube. The spring normally biases the armature in a closing direction of the valve.

[0003] The object of the invention is to provide an injection valve and a method for adjusting a pretension of a spring to a closing member that allows a changing of the pretension of the spring in a simple way.

[0004] The task of the invention is solved by an injection valve according to claim 1 and by a method for adjusting the injection valve according to claim 11.

[0005] The injection valve according to claim 1 has the advantage that the adjusting tube could be easily moved closer to the spring raising the pretension of the spring that is carried forward to the closing element. This feature has the advantage that the pretension of the spring can easily be raised, if necessary.

[0006] Further preferred embodiments of the invention are disclosed in the dependent claims.

[0007] In a preferred embodiment of the invention the retaining element comprises a holding tube and a retaining tube. The holding tube is fixed to the inlet tube and the retaining tube is arranged between the holding tube and the adjusting tube. The retaining tube is fixed to the holding tube and connected with the adjusting tube enabling a unidirectional incremental movement of the adjusting tube towards the spring. This embodiment of the retaining element has the advantage that it is composed of simple parts that are inexpensive in production.

[0008] In another preferred embodiment of the invention the retaining tube is fixed with one end to the holding tube and the other end of the retaining tube comprises a flange that at least partly engages into a groove of the adjusting tube.

[0009] Preferably the retaining tube comprises a flange that is bent inwardly to the outer surface of the adjusting tube. The inwardly bent flange is a simple means to retain the adjusting tube.

[0010] In a further developed embodiment, the retaining element comprises a flange that is divided by trenches in several portions that engage into a groove of the adjusting tube. The trenches between the portions of the flange have the advantage that the flange is more flexible and therefore less force is required to push the adjusting tube closer to the spring. Accordingly, the trenches the flange portions could be more easily bent outwards enabling the movement of the adjusting tube towards the spring.

[0011] In a preferred embodiment, the holding tube comprises an upper rim that is inwardly bent in a U-shape. In the annular space of the U-shaped upper rim of the holding tube an upper rim of the retaining tube is arranged. The bent upper rim is a simple construction for retaining the retaining tube at the holding tube.

[0012] In a further developed embodiment of the invention, the retaining tube is inwardly bent alongside providing an annular clearance between the retaining tube and the holding tube. This feature has the advantage that the clearance enables an inward deformation of the holding tube which could be achieved by fixing the holding tube to the inlet tube without damaging the retaining tube. The clearance guarantees a non-constricted function of the retaining tube although the holding tube is inwardly deformed.

[0013] Preferably the adjusting tube comprises at an outer face a recess structure, especially ring shaped grooves. The recess structure improves the retaining between the holding tube and the retaining tube.

[0014] In a preferred embodiment of the invention, the adjusting tube comprises at an outer surface a recess structure that is used to engage with a flange of the retaining tube. The recess structure preferably comprises ring grooves that are disposed perpendicularly to the longitudinal axis of the adjusting tube at given distances. The grooves preferably comprise a lower and an upper side surface. The lower side surface is arranged at the side of the spring and the upper side surface is arranged oppositely. The upper side surface is arranged at an angle to the longitudinal axis of the adjusting tube that is smaller than the angle of the lower side surface. Preferably the lower side surface is arranged perpendicularly to the longitudinal axis of the adjusting tube. The different angles of the lower and the upper side surface constrict a movement of the adjusting tube off the spring and enable a movement of the adjusting tube towards the spring with low forces.

[0015] In a further preferred embodiment of the invention, the retaining element comprises a ring element that is fixed to the adjusting tube. The ring element comprises an upper rim that is adjacent to a lower rim of the holding tube. The upper and the lower rim are in the shape of steps. The distance between the holding tube and a supporting surface arranged at a lower end of the adjusting tube depends on the rotational position of the holding tube and the adjusting tube to each other. This embodiment has the advantage that the position of the supporting surface of the adjusting tube that is adjacent to the spring can easily be changed by rotating the adjusting tube compared to the holding tube.

[0016] For an easy rotating of the adjusting tube, it is proposed that the adjusting tube protrude above the holding tube and that the adjusting tube comprise at least one recess at the protruded end for rotating the adjusting tube relative to the holding tube.

[0017] The invention will now be discussed using embodiments that are depicted in the Figures.

[0018] Fig. 1 depicts a sectional view of an injection valve.

[0019] Fig. 2 depicts a sectional view of a detailed representation of the retaining element and the adjusting tube.

[0020] Fig. 3 shows a sectional view of a part of the adjusting tube with the grooves.

[0021] Fig. 4 shows a flange of a retaining tube engaging with the adjusting tube in detail.

[0022] Fig. 5 depicts two adjustment stages of the injection valve.

[0023] Fig. 6 shows different views of the retaining tube, the adjusting tube and the holding tube.

[0024] Fig. 7 shows a second embodiment of the retaining element.

[0025] Fig. 8 shows a sectional and a perspective view of the mounted second holding tube and second adjusting tube.

[0026] Fig. 9 depicts a schematic view of an injection valve with the second adjusting tube and the second holding tube.

[0027] Preferred embodiments of the injection valve according to the present invention will now be described with reference to the drawings.

[0028] Before the embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in this application to the details of construction and the arrangements of the components set fourth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or being carried out in various ways.

