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(71) Applicant (for all designated States except US):
SIEMENS AKTIENGESSELLSCHAFT [DE/DE]; Witel-
telsbacherplatz 2, 80333 Munich (DE).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **HAGMANN, Stefan**
[CH/CH]; Gubelstrasse 22, CH-6301 (CH). **ZHANG, Ping**
[CN/CN]; No.501 Gate 13, Building 6, JiaoMenXiLi,
Fengtai District, Beijing 100068 (CN). **YAO, Yu Chao**
[CN/CN]; ShangJiaZhuang,TangGuanTun Town,Jinghai
County, Tianjin 301608 (CN). **ZHAN, Ning** [CN/CN];
No.1701, Unit 6 Building 3 YangZhuangZhong Com-
munity, Shijingshan District, Beijing 100043 (CN).
WANG, Jian Hui [CN/CN]; No. 414, Building 710,
Wangjing Xiyuan Siqu, Chaoyang District, Beijing 100102
(CN).

(74) Agent: **KANGXIN PARTNERS, P.C.**; Floor 16, Tower
A, InDo Building, A48 Zhichun Road, Haidian District,
Beijing 100098 (CN).

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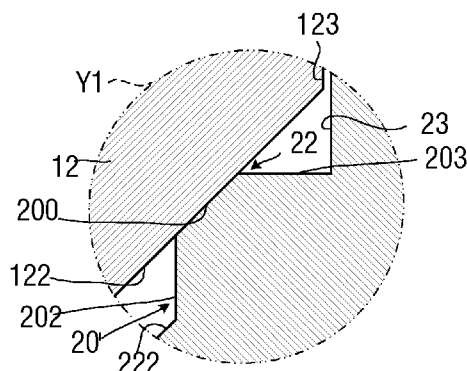


FIG. 9B

(57) Abstract: A valve assembly is provided. It includes: a valve body (1); a valve seat (11, 12) disposed in an inner chamber of the valve body (1); and a valve plug (2) capable of moving relative to the valve seat (11, 12). The valve seat (11, 12) includes a first valve seat (11) and a second valve seat (12) disposed longitudinally; the valve plug (2) includes a first contact portion (21) and a second contact portion (22), the first contact portion (21) is capable of contacting the first valve seat (11) to form a seal, the second contact portion (22) includes an annular protrusion (20) being deformable after being extruded with the second valve seat (12), the second contact portion (22) is capable of forming a seal by contacting the second valve seat (12) through the deformed protrusion (20'), and the valve body (1) has a blocking part (19) which is capable of blocking rotation of the valve plug (2). With the annular protrusion (20) disposed on the valve plug (2), the protrusion (20) can be deformed in an extrusion manner, so as to achieve a sealing effect of the valve plug (2) and the valve seat (11, 12), which omits precise machining on the valve plug (2) and the valve seat (11, 12).



VALVE ASSEMBLY

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a valve assembly, and more particularly to a
5 double-seat valve.

Related Art

The design of the double-seat valve is widely applied, for the double-seat valve can balance and compensate for a force applied to a valve plug better. The use of the double-seat valve has lots of advantages, and in particular, an actuator can drive the valve
10 plug to close the valve seat by only being applied with a smaller force. However, it is a difficulty to control a gap between the valve seat and the valve plug, the difficulty is more obvious particularly when the valve seat and the valve plug adopt a metal-to-metal seal, and this is the reason why seepage of the double-seat valve is higher than that of the single-seat valve.

15 In the prior art, it is common to perform finish machining on the valve plug and the valve seat to reduce seepage. On one hand, the valve plug is machined according to the surface design of the valve seat, so as to achieve a satisfactory sealing effect when in contact with the surface of the valve seat. On the other hand, it is also necessary to perform machining such as grinding on the surface of the valve seat, so that the surface of
20 the valve seat can fit in with the surface of the valve plug. It can be seen that the technical process of the method is complicated and the cost is high.

SUMMARY OF THE INVENTION

The present invention is directed to a valve assembly capable of achieving a higher sealing effect in a simple manner.

To achieve the objectives of the present invention, a valve assembly is provided, where the valve assembly includes:

a valve body;

a valve seat disposed in an inner chamber of the valve body, the valve seat including a
5 first valve seat and a second valve seat disposed longitudinally; and

a valve plug capable of moving relative to the valve seat, the valve plug including a first contact portion and a second contact portion, the first contact portion capable of contacting the first valve seat to form a seal, the second contact portion including an annular protrusion, the protrusion being deformable after being extruded with the second
10 valve seat, the second contact portion capable of forming a seal by contacting the second valve seat through the deformed protrusion;

wherein, a blocking part capable of blocking rotation of the valve plug is disposed in the inner chamber of the valve body.

Since only the annular protrusion is disposed on the valve plug, and the protrusion can
15 be deformed in an extrusion manner, so as to form a sealing effect of the valve plug and the valve seat, it is unnecessary to perform precise machining on the valve plug, so that the valve plug has a contact shape fitting in with the valve seat. Meanwhile, it is also unnecessary to perform operations such as grinding on the valve seat, and a good sealing effect between the valve plug and the valve body can be achieved only by extruding the
20 valve plug, which ensures that leakage flow is controlled within a required range in a closed state, thereby saving the cost of the machining. Additionally, the blocking part could prevent rotation of the valve plug in the valve body, thereby realizing a better sealing effect.

According to one embodiment of the present invention, material hardness of the protrusion is less than that of the valve seat, so as to ensure that the protrusion is
25 deformable in the case of extrusion.

In particular, the protrusion is made of bronze, and the valve seat is made of cast iron. In this way, material hardness of the protrusion on the valve plug is lower than that of the valve seat, and thus the protrusion is deformed when the valve plug is subject to an extrusion force.

5 According to another embodiment of the present invention, the first valve seat includes a first inclined surface, the first contact portion of the valve plug includes a first contact surface substantially in parallel with the first inclined surface, and the first inclined surface is capable of forming a seal when contacting the first contact surface, so as to achieve the sealing effect through surface-to-surface hard contact.

10 According to yet another embodiment of the present invention, the second valve seat includes a second inclined surface, and the protrusion of the valve plug is deformable after being extruded with the second inclined surface. Since the protrusion is deformable after being extruded with the second inclined surface, the protrusion can also form a contact surface corresponding to the second inclined surface.

15 According to one embodiment of the present invention, the protrusion is located on a second contact surface, and the second contact surface is substantially in parallel with the first inclined surface.

20 According to one embodiment of the present invention, the protrusion is a right-angle boss. It is easier for the boss to be deformed in the case of extrusion due to existence of the right angle.

