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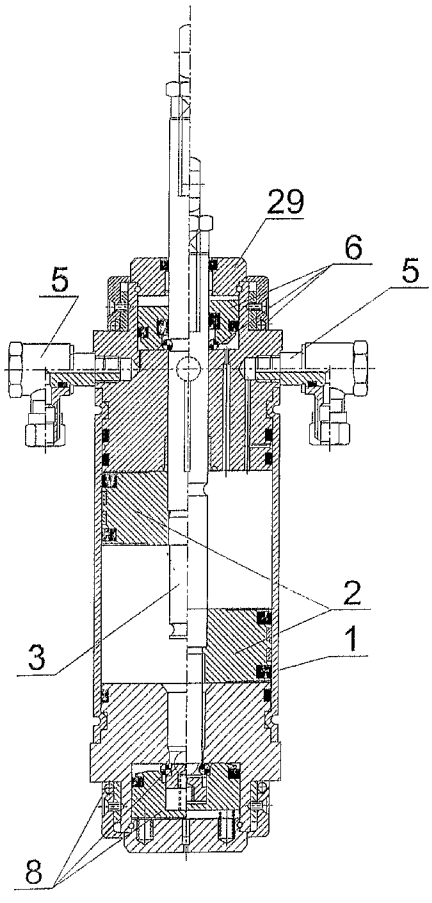
**Declaration under Rule 4.17:**

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

*[Continued on next page]*

(54) Title: PNEUMATIC-AND-HYDRAULIC CYLINDER WITH PISTON ROD INTERLOCK




(57) Abstract: Pneumatic-and-hydraulic cylinder with interlock of its piston rod consisting of cylinder with two end covers, internal piston rod provided with piston moving between said covers as well as with eye bolt, both said covers being interconnected with pipe connector through angular connectors, wherein one end of the cylindrical sleeve (1) is provided with tight-mounted front cover (4) with locking unit (6) and at the other end said sleeve is provided with tight-mounted rear cover (7) with locking unit (8). Both the front cover (4) and the rear cover (7) are provided with locking units of similar design, whereas the locking unit (6) of said front cover (4) consists of plunger (23) mounted tight on piston rod (3) and in the seat of sleeve body (3CB), with steel balls (27) located in-between and adjacent to the surface piston rod (3), which is pressed from above with helical springs (35) that are based in the lid (29) covering the upper end of the sleeve body (1) as well as the unlocking ring (13), mounted rotatably on its external surface, said unlocking ring (13) being connected with said body through springing means (19) so that its turning angle is limited.

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**Published:**
— *with international search report*
— *with amended claims*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

# Pneumatic-and-hydraulic cylinder with piston rod interlock

The subject of this invention is the pneumatic-and-hydraulic cylinder with interlock of its piston rod, for application in control systems for opening and closing industrial fixtures, such as fume-extraction flap valves.

A hydraulic cylinder known from Polish patent application, P-317708, has two cylinder end caps, one provided with a hole for piston rod connected with piston that is reciprocal between said two cylinder end caps. The cylinder end caps are joined on their one side with the cylinder through a screw joint, whereas their other sides are provided with channels for hydraulic medium inlet and outlet to and from respective chambers created between the piston and the cylinder end caps, whereas each of the end caps contains an external member and insert, and the hydraulic medium channels are shaped through the external member and that insert.

The hydraulic cylinder known from Polish application for utility pattern, W-104190, has a bottom with catch eye means fixed to it and a piston inside the cylinder with the piston rod ending with front eye means, as well as an in-built hydraulic system with a double, crosswise through hole controlled by a check valve that consists of forward check valve and retreat check valve. The cylinder bottom is provided with two flat cutouts at both outlets of the crosswise through hole, and the retreat check valve is provided with an internal channel that is connected with external output head, with and external pipe connected to it.

Hydraulic-and-pneumatic cylinder known from Polish patent specification, P-334324, has front and rear cylinder covers that are connected with sleeve coupler through hollow angle connectors, and the end of its piston rod is provided with eye bolt and locking piston fixed to it, with the top seal of the latter adhering to cylindrical surface of the front cover, whereas an annular chamber is created between the front cover face and the face of the locking piston. Said chamber contains steel balls resting on piston rod surface, whereas the end of cylindrical surface of the front cover is separably connected with the bottom which adheres to locking piston surface, and a helical spring is installed in the circumferential gap created between the bottom and the locking piston. The front cover has a small channel which joins the angular connector seat with annular chamber with cylinder chamber, whereas the side surface of the rear cover has also two stub pipes for cylinder working medium screwed in coaxially to each other, and the stub pipes and

angular connector are connected with channels, as well as the channel provided in main axis of the real cover.

The invention aims to develop a new design of pneumatic-and-hydraulic cylinder with an interlock in order to ensure its safe cooperation with opening and closing mechanisms of fume extraction flap valves.

The essence of the pneumatic-and-hydraulic cylinder with interlock of its piston rod of this invention is that it has a front cover with locking unit mounted tightly at one end inside cylindrical sleeve, and a rear cover, also with locking unit, mounted tightly at the other end of that sleeve. The locking unit of the front cover of the cylinder consists a piston in tight mounting on piston rod and in the sleeve body seat, with steel balls located in-between and adhering to piston rod surface, said piston rod being pressed from above with helical springs that are based in the lid covering the upper end of the sleeve body, as well as the unlocking ring mounted rotatably on its external surface, said unlocking ring being connected with said body through springing means so that its turning angle is limited. In turn, the locking unit at the rear cover of the cylinder consists of a plunger with axial seat accommodating other plunger with locking steel balls on its upper surface, whereas the lower surface of the external plunger is pressed by helical springs based in the lid that covers the lower end of sleeve body, whereas the unlocking ring is rotatable on the external surface of the body and is connected to it through springing means limiting its turning angle. Both locking units have profile slot cutouts provided side surface of the unlocking ring, situated opposite each other, and functioning as cams, containing the head of bolt mounted in the sleeve body, whereas the spring means with the unlocking ring are shielded with cover separably connected with that ring. Favorably, said springing means are in the form of helical tensioning springs with their one end hitched to pins located in unlocking ring and their other ends hitched to pins located on sleeve body.