[0029] Fig. 1 shows a longitudinal sectional view of an injection valve 1 that could be used for a direct injection in a combustion chamber of a motor vehicle. The injection valve 1 is preferably used for injecting gasoline. The injection valve 1 comprises a valve body 2 in which a fuel chamber 3 is incorporated. Within the fuel chamber 3 a needle 4 is arranged that is fixed to an armature 8 at one end. Another end of the needle comprises a sealing face that is dedicated to a valve seat 5. The valve seat 5 encircles an orifice 6. In a closed position of the injection valve 1, the orifice 6 is closed by the tip of the needle 4 and no fuel is injected from the fuel chamber 3.

[0030] The armature 8 is guided in a guiding section of the valve body 2 which can be moved along the longitudinal axis of the injection valve 1. An upper annular end face of the armature 8 is dedicated to a lower annular end face of an inlet tube 7. The inlet tube 7 is fixed to the valve body 2. Within the inlet tube 7 an adjusting tube 14 is arranged that is retained by a retaining tube 13. The adjusting tube 14 is at least partly surrounded by the retaining tube 13. The retaining tube 13 is fixed to an holding tube 12 that is fixed to the inlet tube 7. The holding tube 12 at least partly surrounds the retaining tube 13. An annular supporting surface at the bottom of the adjusting tube 14 is adjacent to an upper end of a spring 10. The lower end of the spring 10 abuts on a seat of the armature 8. Depending on the position of the adjusting tube 14 the pretension of the spring 10 that preloads the needle 4 to the valve seat 5 is different. The inlet tube 7 is connected to a fuel reservoir that contains fuel under high pressure. The fixing is preferably carried out by a crimping tool 34 that presses on the outer surface of the inlet tube 7, thereby narrowing the inner diameter of the inlet tube 7. This results in a press-fit connection between the holding tube 12 and the inlet tube 7. Fuel is delivered to the fuel chamber 3 via the inlet tube 7, the adjusting tube 14 and a bore 11 that is arranged in the armature 8.

[0031] In the valve body 2 a coil assembly 9 is arranged that is used to move the armature 8 into a closed or into an open position. In a de-energized condition of the coil assembly 9, the armature 8 is pressed downwards by the force of the spring 10, pushing the needle 4 onto the valve seat 5, thereby closing the orifice 6. If fuel should be injected by the injection valve the coil assembly 9 is energized generating a magnetic field that lifts the armature 8 up against the force of the spring 10. The armature 8 becomes attached to the inlet tube 7. At this position the needle 4 is lifted off the valve seat 5 opening the orifice 6. Fuel is injected from the fuel chamber 3 via the orifice 6. The value of the pretension of the spring 10 is a main feature that determines the injection function of the injection valve.

[0032] Fig. 2 shows the retaining element that comprises the holding tube 12 and the retaining tube 13 in greater detail. Preferably, the holding tube 12 comprises a structured region 2 at an outer surface 5. The structured region 25 comprises recesses or grooves that support the press-fit connection between the inlet tube 7 and the holding tube 12.

[0033] The holding tube 12 shows at the upper end a rim 23 that is bent inwardly forming a U-shape in a cross-sectional view. The rim 23 and the outer part of the holding tube 12 form an annular space in which an upper end of the retaining tube 13 is arranged. The upper end of the retaining tube 13 is supported against the bent upper end of the holding tube 12. The rim 23 of the holding tube 12 is adjacent to the adjusting tube 14. The retaining tube 13 extends top down protruding from the holding tube 12. The lower end of the retaining tube 13 comprises a flange 19 that is inwardly bent to an outer surface of the adjusting tube 14. In a preferred embodiment of the retaining tube 13 the retaining tube 13 has along the long side an inwardly bent shape. Therefore a clearance 18 is arranged between the holding tube 12 and the retaining tube 13. The clearance 18 has the advantage that the holding tube 12 could be pressed inwards at a given distance without damaging the retaining tube 13.

[0034] The flange 19 that is directed with its rim onto the surface of the adjusting tube 14 engages with a groove 15 or a recess on the outer surface of the adjusting tube 14.

[0035] Fig. 3 shows in greater detail a cross-sectional view of a part of the adjusting tube 14 with ring shaped grooves 15 that are arranged on the outer surface of the adjusting tube 14. A groove 15 comprises a first and a second side surface 16, 17. The first side surface 16 is preferably arranged perpendicular to the longitudinal axis of the adjusting tube 14. This alignment constricts a movement of the adjusting tube 14 away from the armature 8, because the edge of the flange 19 that engages the groove 15 cannot slide out of the groove 15. The second side surface 17 of the groove 15 is arranged at an angle that is preferably smaller than 90°, preferably 45°, in comparison to the longitudinal axis of the adjusting tube 14. The alignment of the second side surface 17 has the advantage that the adjusting tube 14 could be easily pushed towards the spring 10 because the rim of the flange 19 that engages the groove 15 can easily slide out of the groove 15 on the second side surface 17.

[0036] Fig. 4 shows a cross-sectional view of the bottom of the holding tube 12 and the lower end of the retaining tube 13. The flange 19 of the retaining tube 13 is bent inwardly at an angle of about 100° compared to the upper part of the retaining tube 13. The rim of the flange 19 engages a groove 15.

