

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
7 December 2006 (07.12.2006)

PCT

(10) International Publication Number
WO 2006/129159 A1

(51) International Patent Classification:

D06F 39/08 (2006.01)

(21) International Application Number:

PCT/IB2006/001389

(22) International Filing Date: 26 May 2006 (26.05.2006)

(25) Filing Language: Italian

(26) Publication Language: English

(30) Priority Data:

TO2005A000365 30 May 2005 (30.05.2005) IT

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

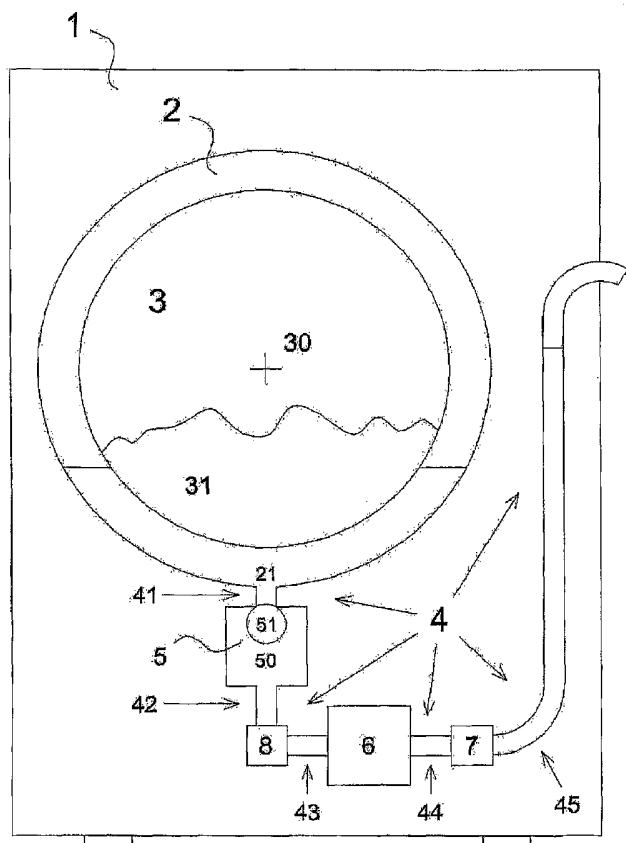
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

[Continued on next page]

(54) Title: WASHING MACHINE WITH NON-RETURN VALVE



(57) Abstract: The present invention relates to a washing machine (1), in particular a household washing machine or washing/drying machine, comprising a tub (2) adapted to contain items (31) to be washed and having a drain aperture (21), and a drain duct (4) connected on a first end to the drain aperture (21) of the tub and on a second end to a drain pipe; at least the following components are located in this order along the drain duct (4): a stop valve (5) of the float-type (51) for shutting the drain duct (4), a drain pump (6), and a non-return valve (7); there is a passage (73) which connects a first portion (45) of the drain duct downstream of the non-return valve (7) to a second portion (44) of the drain duct upstream of the non-return valve (7).



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.

WASHING MACHINE WITH NON-RETURN VALVE

DESCRIPTION

The present invention relates to a washing machine, in particular a household washing machine or washing/drying machine, according to the preamble of claim 1.

5 In such a washing machine, the items to be washed are placed into a tub of the machine; in laundry washing machines and washing/drying machines, the laundry is placed into a drum located inside the tub.

During a wash phase, a wash liquid, typically water or a water solution, is poured into the tub; the most common wash phases are called "prewash", "wash" and "rinse".

10 During a wash phase, a washing agent (detergent, softener, rinse aid, ...) is typically introduced into the tub.

During a wash phase, typically at the end of the wash phase, the wash liquid is drained. To that end, the tub is fitted with a drain aperture connected to a drain duct, which in turn is connected to a drain pipe usually belonging to the
15 hydraulic system of a building; at least a stop valve for the drain duct, a drain pump and a non-return valve are typically installed along the drain duct of the washing machine, in this order.

Especially in laundry washing machines and washing/drying machines, the stop valve is located immediately downstream of the drain aperture of the tub,
20 and prevents the washing agents from leaving the tub during the wash phases; typically, the drain aperture of the tub is located in a low area of the machine, and the drain duct extends from said low area of the machine up to a high area of the same, where the drain duct connects to the drain pipe, at a height typically comprised between 60 cm and 90 cm.