The subject of the invention is illustrated on the example of its embodiment in the drawings, where fig.1 and 2 present the pneumatic-and-hydraulic cylinder with interlock in form of two axial sections perpendicular to each other along the lines A-A and B-B showing its piston rod in the extreme front position in blocked condition and in the extreme rear position in blocked condition, fig.3 is the front view of the front cover with feeding and locking of the same cylinder, fig.4 is the axial section of the same cover with locking ring in blocked and unblocked positions, sectioned along the line C-C in fig.3, fig.5 is the axial section of the same cover with locking ring in blocked and unblocked positions, sectioned along the line D-D in fig.4, fig.6 is the

cross section of the same cover sectioned along the line E-E, fig.7 is the cross section of the same cover sectioned along the line F-F, fig.8 is the vertical section of the same cover sectioned along the line G-G in fig.7, fig.9 is the cross section of the same cover sectioned along the line H-H in fig.7, fig.10 is the axial section of the rear cover with cylinder interlock with locking ring, fig.11 is the axial section of the same cover sectioned along the line K-K in fig.10, fig.12 is the cross section of the same cover sectioned along the line L-L in fig.10, fig.13 is the cross section of the same cover sectioned along the line N-N, fig.14 is the cross section of the same cover sectioned along the line P-P in fig.13, fig.15 is the vertical section of the same cover sectioned along the line R-R in fig.13 and fig.16 is the cross section of the same cover sectioned along the line T-T- in fig.10.

Pneumatic-hydraulic with the interlock of its piston rod consists of cylindrical sleeve 1 containing shiftable piston 2, on piston rod 3 located in the axis of the sleeve 1, one end of said sleeve being provided with tight-mounted front cover 4 provided with feeding connectors 5 and the locking unit 6, and the other end being provided with tight-mounted rear cover 7 with locking unit 8 and feeding connectors 9 connected, through sleeve connectors 10, with feeding connectors 5 of the front cover 4.

The front cover 4 consists of sleeve body 11 with a three-stage outer diameter and a two-stage inner diameter with circumferential flange 12, which bears the locking unit constituting a rotatable unlocking ring 13 having on its side surface two opposite profiled slot ports 14 with its curvilinear lower edges 15 functioning as cams containing the heads of bolts 16 screwed in the upper end of the body, whereas the upper surface 17 of its flange 12 and the side surface of the unlocking ring 13 are provided with two pins 18, located opposite each other, with two hitched tensioning springs 19 enabling the unlocking of that ring, whereas the sleeve body 11 is mounted inside one end of the cylindrical sleeve 1. Both tensioning springs 19 with the unlocking ring 13 are shielded with the cover 20 connected with that ring with crews 21. In turn, the inner upper face 22 of the sleeve body 11 bears the front locking plunger 23 provided with external seal 24 adhering to the surface of sleeve body 11 and with internal seal 25 adhering to the piston rod 3, whereas the lower end of the plunger has a chamfer 26 contacting circumferentially arranged locking balls 27, which rest also on the upper face 22 of the sleeve body 11, and are contained in the circumferential channel 28 of the piston rod 3. Besides, the upper face of the sleeve body 1 bears the lid 29 of the front cover 4 connected with that body with mounting ring 30, whereas the lover end of the body is provided with slide sleeve 31, and the lid 29 is provided with slide

sleeve 32 and the scraping ring 33, whereas the lower face of the lid 29 has two cylindrical seats 34, containing helical tensioning springs 35 with their lower ends resting on the face 22 of the sleeve body 11.

The rear cover 7 is of similar design as the front cover 4 and it also comprises the sleeve body 36 three-stage outer diameter and two-stage inner diameter with circum-ferential flange 37. Similarly as in the front cover, the flange 37 bears the rotatable locking unit 8 constituting an unlocking ring 13, also having on its side surface two opposite profiled slot ports 14 functioning as cams containing the heads of bolts 16 screwed in the upper end of that body and functioning as guides, whereas the upper surface 38 of its flange 37 and the side surface of the unlocking ring 13 and the side surface of the unlocking ring 18, located opposite each other, with two hitched tensioning springs 19 enabling the unlocking of that ring. Both tensioning springs 19 and the unlocking ring 13 are shielded with the cover 20 connected with that ring with crews 21.

In turn, the inner upper face 38 of the sleeve body 36 bears the rear lock plunger 40 with the seal 41, and containing the plunger 42 of locking balls 43 arranged between face 39 and the rear lock plunger 40. Besides, the upper face of the sleeve body 36 bears the lid 45 that closes the rear cover 7 connected with that body with mounting ring 30, whereas the lover face of the lid 45 has two cylindrical seats 44, containing helical compression springs 46, with their lower ends resting on the face of the plunger 40 of the real lock.

The cylinder of the invention is supplied with pneumatic or oil working medium enabling its operation in the manner that is commonly known and applied.