[0037] Fig. 5 shows on its left side an injection valve 1 with the holding tube 12 that is fixed to the inlet tube 7 at a first step. The position of the holding tube 12 was chosen in such a way that the injection valve delivers a predetermined amount of fuel for an injection. In order to determine the amount of fuel that is injected by the injection valve 1, the holding tube 12 with the retaining tube 13 and the adjusting tube 14 are step by step pushed down the inlet tube 7. At each step the coil assembly 9 is energized. Fuel is delivered via the inlet tube 7, the bore of the adjusting tube 14 along the spring 10 through the bore 11 of the armature 8 in the fuel chamber 3. The amount of fuel that is injected by energizing the coil assembly is checked with a predetermined amount of fuel. If the injected fuel is more than the predetermined amount of fuel then the holding tube 12 with the retaining tube 13 and the adjusting tube 14 is pushed down a further step towards the spring 10 arising the tension of the spring 10. After this step the injection valve is activated again and the injected amount of fuel is assessed and compared with the predetermined amount. If the injected amount of fuel is within the range of the predetermined amount of fuel, the holding tube 12 is fixed to the inlet tube 7. This is done, for example, using crimping tools 34, as shown in Fig. 1, and by an inward deformation of the diameter of the inlet tube 7. A press-fit connection is attained that fixes the holding tube 12 to the inlet tube 7. This condition is shown at the left side of Fig. 5.

[0038] After the fixing of the holding tube 12 the injection valve 1 is activated again and it is checked whether the injected amount of fuel matches the predetermined amount of fuel. If this is the case, the adjusting procedure of the tension of spring 10 is finished.

[0039] If the injected amount of fuel is less than the predetermined amount of fuel then it is necessary to raise the tension of spring 10.

[0040] In order to raise the tension of spring 10, a pushing tube 21 is inserted into the inlet tube 7 abutting on the upper rim of the adjusting tube 14, as shown on the left side of Fig. 5. Now the adjusting tube 14 is pushed down step by step, thereby moving the pushing tube 21. At each step the injection function of the injection valve 1 is assessed. Fuel is delivered into the fuel chamber 3 via an inner bore of the pushing tube 21, the inner bore of the adjusting tube 14, along the spring 10 over the bore 11 of the armature 8. The injection valve 1 is activated energizing the coil assembly 9 for an injection. The injected amount of fuel is compared with the predetermined amount of fuel. The adjusting tube 14 is pushed down until the injected amount of fuel of the injection valve 1 matches the range of the predetermined amount of fuel. This condition is shown in the right-hand figure of Fig. 5. The spring 10 is more compressed at the right side compared to the left side. This means that the tension of the spring 10 is higher causing a higher preload on the needle 4 in the direction of the valve seat 5.

[0041] Fig. 6 shows a preferred embodiment of the retaining tube 13 in two views rotated at 90°. The lower end of the retaining tube 13 comprises trenches 22 that are arranged in parallel to the longitudinal axis of the retaining tube 13. The retaining tube 13 comprises four trenches 22 that are rotated at 90° to each other. The trenches 22 provide a more flexible behavior of the flanges 19 holding the adjusting tube 14. This has the advantage that the adjusting tube 14 could be pushed down with less force because the flange 19 bends more easily outwards.

[0042] The holding tube 12 is shown in a cross-sectional view and in a perspective view. In the cross-sectional view, the U-shaped upper end of the holding tube 12 with the inwardly bent rim 23 is shown. In the perspective view, a structured region 25 on the outer surface of the holding tube 12 is depicted. The structured region 25 comprises grooves or recesses that facilitate the press-fit connection between the inlet tube 7 and the holding tube 12. Fig. 6 also shows a cross-sectional view of the adjusting tube 14 and a perspective view of the adjusting tube 14. In the cross-sectional view it is depicted that the adjusting tube 14 has basically the shape of a sleeve. On the lower end of the adjusting tube 14 a second structured region 26 is arranged on the outer surface of the adjusting tube 14. The second structured region 26 comprises recesses or grooves 15 that support the retaining of the adjusting tube 14 by the retaining tube 13. Preferably, grooves 15 with a ring shape are arranged in the second structured region 26. For mounting the assembly of the holding tube 12, the retaining tube 13 and the adjusting tube 14, the retaining tube 13 is inserted from the bottom up into the holding tube 12 until the upper rim of the holding tube 13 abuts on the inner face of the U-shaped upper end of the holding tube 12. Then, the adjusting tube 14 is inserted from the top down into the holding tube 12 and the retaining tube 13 until the flange 19 of the retaining tube 13 engages with a groove of the second structured region 26 of the adjusting tube 14. This pre-assembled assembly is pushed from the top down into the inlet tube 7, as shown in Fig. 1.

[0043] Fig. 7 shows a second holding tube 29 in a perspective view with a structured region 25. The second holding tube 29 comprises a second ring element 32 as a retaining element. At the bottom, the second ring element comprises a first ring face 30 with a stepped structure. The height of the second ring element 32 decreases step by step along its circumference. Dedicated to the second holding tube 29 a second adjusting tube 27 is shown in Fig. 7. The second adjusting tube 27 comprises at an outer side a ring element 28. The bottom of the ring element 28 encircles the second adjusting tube 27 and comprises at the top a second ring face 31. The second ring face 31 comprises a step-structure changing the height of the ring element 28 along its circumference step by step.

[0044] The shape of the first and the second ring face match so that the second adjusting tube 27 can be inserted from the bottom up and a supporting surface 35 at the bottom of the second adjusting tube 27 is arranged in a plane that is perpendicular to the longitudinal axis of the second holding tube 29.

[0045] At the left side, Fig. 8 depicts a cross-sectional view of the second adjusting tube 27 that is mounted in the second holding tube 29. At the right side a perspective view of the mounted second adjusting tube 27 and the second holding tube 29 is depicted. The second adjusting tube 27 protrudes above the second holding tube 29 and comprises at the upper end a recess 33 that could be used for rotating the second adjusting tube 27.

