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

(11) EP 0 945 687 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.09.1999 Bulletin 1999/39

(51) Int. Cl.[6]: **F24D 19/10**

(21) Application number: **99105040.2**

(22) Date of filing: **22.03.1999**

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

(30) Priority: **24.03.1998 IT VR980019**

(71) Applicant: **Rossignoli, Michele**
37068 Vigasio (Verona) (IT)

(72) Inventor: **Rossignoli, Michele**
37068 Vigasio (Verona) (IT)

(74) Representative:
Modiano, Guido, Dr.-Ing. et al
Modiano & Associati SpA
Via Meravigli, 16
20123 Milano (IT)

(54) Pressure-actuated diverting valve

(57) A pressure-actuated diverting valve (1) having a three-way valve portion (3) with a movable control valve element (38,39) for controlling the flow from a primary circuit, a diaphragm valve portion (2) for controlling the flow to a secondary circuit, a first control shaft (17) and a second control shaft (40) which are arranged parallel to, or aligned with, each other and are slidingly mounted on seals (19,51), the second control shaft (40) being designed to actuate the control element (38,39) and the first control shaft (17) being designed to be actuated by the diaphragm (10) of the diaphragm valve portion (2), and resilient loading means (48,24,16) for the control element (38,39) and for the diaphragm (10). Between the first control shaft (17) and the second control shaft (40) there is provided a transverse slider (61) which can move axially and has one end (62) operatively engaged with the first and second control shafts (17,40), so that the slider moves or rotates in one direction, if the control shafts (17,40) move mutually closer, and in the opposite direction, if they move apart, and its other end (64) arranged to actuate switching means (67,67a).

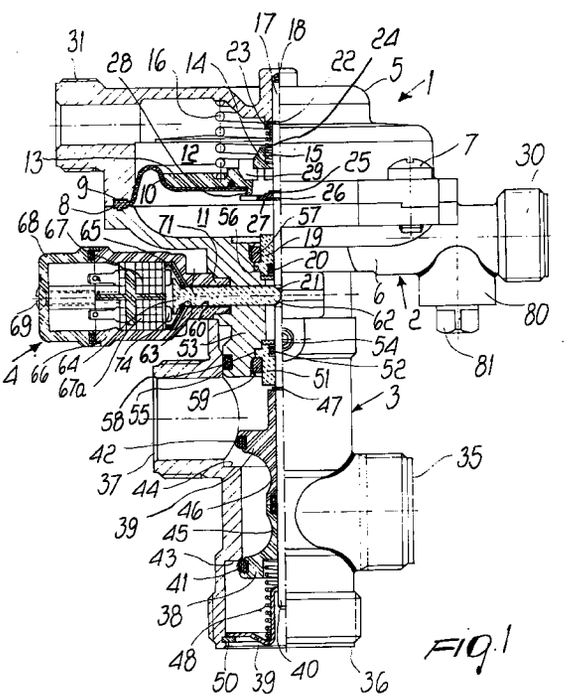

Fig.1

EP 0 945 687 A1

Description

[0001] The present invention relates to a pressure-actuated diverting valve with transversely controlled switching.

[0002] In modern boilers, particularly in wall-mounted boilers for domestic heating, it is increasingly imperative to have components which are highly reliable over time and of small dimensions. A three-way valve in such boilers has already been proposed which is associated with a membrane valve for connection, on the one side, between the boiler (primary hot gas/water exchanger) and a battery of radiators in a heating system (primary circuit), and, on the other side, between a water supply duct and a secondary water/water exchanger (secondary circuit) for producing sanitary water.

[0003] Such a three-way valve is provided with a control shaft which is slidably mounted on seals and is actuated by a switching system arranged at the head of the valve. Although such a valve has proved to be satisfactory from many viewpoints, it has the drawback of being quite long and thus too bulky. Additionally, since the control shaft slidingly engages a certain number of seals, the smaller the number of engaged seals, the more reliable its operation is.

[0004] The main object of the present invention is to provide a pressure-actuated diverting valve which is highly efficient and with minimum load losses both in the three-way portion and in the membrane portion of the valve.

[0005] Another object of the present invention is to provide a new actuation device which, by taking advantage of the longitudinal translatory motion of the valve control shaft, is designed to actuate switching means arranged on one side of the valve.

