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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 March 2004 (18.03.2004)

PCT

(10) International Publication Number
WO 2004/023047 A1

(51) International Patent Classification[7]: F24F 13/10, F16K 7/08

(21) International Application Number: PCT/SE2002/001595

(22) International Filing Date: 5 September 2002 (05.09.2002)

(25) Filing Language: Swedish

(26) Publication Language: English

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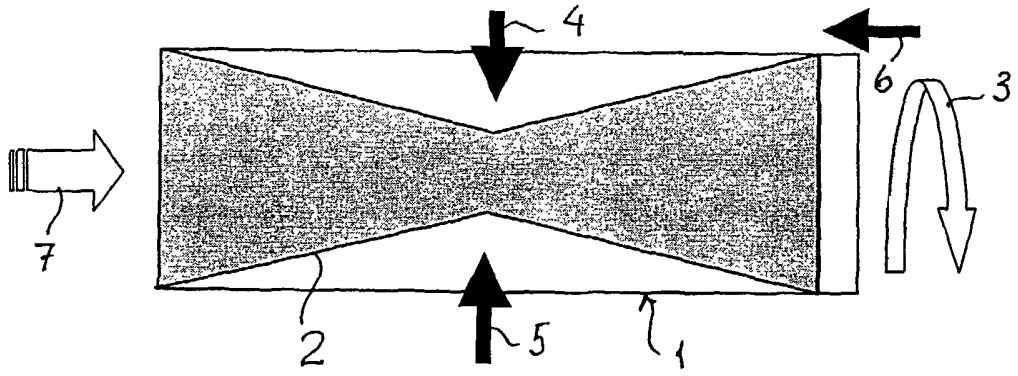
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO,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

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

Published:
— *with international search report*

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: CONTROL DAMPER



(57) **Abstract:** The control damper relates to a control valve which is primarily intended for controlling air flow, although the valve may also be used to control other flowing media. The valve comprises a sleeve (2) of flexible material, the cross-section of which largely corresponds to the duct (1, 22) in which the flow occurs, one end of the sleeve being fixed in relation to the duct and the other end thereof being rotatable with displacement in an axial direction that is controlled in proportion to the rotation. When turned, the sleeve (2) assumes a cross-section in the form of a multi-pointed star (13). The valve is surrounded by sound insulation material (23) and the pipe (22) that surrounds the sleeve is air-permeable.

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Control damper

The present invention relates to a valve for controlling air flow or other flowing medium. The valve comprises a sleeve of flexible material, one end of which is fixed in relation to the duct in which the flow occurs and the other end of which can be turned with displacement in an axial direction that is controlled in proportion to the rotation. Control valves of the type to which the invention relates are used primarily for controlling the air flow in air conditioning installations and ventilation systems by causing a fall in pressure and for controlling the air flow to individual rooms and proportionately to other rooms within the area of the same ventilation system. In order to achieve this, control valves are fitted at a number of different points within the system. In addition to controlling the flow rates, valves are also used for measuring the pressure drop over the valve, which forms the basis for calculation of the flow rates in the system.

Two different types of known valve are most commonly used for these purposes. The simplest type consists of a disk which is rotatably mounted in the flow duct so that the disk is perpendicular to the direction of flow when the valve is closed. From this position the disk can be rotated about an axis in the plane of the disk and passing though its centre. The ventilation ducts are most commonly sheet metal conduits of circular cross-section and the valve then suitably takes the form of a circular sheet metal plate, the size of which corresponds to the inside diameter of the duct. This type of valve has significant disadvantages due to turbulence in the air flow downstream of the valve, which gives rise to undesirable noise and may distort the measuring conditions for the differential pressure measurement.

Iris valves may be used in order to obtain better air flow conditions. These provide a centred restriction of the air flow, which results in a smoother air flow. Iris valves also have a short overall length. However, iris valves also cause turbulence in that the air in this case, too, must pass over a sharp edge, and they are considerably more expensive to manufacture than the simple turning valve.

It has also been proposed to design a valve function in which the air is made to flow through a sleeve of elastic material which is designed to be constricted at the middle so that the diameter thereof is reduced.