[0046] Due to the stepped first and second ring face 30, 31 the position of the supporting surface 35 could be lowered towards the spring 10 by rotating the second adjusting tube 27 when the second holding tube 29 is fixed with the inlet tube 7. This situation is shown in Fig. 9 that shows a cross-sectional view of a part of an injection valve 1 using the second adjusting tube 27 and the second holding tube 29 that are used for tensing the spring 10. A first tension of the spring 10 is achieved by pushing the pre-assembled assembly of the second adjusting tube 27 and the second holding tube 29 from the top-down in the inlet tube 7 step by step until a predetermined function of the injection valve 1 in example a predetermined amount of fuel is injected by the injection valve 1 at a given activation of the coil assembly 9.

[0047] If the predetermined function of the injection valve 1 is attained then the second holding tube 29 is fixed to the inlet tube 7. The fixing could be done by crimping tools 39 that lesson the diameter of the inlet tube 7 attaining a press-fit connection between the inlet tube 7 and the second holding tube 29. After this step the function of the injection valve 1 is checked again and if the injected amount of fuel is more than the predetermined amount of fuel then a further step for arising the tension of the spring 10 is proceeded.

[0048] In order to raise the tension of spring 10 a rotating tool is used that is introduced in the recess 33 at the upper end of the second adjusting tube 27. Then the second adjusting tube 27 is rotated. The rotation of the second adjusting tube 27 causes a step by step move down of the supporting surface 35 because of the stepped first and second ring face 30, 31 of the ring element 28 and the second ring element 32. After each step the function of the injection valve 1 is checked and compared with a predetermined function. If the injected amount of fuel of the injection valve matches a predetermined amount of fuel then the rotation of the second adjusting tube 27 is stopped. Now the injection valve 1 shows the desired injection function.

[0049] Instead of the stepped shape, the first and the second ring face could comprise different shapes that enables the supporting surface 35 to move downwards by a rotation of the second adjusting tube 27. For example, slanted ring faces could be used.

Claims

1. Injection valve (1) with a valve closing element (4) that is biased against a valve seat (5) by a spring (10), whereby the spring is preloaded by an adjusting tube (14) that is arranged within a inlet tube (7) and connected to the inlet tube (7),
characterised in that the adjusting tube (14) is retained by a retaining element (12, 13) that is fixed to the inlet tube (7), that the retaining element (12, 13) blocks a movement of the adjusting tube (14) off the spring (10) and that the retaining element (12, 13) enables an incremental movement of the adjusting tube (14) towards the spring (10).

2. Injection valve according claim 1, **characterised in that** the retaining element comprises a holding tube (12) and a retaining tube (13), that the holding tube (12) is fixed to the inlet tube (7), that the retaining

tube (13) is arranged within the holding tube (12), that the adjusting tube (14) is arranged within the retaining tube (13), that the retaining tube (13) is fixed to the holding tube (12) and that the retaining tube (13) is in connection with the adjusting tube (14) enabling a unidirectional incremental movement of the adjusting tube (14) towards the spring (10).

3. Injection valve according claim 2, **characterised in that** the retaining tube (13) is fixed with one end to the holding tube (12), that another end of the retaining tube (13) comprises a flange (19) that engages at least partly with a groove (15) of the adjusting tube (14).

4. Injection valve according claim 2 or 3, **characterised in that** the flange (19) is bent inwardly to the outer surface of the adjusting tube (14).

5. Injection valve according to any one of the claims 2 to 4, **characterised in that** the flange (19) of the retaining tube (13) comprises trenches (22) and that the flange (19) is divided in several portions that engage a groove (15) of the adjusting tube (14).

6. Injection valve according to any one of the claims 2 to 5, **characterised in that** an upper rim (23)of the holding tube (12) is inwardly bent in a U-shape and that an upper rim of the retaining tube (13) abuts the U-shaped rim (23) of the holding tube (12).

7. Injection valve according to any one of the claims 2 to 6, **characterised in that** the retaining tube (13) is inwardly bent alongside providing an annular clearance (18) between the retaining tube (13) and the holding tube (12).

8. Injection valve according to any one of the claims 2 to 7, **characterised in that** the adjusting tube (14) comprises ring-shaped grooves (15) at an outer surface.

9. Injection valve according to any one of the claims 2 to 8, **characterised in that** the groove (15) of the adjusting tube (14) comprises two side surfaces (16, 17), that a lower side surface (16) is arranged at the side of the spring (10) and that an upper side surface (17) is arranged oppositely, that the upper side surface (17) is arranged at an angle to the longitudinal axis smaller than 90° and that the lower side surface (16) is preferably arranged perpendicularly to the longitudinal axis of the adjusting tube (14).

10. Injection valve according to claim 2, **characterised in that** the retaining element (13) comprises a ring element (28) that is fixed to a second adjusting tube (14) and that the ring element comprises an upper ring face (31) that is adjacent to a lower ring face (30) of a second holding tube (12), that the upper and the lower ring faces (30, 31) are shaped in steps and that the position of a lower end face (35) of the second adjusting tube (14) depends on the rotational positions of the second holding tube (29) and the second adjusting tube (27) to each other.

11. Injection valve according to claim 10, **characterised in that** the second adjusting tube (27) protrudes from the second holding tube (29) and that the second adjusting tube (27) comprises at least a recess (33) for rotating the second adjusting tube (27) relatively to the second holding tube (29).