[0006] Another object of the present invention is to provide a pressure-actuated diverting valve at competitive manufacturing costs.

[0007] These and other objects which will become better apparent hereinafter are achieved by a pressure-actuated diverting valve having a three-way valve portion with a movable control valve element for controlling the flow from a primary circuit, a diaphragm valve portion for controlling the flow to a secondary circuit, a first control shaft and a second control shaft which are arranged parallel to each other and slidingly mounted on seals, the said first control shaft being designed to actuate said control valve element and said second control shaft being designed to be actuated by said diaphragm of said diaphragm valve portion, and resilient loading means for said control valve element and for said diaphragm, characterized in that between said first control shaft and said second control shaft there is provided a transverse slider which is axially movable and has one end thereof operatively engaged with said first and second control shafts, whereby the said slider moves or rotates in one direction, if the control shafts move mutually closer, and in the opposite direction, if they move apart from each other, and its other end arranged to actuate control means.

[0008] Advantageously, the adjacent ends of said first and second control shafts and said end of said transverse slider engaged therewith are frusto-conical in shape, thereby forming an inclined-surface motion transmission system.

[0009] Further aspects and advantages of the present invention will become better apparent from the following detailed description of some embodiments thereof, given by way of non-limiting example only, with reference to the accompanying drawings, in which.

Figure 1 is a half cross-section view of a first embodiment of a pressure-actuated diverting valve according to the invention;
Figure 2 shows a modification of Figure 1;
Figure 3 is a front elevation view of a box-like body belonging to the switching portion;
Figure 4 is a side view of Figure 3; and
Figure 5 is a cross-section view taken along the line V-V of Figure 4.

[0010] In the accompanying drawings, identical or similar parts or components have been designated by the same reference numerals.

[0011] Initially with reference to Figure 1, it will be noted that a diverting valve 1 according to the invention comprises three main parts, i.e. a pressure-actuated portion 2, a hydraulic diverting portion 3 and an electrical switching portion 4. The pressure-actuated portion 2 is constituted by two half-shells 5 and 6, e.g. made of brass, which are fixed together, so as to face each other, by means of four angularly spaced screws 7 and delimit an inner chamber. An annular seat 8 is formed along the peripheral rim of each half-shell 5 and 6 and is arranged to accommodate the enlarged peripheral rim 9 of a flexible annular membrane 10 which divides the internal chamber delimited by the half-shells 5 and 6 into two compartments 11 and 12 and also acts as a sealing gasket between the half-shells.

[0012] In its central region, the membrane 10 is supported by an axial annular plate 13, e.g. made of plastics, which has, on its side directed towards compartment 12, an axial raised portion 14 that delimits a seat 15.

[0013] A relatively strong helical spring 16 is accommodated in the compartment 12 and arranged concentric with respect to the membrane 10 and the plate 13; its other end reacting against the internal wall of the half-shell 5.

[0014] An axial control shaft 17 is mounted so that it can be axially moved through the compartments 11 and 12 inside the half-shell 5 and in a sleeve 19 made of self-lubricating material, such as Teflon, provided with an inner sealing O-ring 20 accommodated in a suitable seat formed in the half-shell 6. The control shaft extends out of the half-shell 6 and terminates with a frusto-coni-

cal tip 21.

[0015] Inside the compartment 12, the control shaft 17 is provided with a snap ring 22 against which a flanged sleeve abuts; an end of a helical spring 24, weaker than the spring 16, abuts against said sleeve and the other end of said spring abuts against the seat 15 of the plate 13.

[0016] At the compartment 11, the control shaft 17 supports, e.g. by means of two retaining rings 25 and 26, a minimum flow-rate plate 27 which is arranged to abut against an axial annular rib 28 of the plate 13.

[0017] Above the plate 27 the plate 13 has a certain number of central maximum flow-rate slots 29 through which connection between the compartments 11 and 12 is established.