25 With respect to the embodiment in which the protrusion is the right-angle boss, the protrusion is capable of forming a contact surface after being extruded with the second valve seat, and the contact surface is substantially in parallel with the second inclined surface. In this way, the contact surface formed can form a seal with the second inclined surface.

According to one embodiment of the present invention, the protrusion is specifically constructed as: a gap exists between the first inclined surface and the first contact surface when the protrusion contacts the second inclined surface without being applied with an external force. In the case of being applied with an external force, the protrusion is deformed due to the external force and can achieve sealing contact with the second inclined surface, the gap between the first inclined surface and the first contact surface is narrowed to the extent that the first inclined surface contacts the first contact surface to realize a better sealing effect.

According to another embodiment of the present invention, a fitting surface between the first contact surface and the second contact surface and one surface of the second valve seat close to the valve plug are clearance fit, so as to realize up and down movement of the valve plug relative to the valve seat more conveniently.

According to a further embodiment of the present invention, the valve plug includes at least one pair of projecting lugs disposed oppositely, a slot is formed between the at least one pair of projecting lugs, the valve body includes a bump fitting in with a position of the slot, and the blocking part is capable of at least partially extending into the slot, so as to prevent rotation of the valve plug in the valve body, thereby realizing a better sealing effect.

BRIEF DESCRIPTION OF THE DRAWINGS

The following accompanying drawings are only directed to schematically illustrate and explain the present invention, and do not limit the scope of the present invention, wherein:

FIG 1 is a sectional view of a valve body according to an embodiment of the present invention;

FIG 2A is a drawing of partial enlargement of an embodiment of a first valve seat in FIG 1;

FIG 2B is a drawing of partial enlargement of FIG 2A;

FIG 3 is a drawing of partial enlargement of an embodiment of a second valve seat in FIG 1;

FIG 4A is a top view of a valve plug according to an embodiment of the present
5 invention;

FIG 4B is a C-C sectional view of the valve plug shown in FIG 4A;

FIG 5 is a drawing of partial enlargement of Q in FIG 4B;

FIG 6 is a drawing of partial enlargement of P in FIG 4B;

FIG 7A is an E-E sectional view of the valve assembly according to an embodiment of
10 the present invention;

FIG 7B is a sectional view of the valve assembly according to an embodiment of the present invention;

FIG 8A is a drawing of partial enlargement of X in FIG 7B;

FIG 8B is a drawing of partial enlargement of X1 in FIG 8A;

15 FIG 9A is a drawing of partial enlargement of Y in FIG 7B;

FIG 9B is a drawing of partial enlargement of Y1 in FIG 9A;

FIG 10A is a drawing of partial enlargement of Z in FIG 7A;

FIG 10B is an F-F sectional view of the valve assembly in FIG 7A, illustrating the blocking part which could prevent rotation of the valve plug in the valve body;

20 FIG 11 is a schematic view of the valve assembly in a half-open state according to an embodiment of the present invention;

FIG 12A is a drawing of partial enlargement of S in FIG 11;

FIG 12B is a drawing of partial enlargement of T in FIG 11; and

FIG 13 is a drawing of the relationship of the aperture of the valve body and the external force applied on the valve plug when assembling.

5 Descriptions of reference signs

	1	Valve body
	11	First valve seat
	111	First inclined surface
	12	Second valve seat
10	122	Second inclined surface
	123	Receiving surface
	14	Upper opening
	16	Inner chamber
	17	Defining surface
15	18	Lower opening
	19	Blocking part
	2	Valve plug
	29	Projecting lug
	290	Slot
20	28	Openings of the valve plug
	21	First contact portion

22 Second contact portion

23 Fitting surface

24 Distal surface

20 Protrusion

5 20' Deformed protrusion

222 Second contact surface

27 Defining surface

211 First contact surface

200 Boss contact surface

10 DETAILED DESCRIPTION OF THE INVENTION

In order to make the technical solutions, objectives, and effects of the present invention more comprehensible, the specific embodiments of the present invention are described below with reference to the accompanying drawings.

The present invention provides a valve assembly. Although a "push-to-open" type
15 double-seat valve is used to describe the specific embodiments herein, the valve assembly is also applicable to valves with other types and structures, for example, a "push-to-close" type double-seat valve. The present invention is not limited to a valve of a particular type, and the structure of the valve is also applicable to many different types of a medium.

The valve assembly according to the present invention includes, as shown in FIG 1, a
20 valve body; a valve seat disposed in an inner chamber of the valve body; and a valve plug capable of moving relative to the valve seat, and up and down movement of the valve plug relative to the valve seat can define different open positions (full open, partial open or half-open, closed) of the valve.

In such a double-seat valve, a first valve seat and a second valve seat are disposed longitudinally, and the valve plug includes a first contact portion and a second contact portion, the first contact portion capable of contacting the first valve seat to form a seal, the second contact portion including an annular protrusion, the protrusion being deformable
5 after being extruded with the second valve seat, the second contact portion capable of forming a seal by contacting the second valve seat through the deformed protrusion.

When the first contact portion contacts the first valve seat to form a seal and the second contact portion forms a seal by contacting the second valve seat through the deformed protrusion, a closed position of the valve is defined.

10 When the valve plug moves relative to the valve seat, the first contact portion and the first valve seat are out of contact, and the deformed protrusion of the second contact portion is also out of contact with the second valve seat, different states from partial open to full open of the valve are defined.

Additionally, the blocking part could prevent rotation of the valve plug in the valve
15 body, thereby realizing a better sealing effect.

Referring to a valve body 1 shown in FIG 1, the valve body 1 includes an inner chamber 16, and includes an upper opening 14 capable of placing a valve stem (not shown), and a valve plug (not shown) can enter the inner chamber 16 of the valve body 1 through a lower opening 18 of the valve body 1 and jam the valve plug through a bump 19 in the
20 valve body 1, so as to prevent rotation of the valve plug in the inner chamber 16 of the valve body.

Referring to FIGs. 2A, 2B, and 3, the valve body 1 includes a first valve seat 11 and a second valve seat 12 disposed longitudinally.

In the diagram of partial enlargement as shown in FIGs. 2 A and 2B, the first valve seat
25 11 includes a first inclined surface 111 and a defining surface 17, in which the first inclined

surface 111 can contact a valve plug (not shown) to form a seal, the defining surface 17 can define an opening together with an opposite defining surface (not shown), and the opening and the valve plug (not shown) can define different flows of a medium together.

In the diagram of partial enlargement of the second valve seat 12 as shown in FIG 3,
5 the second valve seat 12 includes a second inclined surface 122 and a receiving surface 123, in which the second inclined surface 122 can contact a valve plug (not shown) to form a seal, the receiving surface 123 can define an opening together with an opposite surface (not shown) to receive the valve plug, and the valve plug and the receiving surface 123 are placed in the valve body 1 in a manner of clearance fit.