FIG 1

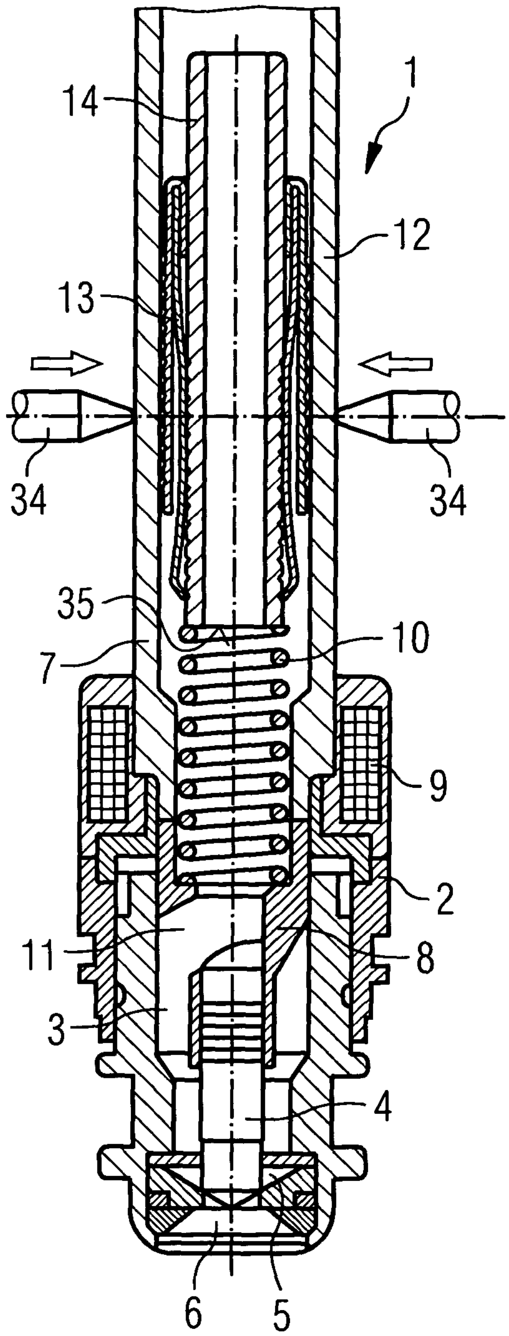


FIG 2

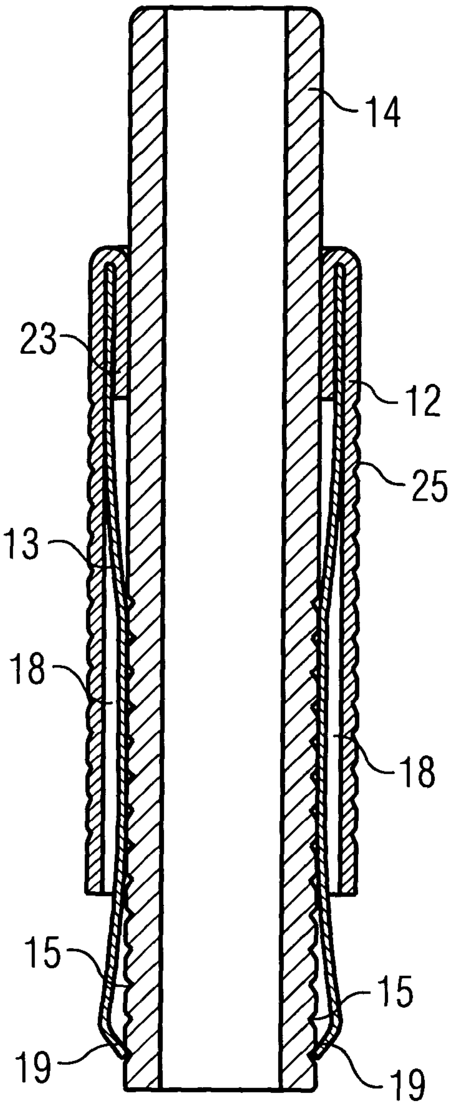


FIG 3

