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Remarks:
Amended claims in accordance with Rule 137(2) EPC.

(54) Injection nozzle

(57) An injection nozzle (30) for a compression-ignition internal combustion engine, the injection nozzle (30) comprising:
a nozzle body (32) provided with a bore (35) within which a valve needle (34) is movable along a primary valve needle axis (A-A), the valve needle (34) being engageable with a valve seating (38) defined by the bore (35) to control fuel delivery through a nozzle outlet;
the bore (35) comprising first and second regions (36, 37), the second bore region (37) having a smaller diameter than the first bore region (36), and a transition (48) between the first and second bore regions (36, 37);
the valve needle (34) including a guide region (44) for guiding the movement of the valve needle (34) within the nozzle body (32), the guide region (44) comprising a shoulder portion (54) and a relieved region disposed downstream of the shoulder portion (54);

wherein, when the valve needle (34) is in a zero lift state, the shoulder portion (54) is disposed adjacent to the transition (48) so as to define a restriction therebetween for restricting the flow of fuel therethrough, and the overlap between the shoulder portion (54) and the transition (48) in the direction of the primary valve needle axis (A-A) is less than the height of the full lift of the valve needle (34).

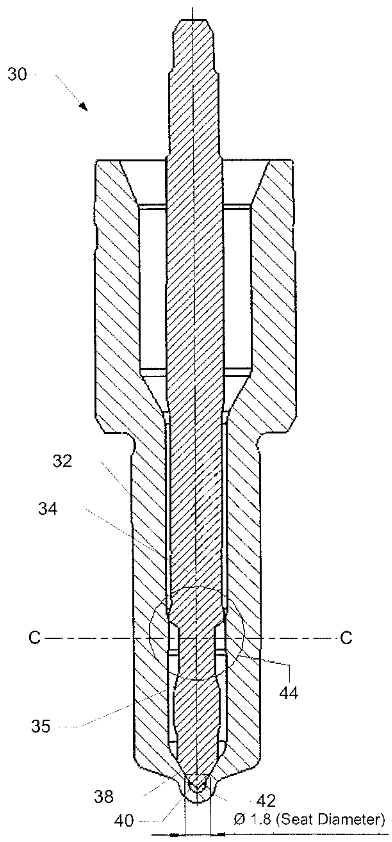

Figure 3

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Description

Technical Field

[0001] The present invention relates to an injection nozzle for use in a fuel injection system for an internal combustion engine. It relates particularly, but not exclusively, to an injection nozzle for use in a common rail fuel injection system for an internal combustion engine.

Background to the Invention

[0002] In common rail fuel injection systems, a plurality of injectors are provided to inject fuel at high pressure into the engine cylinders. Each injector includes an injection nozzle having a valve needle which is operated by means of an actuator to move towards and away from a valve seating so as to control fuel delivery by the injector.

[0003] Figure 1 is a part-perspective view of a conventional injection nozzle. Referring to Figure 1, the injection nozzle 10, comprises a nozzle body 12 and a valve needle 14. In Figure 1, the valve needle 14 is shown in perspective and the nozzle body 12 is shown in cross-section. The nozzle body 12 is provided with a blind bore 16 within which the valve needle 14 is movable to engage with, and disengage from, a valve needle seating 18 defined by the blind end of the bore 16. The nozzle body 12 also includes a set of nozzle outlets 20 through which fuel can be injected into the associated engine cylinder or combustion space, in circumstances in which the valve needle 14 is lifted from its seating 18. The blind end of the bore 16 defines a sac volume 22 with which inlet ends of the nozzle outlets 20 communicate.

[0004] The valve needle 14 has a generally circular cross-section along it's primary axis, and is divided into a plurality of regions which are shaped so as to optimise the flow of fuel from the injection nozzle 10 to the associated engine cylinder. In particular, the valve needle 14 comprises a guide region 24 for guiding the valve needle 14 as it moves within the nozzle body 12. The guide region 24 is formed from a generally cylindrical region into which there are machined a plurality of flat portions 24a.

[0005] Figure 2 is a sectional view of the injection nozzle of Figure 1 along the line B-B. Referring to Figure 2, the guide region 24 comprises three flat portions 24a. Each of the flat portions 24a, are separated by a corresponding guide portion 24b in the circumferential direction of the guide region 24.

[0006] The radius of each of the guide portions 24b is sized so as to be a close clearance fit with the surface of the bore 16, i.e. typically -0.015mm. Accordingly, the proximity of each guide portion 24b to the surface of the bore 16 ensures the movement of the valve needle 14 toward and away from the valve seating 18 is co-axial with the primary axis of the bore 16, labelled A-A in Figure 1.

[0007] Each flat portion 24a of the guide region 24 defines a corresponding relieved region 26 between the surface of the guide region 24 and the adjacent surface of the bore 16. The purpose of the flat portions 24a is to allow sufficient fuel to flow from an upper inlet end of the injection nozzle 10, past the guide region 24, and toward the valve seating 18 disposed at the lower end of the injection nozzle 10.

[0008] There is a problem with the conventional injection nozzle 10 in that it is difficult to control the injection of small quantities of fuel, especially at very high pressures, i.e. 2000bar to 2400bar. Typically this is due to an inability to raise and lower the valve needle 14 quickly enough, such that only the desired amount of fuel is injected. Accordingly, after the valve needle 14 has been lifted from the valve seating 18, too much fuel flows through the outlets 20 before the valve needle 14 is lowered again.

[0009] It is an object of the present invention to provide an injection nozzle which substantially overcomes or mitigates the aforementioned problem and enables the accurate injection of a small amount of fuel from a low valve needle lift.

Summary of Invention

[0010] According to a first aspect of the invention, there is provided an injection nozzle for a compression-ignition internal combustion engine, the injection nozzle comprising:

> a nozzle body provided with a bore within which a valve needle is movable along a primary valve needle axis, the valve needle being engageable with a valve seating defined by the bore to control fuel delivery through a nozzle outlet;
>
> the bore comprising first and second regions, the second bore region having a smaller diameter than the first bore region, and a transition between the first and second bore regions;
>
> the valve needle including a guide region for guiding the movement of the valve needle within the nozzle body, the guide region comprising a shoulder portion and a relieved region disposed downstream of the shoulder portion;

wherein, when the valve needle is in a zero lift state, the shoulder portion is disposed adjacent to the transition so as to define a restriction therebetween for restricting the flow of fuel therethrough, and the overlap between the shoulder portion and the transition in the direction of the primary valve needle axis is less than the height of the full lift of the valve needle.

[0011] By providing an injection nozzle having the above-described configuration, the accurate control of the injection of a small amount of fuel is possible at low needle lifts, since the restriction between the shoulder portion and the transition prevents excessive fuel from flowing through the nozzle. Furthermore, the restriction enables more accurate valve needle control, by causing a reduction in the fuel pressure downstream of the restriction at low needle lifts, and a corresponding reduction in the opening force exerted on the valve needle, thereby providing a damping effect which reduces the speed at which the valve needle lifts.

