

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
15 February 2001 (15.02.2001)

PCT

(10) International Publication Number
WO 01/11204 A1

(51) International Patent Classification⁷: **F01L 7/02**

(21) International Application Number: PCT/IT00/00332

(22) International Filing Date: 2 August 2000 (02.08.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
MI99A001758 4 August 1999 (04.08.1999) IT

(71) Applicant (for all designated States except US): **MIL-LENNIUM ENGINEERING S.R.L.** [IT/IT]; Via Roma, 9, I-25025 Manerbio (IT).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **FILIPPINI, Mauro** [IT/IT]; Via Paolo Farina, 32, I-25020 Cigole (IT).

(74) Agents: **JORIO, Paolo** et al.; Studio Torta S.r.l., Via Viotti, 9, I-10121 Torino (IT).

(81) Designated States (*national*): AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

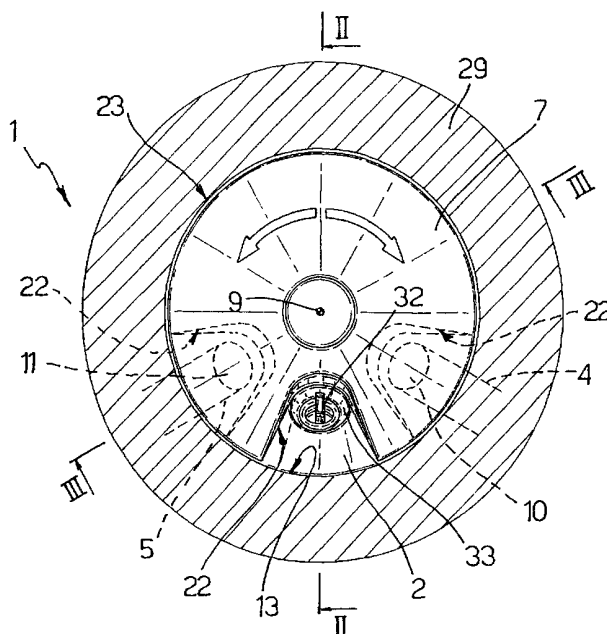
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

- With international search report.
- Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.

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.

(54) Title: GAS EXCHANGE ROTARY VALVE FOR AN INTERNAL COMBUSTION ENGINE



(57) Abstract: A valve unit (1) for selectively cutting off two fluid streams, in particular the inlet and exhaust streams of an internal combustion engine cylinder, and having a body (2) in which are formed a first and a second channel (4, 5), both communicating with the same sealing seat (6) for a single shutter (7); the shutter (7) has a sealing surface (8) cooperating in fluidtight manner with the sealing seat (6), and is housed in rotary manner inside said sealing seat (6), so as to rotate reciprocally to selectively and alternately open-close the first channel (4) and the second channel (5).



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GAS EXCHANGE ROTARY VALVE FOR AN INTERNAL COMBUSTION ENGINE

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TECHNICAL FIELD

The present invention relates to a valve unit for selectively cutting off two fluid streams, and which is particularly suitable for use as an inlet-exhaust valve unit for an internal combustion engine cylinder.

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BACKGROUND ART

As is known, in reciprocating (piston) internal combustion engines, the cylinders, which are normally defined by respective cavities formed in the engine block and closed by a cylinder head, are fitted with inlet valves by which fuel is drawn into the cylinders, and with exhaust valves by which fuel combustion residue is removed from the cylinders.

20

Separate suction and exhaust conduits are normally provided, each with a respective valve, which is typically defined by a cylindrical rod with a mushroom-shaped head cooperating in fluidtight manner with a seat formed in the cylinder head. The valve opens when the

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head on the rod, activated by the camshaft and in opposition to a counter spring, is detached from its flared seat and penetrates the cylinder, thus permitting passage of the fluid (fuel mixture or exhaust gas).

5 As is known, besides being relatively expensive and difficult to manufacture and install, valves of the above type also pose problems in terms of size, and, above all, require a control system (normally featuring a camshaft) which is also fairly complex, bulky and susceptible to
10 operating problems. Moreover, when the valve is open, the head on the rod, which defines the shutter of the valve, is located along the fluid stream flowing through the valve, thus resulting in irregular flow (and, hence, increased load losses).