[0018] The compartment 11 is provided with an inlet connector 30 and the compartment 12 has an outlet connector 31. The pressure-actuated portion 2 is arranged to be connected to a sanitary circuit between a line coming from a water distribution system connected to the connector 30 and a secondary water/water exchanger (not shown in the drawings), in which water delivered through the outlet connector 31 is heated before reaching a user's outlet. When the user's outlet opens to deliver sanitary hot water, a differentiated pressure is generated in the pressure-actuated portion 2, which acts on the membrane 10 until it overcomes the force of the spring 16, so that the control shaft 17, under the thrust of the spring 24, moves axially in the direction from the compartment 12 to the compartment 11, whereas, when the user's outlet is closed, an equilibrium is reached between the force of the spring 16 and the mains pressure, thereby forcing the control shaft 17 to move backward against the action of the spring 24.

[0019] The hydraulic diverting portion 3 comprises a three-way valve body, i.e., a body provided with an inlet connector 35 for hot water coming from a primary exchanger (boiler), a connector 36 for delivering hot water to heating radiators, and a connector 37 for delivering hot water to a secondary water/water exchanger to produce sanitary water. A double control valve element 38, 39 is slidably mounted in the valve body on a control shaft 40 which is parallel to, or axially aligned with, the control shaft 17 of the pressure-actuated portion 2.

[0020] Each valve element 38 and 39 supports a peripheral sealing O-ring, 41 and 42 respectively, arranged to abut against a respective inner shoulder 43 and 44. The outer surface of the double valve element is radiused at 45 and 46 in order to minimize load losses. More particularly, the double valve element 38, 39 has one end abutting against a retaining ring 47 carried by the control shaft 40 and its other end abutting against an axial helical spring 48 which in turn reacts against, and is guided by, a three-spoke member 39 which is kept in its seat by a retaining ring 50 and also acts as a guide for the control shaft 40.

[0021] The control shaft 40, on its side directed towards the pressure-actuated portion 2, is axially sliding supported by a sleeve 51 made of self-lubricating material, such as Teflon, with a sealing O-ring 52 interposed, and terminates with a frusto-conical tip.

[0022] The three-way body, at its end opposite to the connector 36, internally accommodates an extension 53 of the half-shell 6, which is fixed in position by means of stop dowels 54, while sealing is provided by an O-ring 55 Two seats are also formed in the extension 53: one seat 56 is designed to accommodate the sleeve 19, that supports the control shaft 17, and a sealing gasket 57, and the other seat 58 is designed to accommodate the sleeve 51 for supporting the control shaft 40, and a sealing gasket 59

[0023] In the extension 53 there are four radial co-planar holes 60 which are angularly spaced from one another. Each hole has an internal aperture having a plurality of diameters which increase in an outward direction. An electrical switching portion 4 is accommodated in one of the holes 60 and comprises a cylindrical slider 61, preferably made of self-lubricating material such as Teflon, whose distal end 62 is frusto-conical in shape and whose proximal end is provided with a collar 63 and an enlarged head 64, a fusto-conical membrane 65 which is inserted in the collar 63 of the slider at its smaller flat face, a tight box-like body 66 containing the membrane 65 and acting as a guide for the slider 61, and one or more microswitches 67, 67a which are accommodated in the box-like body 66 and abut against the membrane 65.

[0024] If desired, the box-like body 66 can be provided with a removable cover 68 which can be fixed in position, e.g. by one or more screws 69.

[0025] Preferably, the box-like body 66, as shown in Figures 3 to 5, has two lower extensions 70 in the shape of an at least partly resilient half-collar and arranged to be inserted, by snapping, around the extension 53 of the half-shell 6, as well as a hollow projection 71 on the centerline of the collar, which is designed to fit in the outer diameter or diameters of a hole 60 and to act as a sliding guide for the slider 61.

[0026] A flared area 72 is provided at the inner end of the internal opening of the projection 71 to delimit a seat for the frusto-conical membrane 65. A space 73 is delimited above said flared region to accommodate the microswitches 67 provided with push-buttons 74 which are directed toward the head 64 of the slider 61.

[0027] With the above-described configuration, when the user's outlet delivers sanitary hot water (e.g. a dispensing cock is opened), the force of the spring 16 is overcome and thus the two control shafts 17 and 40 are pushed by the spring 48, thereby closing the control valve element 38 and thus the delivery path 36 towards the radiators, and the control valve element 39 opens.

[0028] The hot water coming from the primary exchanger through the connector 35 is then forwarded to the secondary exchanger to start the production of

sanitary hot water. However, in order to start production of sanitary hot water, in addition to switching of the hydraulic circuit, an electrical switching must occur at the portion 4.