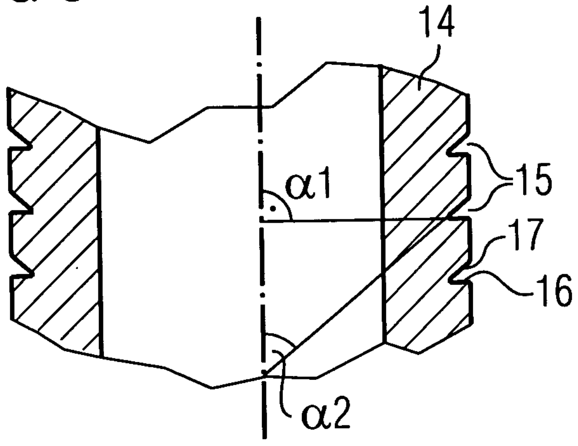


FIG 4

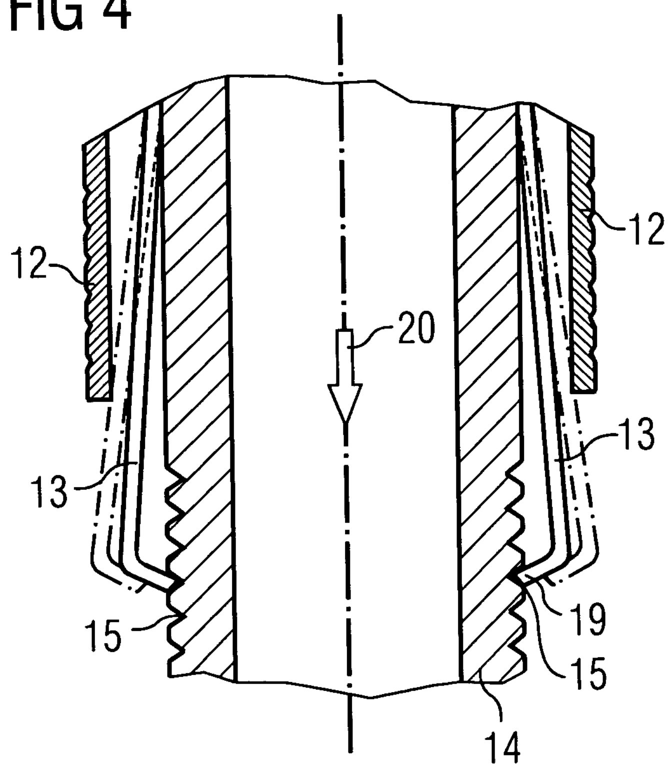
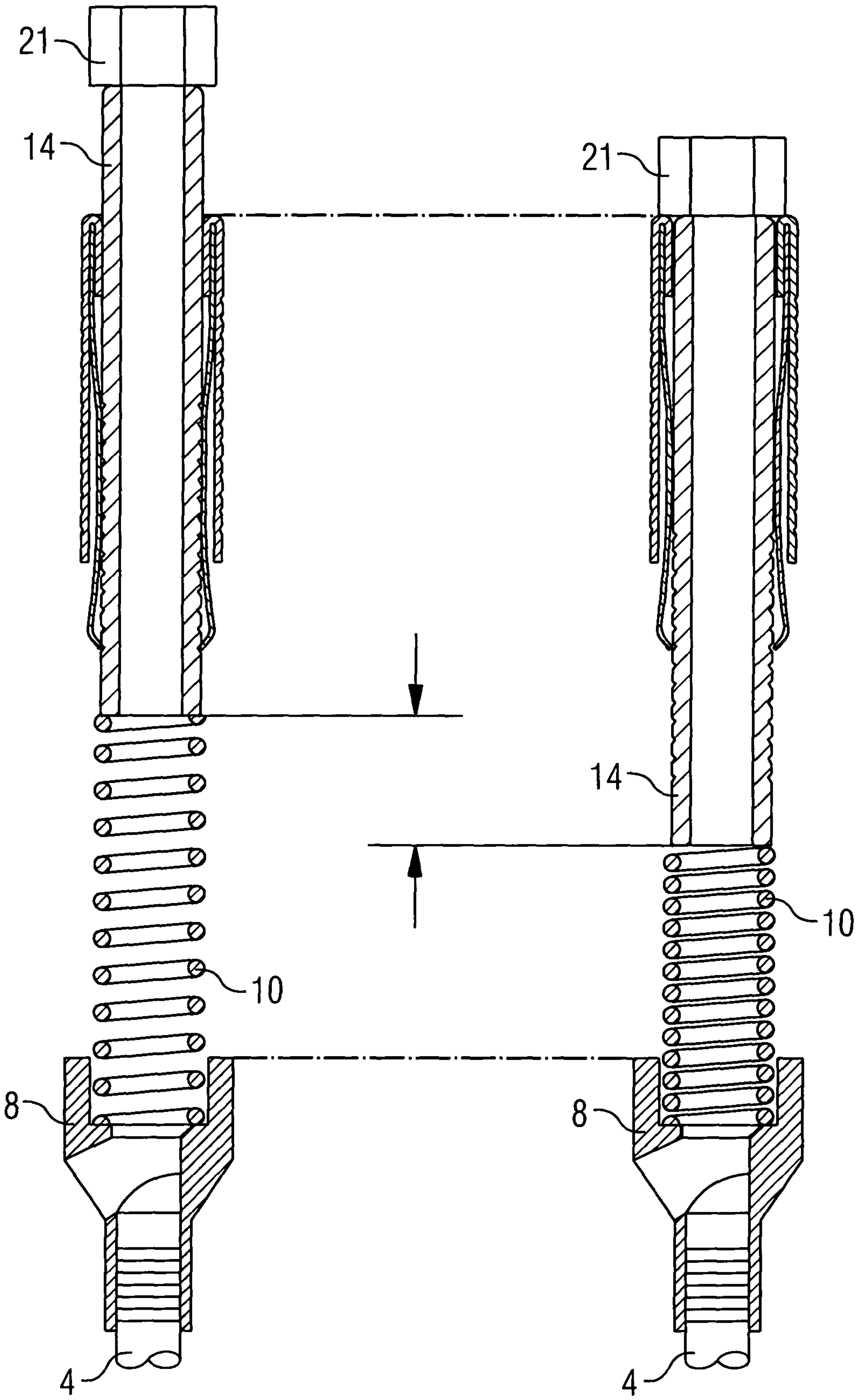