15 On the other hand, generally speaking, no valve units are currently available for selectively cutting off two different fluid streams, and which at the same time are compact, cheap and easy to manufacture, and of straightforward, reliable operation.

20 DISCLOSURE OF INVENTION

It is an object of the present invention to provide a valve unit for cutting off two fluid streams, which is efficient, cheap and easy to produce, accurate, reliable and compact, and therefore particularly suitable for use
25 as an inlet-exhaust valve unit for an internal combustion engine cylinder.

According to the present invention, there is provided a valve unit for selectively cutting off two

fluid streams, in particular the inlet and exhaust streams of an internal combustion engine cylinder, and comprising a body in which is formed at least one channel having a sealing seat for at least a respective shutter for opening-closing said channel; the valve unit being
5 characterized in that a first and a second channel are formed in said body for the passage of two separate fluid streams; said first and said second channel both communicating with the same sealing seat for a single
10 shutter having a sealing surface cooperating in fluidtight manner with said sealing seat; said shutter being housed in rotary manner inside said sealing seat, so as to rotate reciprocatingly to selectively and alternately open-close said first channel and said second
15 channel. Operation of the valve unit according to the invention does not require a complex camshaft control system.

The valve unit according to the invention thus provides for selectively cutting off two different fluid
20 streams in a straightforward, accurate, reliable manner, while at the same time being cheap and easy to produce and install and extremely compact. Moreover, when either of the channels is open, the shutter is never located along, and therefore never interferes with or affects,
25 the respective fluid stream.

The valve unit according to the invention is particularly suitable for use as an inlet-exhaust valve unit for a piston (reciprocating) internal combustion

engine, precisely on account of operating simply and accurately, being compact in size, and not only requiring no complex camshaft control system, but also permitting extremely straightforward adjustment of the open/close lead/delay settings. In this application, the valve unit according to the invention provides for controlling both the fuel inlet channel and the exhaust channel by means of one shutter, which, not being located along the fluid streams, interferes with neither when the corresponding channel is open. The valve unit according to the invention is particularly suitable for use in reciprocating engines in which the pistons slide in tangential cylinders rotating together with the drive shaft, such as the engine described in a co-pending patent application by the present Applicant. In which case, a valve unit in accordance with the invention is fitted to the head of each cylinder, and is controlled by a gear integral with the shutter and operated by a movable rack.

BRIEF DESCRIPTION OF THE DRAWINGS

A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a schematic plan view of a valve unit in accordance with the invention and applied by way of example to a cylinder head of a reciprocating internal combustion engine;

Figures 2 and 3 show two sections, along lines II-II

and III-III respectively, of the Figure 1 valve unit in two different operating positions.

BEST MODE FOR CARRYING OUT THE INVENTION

With reference to the accompanying drawings, a valve
5 unit 1 for selectively cutting off two fluid streams
comprises a body 2 closing a cavity 3 and in which are
formed two channels 4, 5 for the passage of separate
respective fluid streams; a sealing seat 6 defined inside
cavity 3; and a respective shutter 7 having a sealing
10 surface 8 cooperating in fluidtight manner with sealing
seat 6.

Sealing seat 6 is axially symmetrical with respect
to a predetermined axis 9 and, in the non-limiting
example shown, is truncated-cone-shaped; both channels 4,
15 5 communicate with sealing seat 6 via respective mouths
10, 11 formed in an inner surface 12 of sealing seat 6
and spaced angularly apart and a predetermined distance
from a peripheral edge 13 of sealing seat 6.

Shutter 7 comprises a bell 15 defined by a
20 truncated-cone-shaped lateral wall 16 complementary in
shape to sealing seat 6; and a rod 17 extending from the
smaller-diameter axial end 18 of bell 15 and fitted
through a sliding seat 19 formed through an end wall 20
of body 2 and connected to sealing seat 6. Sealing
25 surface 8 of shutter 7 is defined, in the example shown,
by a substantially continuous outer lateral surface of
lateral wall 16 of bell 15; and an end 21 of rod 17
extends outwards of sliding seat 19 on the opposite side

to cavity 3.