[0029] When the control shaft 40, due to the thrust of the spring 48, terminates its stroke, thereby closing the connector 36, the control shaft 17 continues its stroke under the urge of the spring 24, and moves away from the control shaft 40, thereby leaving free a portion which is sufficient to allow the slider 61 to insert owing to the thrust of the resilient membrane 65 its frusto-conical end 62 between the two frusto-conical ends of the shafts 17 and 40. This movement of the slider 61 is of the order of 1.5 mm and is responsible for the release of the push-buttons 74 of the microswitches 67 and 67a, thereby effecting electrical switching.

[0030] Both hydraulic and electric switchings occur starting from a minimum flow-rate of approximately 2 liters/minute, which is adjusted by two calibrated slots formed in the minimum flow-rate plate 27, which is moved by the control shaft 17 and is kept against the rib 28 of the membrane supporting plate 13 by the spring 24.

[0031] When the flow-rate increases above a minimum value, the differential pressure applied onto the membrane 10 also increases, until it overcomes the force of the spring 24, and thus an increasingly larger aperture opens between the minimum flow-rate plate 27 and the membrane supporting plate 13, whereby fluid flows through the maximum flow-rate slots 29 toward the connector 31.

[0032] Finally, when the use of sanitary hot water terminates, pressure in the pressure-actuated portion 2 reaches an equilibrium level, thereby allowing owing to the thrust of the spring 16 backward translatory motion of the control shaft 17. The latter before abutting against the shaft 40 pushes the slider 61 causing it to move back against the thrust of the membrane 65 into the box-like body 66 in order to press the push-buttons 74 thereby producing electrical switching. After abutting against the shaft 40, the shaft 17 continues its translatory motion together with it until it closes the control valve element 39 and simultaneously opens the control valve element 38 to divert the flow toward delivery connector 36.

[0033] If desired, on the connector 30 a manual flow-rate regulator 80 is provided which can be actuated by a square-head element 81 which, by being rotated through 90° throttles the water intake.

[0034] In the embodiment of Figure 2 a shaped annular disk 85 is provided in the compartment 12 between the membrane 10 and the outlet 35. Thus, when the sanitary water tap is opened, control shaft 17 moves until the retaining ring 22 is displaced in abut engagement. At this point, as the flow-rate, and thus the differential pressure, increases owing to the pressure applied to the membrane 10, a gap is formed between the plate 13 and the minimum flow-rate plate 27. The flow-rate through the calibrated slots 29 of the plate 13, together with the throttling effect performed by the cone 14 at the central hole 86 of the disk 85, is responsible for a stabilization process of the differential pressure between the compartment 11 and the intermediate compartment 12a and between the membrane 10 and the disk 85, which leads to a stabilization of the flow-rate which depends upon the number and amplitude of the calibrated slots 29.

[0035] With this system it is possible to maintain preset flow-rates stable (e.g. 10 liters/minute) even if the inlet pressure varies between 1 and 6 bar.

[0036] The above-described invention is susceptible to numerous modifications and variations within the scope of the claims.

[0037] The disclosures in Italian Patent Application No. VR98A000019 from which this application claims priority are incorporated herein by reference.

[0038] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A pressure-actuated diverting valve having a three-way valve portion with a movable control valve element (38,39) for controlling the flow from a primary circuit, a diaphragm valve portion (2) for controlling the flow to a secondary circuit, a first control shaft (17) and a second control shaft (40) which are arranged parallel to each other and slidingly mounted on seals (51,57), the said second control shaft (40) being designed to actuate said control valve element (38,39) and said first control shaft (17) being designed to be actuated by diaphragm (10) of said diaphragm valve portion (2), and resilient loading means (48;24;16) for said control valve element (38,39) and for said diaphragm (10), characterized in that between said first control shaft (17) and said second control shaft (40) there is a transverse slider (61) which is axially movable and has one end (62) thereof operatively engaged with said first and second control shafts (17,40), whereby the said slider (61) moves or rotates in one direction, if the control shafts (17,40) move mutually closer, and in the opposite direction, if they move apart from each other, and its other end (64) arranged to actuate control means (67,67a).

2. The diverting valve according to claim 1, characterized in that said transverse slider (61) comprises resilient loading means (65).