FIG 5



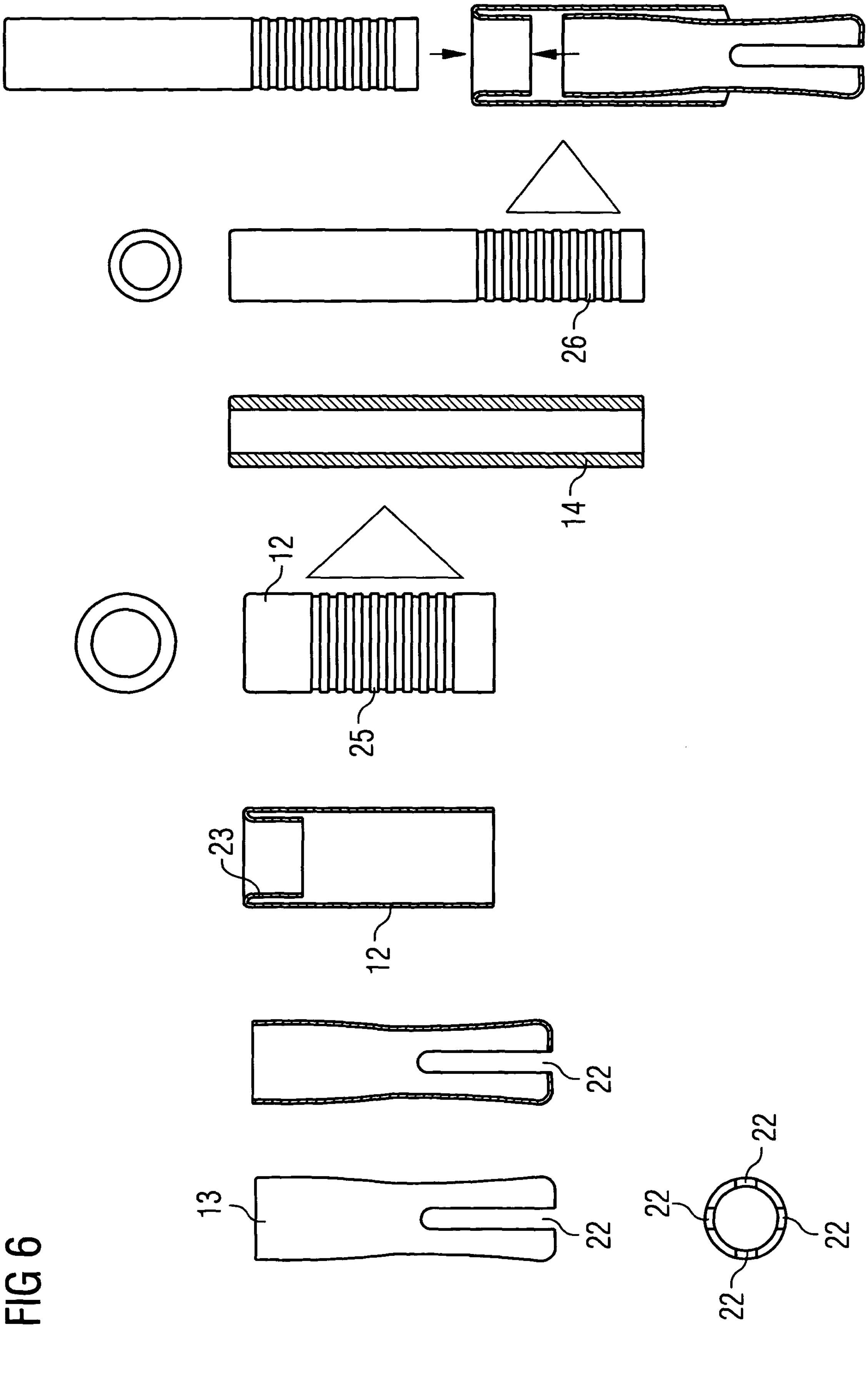


FIG 6

FIG 7

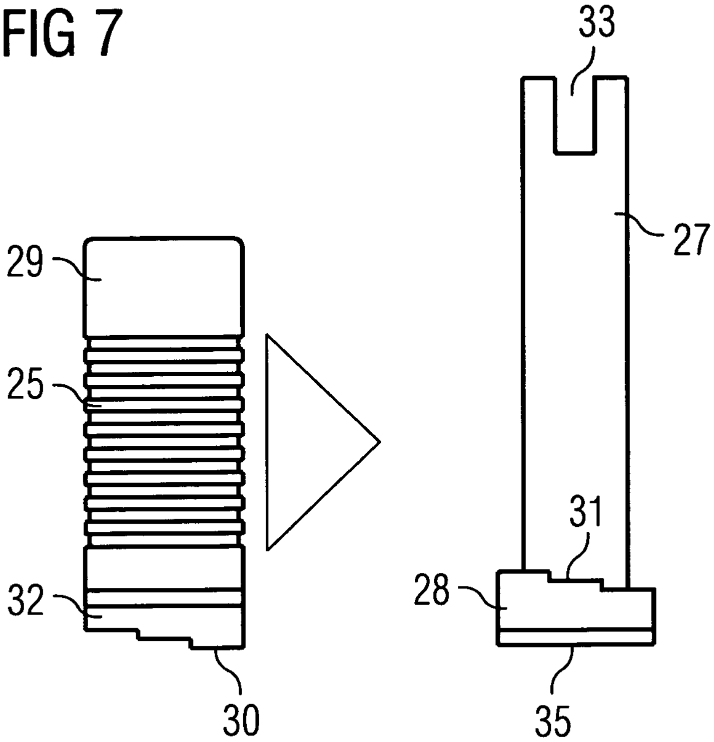


FIG 8

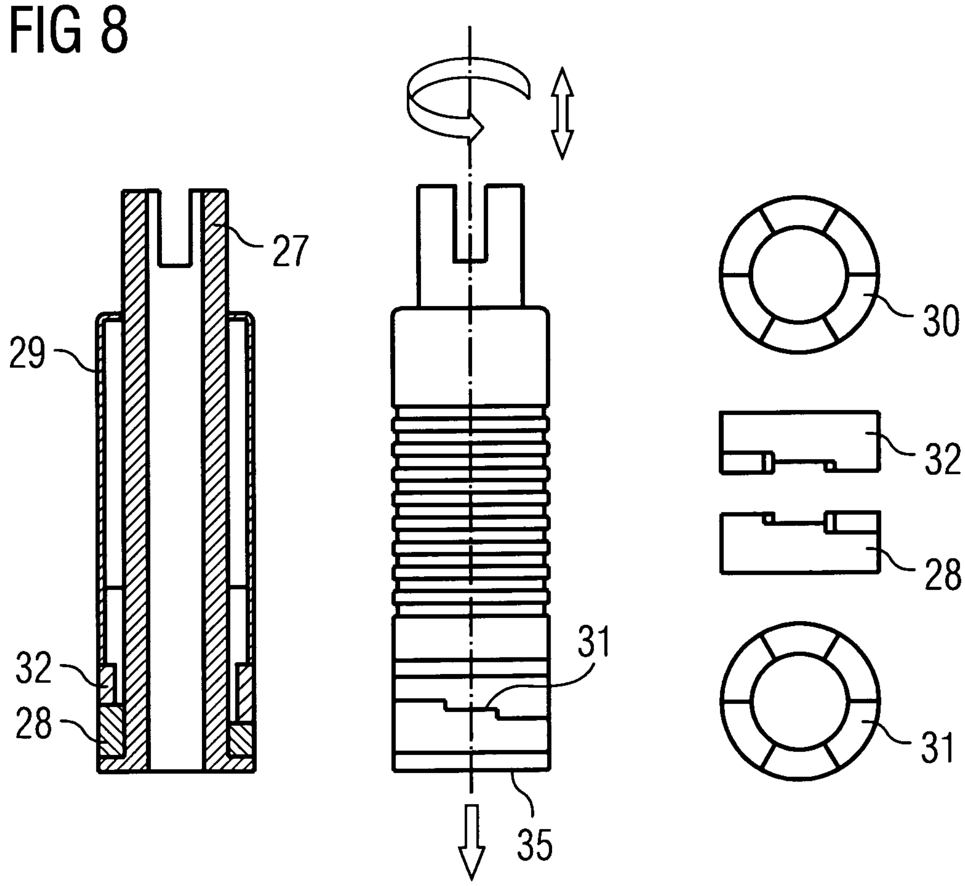
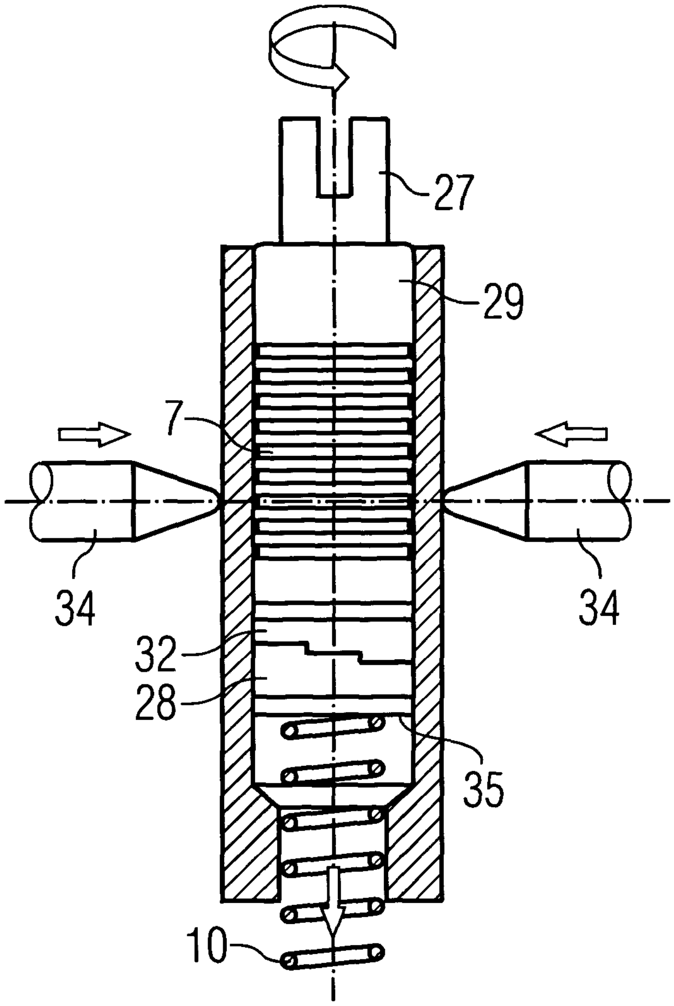


FIG 9



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EUROPEAN SEARCH REPORT

Application Number
EP 03 00 8497

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.7)
A	US 6 464 153 B1 (PERRY ROBERT B ET AL) 15 October 2002 (2002-10-15) * column 2, line 34 - column 3, line 19; figure 1 * ---	1	F02M61/20 F02M51/06
A	US 5 996 910 A (TAKEDA HIDETO ET AL) 7 December 1999 (1999-12-07) * column 2, line 43 - column 3, line 15; figure 1 * ---	1	
A	US 4 092 001 A (HOFMANN KARL) 30 May 1978 (1978-05-30) * column 3, line 3 - line 43; figures 3,4 * ---	1	
D,A	US 5 967 419 A (KATO YUKINORI ET AL) 19 October 1999 (1999-10-19) * column 3, line 59 - line 64; figure 1 * -----	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)
F02M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 August 2003	Hakhverdi, M

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 03 00 8497

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Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 6464153	B1	15-10-2002	NONE		
US 5996910	A	07-12-1999	JP	11132127 A	18-05-1999
US 4092001	A	30-05-1978	DE	2554987 A1	16-06-1977
			GB	1557057 A	05-12-1979
			JP	52070228 A	11-06-1977
US 5967419	A	19-10-1999	JP	10196488 A	28-07-1998

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