Shutter 7 also comprises a through opening 22 formed in a predetermined position through lateral wall 16 of bell 15. In the example shown, opening 22 is an open window on a peripheral end edge 23 of bell 15, and is, for example, roughly trapezoidal with rounded edges.

Shutter 7 is housed for rotation inside sealing seat 6, and valve unit 1 also comprises control means 25 for rotating shutter 7, inside sealing seat 6, about a predetermined axis of rotation - in the example shown, axis 9. Control means 25 may be of any known type capable of acting on and rotating rod 17 about a longitudinal axis of symmetry (axis 9) of the rod. Since rod 17 is connected integrally to bell 15, rotation of rod 17 obviously results in rotation of shutter 7 as a whole.

In the non-limiting example shown, control means 25 comprise a wheel 26 fitted to end 21 of rod 17, having a supporting element 27 insertable inside a respective seat (not shown for the sake of simplicity), and activated by an external control (not shown, and which may, for example, be defined by a rack meshing with wheel 26, which, in that case, is a gear). Rod 17 is fitted, close to end 21, with a spring 28 compressed between wheel 26 and end wall 20 of body 2, so as to exert a predetermined axial force on wheel 26, and hence on rod 17 to keep sealing surface 8 of shutter 7 resting against the inner surface 12 of sealing seat 6.

Valve unit 1 is particularly suitable for use as an

inlet-exhaust valve unit for a cylinder 29 of a reciprocating internal combustion engine. In which case, and as shown in the accompanying drawings, body 2 forms part of a head of cylinder 29 (only part of which is shown schematically); cavity 3 is defined by a combustion chamber in turn defined inside cylinder 29 itself; and a known spark plug 30 is inserted inside a respective seat 31 formed in body 2, with the spark electrode 32 end of the plug projecting inside a recess 33 in cavity 3, so as to be located beneath inner surface 12 of sealing seat 6 and a predetermined distance from peripheral edge 13 of sealing seat 6, e.g. equal to the distance between peripheral edge 13 and mouths 10, 11 of channels 4, 5.

Plug 30 is preferably located in an intermediate position with respect to mouths 10, 11 of channels 4, 5, which mouths are located symmetrically with respect to plug 30.

Opening 22 is radially longer than the distance between peripheral edge 13 of sealing seat 6 and spark electrode 32, and the distance between peripheral edge 13 of sealing 6 and mouths 10, 11 of channels 4, 5, and is wider (circumferentially) than mouths 10, 11.

In actual use, shutter 7 is housed inside sealing seat 6, with sealing surface 8 maintained (by the axial force of spring 28) contacting inner surface 12 of sealing seat 6, and with peripheral edge 23 of bell 15 substantially mating with peripheral edge 13 of sealing 6, can be rotated inside sealing seat 6 about axis 9, is

movable axially along axis 9, and, by acting on control means 25, can be set selectively to either of the following work positions:

- a first work position - shown by the dash line in
5 Figure 1 and the Figure 3 section - wherein opening 22 of shutter 7 is aligned with mouth 11 of channel 5, channel 5 therefore communicates fluidically with cavity 3, and respective adjacent, circumferentially spaced portions of sealing surface 8 close mouth 10 of channel 4 and recess
10 33 housing spark electrode 32 : in the example shown of an inlet-exhaust valve unit for an internal combustion engine, this situation corresponds to the suction stroke;

- a second work position - also shown by the dash line in Figure 1 - wherein opening 22 of shutter 7 is
15 aligned with mouth 10 of channel 4, channel 4 communicates fluidically with cavity 3, and sealing surface 8 closes mouth 11 of channel 5 and recess 33 housing spark electrode 32 : in the case of an inlet-exhaust valve unit for an internal combustion engine,
20 this situation corresponds to the exhaust stroke;

- a third work position - shown by the continuous line in Figure 1 and the Figure 2 section - wherein opening 22 of shutter 7 is aligned with spark electrode 32, and sealing surface 8 of shutter 7 closes both mouths
25 10, 11 of channels 4, 5 : in the case of an inlet-exhaust valve unit for an internal combustion engine, this situation corresponds to the explosion and compression strokes.

Shutter 7 is set alternately to the above work positions by a reciprocating rotary movement shown schematically by the curved arrows in Figure 1. The third work position described above is between the other two, so that shutter 7 is set alternately to the first and second work positions by rotating in opposite directions from the third work position.