3. The diverting valve according to claim 2, character-

ized in that said resilient means (65) comprise a resilient membrane.

4. The diverting valve according to any claim 1 to 3, characterized in that said slider (61) comprises containment and guiding means (66) which can be fitted on one of said three-way and diaphragm valve portions (2,3).

5. The diverting valve according to claim 4, characterized in that said containment and guiding means (66) comprise a collar-shaped portion (70) for snap-engaging with one of said three-way and diaphragm valve portions (2,3).

6. The diverting valve according to claim 4, characterized in that said containment and guiding means comprises a tubular portion (71) which can be inserted in a transverse opening (60) in said three-way or diaphragm valve portion (2,3) and is arranged to partly contain said slider (61), and a box-like body (66) which is connected to said tubular portion (71) and is arranged to receive said actuation means (67,67a).

7. The diverting valve according to claim 6, characterized in that said box-like body (66) comprises a detachable cover (68).

8. The diverting valve according to any claim 1 to 7, characterized in that said control means comprise at least one push-button microswitch.

9. A pressure-actuated diverting valve having a three-way valve portion (3) with a movable control valve element (38,39) for controlling the flow from a primary circuit, a diaphragm valve portion (2) which is arranged to control the flow to a secondary circuit and is internally divided into an inlet compartment (11) and into an outlet compartment (12) with respect to a diaphragm (10), a first control shaft (17) and a second control shaft (40) which are arranged parallel to each other and are slidably mounted on seals (51,57), said second control shaft (40) being arranged to actuate said control valve element (38,39) and said first control shaft (17) being designed to be actuated by said diaphragm (10) of said diaphragm valve portion (2), resilient loading means (48,24,16) for said control valve element (38,39) and for said diaphragm (10), and electrical switching means (67,67a) actuated by at least one of said control shafts (17,40), characterized in that said diaphragm valve portion (2) includes an annular flow control disk (13) having at least one calibrated passage (29) in said outlet compartment (12) for stabilizing the differential pressure in the compartments of the diaphragm valve portion (2).

10. The diverting valve according to any preceding claim, characterized in that said diaphragm valve portion (2) comprises an annular disk (27) for providing an annular support for said membrane (10), which is arranged around said first control shaft (17), and said minimum flow-rate plate (13) which is arranged upstream of said diaphragm (10) at an annular passage of said annular disk (27), said membrane supporting plate (13) having an axial protrusion (14) around said first control shaft (17) and extending away from said minimum-flow plate (13), and at least one calibrated slot (29) for flow passage through said supporting plate (13) proximate to said axial protrusion (14).

11. The diverting valve according to claim 10, characterized in that said diaphragm valve portion (2) has an extension (53) sealingly connected to or in said three-way valve portion (3) and secured thereto by fixing means (54).

12. The diverting valve according to claim 11, characterized in that said extension has two sealed seats (56,58) for sealingly receive a guide and support sleeve (19,51) for said first and second control shafts (17,40).

13. The diverting valve according to any one of the preceding claims, characterized in that the movable control valve element (38,39) has a radiused external surface (45,46) to reduce load losses.