[0012] Preferably, the relieved region comprises a first flat portion and a first tapered portion, disposed between the first flat portion and the shoulder portion.

[0013] Preferably, the first flat portion is adjacent to the transition between the first and second bore regions when the valve needle is in a full lift state. Accordingly, when the valve needle is in the full lift state, the restriction to the flow of fuel between the first flat portion and the transition is less than the restriction defined between the transition and the shoulder portion. Thus, when the valve needle is at full lift the restriction to the flow of fuel is reduced such that the efficiency of the injection nozzle is not compromised at higher pressures and higher flows.

[0014] Preferably, the first tapered portion is adjacent to the transition between the first and second bore regions when the valve needle is between a zero lift state and a full lift state.

[0015] Conveniently, the relieved region comprises a second flat portion and second tapered portion disposed between the second flat portion and the shoulder portion, wherein the second flat portion and the second tapered portion are spaced circumferentially around the valve needle from the first flat portion and the first tapered portion.

[0016] Conveniently, the first flat portion and the first tapered portion are disposed on opposed sides of the valve needle from the second flat portion and the second tapered portion.

Brief Description of Drawings

[0017] The invention will now be described, by way of example only, with reference to Figures 3 to 8 of the accompanying drawings, in which;

Figure 1 is a part-perspective view of a conventional injection nozzle;

Figure 2 is a sectional view of the injection nozzle of Figure 1 along the line B-B;

Figure 3 is a sectional view of an embodiment of an injection nozzle according to the present invention;

Figure 4 is an enlarged view of a guide region of the valve needle in the injection nozzle shown in Figure 3;

Figure 5 is a sectional view of the injection nozzle of Figure 3 along the line C-C;

Figure 6 is an enlarged sectional view of a guide region of the injection nozzle of Figure 3 when the valve needle is in a zero lift state;

Figure 7 is an enlarged sectional view of a guide region of the injection nozzle of Figure 3 when the valve needle is in a partial lift state; and

Figure 8 is an enlarged sectional view of a guide region of the injection nozzle of Figure 3 when the valve needle is in a full lift state.

Detailed Description of Preferred Embodiments

[0018] The injection nozzle of the present invention is of the type suitable for implementation within an injector having a piezoelectric actuator for controlling movement of an injection nozzle valve needle. The injector is typically of the type used in common rail fuel injection systems for internal combustion engines (for example compression-ignition diesel engines). Embodiments of an injection nozzle according to the present invention can be used in direct-acting piezoelectric injectors, where the piezoelectric actuator controls movement of the valve needle through a direct action, either via a hydraulic or mechanical amplifier or coupler, or by means of a direct connection. Embodiments of an injection nozzle according to the present invention may also be used in injection systems which rely on the balance of spring and hydraulic forces to determine the valve needle actuation.

[0019] Referring to Figure 3, the injection nozzle 30, comprises a nozzle body 32 and a valve needle 34. The nozzle body 32 is provided with a blind bore 35 within which the valve needle 34 is movable to engage with, and disengage from, a valve needle seating 38 defined by the blind end of the bore 35. The valve seating 38 is of substantially frusto-conical form, as is known in the art. The valve needle 34 terminates in valve tip 40, which has a generally conical shape.

[0020] The nozzle body 32 also includes a set of nozzle outlets (not shown) through which fuel can be injected into the associated engine cylinder or combustion space, in circumstances in which the valve needle 34 is lifted from its seating 38. The blind end of the bore 35 defines a sac volume 42 with which inlet ends of the nozzle outlets communicate.

[0021] The valve needle 34 also includes a guide region 44 for guiding the valve needle 34 as it moves within the nozzle body 32 so as to ensure that the movement of the valve needle 34 is co-axial with the primary axis of the injection nozzle 30 A-A. The guide region 44 is disposed between the valve tip 40 and the opposite end of the valve needle 34, where the valve needle 34 is coupled to an actuator (not shown). The guide region 44 will now be described in more detail with reference to Figures 4 and 5.

[0022] The guide region 44 is formed from a generally cylindrical region which includes first and second flat portions 46a, 46b. The flat portions 46a, 46b are disposed on opposed sides of the primary axis of the valve needle 34 and may be formed by machining the surface of the guide region 44. The first and second flat portions 46a, 46b are separated from one another, in the circumferential direction of the valve needle 34, by first and second radiussed portions 47a, 47b as shown in Figure 5.

[0023] The first and second radiussed portions 47a, 47b are sized so as to be a close clearance fit with the adjacent surface of the bore 35 of the nozzle body 32. The bore 35 comprises first and second regions 36, 37, the second bore region 37 having a smaller diameter than the first bore region 36 and being disposed adjacent to the first bore region 36 in the axial direction of the injection nozzle 30. The second bore region 37 is disposed adjacent to the guide region 44 of the valve needle 34. In the present embodiment, the clearance between the radiussed portions 47a, 47b and the second bore region 37 is 0.015mm.

[0024] At the upper end of the second bore region 37 there is a transition edge 48 between the second bore region 37 and the first bore region 36, from which point the bore 35 widens so as to define an entry volume 49 of the injection nozzle 30 between the valve needle 34 and the first bore region 36.

[0025] The first flat portion 46a is spaced from the surface of the second bore 37 so as to define a first transition volume 50a therebetween. In the present embodiment, the spacing between the first flat portion 46a and the second bore region 37 is 0.675mm.

[0026] The first flat portion 46a terminates at its upper end in a first tapered portion 52a. The radius of the valve needle 34 increases across the first tapered portion 50a in the upstream direction, and terminates at a shoulder portion 54 at the upper end of the guide region 44. The shoulder portion 54 of the guide region 44 has a substantially circular cross-section and is a close clearance fit with the second bore region 37 around the entire circumference of the valve needle 34 in the region of the transition edge 48, when the valve needle 34 is in a zero lift position as shown in Figure 4.

[0027] The second flat portion 46b is of the same configuration as the first flat portion 46a and defines a second transition volume 50b with the second bore region 37. A second tapered portion 52b is provided between the upper end of the second flat portion 46b and the shoulder portion 54.

[0028] The operation of the injection nozzle 30 will now be described with reference to Figures 6 to 8.

[0029] Referring first to Figure 6, when the valve needle 34 is in a zero lift state, the shoulder 54 portion of the guide region 44 is disposed adjacent to the second bore region 37 and below the transition edge 48. The length of the overlap in the axial direction of the injection nozzle 30 between the shoulder portion 54 and the second bore region 37 is labelled 'lift 1'. In the present embodiment, lift 1 is 0.03mm. As described previously, the gap between the shoulder portion 54 and the second bore region 37 is 0.015mm. In this position, the flow area is equivalent to a hole with a diameter of 0.49mm. Accordingly, the flow of fuel from the entry volume 49 toward the sac volume 42 is substantially restricted.