# Patent Claims

1. Pneumatic-and-hydraulic cylinder with interlock of its piston rod consisting of cylinder with two end covers, internal piston rod provided with piston moving between said covers as well as with eye bolt and locking piston resting on steel balls backed by the face of the front cover, provided with channels connecting the inter-piston chamber with the seat of angular connector and with the chamber under locking piston, both said covers being interconnected with pipe connector through angular connectors, **wherein** one end of the cylindrical sleeve (1) is provided with tight-mounted front cover (4) with locking unit (6) and at the other end said sleeve is provided with tight-mounted rear cover (7) with locking unit (8).
2. Pneumatic-and-hydraulic cylinder as set forth in claim 1 **wherein** said locking unit (6) of said front cover (4) consists of plunger (23) mounted tight on piston rod (3) and in the seat of sleeve body (11), with steel balls (27) located in-between and adjacent to the surface piston rod (3), which is pressed from above with helical springs (35) that are based in the lid (29) covering the upper end of the sleeve body (1) as well as the unlocking ring (13), mounted rotatably on its external surface, said unlocking ring (13) being connected with said body through springing means (19) so that its turning angle is limited.
3. Pneumatic-and-hydraulic cylinder as set forth in claim 1 **wherein** the locking unit (8) of the rear cover (7) consists of plunger (40) with axial seat axial seat accommodating the plunger (42) with locking steel balls (43) on its upper surface, whereas the lower surface of the plunger (40) is pressed by helical springs (46) based in the lid (45) that covers the lower end of sleeve body (36), whereas the unlocking ring (13) is mounted rotatable on the external surface of said body and connected to it with spring means (19) limiting its turning angle.
4. Pneumatic-and-hydraulic cylinder as set forth in claim 1 or 2 or 3 **wherein** the unlocking ring (13) is provided with profile slot ports (14) on its side surface arranged opposite each other and functioning as cams containing the head of bolt (26) based in the sleeve body (11) and (36).
5. Pneumatic-and-hydraulic cylinder as set forth in claim 1 or 2 or 3 **wherein** the springing elements (19) are in the form of

helical tensioning springs with their ends engaging the pins (18) based in the unlocking ring, and their other ends engaging the pins (18) based in the sleeve body (11) or (36).

6. Pneumatic-and-hydraulic cylinder as set forth in claim 1 or 2 or 3 or 5 **wherein** the springing means (19) with unlocking ring (13) are shielded with the cover (20) connected separably with said ring.

# AMENDED CLAIMS
## received by the International Bureau on 07 February 2007 (07.02.2007)

Patent Claims

1. Pneumatic-and-hydraulic cylinder with interlock of its piston rod consisting of cylinder with two end covers, internal piston rod provided with piston moving between said covers as well as with eye bolt and locking piston resting on steel balls backed by the face of the front cover, provided with channels connecting the inter-piston chamber with the seat of angular connector and with the chamber under locking piston, both said covers being interconnected with pipe connector through angular connectors, in addition one end of the cylindrical sleeve is provided with tight-mounted front cover with locking unit and at the other end said sleeve is provided with tight-mounted rear cover with locking unit **wherein** said locking unit (6) of said front cover (4) consists of plunger (23) mounted tight on piston rod (3) and in the seat of sleeve body (11), with steel balls (27) located in-between and adjacent to the surface piston rod (3), which is pressed from above with helical springs (35) that are based in the lid (29) covering the upper end of the sleeve body (1) as well as the unlocking ring (13), mounted rotatably on its external surface, said unlocking ring (13) being connected with said body through springing means (19) so that its turning angle is limited.
2. Pneumatic-and-hydraulic cylinder as set forth in claim 1 **wherein** the locking unit (8) of the rear cover (7) consists of plunger (40) with axial seat axial seat accommodating the plunger (42) with locking steel balls (43) on its upper surface, whereas the lower surface of the plunger (40) is pressed by helical springs (46) based in the lid (45) that covers the lower end of sleeve body (36), whereas the unlocking ring (13) is mounted rotatable on the external surface of said body and connected to it with spring means (19) limiting its turning angle.

3. Pneumatic-and-hydraulic cylinder as set forth in claim 1 or 2 or 3 **wherein** the unlocking ring (13) is provided with profile slot ports (14) on its side surface arranged opposite each other and functioning as cams containing the head of bolt (26) based in the sleeve body (11) and (36).

4. Pneumatic-and-hydraulic cylinder as set forth in claim 1 or 2 or 3 **wherein** the springing elements (19) are in the form of helical tensioning springs with their ends engaging the pins (18) based in the unlocking ring, and their other ends engaging the pins (18) based in the sleeve body (11) or (36).

5. Pneumatic-and-hydraulic cylinder as set forth in claim 1 or 2 or 3 or 5 **wherein** the springing means (19) with unlocking ring (13) are shielded with the cover (20) connected separably with said ring.