10 In the valve plug 2 as shown in FIGs. 4A and 4B, the valve plug 2 includes two projecting lugs 29 disposed oppositely on one side of its bottom, in which the projecting lugs 29 protrude outwardly along a direction perpendicular to the axis, and extend along a direction in parallel with the axis. A slot 290 is formed between the two projecting lugs 29, two openings 28 are opened on the top of the valve plug 2, and a medium can flow into
15 the valve plug 2 from the openings 28 when the valve plug 2 is placed in the valve body (not shown).

In the diagram of partial enlargement of the valve plug 2 as shown in FIG 5, the valve plug 2 includes a distal surface 24 and a fitting surface 23, a second contact portion 22 of the valve plug 2 exists between the distal surface 24 and the fitting surface 23, and the
20 position of the second contact portion 22 in the valve body can be designed as being in contact with the second valve seat 12, so as to form a lower seal.

Specifically, the second contact portion 22 may be a second contact surface 222 including an annular protrusion 20. To achieve the objective that the protrusion 20 is deformable after being extruded with the second valve seat 12, the protrusion 20 can be
25 selected as being made of a material whose hardness is lower than that of the valve seat 12,

for example, the valve seat 12 is made of cast iron, and the protrusion 20 is made of bronze. Since hardness of the bronze is lower than that of the cast iron, when a certain pressure is applied to the valve plug 2 so that the protrusion 20 made of bronze is extruded with the valve seat 12 made of cast iron, a slight plastic deformation may occur to the protrusion 20 made of bronze, and the deformed protrusion may form a contact surface fitting in with an extruding surface, so that a better sealing effect is achieved between the contact surface and the second valve seat 12.

The protrusion 20 may be a right-angle boss, and the right-angle boss includes a horizontal plane 203 and a vertical plane 202. When a certain pressure is applied, a right-angle edge between the horizontal plane 203 and the vertical plane 202 can be extruded with the valve seat 12, which is easier for deformation to occur.

In another diagram of partial enlargement of the valve plug 2 as shown in FIG 6, the valve plug 2 includes a first contact portion 21 connecting the fitting surface 23 and the defining surface 27. Specifically, the first contact portion 21 may be a first contact surface 211, the position of the first contact portion 21 in the valve body can be designed as being in contact with the first valve seat 11, and particularly, an upper seal is formed through hard contact of the first contact surface 211 and the first valve seat 11. Thus, the first contact surface 211 can be substantially in parallel with the first inclined surface of the first valve seat 11, and the two surfaces substantially in parallel with each other contact to form a sealing surface, so as to ensure that the leakage flow of a medium of the first contact surface 211 is controlled within a required range in the closed position.

FIGs. 7A and 7B are schematic views of pulling the valve plug upward to make the valve body in the closed position. In FIGs. 7A and 7B, a valve stem 3 extends into the inner chamber 16 of the valve body through the upper opening 14 of the valve body 1, one end of which is connected to the valve plug 2, and the other end is connected to an actuator (not shown) through a connecting mechanism 4.

When the actuator drives the valve stem 3 to pull the valve plug 2 upward to stillness through the connecting mechanism 4, the valve is in a closed state (as shown in FIGs. 7A and 7B). When the actuator drives the valve stem 3 to pull the valve plug 2 downward through the connecting mechanism 4, the valve is in an open state (as shown in FIG 11).

5 Now, relative positions of the valve plug 2 and the valve body 1 when the valve is in the closed state are described with reference to FIGs. 8A, 8B, 9A, and 9B.

As shown in FIGs. 8A and 9A, when the valve is in the closed state, the circulation of a medium between the defining surface 17 of the valve body and the defining surface 27 of the valve plug is blocked, and the circulation of a medium flowing out of the openings 28
10 of the valve plug is also blocked due to sealing contact between the second contact portion 22 and the second valve seat 12, so as to close the valve.

As shown in FIG 8B, since a hard contact seal exists between the first contact portion 21 of the valve plug 2 and the first valve seat 11 of the valve body, specifically, since the first contact portion 21 of the valve plug includes the first contact surface 211 substantially
15 in parallel with the first inclined surface 111 of the first valve seat 11, hard contact of the two surfaces forms a sealing surface, and the sealing effect is that the leakage flow of the medium between the defining surface 17 of the valve body and the defining surface 27 of the valve plug is controlled within a required range.

As shown in FIG 9B, the boss on the second contact surface 222 of the valve plug is
20 easy to be deformed in the case of extrusion due to lower material hardness. Then, a deformed protrusion 20' is formed after the extrusion, and the protrusion 20' forms a boss contact surface 200 almost in parallel with the second inclined surface 122 due to extrusion with the second inclined surface 122 of the second valve seat 12. The seal of the valve plug 2 and the second valve seat 12 can be realized by means of the boss contact surface
25 200, so as to control the leakage flow of the medium within the required range.

Since the valve plug 2 needs to move up and down relative to the valve seat (11, 12), clearance fit can be adopted between the fitting surface 23 of the valve plug and one surface (that is, the receiving surface 123) of the second valve seat close to the valve plug. It is convenient for the valve plug to move up or down.

5 Further, to avoid that the valve plug 2 rotates in the valve body 1 and affects the sealing effect, the valve plug 2 includes at least one pair of projecting lugs 29 disposed oppositely, and a slot 290 is formed between the projecting lugs 29. As shown in FIG 10A and FIG 10B, the valve body 1 includes a blocking part 19 fitting in with a position of the slot 290, and the blocking part 19 is capable of at least extending into the slot 290, so as to prevent
10 the valve plug 2 from rotating in the valve body 1 and avoid affecting the sealing effect.

The blocking part 19 could be constructed as a bump, a boss or the like. Alternatively, the prevention of rotation of the valve plug 2 in the valve body 1 could also be possible if similar solution is adopted, such as, the blocking part 19 is constructed as a groove, while a protrusion is disposed correspondingly on the valve plug 2, which could be engaged into
15 the groove, the prevention of rotation as expected could be realized due to the contact of the groove and the protrusion.

FIG 11 is a schematic view of the valve in a half-open state. Referring to the diagram of partial enlargement shown in FIGs. 12A and 12B, when the valve plug 2 moves down relative to the valve seat (11, 12), since the first contact portion 21 of the valve plug 2 is out
20 of contact with the first valve seat 11 of the valve body, specifically, since the first contact surface 211 on the first contact portion 21 of the valve plug is out of contact with the first inclined surface 111 of the first valve seat 11, the sealing surface originally formed between the two surfaces through hard contact no longer exists, the medium between the defining surface 17 of the valve body and the defining surface 27 of the valve plug flows down, and
25 the medium realizes communication. The deformed protrusion 20' may also be out of contact with the second inclined surface 122 of the second valve seat 12, and the valve plug

2 moves down along the fitting surface 23.