[0030] It should be noted that when the valve needle 34 is in the zero lift state, this corresponds to a non-injecting state of the injection nozzle 30. In this state, the valve tip 40 is engaged with the valve seating 38 of the nozzle body 32 and, accordingly, fuel is prevented from being injected into the associated engine cylinder.

[0031] As mentioned previously, the upper end of the valve needle 34 is coupled an actuator, such as a piezoelectric actuator, which is operable to lift the valve needle 34 so as to disengage from the valve seating 38 such that fuel is injected into the associated engine cylinder. When the actuator is energised and the valve needle 34 is lifted by a distance up to 'lift 1', the valve tip 40 is raised from the valve seating 38, allowing fuel to flow into the sac volume 42 and be injected into the associated cylinder. However, up to a height of lift 1, i.e. 0.03mm, the gap between the shoulder portion 54 and the second bore region 37, is a constant 0.015mm. Accordingly, the flow of fuel from the entry volume 49 of the injection nozzle 30 through to the transition volume 50a, 50b and down to the sac volume 42 is restricted. Thus, an excessive amount of fuel is prevented from being injected at a low needle lift. Furthermore, by restricting the fuel flow between the shoulder portion 54 and the transition edge 48 at low needle lifts, the pressure in the nozzle downstream of the restriction, i.e. in the transition volume 50a, 50b and the sac volume 42, reduces more rapidly as fuel exits the nozzle through the nozzle outlets. Accordingly, the opening force exerted on the valve needle 34 is reduced and, therefore, the speed with which the valve needle 34 lifts is also reduced. This effect is reversed when the valve needle 34 is closed. More specifically, during closing of the valve needle 34, the restriction results in reduced pressure downstream of the shoulder portion 54 and transition edge 48. Accordingly, the valve needle 34 can be closed more quickly . Thus, there is a damping effect set up which helps to control the valve needle 34 for small deliveries. Hence, by controlling the flow of fuel within the injection nozzle 30, the movement of the valve needle 34 can also be controlled.

[0032] Referring to Figure 7, when the valve needle 34 is lifted by a distance in excess of lift 1, the shoulder portion 54 is raised above the level of the transition edge 48 and the second tapered portion 52b is positioned adjacent to the transition edge 48. Accordingly, the restriction between the second bore region 37 and the guide region 44 of the valve needle 34 is defined by the transition edge 48 and the first and second tapered portions 52a, 52b. Since the radius of the valve needle 34 at the first and second tapered portions 52a, 52b varies with the position along the primary axis of the valve needle 34, the width of the restriction increases as the valve needle 34 is raised above a height of lift 1.

[0033] Referring to Figure 8, when the valve needle 34 is raised to a full lift state, the restriction between the second bore region 37 and the guide region 44 of the valve needle 34 is defined by the transition edge 48 and the first and second flat portions 46a, 46b. In the present embodiment, full lift of the valve needle 34 is a height of 0.3mm, although this could vary between 0.25mm and 0.4mm. At full lift, the width of the restriction is 0.675mm, i.e. the depth of the flat portions 46a, 46b. In this position, the flow area is 2.8mm^2 which is equivalent to a hole with a diameter of 1.89mm.

[0034] Since the depth of the first and second flat portions 46a, 46b is constant, in the event that the valve needle 34 is raised higher than the full lift position, the restriction remains constant, so there is no added restriction to the flow of fuel through the injection nozzle 30.

[0035] The above described embodiment thus provides an injection nozzle in which fuel flow therethrough is substantially restricted at low needle lifts, thereby allowing the accurate injection of small quantities of fuel. Conversely, at high needle lifts, the restriction to the flow of fuel is reduced such that the efficiency of the injection nozzle is not compromised at higher pressures and higher flows.

[0036] It will be appreciated by those skilled in the art that the depth of the first and second flat portions 46a, 46b, and the angle of the tapered portions 52a, 52b may be varied in order to obtain the optimal compromise between control of fuel flow at small needle lifts and increased fuel flow at large needle lifts.

[0037] In the above-described embodiment, the guide region 44 comprises first and second flat portions 46a, 46b which, together with the first and second tapered portions 52a, 52b, define a pair of relieved portions of the guide region 44. However, it will be appreciated by those skilled in the art that the guide region 44 may be provided with only a single flat portion, and a corresponding tapered portion. Alternatively, the guide portion 44 may be provided with more than two flat portions and a corresponding number of tapered portions spaced circumferentially around the valve needle 34.

[0038] As described above, the flat portions 46a, 46b and the tapered portions 52a, 52b of the guide region 44, may be created by machining the surface of a cylindrical guide region. Thus, the advantages of the present invention, i.e. accurate control of small quantity fuel injection, may be obtained without requiring additional manufacturing steps or substantial redesign of the known injection nozzle shown in Figures 1 and 2.

Claims

1. An injection nozzle (30) for a compression-ignition internal combustion engine, the injection nozzle (30) comprising:

   a nozzle body (32) provided with a bore (35) within which a valve needle (34) is movable along a primary valve needle axis (A-A), the valve needle (34) being engageable with a valve seating (38) defined by the bore (35) to control fuel delivery through a nozzle outlet;

   the bore (35) comprising first and second regions (36, 37), the second bore region (37) having a smaller diameter than the first bore region (36), and a transition (48) between the first and second bore regions (36, 37);

   the valve needle (34) including a guide region (44) for guiding the movement of the valve needle (34) within the nozzle body (32), the guide region (44) comprising a shoulder portion (54) and a relieved region disposed downstream of the shoulder portion (54);

   wherein, when the valve needle (34) is in a zero lift state, the shoulder portion (54) is disposed adjacent to the transition (48) so as to define a restriction therebetween for restricting the flow of fuel therethrough, and the overlap between the shoulder portion (54) and the transition (48) in the direction of the primary valve needle axis (A-A) is less than the height of the full lift of the valve needle (34).

2. An injection nozzle according to claim 1, wherein the relieved region comprises a first flat portion (46a) and a first tapered portion (52a), disposed between the first flat portion (46a) and the shoulder portion (54).

3. An injection nozzle according to claim 2, wherein the first flat portion (46a) is adjacent to the transition (48) between the first and second bore regions (36, 37) when the valve needle (34) is in a full lift state.

4. An injection nozzle according to claim 2 or 3, wherein the first tapered portion (52a) is adjacent to the transition (48) between the first and second bore regions (36, 37) when the valve needle (34) is between a zero lift state and a full lift state.