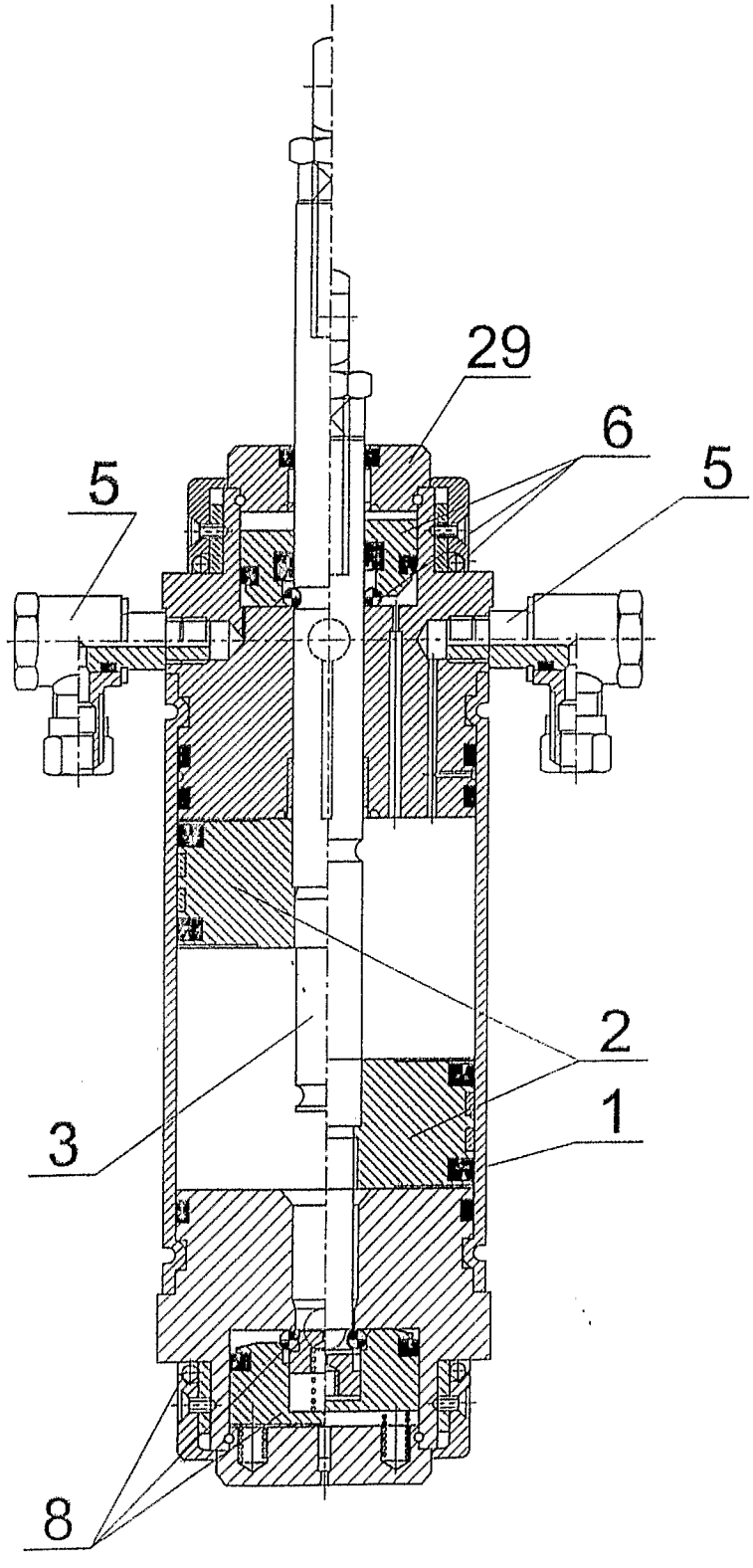


Fig.1

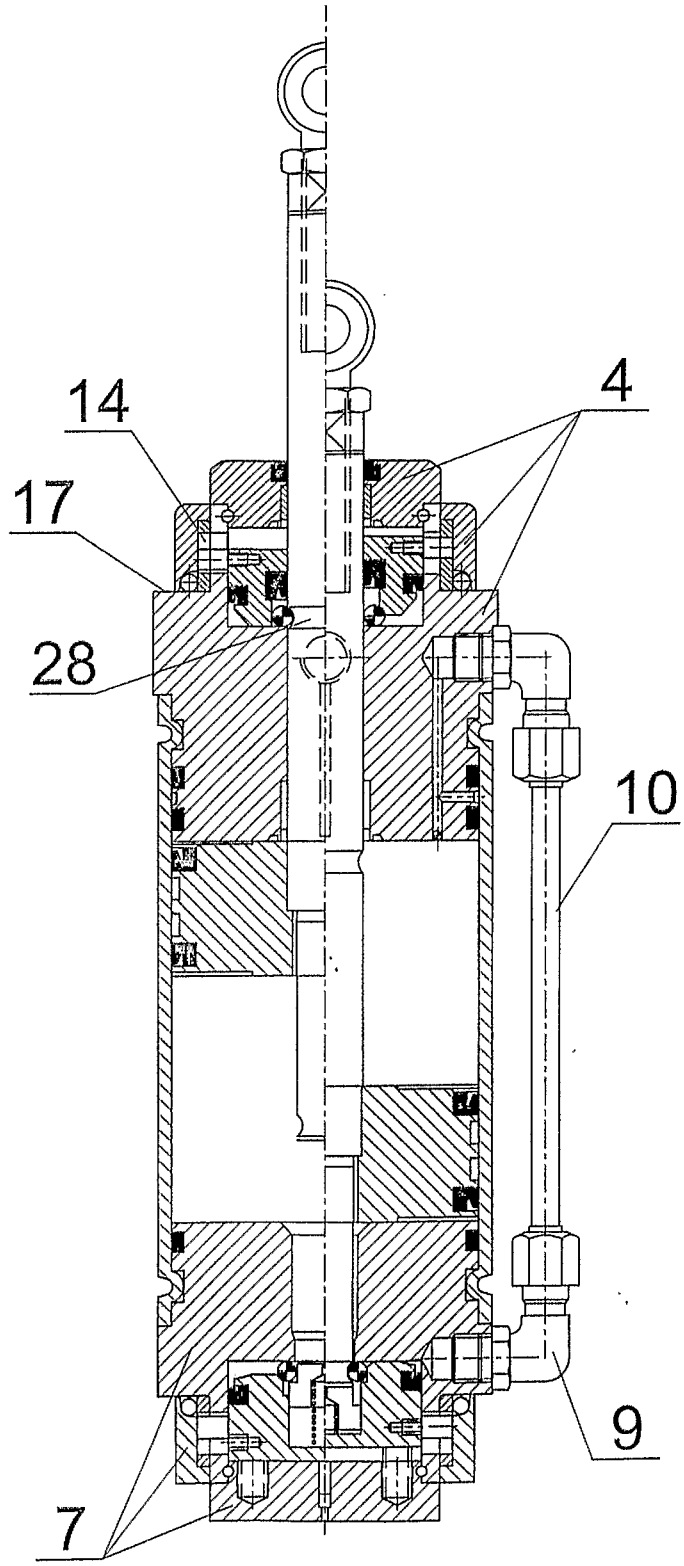


Fig.2

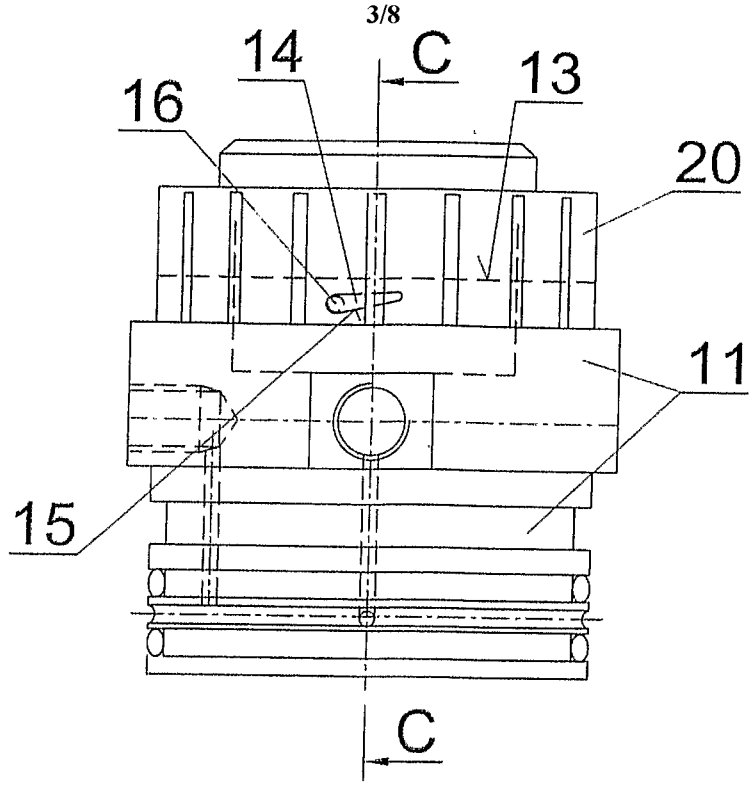