25 As a stop valve placed immediately downstream of the drain aperture of the tub, a valve of the float-type is commonly used (the float being typically a plastic ball).

The drain duct is shut by the float due to the effect of the hydrostatic force exerted by the liquid being present in the drain duct, which is at a lower level

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than the float.

In order to improve the sealing, one may also use, in addition to the effect of the hydrostatic force, the pressure exerted on the float by the liquid being present in the drain duct at a higher level than the float.

- 5 The presence of the non-return valve blocks any action of the liquid being present in the drain duct downstream of the non-return valve; in particular, it blocks the pressure action exerted by the liquid being present in the drain duct at a higher level than the float.

- 10 If the duct is closed by the non-return valve, the liquid downstream of the valve doesn't exert any action on the float of the stop valve.

The general object of the present invention is to obtain a very good sealing of the stop valve located downstream of the drain aperture of the tub, also in the presence of a non-return valve.

- 15 Said object is achieved through the washing machine incorporating the features described in the annexed claims, which represent an integral part of the present description.

The present invention is based on the idea of using a passage which transmits the liquid pressure from downstream to upstream of the non-return valve even when the latter is closed, with just a minimal reflux of liquid.

- 20 In this way, pressure can be exerted on the float even when the non-return valve is closed.

Furthermore, this reduces the noise produced by the washing machine during the drain phases of the wash liquid, because the cavitation noise of the drain pump is eliminated or at least greatly reduced.

- 25 According to a further aspect, the present invention also relates to a non-return valve.

The present invention will become more apparent from the following description and from the annexed drawings, wherein:

- 30 Fig. 1 shows a schematic sectional view of a washing machine according to the present invention, and

Fig. 2 shows very schematically a non-return valve according to the present invention as used in the washing machine of Fig. 1.

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Said description and said drawings are to be considered as non-limiting examples.

Fig. 1 shows a washing machine according to the present invention, indicated as a whole with reference number 1; in particular, said washing machine
5 comprises a special non-return valve, indicated with reference number 7 and illustrated in Fig. 2.

The washing machine 1 comprises a tub 2 housing a drum 3, which is used for containing the laundry items to be washed; in Fig. 1, reference number 31 designates the laundry contained in drum 3.

10 Drum 3 is rotated about its axis 30 by an electric motor (not shown in Fig. 1) under the control of an electronic control unit (not shown in Fig. 1).

Tub 2 is provided with a drain aperture 21 connected to a drain duct of the washing machine, indicated as a whole with reference number 4.

15 Drain duct 4 is connected on a first end to drain aperture 21 and on a second end (upper right in Fig. 1) to a drain pipe (not shown in Fig. 1); in the example of Fig.1, said second end has an elbow.

Along drain duct 4, the following components are installed, in this order: a stop valve 5, a drain filter 8, a drain pump 6, and a non-return valve 7; a first portion 41 of drain duct 4 connects the drain aperture 21 to the inlet of stop
20 valve 5; a second portion 42 of drain duct 4 connects the outlet of stop valve 5 to the inlet of drain filter 8; a third portion 43 of drain duct 4 connects the outlet of drain filter 8 to the inlet of drain pump 6; a fourth portion 44 of drain duct 4 connects the outlet of drain pump 6 to the inlet of non-return valve 7; a fifth portion 45 of drain duct 4 connects the outlet of non-return valve 7 to the
25 drain pipe.

Fig. 1 is a schematic view, and therefore the lengths of portions 41, 42, 43, 44, 45 of drain duct 4 are merely explanatory; typically, for instance, both portions 41 and 44 are very short or at most absent.

Stop valve 5 is of the well-known float type; in Fig. 1, it is schematized
30 through a chamber 50 within which a float 51, typically a plastic ball, can move. In Fig. 1, valve 5 is shown in the closed state, in particular with its float 51 positioned high to shut the upper aperture of chamber 50. During the

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drain phase, float 51 is down next to the lower aperture of chamber 50; of course, the area around the lower aperture of chamber 50 is shaped in such a way as to allow the wash liquid to flow even when float 51 is down.

In Fig. 1, washing machine 1 is shown in an operating condition wherein there is wash liquid in tub 2 and in drain duct 4 nearly up to its upper elbow; in this operating condition, stop valve 5 and non-return valve 7 are both closed.