5. An injection nozzle according to claim 2, 3 or 4, wherein the relieved region comprises a second flat portion (46b) and second tapered portion (52b) disposed between the second flat portion (46b) and the shoulder portion (54), wherein the second flat portion (46b) and the second tapered portion (52b) are spaced circumferentially around the valve needle (34) from the first flat portion (46a) and the first tapered portion (52a).

6. An injection nozzle according to claim 5, wherein the first flat portion (46a) and the first tapered portion (52a) are disposed on opposed sides of the valve needle (34) from the second flat portion (46b) and the second tapered portion (52b).

Amended claims in accordance with Rule 137(2) EPC.

1. An injection nozzle (30) for a compression-ignition internal combustion engine, the injection nozzle (30) comprising:

a nozzle body (32) provided with a bore (35) within which a valve needle (34) is movable along a primary valve needle axis (A-A), the valve needle (34) being engageable with a valve seating (38) defined by the bore (35) to control fuel delivery through a nozzle outlet;

the bore (35) comprising first and second regions (36, 37), the second bore region (37) having a smaller diameter than the first bore region (36), and a transition (48) between the first and second bore regions (36, 37);

the valve needle (34) including a guide region (44) for guiding the movement of the valve needle (34) within the nozzle body (32), the guide region (44) comprising a shoulder portion (54) and a relieved region disposed downstream of the shoulder portion (54);

the relieved region comprising a first flat portion (46a) and a first tapered portion (52a), disposed between the first flat portion (46a) and the shoulder portion (54);

wherein, when the valve needle (34) is in a zero lift state, the shoulder portion (54) is disposed adjacent to the transition (48) so as to define a restriction therebetween for restricting the flow of fuel therethrough, and the overlap between the shoulder portion (54) and the transition (48) in the direction of the primary valve needle axis (A-A) is less than the height of the full lift of the valve needle (34);
characterised in that the radius of the valve needle (34) increases across the first tapered portion (50a) in the upstream direction.

2. An injection nozzle according to claim 1, wherein the first flat portion (46a) is adjacent to the transition (48) between the first and second bore regions (36, 37) when the valve needle (34) is in a full lift state.

3. An injection nozzle according to claim 1 or 2, wherein the first tapered portion (52a) is adjacent to the transition (48) between the first and second bore regions (36, 37) when the valve needle (34) is between a zero lift state and a full lift state.

4. An injection nozzle according to claim 1, 2 or 3, wherein the relieved region comprises a second flat portion (46b) and second tapered portion (52b) disposed between the second flat portion (46b) and the shoulder portion (54), wherein the second flat portion (46b) and the second tapered portion (52b) are spaced circumferentially around the valve needle (34) from the first flat portion (46a) and the first tapered portion (52a).

5. An injection nozzle according to claim 4, wherein the first flat portion (46a) and the first tapered portion (52a) are disposed on opposed sides of the valve needle (34) from the second flat portion (46b) and the second tapered portion (52b).

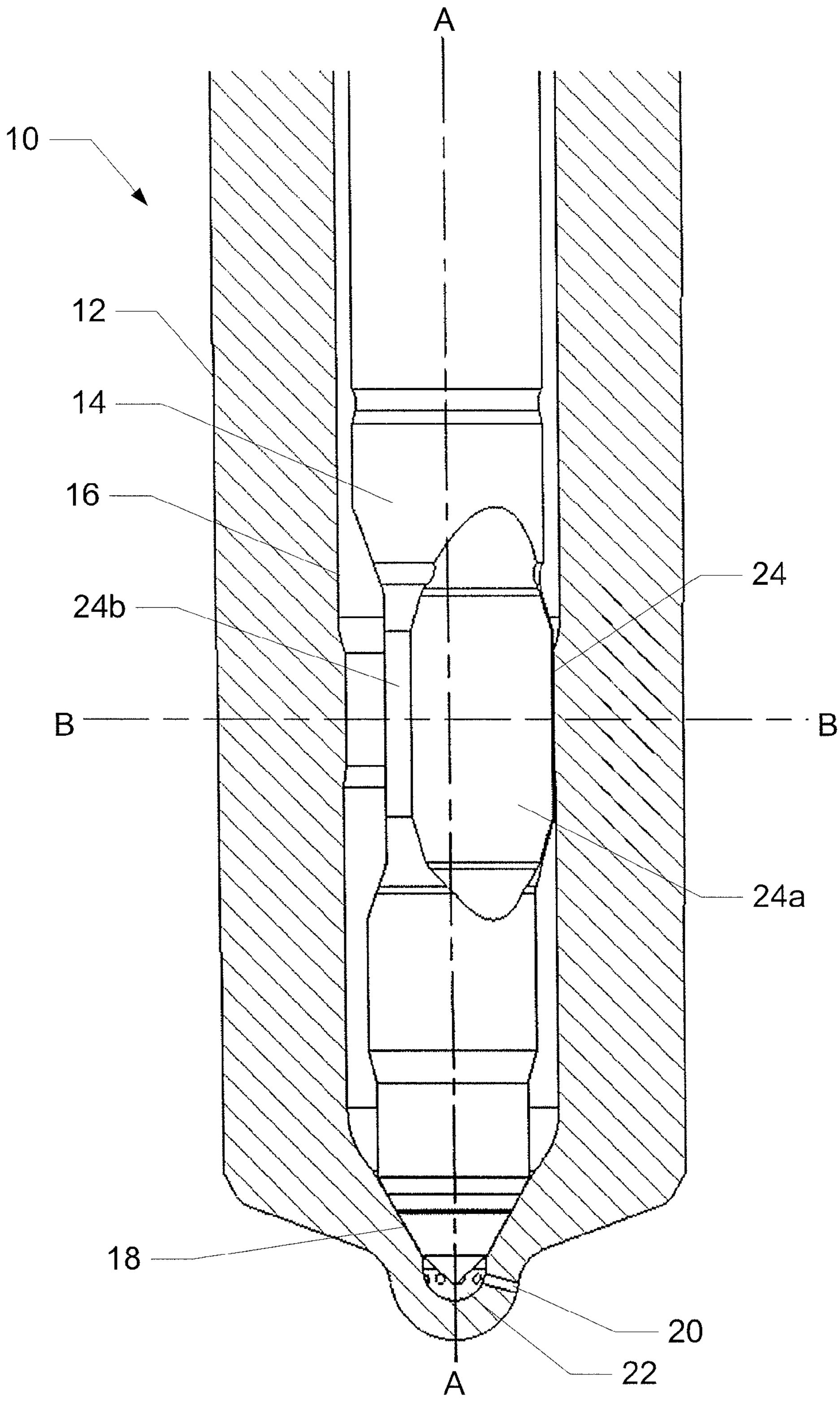

Figure 1
(Prior Art)