In order to achieve a damping of the unwanted noise, which can occur in a ventilation system due to valves or various other causes, separate silencers have been installed in the systems to supplement other components. These silencers take up a relatively large amount of space, firstly since they must cover a certain length of the duct in which they are installed and secondly since they have a larger outside diameter than the rest of the ducting system.

An air-conditioning system should be made of such a material and designed so that it can function for the design life of the installation. The control valve must therefore be made of material which will withstand gases and other substances in the air flow and the surroundings, and it must also be capable of withstanding certain mechanical stresses. It must be possible to carry out adjustments at any time without the valve jamming or being deformed. For hygienic and functional reasons it should be possible to clean the valve which must be designed in such a way that accumulations of dirt, dust and grease cannot permanently restrict the intended function. Unlike shut-off valves, the valve may permit a certain air flow even in its most closed position, and in other embodiments it may also be used as a tight-sealing shut-off valve.

The present invention also relates to a valve by means of which the aforementioned disadvantages of other types of valve can be eliminated or substantially reduced. The fact that valves according to the invention cause substantially less turbulence than previously known valves and also comprise separate means of silencing achieves a reduction in unwanted noise together with a space saving. Valves according to the invention have the characteristic features disclosed in the patent claims.

The invention will be described in more detail below with reference to the examples of embodiment shown in the drawings attached, in which:

Fig. 1 schematically shows the working of a valve according to the invention.

Fig. 2 shows details of a practical embodiment.

Fig. 3 shows a part of a sleeve in the valve.

Figs. 4-6 show the sleeve in various positions of the valve.

Fig. 7 shows the sound propagation directions in a fully opened valve.

Fig. 8 shows the sound propagation directions in a partially restricted valve.

Fig. 1 shows the basic working of the valve according to the invention. The air 7 flows through a duct 1 in which a sleeve 2 of elastic, somewhat air-permeable and stretchable material is arranged. The sleeve, which in the starting position has the shape of a straight, circular cylinder, is designed at one end to be controllably turned as indicated by the arrow 3. This causes a displacement of one sleeve attachment inwards in the direction indicated by the arrow 6 and a reduction in the diameter of the sleeve inwards towards the centre according to the arrows 4 and 5. This results in a reduced flow through the duct so that the flow inside the sleeve thereby diminishes.

Fig. 2 shows some major parts of a practical embodiment of the invention. In a circular duct 1 a sleeve of the aforementioned type is fixed on a piping connection 9 and at its other end to a somewhat longer piping connection that constitutes a flow pipe 8. For sealing against the duct 1 and its extension in both directions, the piping connection 9 and the flow pipe 8 have sealing rings 10-13. The piping connection 9 is fixed in relation to the duct 1, whilst the flow pipe 8 is arranged in the duct 1 so that it is longitudinally displaceable. When the flow pipe is turned in the manner described in more detail below, the sleeve 2 is constricted as folding occurs and the sleeve in various positions takes on the appearance shown in Figs. 3 and 4-6. In other embodiments the piping connection 9 may be turned but not displaced in the longitudinal direction of the duct, without any displacement of the flow pipe 8 occurring.

The sleeve may be made of many different materials, various textile materials being preferred, examples of suitable materials being polyamide, polyester and other materials having a limited elasticity and stretchability. In certain applications rubber or rubber-like materials may be feasible. A sleeve in the form of a hose of textile material can be manufactured by weaving or braiding. This is preferably designed with a thread alignment parallel with the direction of the duct and a thread alignment at right angles thereto. When one attachment is turned as shown in Fig. 1, the sleeve takes on the appearance shown in Fig. 3, which shows the sleeve cut off a short distance from the flow pipe 8 before the middle of the sleeve. When turned, the sleeve 2 is

folded 2 so that a number of ridges 14 and valleys 15 are formed, which in cross-section form a multi-pointed star 20. This can also be seen from Figs. 4A-6A, which show the sleeve in various torsional positions viewed in an axial direction, and Figs. 4B-6B, which show the sleeve in the same positions viewed in a radial direction. Fig. 6B also shows a schematic view of the thread direction for a sleeve of textile material.