The process of how the valve plug according to the embodiment of the present invention is mounted in the valve body is described now.

5 The valve plug extends in the inner chamber 16 of the valve body 1 through the lower opening 18 of the valve body 1 shown in FIG 1, so that the blocking part 19 of the valve body can extend into the slot formed by the projecting lugs of the valve plug.

10 The protrusion the valve plug is specifically constructed as: a gap exists between the first inclined surface and the first contact surface when the valve plug extends in the valve body and the protrusion contacts the second inclined surface without being applied with an external force. At this time, by applying a certain external force, the protrusion may be extruded with the second inclined surface; since material hardness of the protrusion is less than that of the second inclined surface, the protrusion may be deformed to generate a boss contact surface that can fit in with the second inclined surface, thereby, a sealing surface is formed between the boss contact surface and the second inclined surface; accordingly, the gap between the first inclined surface and the first contact surface may be reduced drastically to the minimum to achieve a better sealing effect of hard contact. So far, the valve plug is mounted in the valve body.

20 It should be understood that, the applied external force KN is increased with increase of the diameter of the valve plug, as shown in FIG 13. That is to say, if the aperture of the valve body DN is increased, the diameter of the valve plug may be increased correspondingly, and the external force applied to the valve plug KN is also increased, so as to deform the annular protrusion on the valve plug.

25 Since only the annular protrusion is disposed on the valve plug, and a sealing effect of the valve plug and the valve seat is formed in an extrusion manner, it is unnecessary to perform precise machining on the valve plug, so that the valve plug has a contact shape

fitting in with the valve seat. Meanwhile, it is also unnecessary to perform operations such as grinding on the valve seat, and a good sealing effect between the valve plug and the valve body can be achieved only by extruding the valve plug, which saves the cost of the machining.

5 It should be understood that, although the present specification is described according to various embodiments, it does not indicate that each embodiment only includes an independent technical solution. Such expressions in the specification are merely for clarity. Persons skilled in the art should regard the specification as a whole, and technical solutions in the embodiments can form other embodiments that can be understood by
10 persons skilled in the art with suitable combinations.

The above descriptions are merely exemplary embodiments of the present invention, but not intended to limit the scope of the present invention. Any equivalent variations, modifications, and combinations made by persons skilled in the art without departing from the concept and the principle of the present invention shall fall within the protection scope
15 of the present invention.

CLAIMS

What is claimed is:

1. A valve assembly, comprising:
a valve body (1);
5 a valve seat (11, 12) disposed in an inner chamber (16) of the valve body (1), the valve seat (11, 12) comprising a first valve seat (11) and a second valve seat (12) disposed longitudinally; and
a valve plug (2) capable of moving relative to the valve seat (11, 12), the valve plug (2) comprising a first contact portion (21) and a second contact portion (22), the first contact
10 portion (21) capable of contacting the first valve seat (11) to form a seal, the second contact portion (22) comprising an annular protrusion (20), the protrusion (20) being deformable after being extruded with the second valve seat (12), the second contact portion (22) capable of forming a seal by contacting the second valve seat (12) through the deformed protrusion (20');
15 wherein, a blocking part (19) capable of blocking rotation of the valve plug (2) is disposed in the inner chamber (16) of the valve body (1).
2. The valve assembly according to claim 1, wherein
material hardness of the protrusion (20) is less than that of the valve seat (11, 12).
3. The valve assembly according to claim 2, wherein
20 the protrusion (20) is made of bronze, and the valve seat (11, 12) is made of cast iron.
4. The valve assembly according to claim 1 or 2, wherein
the first valve seat (11) comprises a first inclined surface (111), the first contact
portion (21) of the valve plug (2) comprises a first contact surface (211) substantially in

parallel with the first inclined surface (111), and the first inclined surface (111) is capable of forming a seal when contacting the first contact surface (211).

5. The valve assembly according to claim 1 or 2, wherein

the second valve seat (12) comprises a second inclined surface (122), and the
5 protrusion (20) of the valve plug (2) is deformable after being extruded with the second inclined surface (122).

6. The valve assembly according to claim 1 or 2, wherein

the protrusion (20) is located on a second contact surface (222), and the second contact surface (222) is substantially in parallel with the first inclined surface (111).

10 7. The valve assembly according to claim 1 or 2, wherein

the protrusion (20) is a right-angle boss.

8. The valve assembly according to claim 7, wherein

the protrusion (20) is capable of forming a contact surface (200) after being extruded with the second valve seat (12), and the contact surface (200) is substantially in parallel
15 with the second inclined surface (122).

9. The valve assembly according to claim 1 or 2, wherein

the protrusion (20) is specifically constructed as: a gap exists between the first inclined surface (111) and the first contact surface (211) when the protrusion (20) contacts the second inclined surface (122) without being applied with an external force.

20 10. The valve assembly according to claim 1 or 2, wherein

a fitting surface (23) between the first contact surface (211) and the second contact surface (222) and one surface (123) of the second valve seat (12) close to the valve plug (2) are clearance fit.

11. The valve assembly according to claim 1 or 2, wherein

the valve plug (2) comprises at least one pair of projecting lugs (29) disposed oppositely, a slot (290) is formed between the at least one pair of projecting lugs (29), and the blocking part (19) is capable of at least partially extending into the slot (290).