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Fig.3

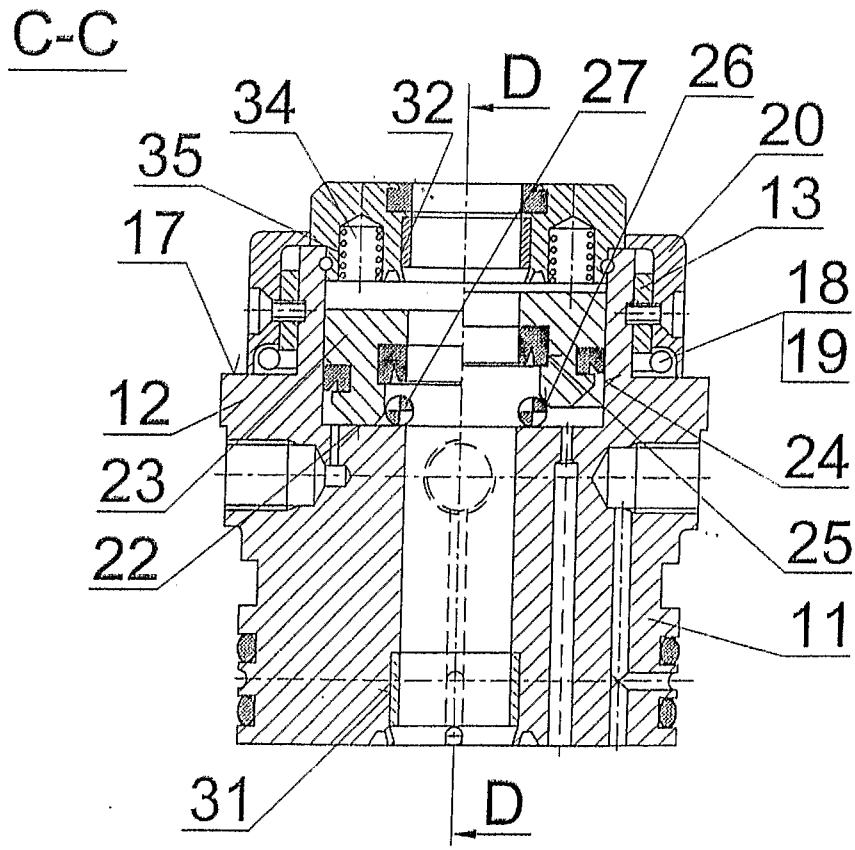
C-C
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Fig.4