Fig. 2 shows schematically a particularly advantageous, but not restrictive, example of embodiment of the non-return valve according to the present invention.

Valve 7 comprises a body with a cavity 70 having an inlet aperture 74 and an outlet aperture 75; during the drain phase, the wash liquid flows from inlet aperture 74, through cavity 70, to outlet aperture 75 as indicated by the arrows in Fig. 2.

Cavity 70 houses a closing element consisting of a flexible tang 71, e.g. made of natural or synthetic rubber; tang 71 is fastened to an inner wall of cavity 70 so that, when at rest, tang 71 shuts inlet aperture 74 by resting on an annular element 72, and the valve is therefore closed.

The peculiarity of valve 7 consists in the presence of a passage which connects inlet aperture 74 to outlet aperture 75 even when tang 71 is closed; in the example of Fig. 2, this passage is a hole 73 in a central area of tang 71.

In the example of Figs. 1 and 2, non-return valve 7 is located immediately downstream of drain pump 6; thus, inlet aperture 74 of valve 7 corresponds to the outlet of pump 6.

The diameter of inlet aperture 74 is typically 1 cm to 2 cm; the diameter of outlet aperture 75 is typically 1 cm to 2 cm; the diameter of hole 73 may be 2 to 6 mm.

During the drain phase, the wash liquid arriving at inlet aperture 74 under the action of drain pump 6 presses tang 71, thereby bending it; in this way, the liquid can flow without substantially encountering any obstacles inside cavity 70 and then, through outlet aperture 75 and portion 45 of drain duct 4, in the drain pipe. When tub 2 is completely empty, drain pump 6 will no longer deliver any liquid to valve 7, so that tang 71 returns to its rest position due to

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its elasticity and valve 7 closes; the liquid in drain duct 4 downstream of valve 7, i.e. in portion 45, tends to flow back toward valve 7, thereby pressing tang 71 against annular element 72 and keeping valve 7 well closed; since hole 73 is very small, the quantity of liquid flowing through it is very small, too; this situation occurs for a short period of time at the end of the drain phase, when drain pump 6 is stopped by the electronic control unit of the washing machine. When drain pump 6 is inactive, e.g. after a drain phase, tang 71 tends to remain in its rest position, and therefore valve 7 is closed. However, the liquid in the drain duct downstream of valve 7, i.e. in portion 45, slowly flows through hole 73, goes up drain duct 4, reaches stop valve 5, and moves float 51 back to its upper position in order to shut the upper aperture of chamber 50; this ensures a perfect sealing of tub 2.

In general, a washing machine according to the present invention comprises:

- a tub for containing items to be washed, provided with a drain aperture,
- a drain duct connected on a first end to the drain aperture and adapted to be connected on a second end to a drain pipe;

at least the following components are placed along the drain duct, in this order:

- a drain duct stop valve, said stop valve being of the float type,
- a drain pump,
- a non-return valve;

a passage connects a first portion of the drain duct downstream of the non-return valve to a second portion of the drain duct upstream of the non-return valve.

Said passage may be obtained in many different ways and may have different lengths depending on how the present invention is implemented; said passage must be made in such a way as to transmit the pressure from downstream to upstream of the non-return valve under static conditions, as well as to greatly limit the flow of liquid from downstream to upstream of the non-return valve under dynamic conditions.

Thanks to the non-return valve, the cavitation noise produced by the drain pump is eliminated or at least considerably reduced.

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Thanks to the passage, a perfect sealing of the stop valve is obtained also in the presence of a non-return valve, even when the latter is closed.

Due to its simplicity and inexpensiveness, the present invention is therefore suited to being applied particularly advantageously to household washing machines or washing/drying machines; as a matter of fact, it is clear that the same problem could also be solved by using much more complex and costly solutions based, for example, on solenoid valves.

A simple way to obtain the desired technical effect consists in providing a passage having a small cross-section at least for a certain length.

Advantageously, the passage may be configured and arranged in such a way as to connect a first portion of the drain duct immediately downstream of the non-return valve to a second portion immediately upstream of the non-return valve; with this solution, for instance, the passage can be associated with or integrated into the non-return valve, and no additional components are required.

A simple and cheap but effective non-return valve particularly suited to the present invention comprises a closing element substantially consisting of a flexible tang, a revolving lid or a movable body within a cavity.