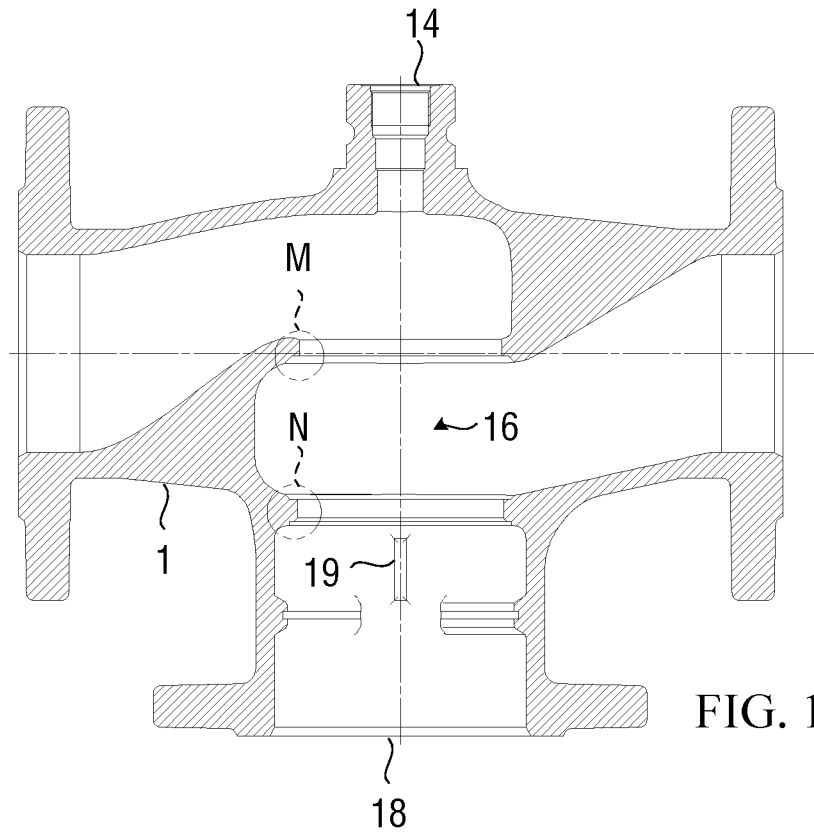


FIG. 1

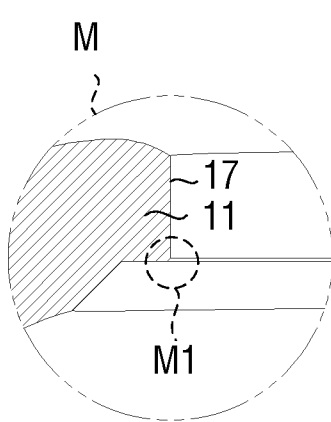


FIG. 2A

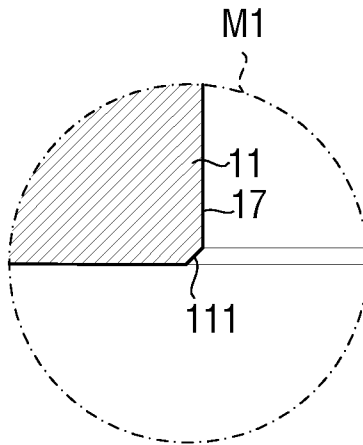


FIG. 2B

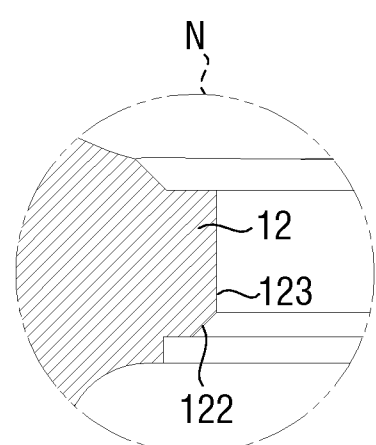


FIG. 3

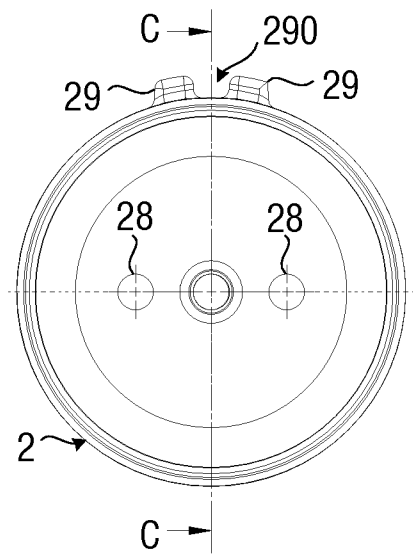