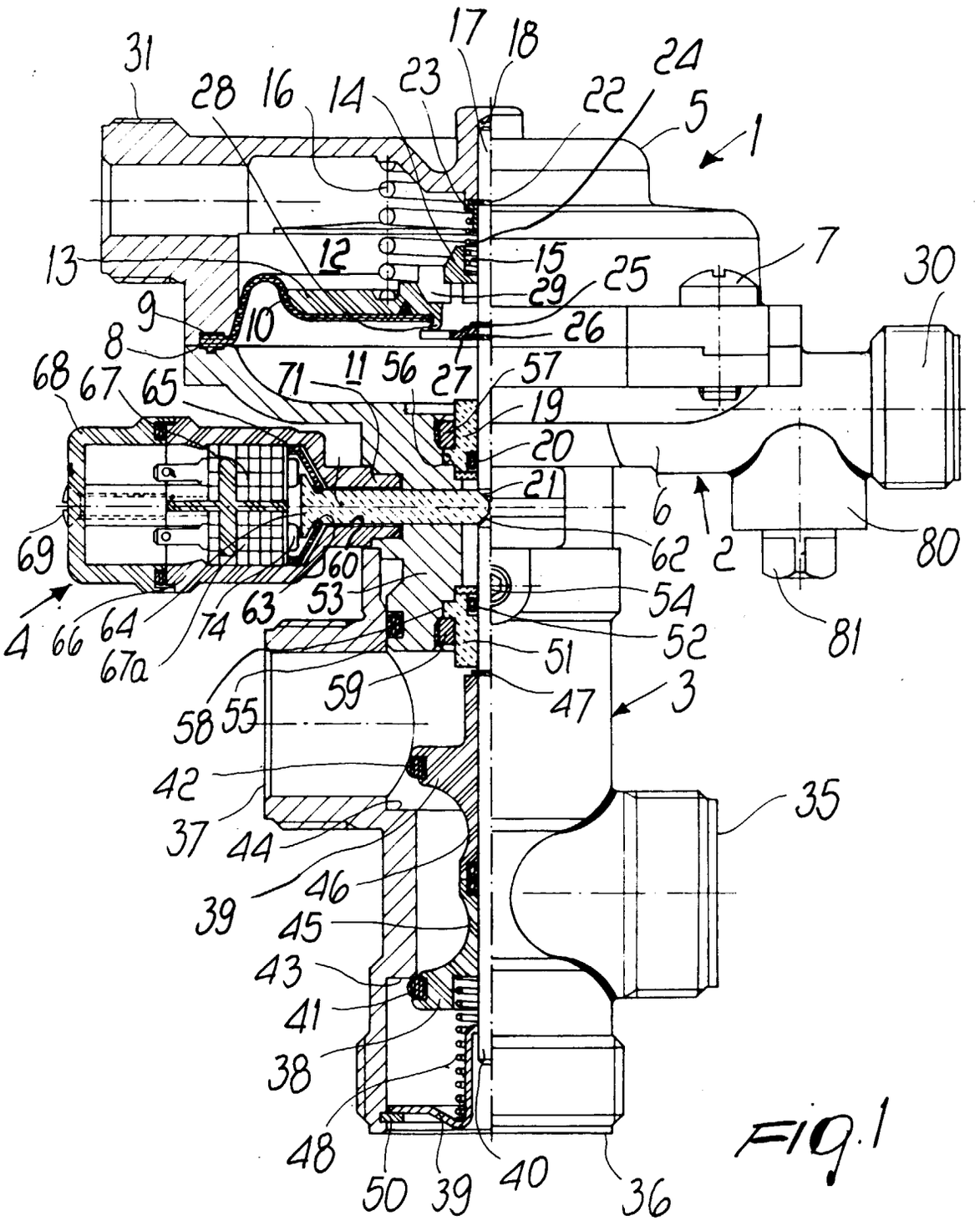
31
28
16
14
23
17
18
24
22
5
1
13
12
15
25
29
7
30
9
10
26
8
68
67
65
71
11
56
27
57
19
20
21
6
62
2
80
69
60
53
54
4
66
64
74
63
52
81
67a
51
59
47
3
58
55
42
35
37
44
46
39
45
43
41
38
48
50
39
40
36