In this case, the passage may simply consist of at least one hole in the closing element, preferably located in a central area of the closing element, as in the example of Fig. 2. In order to allow pressure to be transmitted while limiting the liquid flow, the diameter of said hole must be chosen within a range of approx. 2 mm to approx. 6 mm; with smaller diameters, the hole would tend to be clogged by dirt and/or detergent; larger diameters would not allow to obtain a sufficient restriction of the liquid flow.

As an alternative or in addition to the hole in the movable element, at least one hole in a fixed element may be provided. For example, if the non-return valve comprises an annular rest and the closing element rests on said rest in the event of a reflux, the passage may simply consist of at least one hole in the rest; the above considerations would apply to this hole as well.

The washing machine according to the present invention may also be provided with a drain filter along the drain duct.

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Preferably, such a filter should be located immediately upstream of the drain pump, as in the example of Fig. 1.

As far as the non-return valve is concerned, it may advantageously be located immediately downstream of the drain pump; this solution would minimize the quantity of liquid which may give rise to pump cavitation noise.

5

CLAIMS

1. Washing machine (1), in particular a household washing machine or washing/drying machine, comprising:

- a tub (2) for containing items (31) to be washed, provided with a drain aperture (21),

5 - a drain duct (4) connected on a first end to said drain aperture (21) and adapted to be connected on a second end to a drain pipe;

at least the following components being installed along said drain duct (4), in this order:

- 10 - a stop valve (5) for shutting the drain duct (4), said stop valve being of the float (51) type,
- a drain pump (6),
- a non-return valve (7);

characterized in that it comprises a passage (73) which connects a first portion (45) of the drain duct downstream of the non-return valve (7) to a second portion (44) of the drain duct upstream of the non-return valve (7).

15 2. Washing machine (1) according to claim 1, wherein said passage (73) has a small cross-section.

3. Washing machine (1) according to claim 1 or 2, wherein said first portion (45) is immediately downstream of the non-return valve (7).

20 4. Washing machine (1) according to claim 1 or 2 or 3, wherein said second portion (44) is immediately upstream of the non-return valve (7).

5. Washing machine (1) according to one of the previous claims, wherein said non-return valve (7) comprises a closing element, said closing element essentially consisting of a flexible tang (71) or a revolving lid or a movable body within a cavity (70).

6. Washing machine (1) according to claim 5, wherein said passage consists of at least one hole (73) in said closing element (71), preferably located in a central area of the same.

7. Washing machine (1) according to claim 5 or 6, wherein said non-return valve (7) comprises an annular rest (72), said closing element (71) being adapted to rest on said rest (72) in the event of a reflux, and wherein

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said passage consists of at least one hole in said rest.

8. Washing machine (1) according to claim 6 or 7, wherein the diameter of said hole (73) is comprised between 2 mm and 6 mm.

5 9. Washing machine (1) according to one of the previous claims, characterized in that it comprises a drain filter (8) along said drain duct (4).

10. Washing machine (1) according to claim 9, wherein said drain filter (8) is located immediately upstream of said drain pump (6).

10 11. Washing machine (1) according to one of the previous claims, wherein said non-return valve (7) is located immediately downstream of said drain pump (6).

12. Non-return valve (7), in particular for household appliances, comprising a closing element essentially consisting of a flexible tang (71) or a revolving lid or a movable body within a cavity (70), characterized in that it comprises a passage (73) which connects a space (74) upstream of said closing
15 element (71) to a space (75) downstream of said closing element (71), even when said closing element (71) is in its closed position.

13. Non-return valve (7) according to claim 12, wherein said passage consists of at least one hole (73) in said closing element (71), preferably located in a central area of the same.

20 14. Non-return valve (1) according to claim 12 or 13, characterized in that it comprises an annular rest (72), said closing element (71) being adapted to rest on said rest (72) in the event of a reflux, and wherein said passage consists of at least one hole in said rest.

25 15. Non-return valve (7) according to claim 13 or 14, wherein the diameter of said hole (73) is comprised between 2 mm and 6 mm.