FIG. 4A

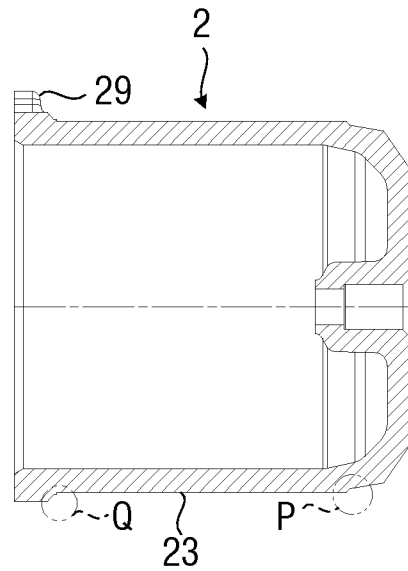


FIG. 4B

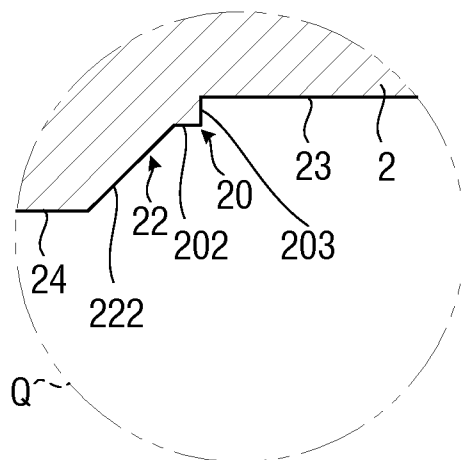


FIG. 5

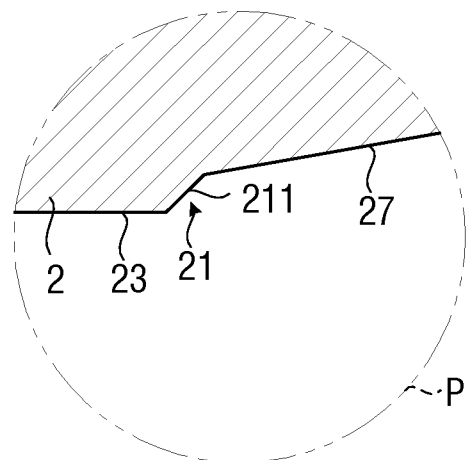
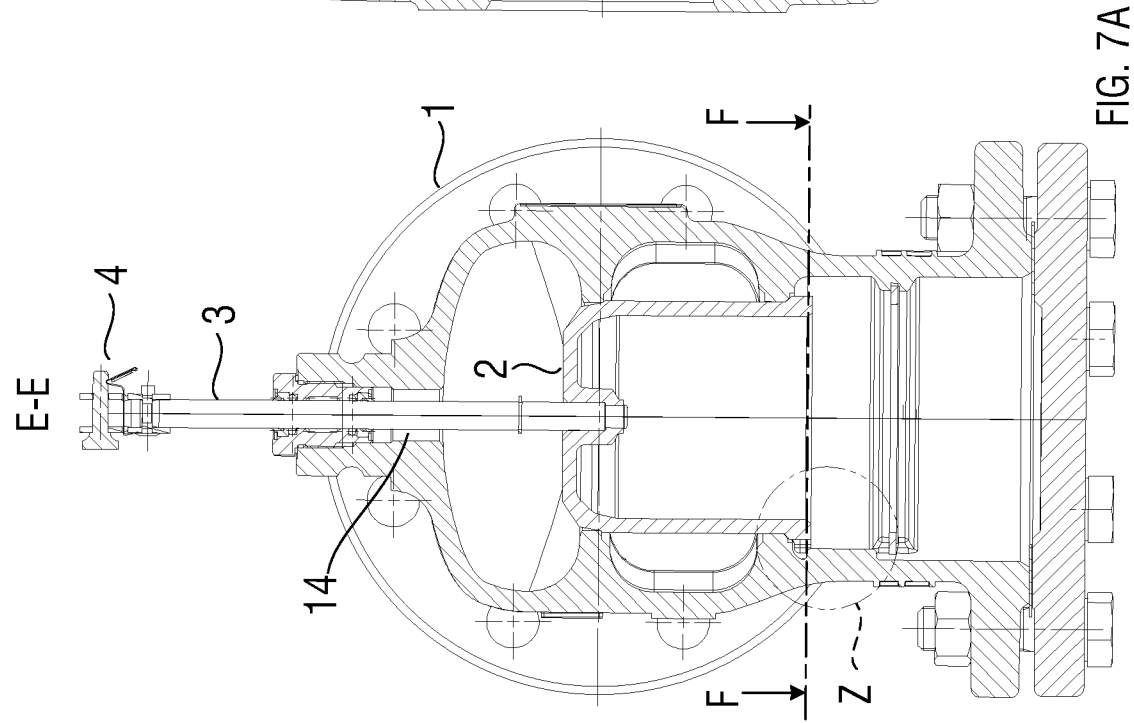
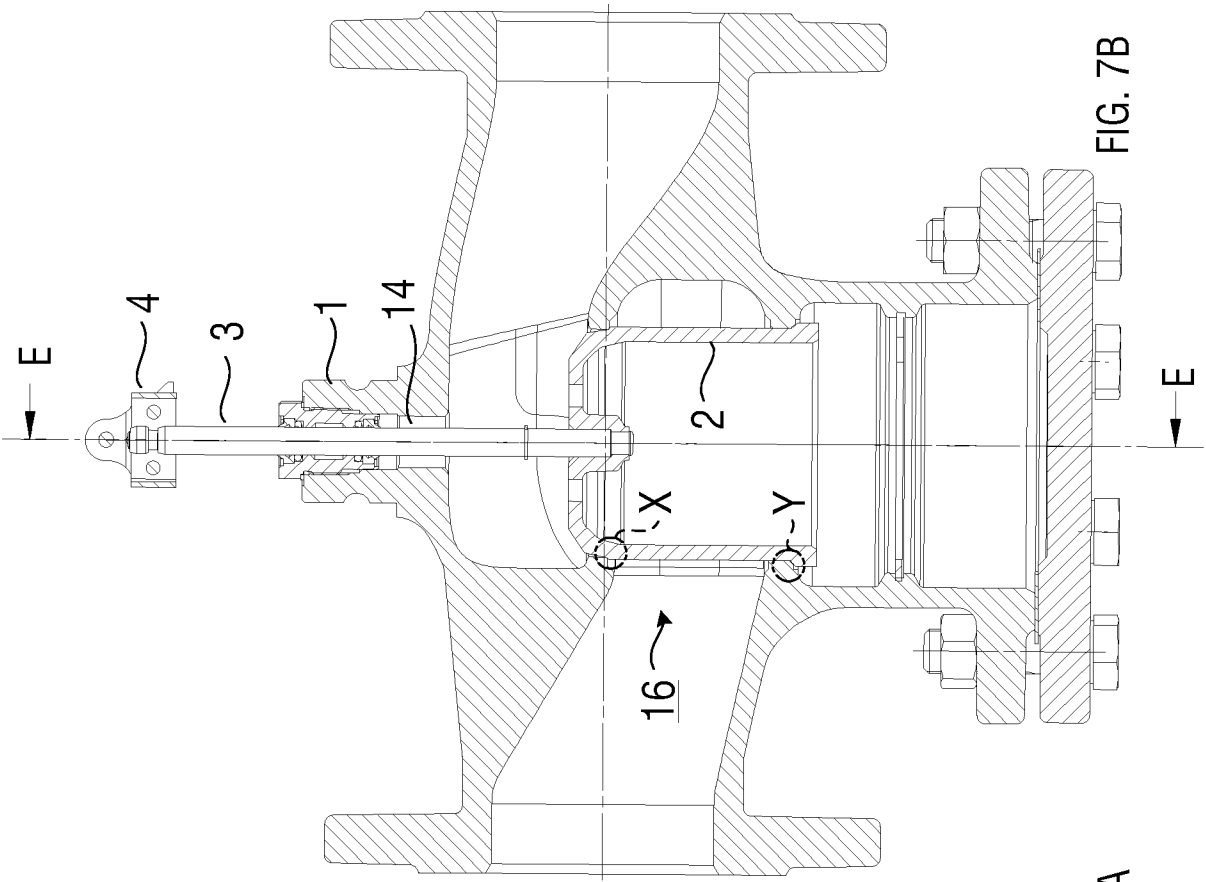