FIG. 1

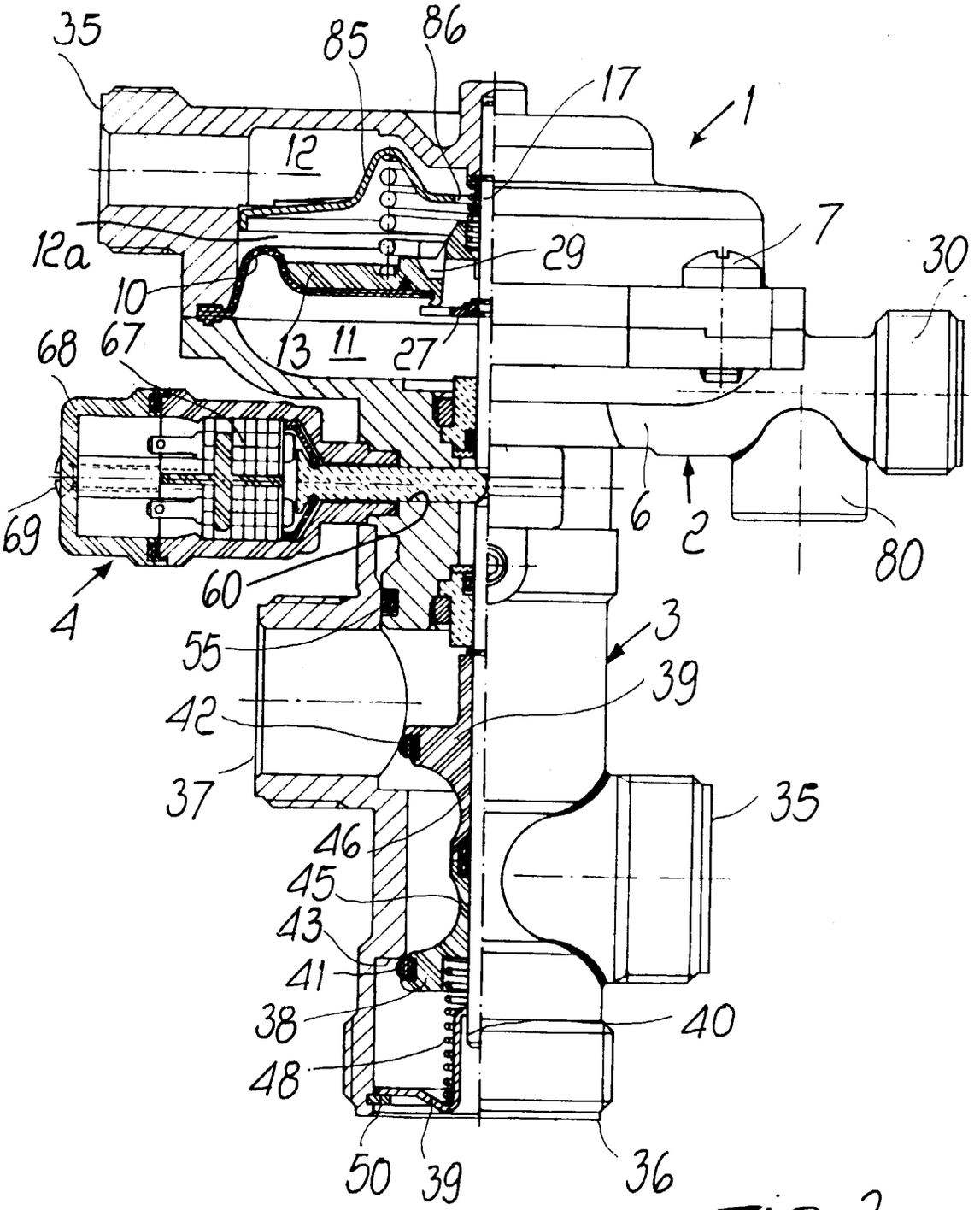
35
85
86
17
1
12
12a
29
7
30
10
68
67
13
11
27
69
6
2
80
60
4
55
3
39
42
37
35
46
45
43
41
38
40
48
50
39
36