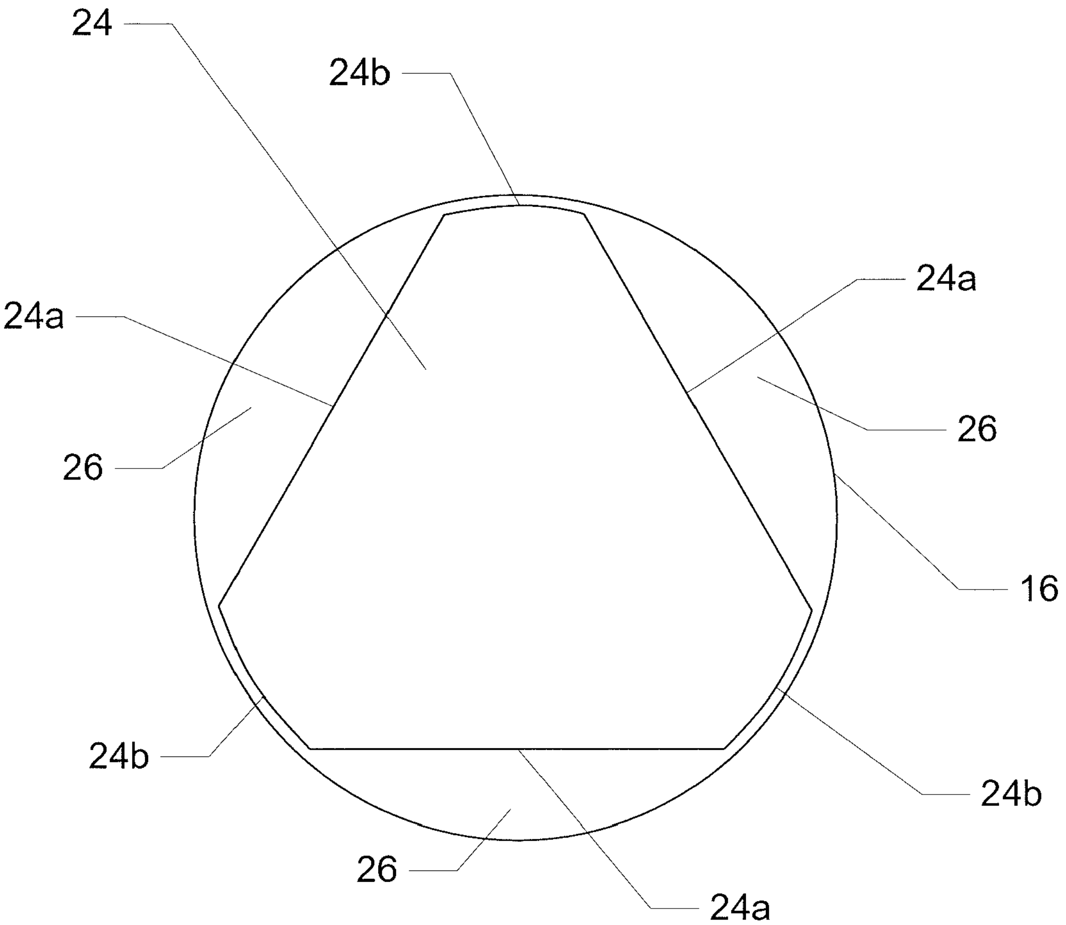

Figure 2
(Prior Art)