In a preferred embodiment, to prevent sealing surface 8 from sliding against inner surface 12 of sealing seat 6 during rotation of shutter 7, valve unit 1 also comprises known axial actuating means 34 (shown schematically in Figure 2) for axially moving shutter 7. Axial actuating means 34 - for example, of the cam or electromagnet type - are connected mechanically to end 21 of rod 17 (possibly by wheel 26 or respective supporting element 27), and, in use, are activated by an external control (not shown), just before shutter 7 is rotated, to exert a predetermined axial force (shown by the arrow in Figure 2) on rod 17, in opposition to the force exerted by counter spring 28, and so detach sealing surface 8 from inner surface 12 of sealing seat 6 (a minimum amount of axial displacement is obviously sufficient to prevent surface 8 from sliding against surface 12).

Clearly, changes may be made to the valve unit as described and illustrated herein without, however, departing from the scope of the present invention.

CLAIMS

1) A valve unit (1) for selectively cutting off two fluid streams, in particular the inlet and exhaust
5 streams of an internal combustion engine cylinder, and comprising a body (2) in which is formed at least one channel having a sealing seat for at least a respective shutter for opening-closing said channel; the valve unit being characterized in that a first and a second channel
10 (4, 5) are formed in said body (2) for the passage of two separate fluid streams; said first and said second channel (4, 5) both communicating with the same sealing seat (6) for a single shutter (7) having a sealing surface (8) cooperating in fluidtight manner with said
15 sealing seat (6); said shutter (7) being housed in rotary manner inside said sealing seat (6), so as to rotate reciprocatingly to selectively and alternately open-close said first channel (4) and said second channel (5).

2) A valve unit as claimed in Claim 1, characterized
20 by comprising control means (25) for rotating said shutter (7), inside said sealing seat (6), about a predetermined axis (9) of rotation, and setting said shutter (7) selectively to a first work position wherein said shutter (7) closes said first channel (4) and leaves
25 said second channel (5) open, to a second work position wherein said shutter closes said second channel (5) and leaves said first channel (4) open, and to a third work position wherein said shutter (7) closes both said first

and said second channel (4, 5).

3) A valve unit as claimed in Claim 2, characterized in that said sealing seat (6) is axially symmetrical; said first and said second channel (4, 5) being connected
5 to said sealing seat (6) by respective mouths (10, 11) formed in an inner surface (12) of said sealing seat (6) and spaced angularly apart; and said shutter (7) having a through opening (22) which is aligned alternately with said mouths (10, 11) when said shutter (7) alternately
10 assumes said first and said second work position.

4) A valve unit as claimed in Claim 3, characterized in that said sealing seat (6) is substantially truncated-cone-shaped; said shutter (7) comprising a bell (15) defined by a substantially truncated-cone-shaped lateral
15 wall (16) complementary in shape to said sealing seat (6), and a rod (17) extending from a smaller-diameter axial end (18) of said bell (15) and fitted through a sliding seat (19) formed through a wall (20) of said body; said sealing surface (8) being defined by a
20 substantially continuous outer lateral surface of said lateral wall (16) of said bell (15); and said opening (22) being formed through said lateral wall (16) of said bell (15).

5) A valve unit as claimed in one of Claims 2 to 4,
25 characterized by comprising elastic means (28) for maintaining contact, with a predetermined force, between said shutter (7) and said sealing seat (6); said rod (17) of said shutter (7) sliding axially inside the respective

sliding seat (19) in opposition to said elastic means (28) to detach said sealing surface (8) of said shutter (7) from said sealing seat (6) before said shutter (7) is rotated from one to another of said work positions.

5 6) An inlet-exhaust valve unit (1) for a cylinder (29) of an internal combustion engine, characterized by comprising a body (2) closing a combustion chamber (3) of said cylinder (29) and having, internally, a first and a second channel (4, 5) for the passage of two separate
10 fluid streams, respectively an inlet stream of a fuel to said combustion chamber (3), and an exhaust stream of combustion residue from said combustion chamber (3); said first and said second channel (4, 5) both communicating with the same sealing seat (6) for a single shutter (7)
15 having a sealing surface (8) cooperating in fluidtight manner with said sealing seat (6); said shutter (7) being housed in rotary manner inside said sealing seat (6), so as to rotate reciprocatingly to selectively and alternately open-close said first channel (4) and said
20 second channel (5).