Fig. 2

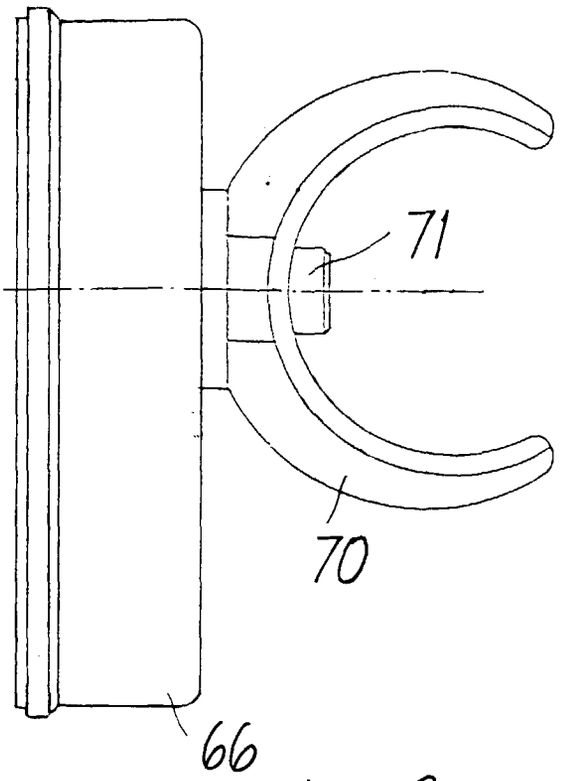

Fig. 3

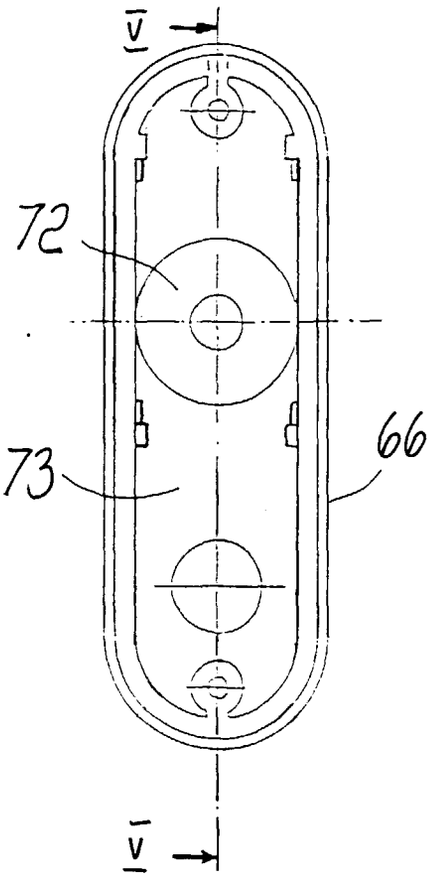

Fig. 4

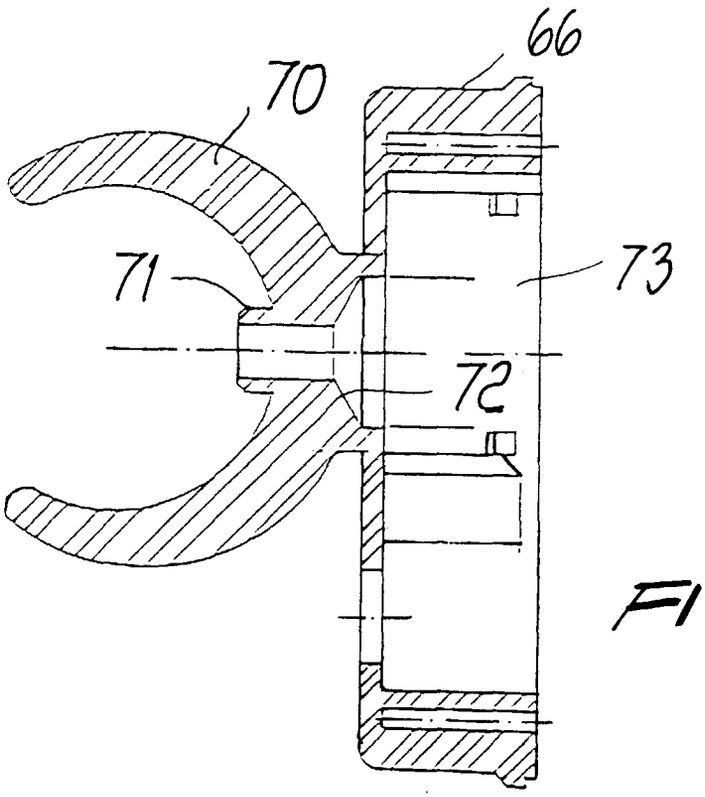

Fig. 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 10 5040

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A X	EP 0 466 010 A (FUGAZZA GIUSEPPE) 15 January 1992 * abstract; figures 1,2 *	1 9	F24D19/10
A	EP 0 447 851 A (FUGAS DI FUGAZZA GIUSEPPE E BA) 25 September 1991 * figure 2 *	1,9	
A	GB 2 179 410 A (ROSSIGNOLI RENZO) 4 March 1987 * figure 1 *	1,9	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F24D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 June 1999	Lokere, H

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
P : intermediate document

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

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 99 10 5040

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

23-06-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0466010 A	15-01-1992	IT 1244296 B	08-07-1994
		ES 2049506 T	16-04-1994
EP 0447851 A	25-09-1991	IT 1240930 B	27-12-1993
GB 2179410 A	04-03-1987	NL 8601749 A,B,	02-02-1987

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82