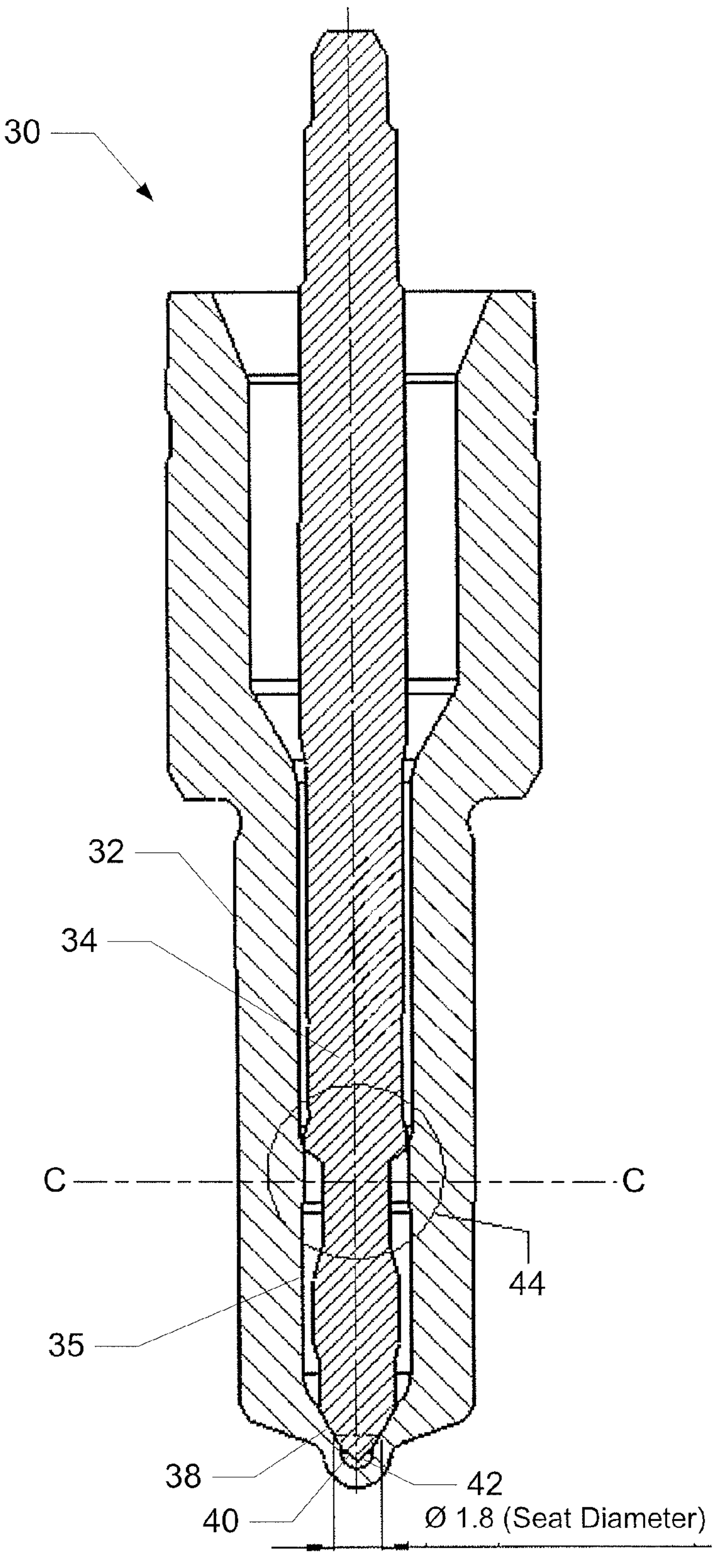

Figure 3

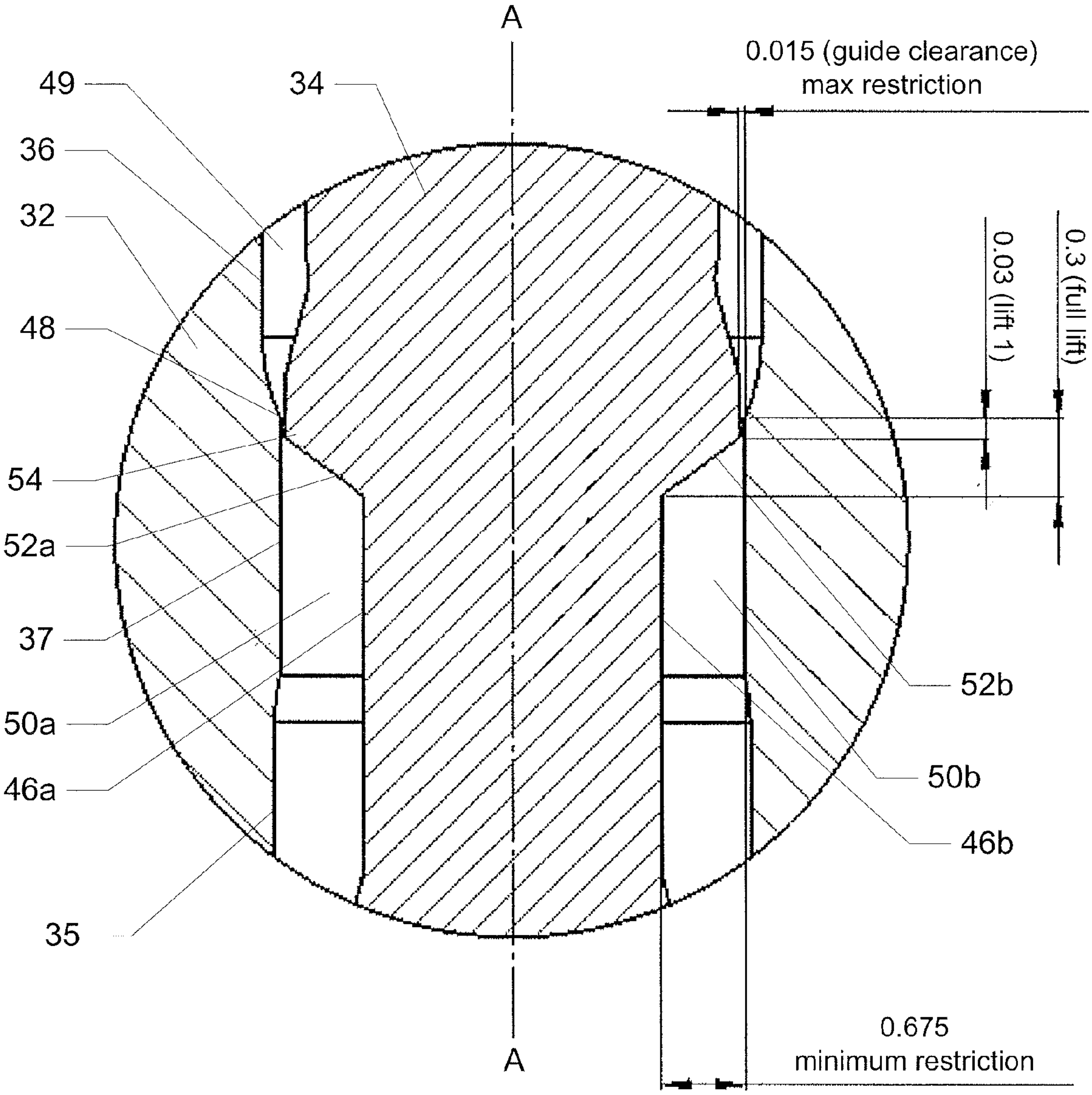
A
0.015 (guide clearance)
max restriction
49
34
36
32
48
54
52a
37
50a
46a
35
0.03 (lift 1)
0.3 (full lift)
52b
50b
46b
A
0.675
minimum restriction