FIG. 6



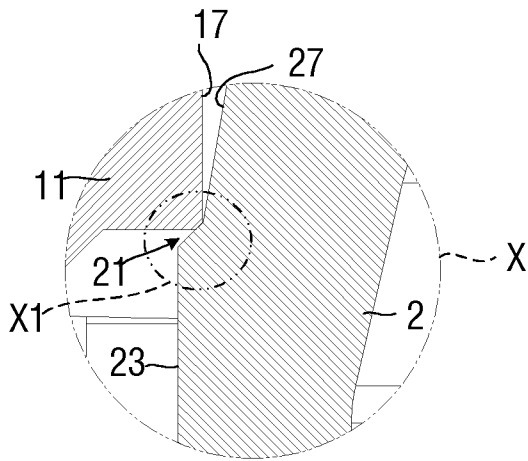


FIG. 8A

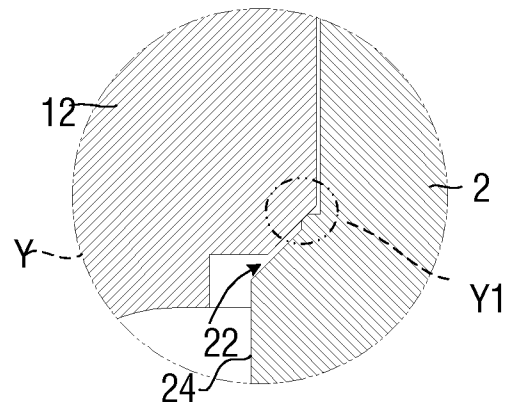


FIG. 9A

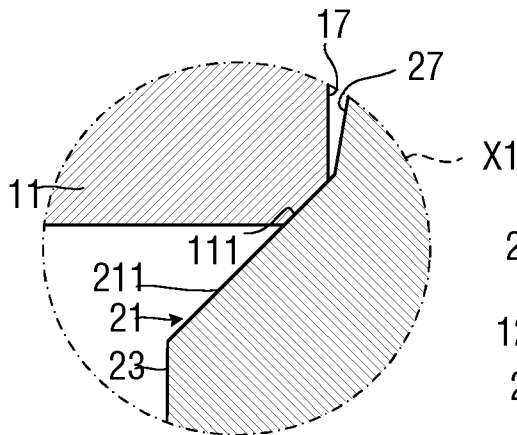


FIG. 8B

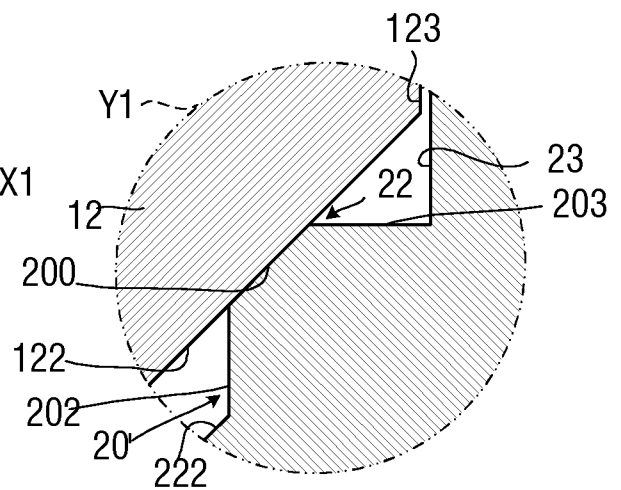


FIG. 9B

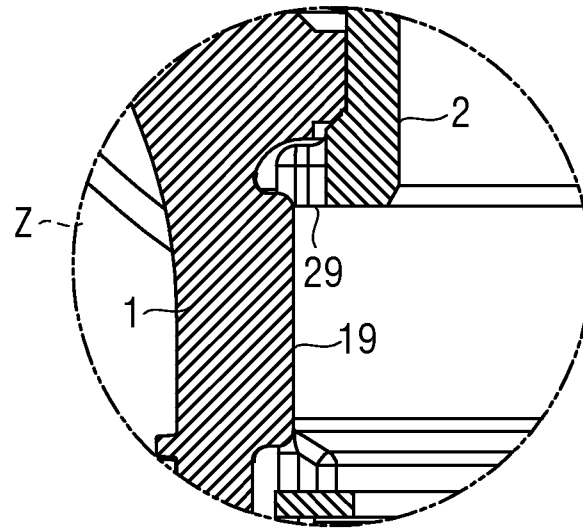


FIG. 10A

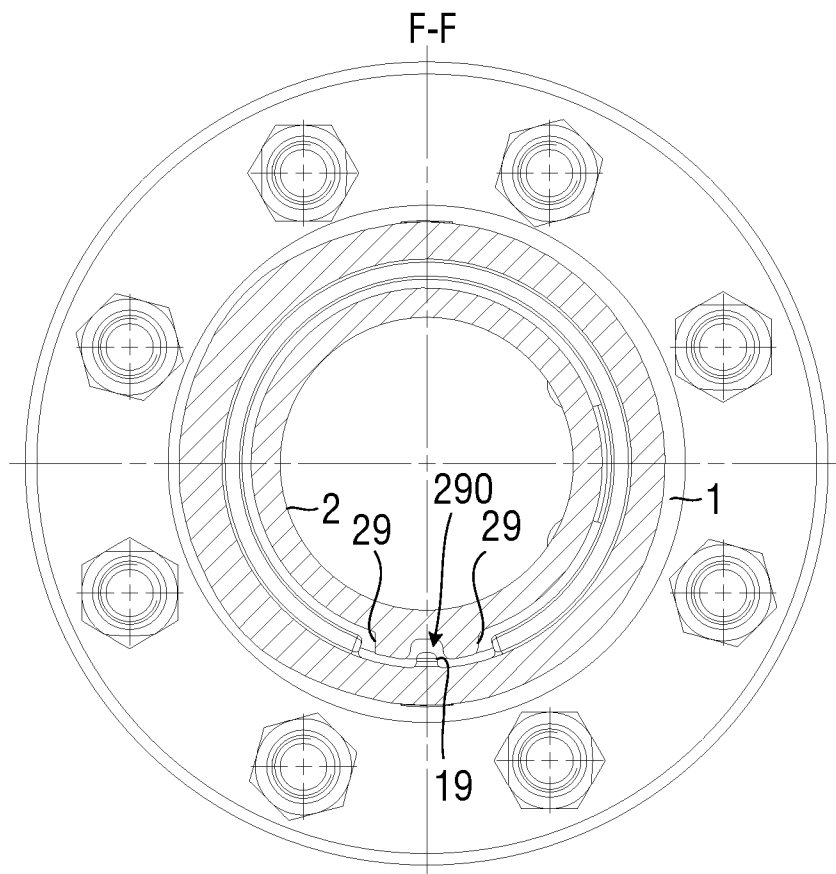


FIG. 10B

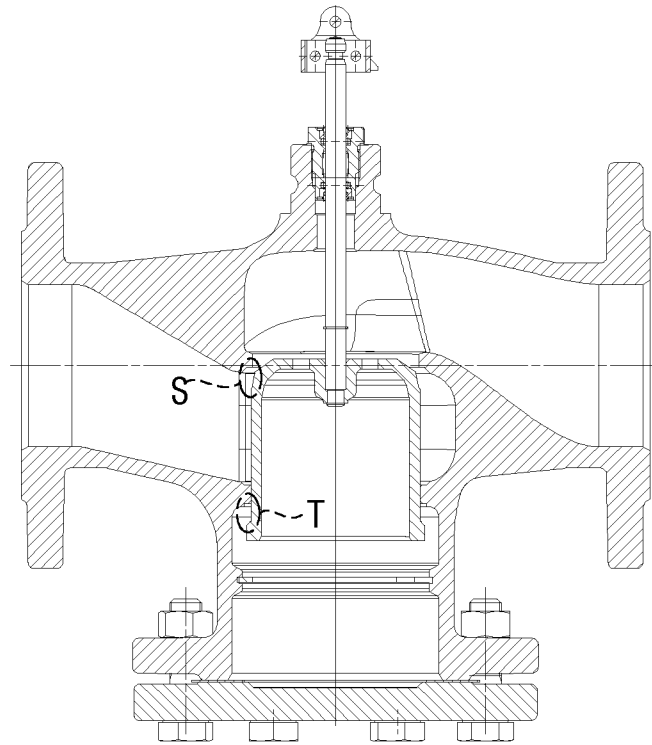


FIG. 11

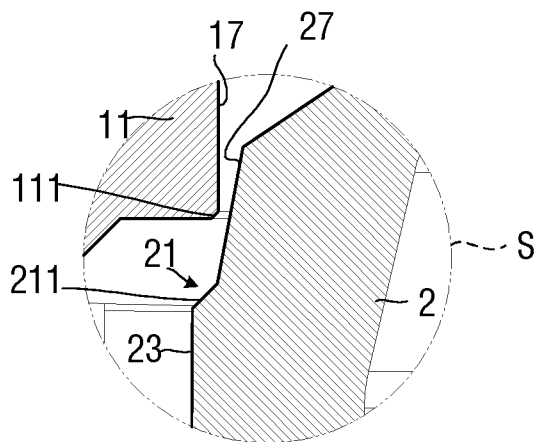


FIG. 12A

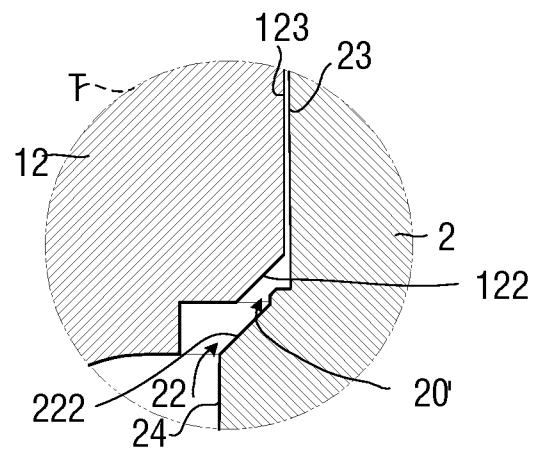


FIG. 12B

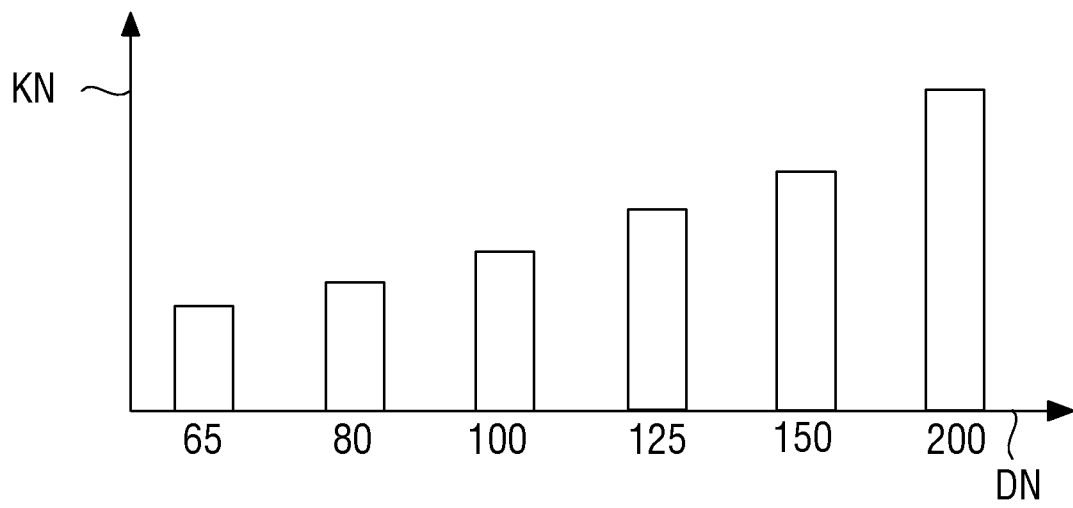


FIG. 13

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2011/071108

A. CLASSIFICATION OF SUBJECT MATTER

see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F16K1;F16K25;F16K5

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI;EPODOC;CNPAT;CNKI:valve,seal+,seat,body,chamber,first,second,double,two,protrusion,deform+,annular,inclin+,plug,bronze,sur
face,contact,block+,rotat+,prevent+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN101858439A(CHEN, Guoshun) 13 Oct. 2010(13.10.2010) claims1-10,figures1-2	1-11
A	DE102005016932B3(TUCHENHAGEN GMBH) 04 Jan. 2007(04.01.2007) claims1-4,figures 1-2	1-11
A	US6772993B1(CONTROL COMPONENTS INC.)10 Aug. 2004(10.08.2004)column 6 line7-50,figures1-3c	1-11
A	US5996966A(TRI-CLOVER,INC.)07 Dec. 1999(07.12.1999) column 6 line12-22,figures1-4	1-11
A	CN201672087U(LI, Xueya)15 Dec. 2010(15.12.2010) claims1-6,figures1-13	1-11
A	CN201228809Y(ZHEJIANG WORLD BRASS CO., LTD.)29 Apr. 2009(29.04.2009) claim1,figures1-3	1