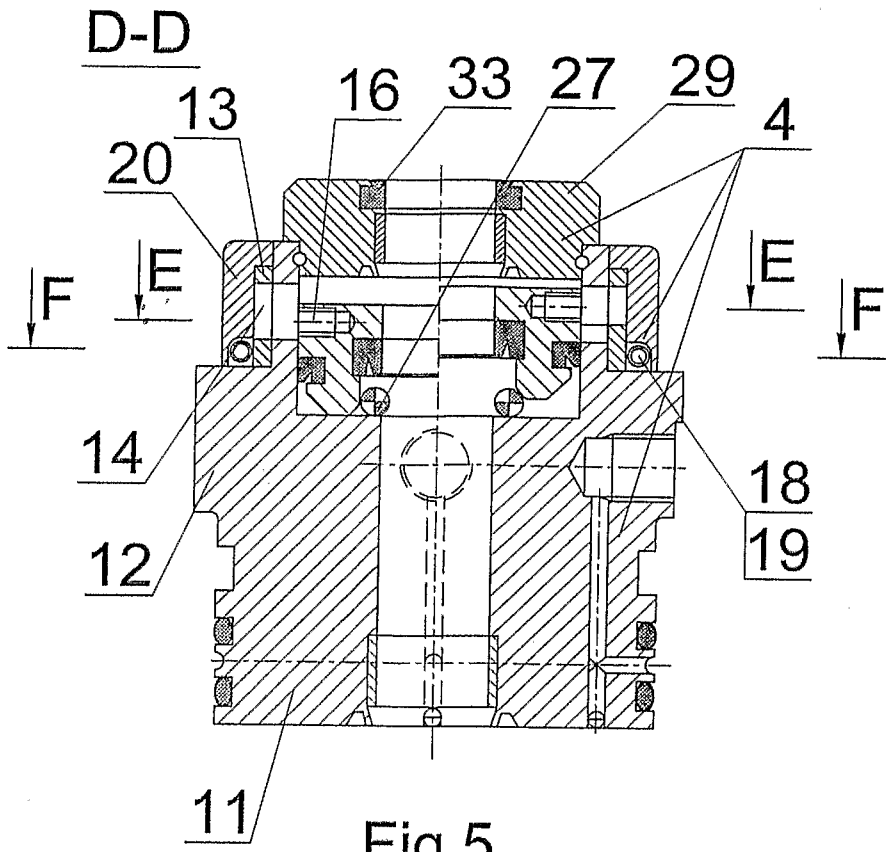


Fig.5

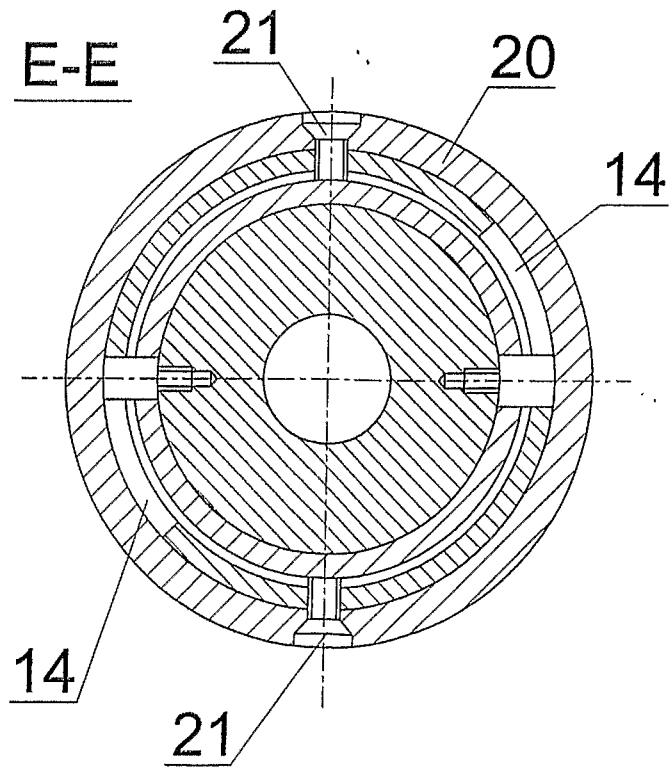


Fig.6

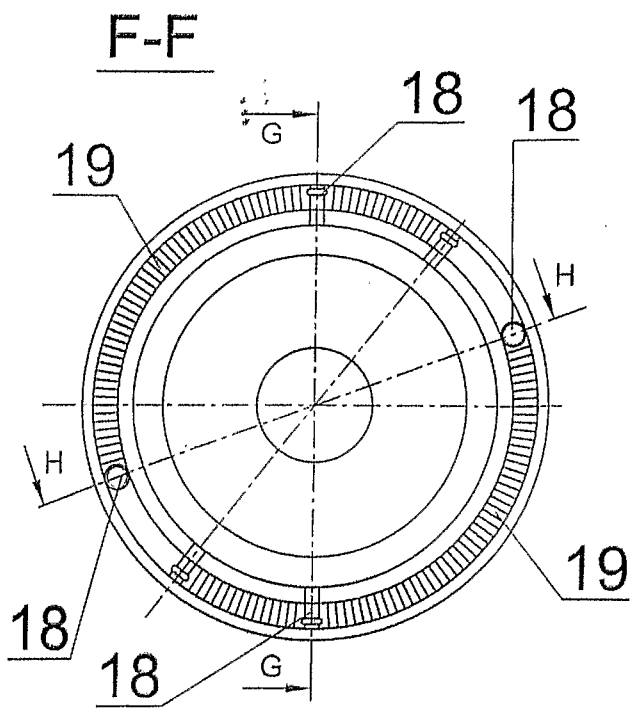


Fig.7

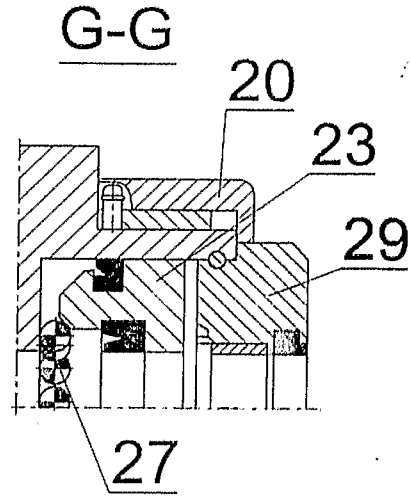


Fig.9

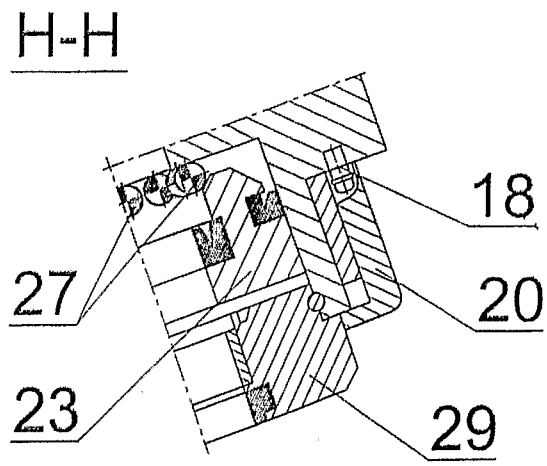