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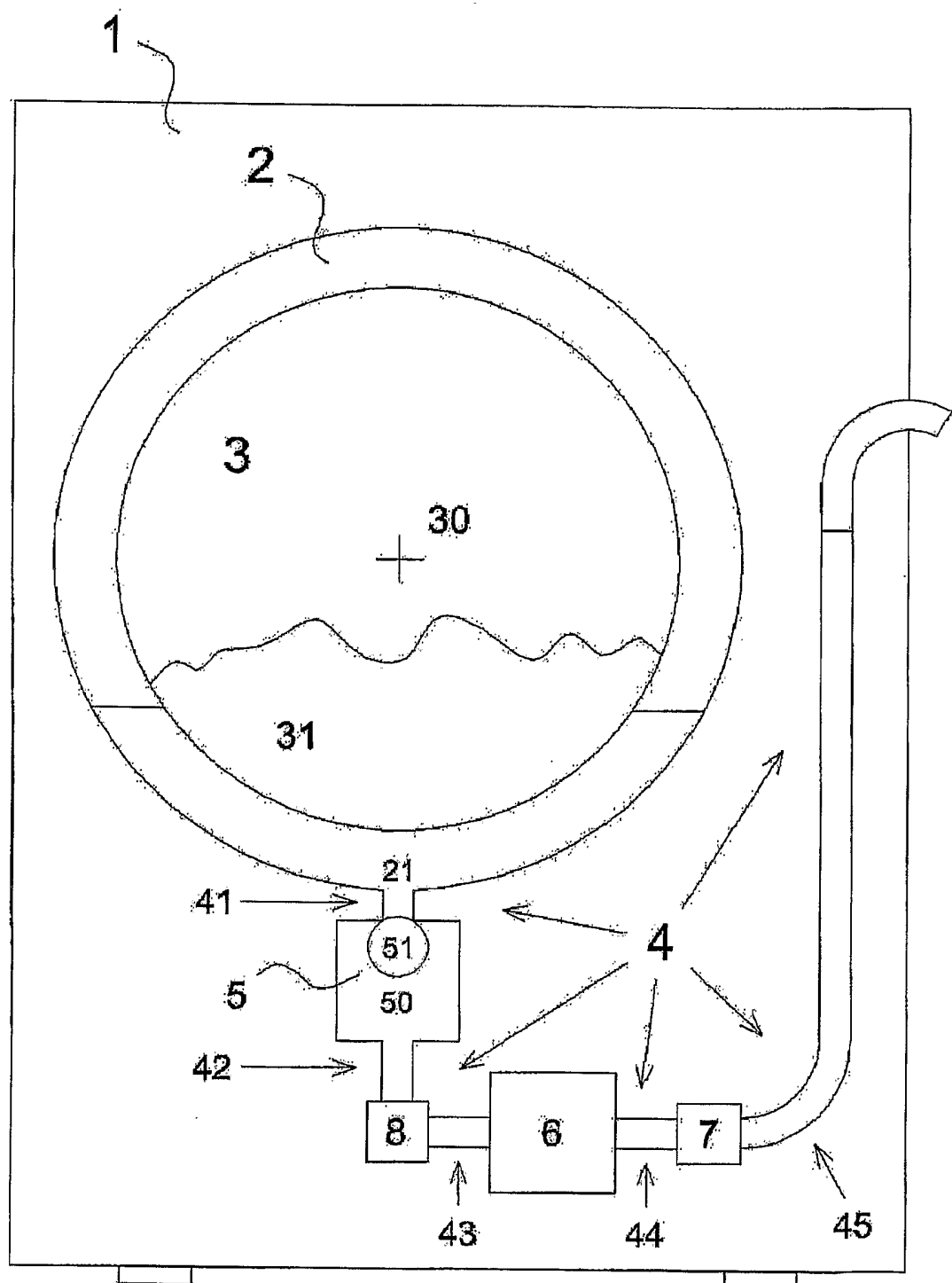