Figure 4

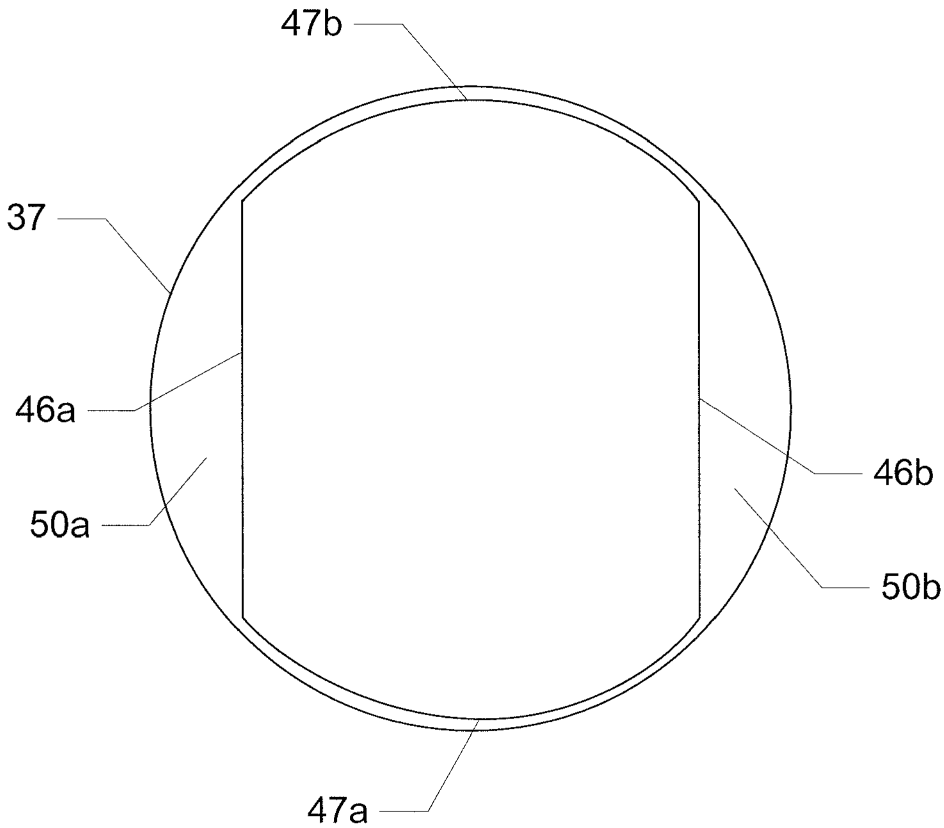

Figure 5

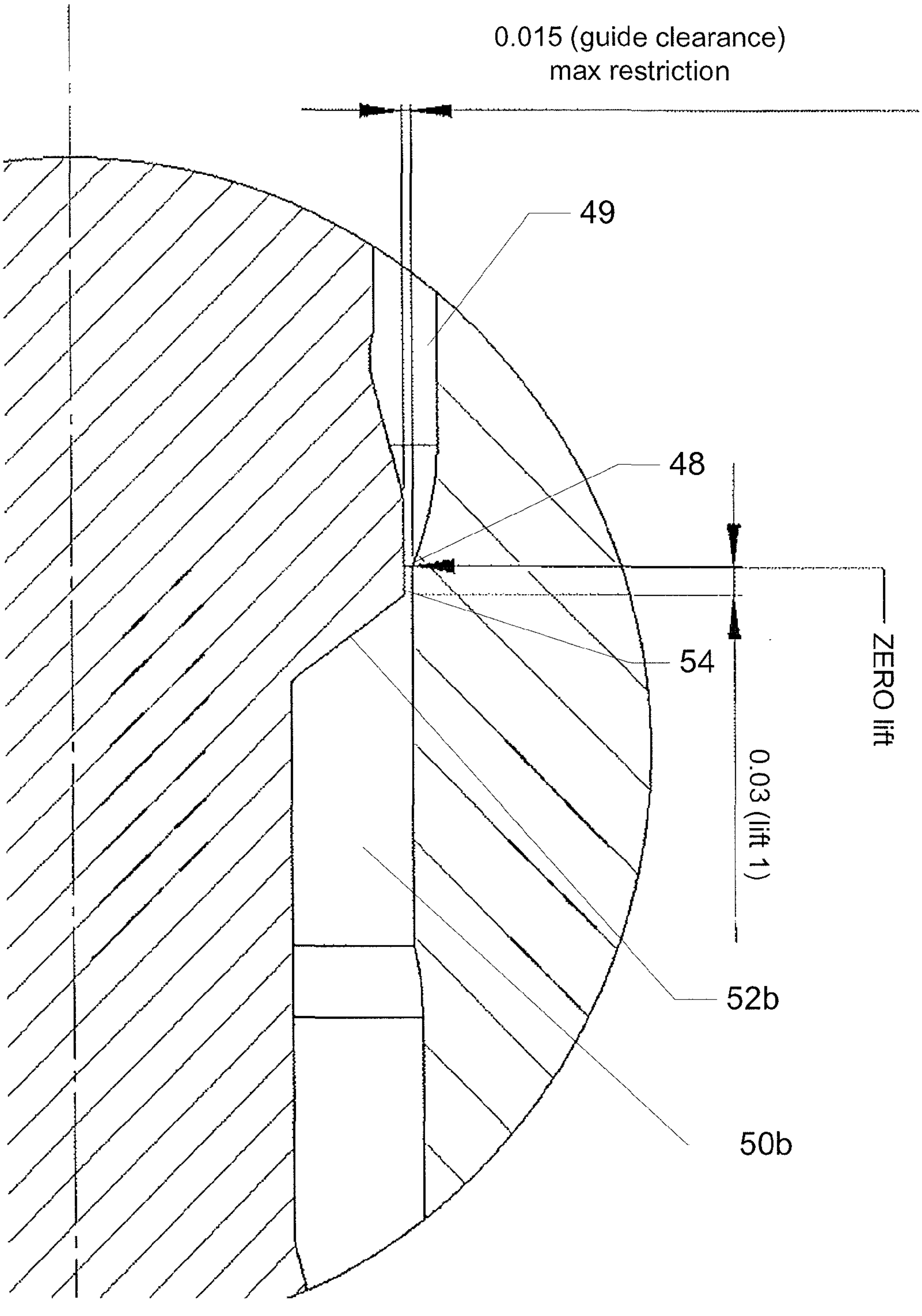
0.015 (guide clearance)
max restriction
49
48
54
ZERO lift
0.03 (lift 1)
52b
50b

Figure 6

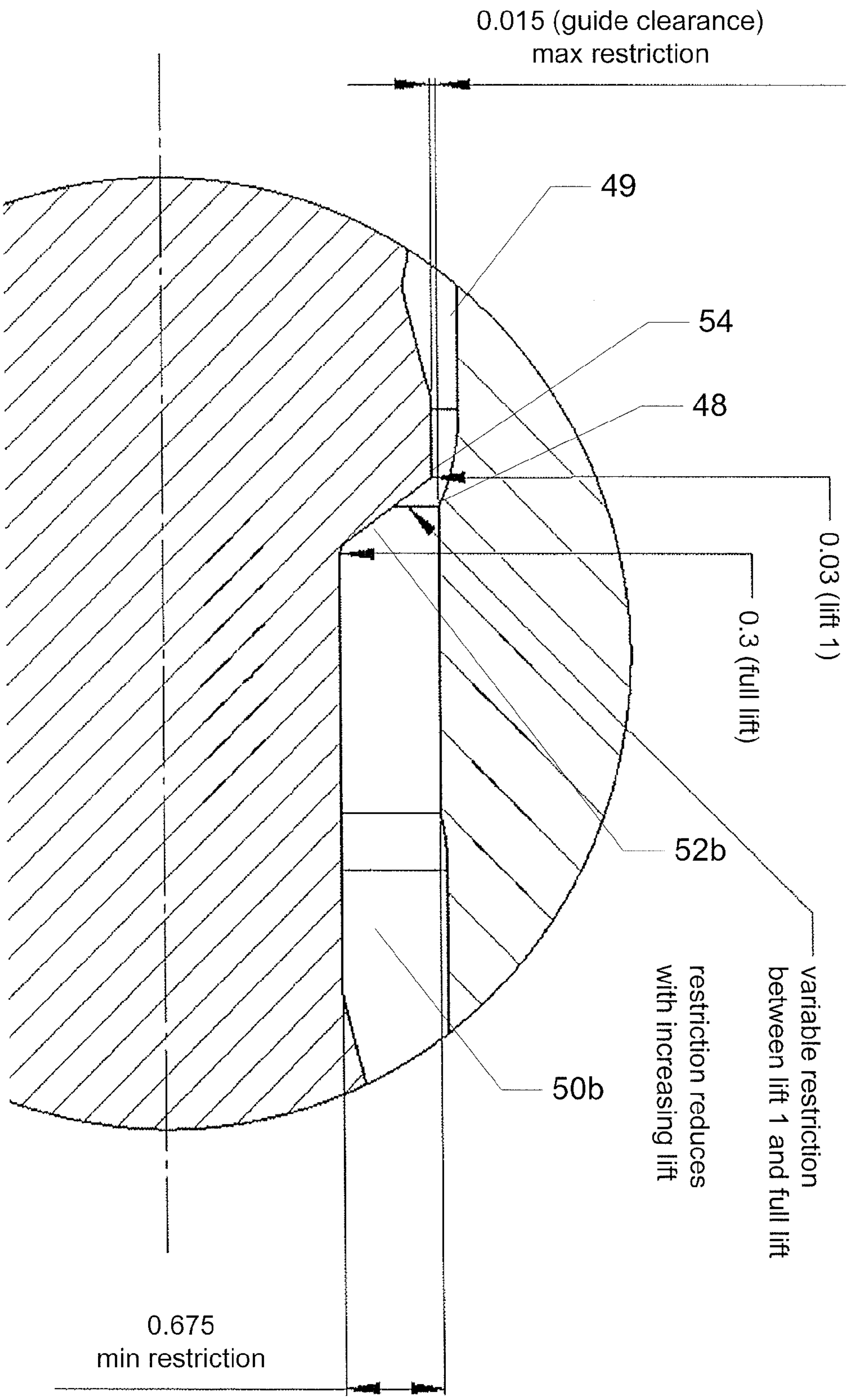
0.015 (guide clearance)
max restriction
49
54
48
0.03 (lift 1)
0.3 (full lift)
52b
variable restriction
between lift 1 and full lift
restriction reduces
with increasing lift
50b
0.675
min restriction