Fig.8

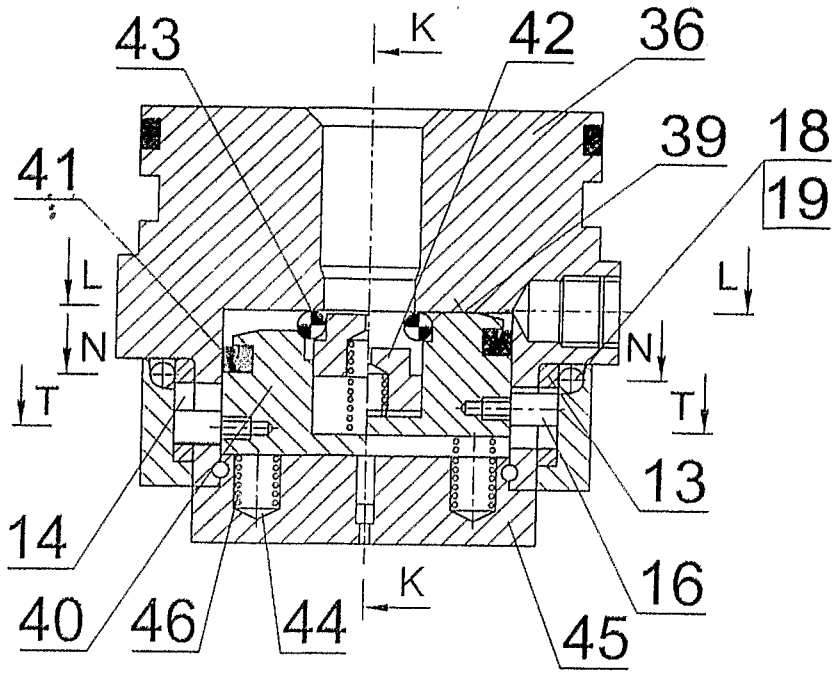
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Fig.10

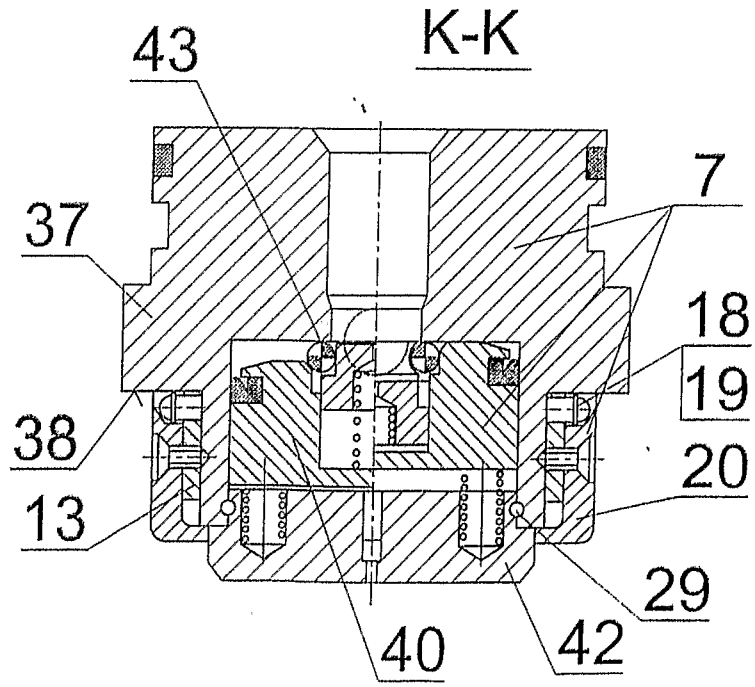
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Fig.11