Fig.1

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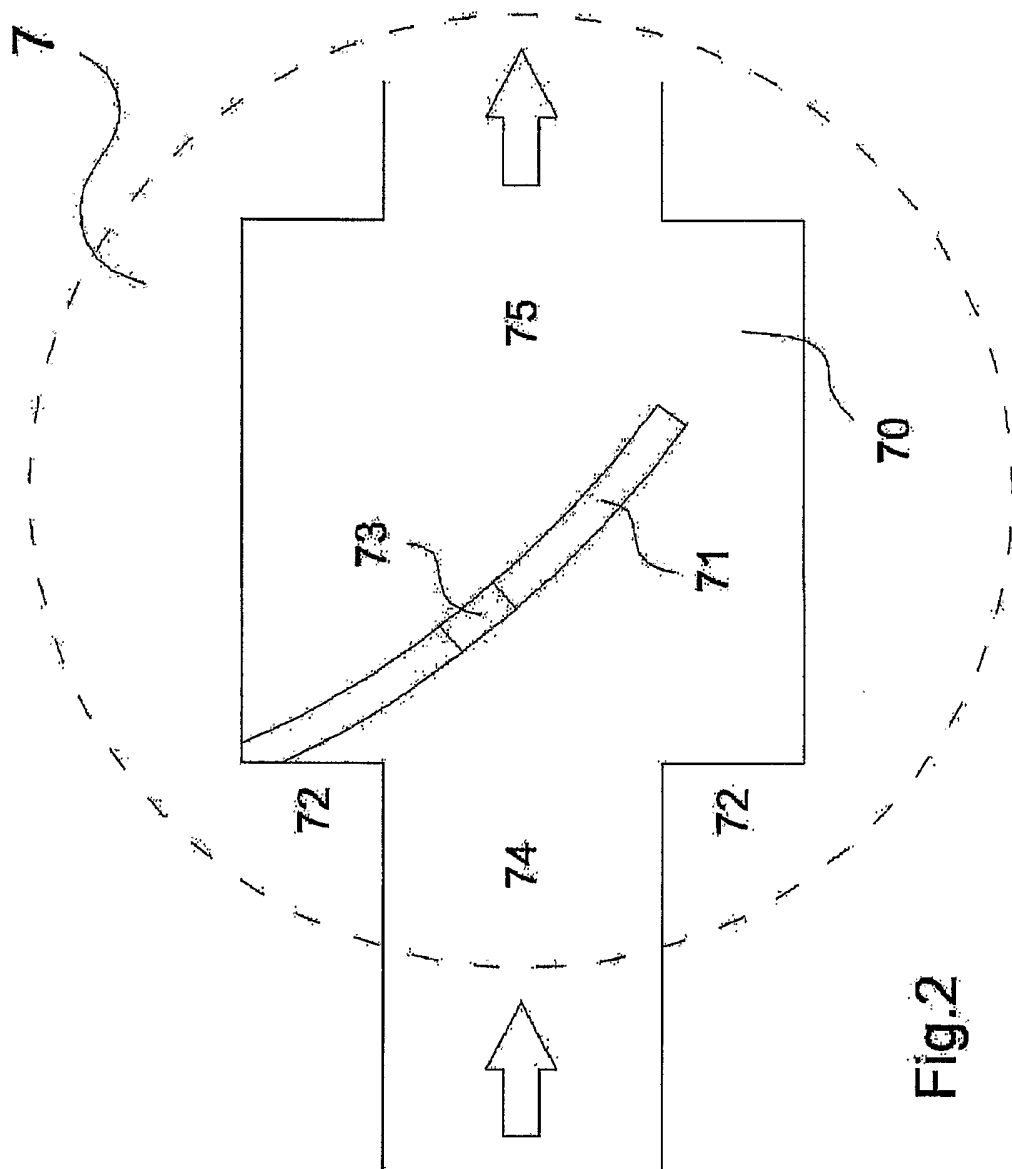


Fig.2

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2006/001389

A. CLASSIFICATION OF SUBJECT MATTER

INV. D06F39/08

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)

D06F A47L F16K

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	WO 03/078840 A (SIEMENS AKTIENGESELLSCHAFT; ARNOLD, BERNHARD; HEROLD, FLORIAN) 25 September 2003 (2003-09-25)	12-14
Y	page 5, line 32 - page 10, line 19;	1-7, 11
A	claims; figures.	8-10, 15
Y	----- US 4 821 537 A (ZINKANN ET AL) 18 April 1989 (1989-04-18)	1-7, 11
A	column 3, lines 25-65; claims; figures. -----	8-10, 12-15

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

☒ See patent family annex.

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"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.

"&" document member of the same patent family

Date of the actual completion of the international search

6 September 2006

Date of mailing of the international search report

18/09/2006

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2006/001389

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
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US 4821537	A	18-04-1989	AU	597596 B2	07-06-1990
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