A	CN201739525U(HANGZHOU ZHELIN VALVE CO.,LTD. et al.)09 Feb.2011(09.02.2011) claim1,figures1-4	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:	“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
“A” document defining the general state of the art which is not considered to be of particular relevance	“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
“E” earlier application or patent but published on or after the international filing date	“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
“L” document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)	“&”document member of the same patent family
“O” document referring to an oral disclosure, use, exhibition or other means	
“P” document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 27 Oct. 2011(27.10.2011)	Date of mailing of the international search report 24 Nov. 2011 (24.11.2011)
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer FENG Yan Telephone No. (86-10)62412857

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2011/071108

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN101858439A	13.10.2010	NONE	
DE102005016932B3	04.01.2007	NONE	
US6772993B1	10.08.2004	NONE	
US5996966A	07.12.1999	WO9951896A	14.10.1999
		CA2325426A	14.10.1999
		EP1068463A	17.01.2001
		JP2002510782A	09.04.2002
		MXPA00009638A	15.10.2004
		JP2009150557A	09.07.2009
CN201672087U	15.12.2010	NONE	
CN201228809Y	29.04.2009	NONE	
CN201739525U	09.02.2011	NONE	

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2011/071108

CONTINUATION OF: CLASSIFICATION OF SUBJECT MATTER

F16K1/44(2006.01)i

F16K25/00(2006.01)i

F16K3/00(2006.01)i