Figure 7

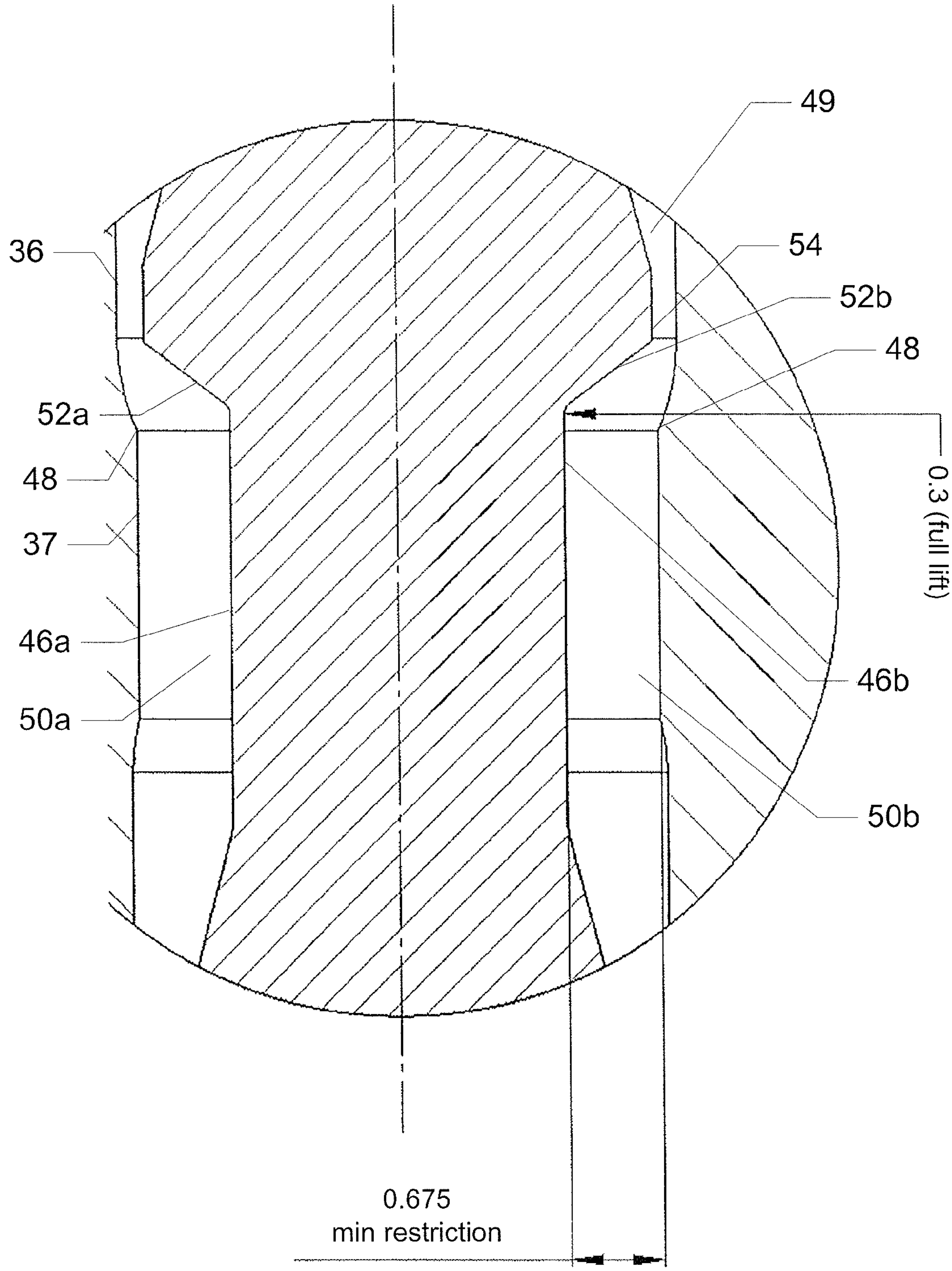
49
54
52b
48
36
52a
48
37
46a
50a
0.3 (full lift)
46b
50b
0.675
min restriction

Figure 8

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 08 00 1566

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	US 4 987 887 A (KELLY WILLIAM W [US]) 29 January 1991 (1991-01-29) * column 4, line 13 - column 5, line 58; figures 3,4 * -----	1-6	INV. F02M45/12 F02M61/12
X	WO 02/48536 A (BOSCH GMBH ROBERT [DE]; POTZ DETLEV [DE]; MOSER FRIEDRICH [DE]; KUEGLE) 20 June 2002 (2002-06-20) * page 6, lines 1-35; figure 2 * * page 4, lines 6-12 * -----	1	
X	DE 198 57 244 A1 (BOSCH GMBH ROBERT [DE]) 15 June 2000 (2000-06-15) * column 4, lines 19-37; figure 2 * -----	1	
X	JP 60 132065 A (NISSAN MOTOR) 13 July 1985 (1985-07-13) * abstract; figure 3 * -----	1	
X	US 5 769 319 A (YEN B M [US] ET AL) 23 June 1998 (1998-06-23) * column 11, line 66 - column 12, line 44; figures 6a,6b * -----	1	TECHNICAL FIELDS SEARCHED (IPC)
A	WO 2005/116441 A (BOSCH GMBH ROBERT [DE]; BOECKING FRIEDRICH [DE]) 8 December 2005 (2005-12-08) * page 6, lines 14-36; figure 2 * -----	1	F02M

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	3 July 2008	Etschmann, Georg

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
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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
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 00 1566

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The members are as contained in the European Patent Office EDP file on
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03-07-2008

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