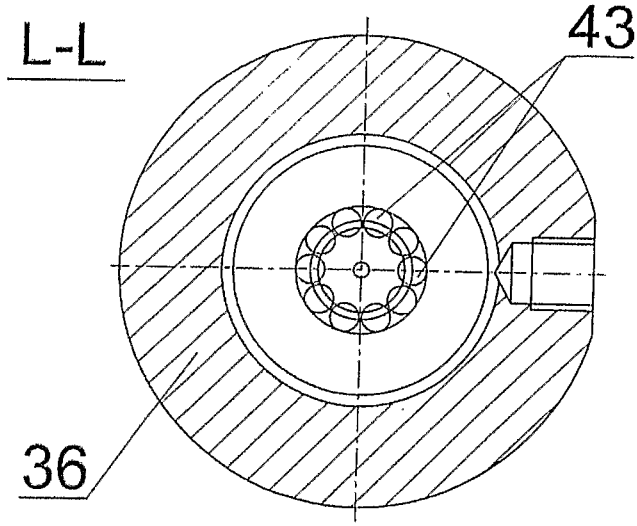


Fig.12

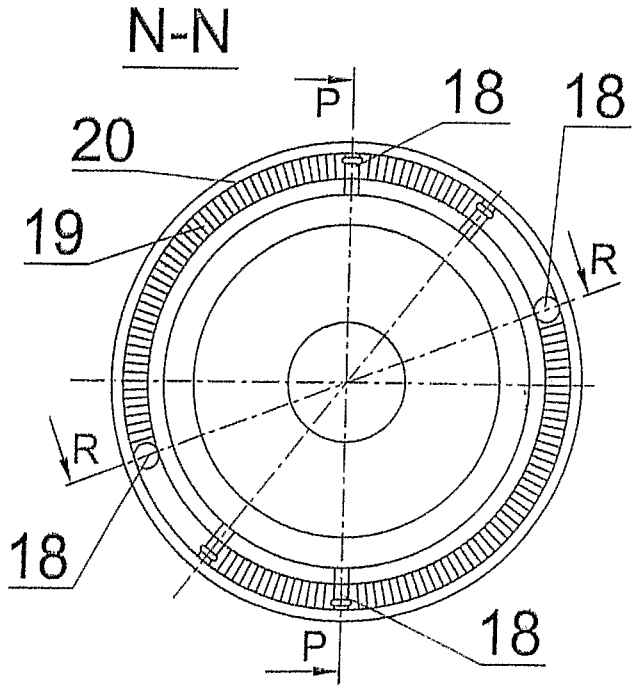


Fig.13

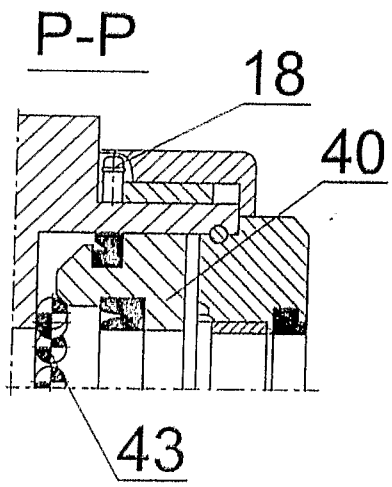


Fig.15

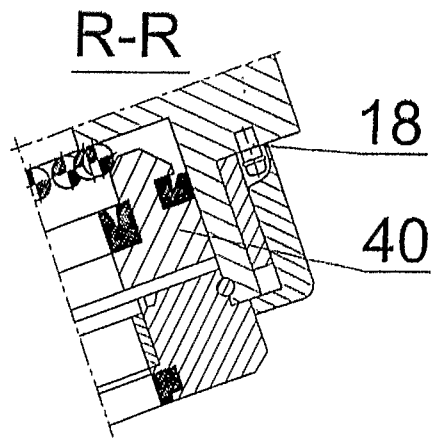


Fig.14

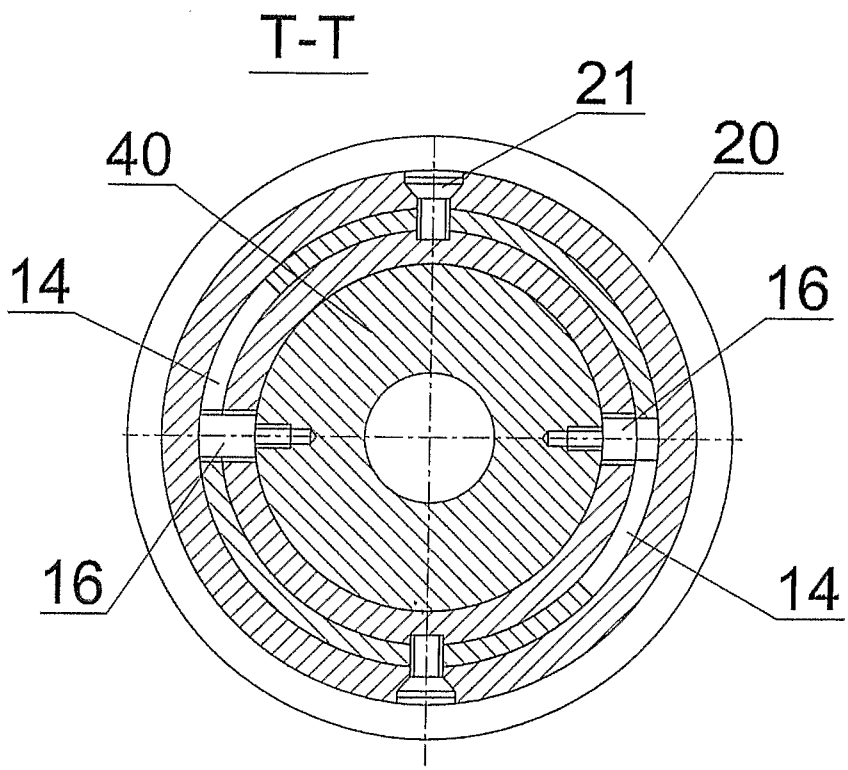


Fig.16

# INTERNATIONAL SEARCH REPORT

International application No
PCT/PL2006/000051

A. CLASSIFICATION OF SUBJECT MATTER
INV. F15B15/26

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)
F15B

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 practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | DE 88 12 882 U1 (FA. OTTO GRASL, 3452 HEILIGENEICH, DE)<br>16 February 1989 (1989-02-16)<br>page 7, line 1 - page 9, line 12; figure 1 | 1 |
| A | | 2,3 |
| A | EP 0 903 502 A (CONTAT FRERES ETS [FR])<br>24 March 1999 (1999-03-24)<br>paragraphs [0039] - [0041]; figures 2,4 | 1-6 |
| A | US 3 397 620 A (SKELTON DAROLD M ET AL)<br>20 August 1968 (1968-08-20)<br>column 2, line 3 - column 4, line 6;<br>figures 1,2 | 1-3 |
| A | DE 30 18 920 A1 (ANDEXER ROLF FA [DE])<br>26 November 1981 (1981-11-26)<br>the whole document | 1 |

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 24 November 2006 | 01/12/2006 |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL – 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,<br>Fax: (+31-70) 340-3016 | Busto, Mario |

# INTERNATIONAL SEARCH REPORT

International application No
PCT/PL2006/000051

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | US 5 806 406 A (PETTERSSON THOMAS [SE])<br>15 September 1998 (1998-09-15)<br>cited in the application<br>the whole document<br>----- | 1 |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/PL2006/000051

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