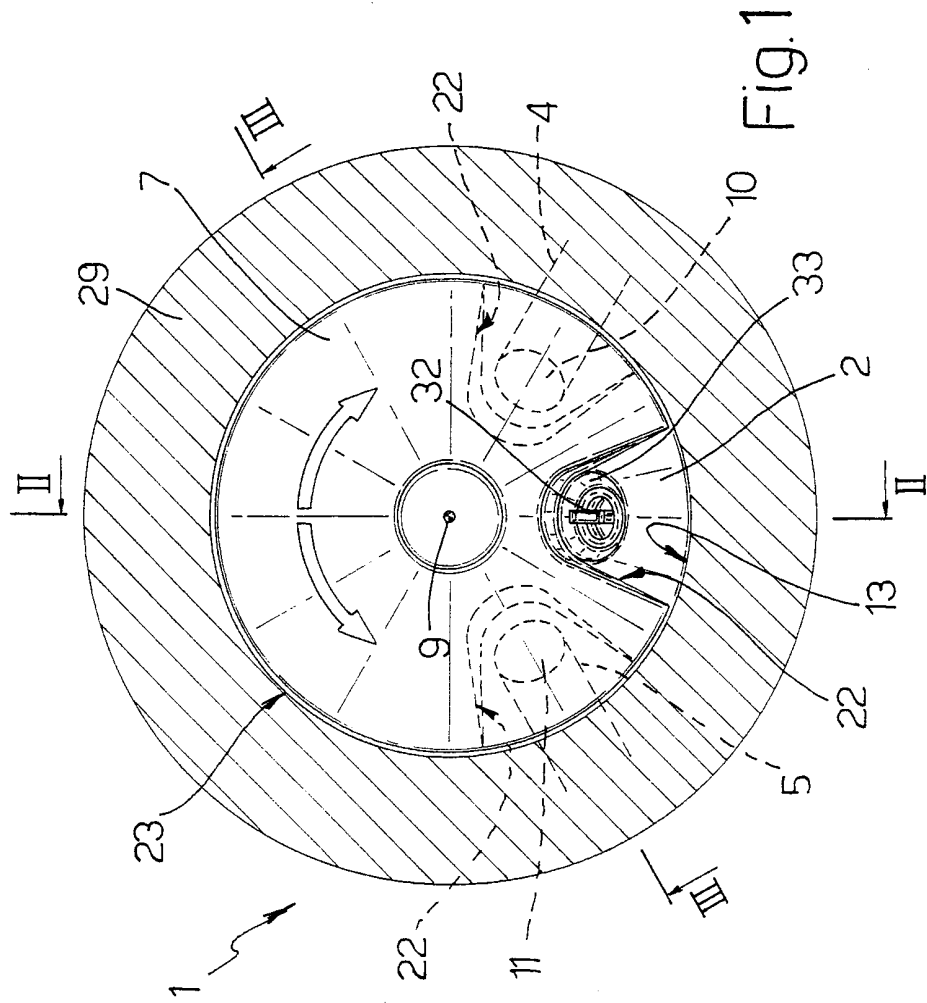


Fig. 1

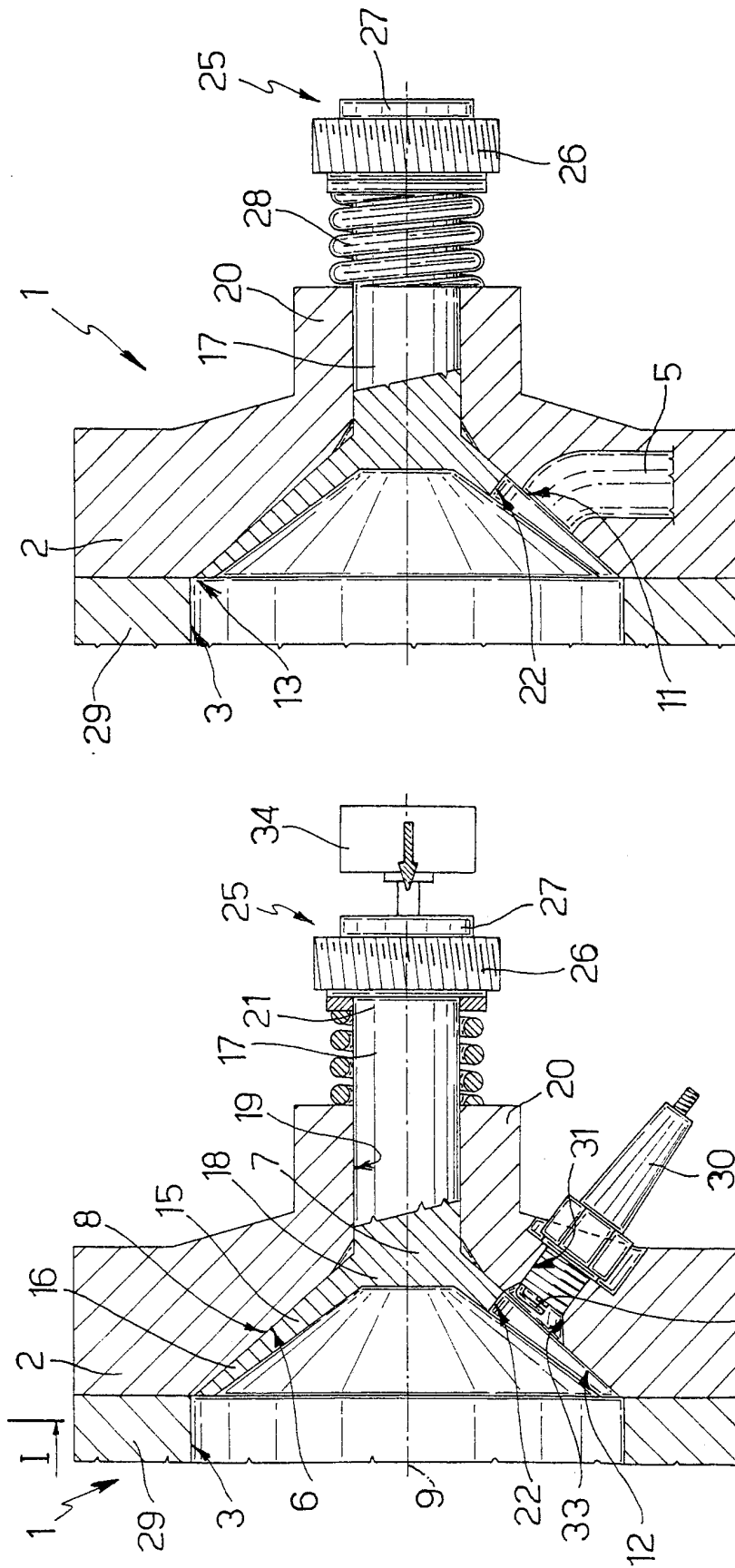


FIG. 3

FIG. 2

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IT 00/00332

A. CLASSIFICATION OF SUBJECT MATTER IPC 7 F01L7/02				
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 7 F01L				
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, PAJ				
C. DOCUMENTS CONSIDERED TO BE RELEVANT				
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
X A X X	US 1 356 506 A (BOETTCHER) 19 October 1920 (1920-10-19) the whole document --- DE 35 27 618 A (CHRIST KARL DIPL ING) 7 May 1986 (1986-05-07) the whole document --- BE 1 008 009 A (TIHON ALFRED JOSEPH) 12 December 1995 (1995-12-12) abstract; claims; figure 13 -----	1-3,6 4,5 1-4,6 1-4,6		
<input type="checkbox"/> Further documents are listed in the continuation of box C.				
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° Special categories of cited documents :				
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Date of the actual completion of the international search <p style="text-align: center; font-size: 1.2em;">29 November 2000</p>		Date of mailing of the international search report <p style="text-align: center; font-size: 1.2em;">08/12/2000</p>		
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer <p style="text-align: center; font-size: 1.2em;">Klinger, T</p>		

INTERNATIONAL SEARCH REPORT
..information on patent family members

International Application No
PCT/IT 00/00332

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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DE 3527618	A	07-05-1986	NONE	
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