Figs. 7 and 8 show cross-sections through a valve according to the invention with sleeve 2 in a tubular duct 22 which is surrounded by insulating, sound-absorbing material 23, which is enclosed by an outer covering 24. The valve is connected to an air duct by the piping connections 25 and 26. The sleeve is fitted to the duct 22 by means of a first fixing ring 18, which is displaceable in the longitudinal direction of the duct, and a second fixing ring 16, which is rotatable in the duct but not displaceable in the longitudinal direction of the duct. The fixing ring 16 is turned by means of an operating device 21, which may be manual or actuated by a servomotor, for example. The operating device is of a design known in the art and is not shown in detail in the figures. The tubular duct 22 is perforated so that its surface is partially open to the insulation 23.

Pressure pipes 17 and 19 may be fitted to the valve and inserted through the casing pipe. The pressure pipes are connected to the air flowing in the duct by slits up against the sleeve fixing rings. This advantageous fitting with a small distance between the measuring points and incorporated into the valve unit is possible due to the characteristics obtained with a valve according to the invention. The folds that are formed in the sleeve material act as guide channels for the air and impart a rotary motion thereto through the sleeve. The more the valve is constricted the more pronounced the guide channels become, as therefore does their effect on the air flow. The rotation is important since it forces the air to follow the circumferential surface of the sleeve, which results in less turbulence, a smaller pressure drop and less generated noise. Less turbulence also makes it possible to measure the pressure and flow more reliably, which is important in modern ventilation systems in which great emphasis is placed on low energy consumption.

In the figures, the directions of the sound waves have been indicated by dashed arrows 27. It will be seen from the figures that there is always an air flow into the surrounding insulation material 23. The fact that the sleeve 2 and the duct 22 are both designed so that they are air-permeable

means that a silencing function is obtained even with the valve fully opened as in Fig. 7, the unit then functioning as an absorption silencer of conventional type. The more the valve is constricted, the more the fixing ring 18 is displaced inwards towards the middle of the valve, consequently exposing more of the sound-absorbing material to direct contact with the air flow without this first having to pass through the sleeve 2. The device functions both as a combined valve and silencer and as a result has a significantly shorter overall length than a conventional combination of silencer and valve arranged side by side. The sound insulation material also means that the unit meets the fire insulation requirements.

A further important characteristic accruing from the reduced turbulence is that the valve becomes less dependent on how it is fitted in the ducting system and can therefore be fitted immediately adjacent to a ducting bend, for example, without this affecting the pressure and flow measurement, which has great practical significance since there is almost always insufficient space in a ventilation system.

The valve according to the invention may naturally be manufactured in various diameters and lengths. One example of suitable dimensions for many applications is a sleeve 160 mm in diameter and 180 mm in length. Turning through 120 degrees, which may be a suitable maximum angle of rotation, results in a reduction in length of approximately 60 mm, the free area at the centre being reduced by 75-80% compared to the initial state.

The controlled formation of folds means that flow around sharp edges is entirely avoided, which in turn results in a substantially reduced turbulence compared, for example, to an iris valve with the same reduction in area. As stated above, the folding means that a form of guide channels are created, which guide the air flow and provide a gentle passage between the valve inlet and outlet. With the valve fully open, the inside is plane and the air flow passes without being disturbed by the valve. In all these situations, therefore, the unwanted noise that is generated is less than in other types of valve.

The tubular duct and the sleeve must be of air-permeable material which allows the sound waves to pass out to the surrounding sound insulation material. That is to say the air-permeable material must allow air molecules to carry sound waves through the material, but on the other

hand it is not necessary for any significant air flow to occur. For this purpose the tubular duct may be made of perforated sheet metal, for example.

As stated, the sleeve may be made of various materials, although textile materials are to be preferred for a number of reasons. Textile materials commonly have a certain limited stretchability or elasticity which can give the sleeve a smoother and more even surface in different torsional positions. A woven or braided material may have a certain permeability for the flowing air and a small proportion of the air flow can then occur between the outside of the sleeve and the surrounding casing pipe. This permeability can have an advantageous effect on the flow conditions, can further reduce the noise generated and can eliminate any disturbance of the pressure measurement. The silencing is largely achieved in that the valve is surrounded by an outer casing of sound insulation material in which there may be through openings for the operating device and the pressure measuring pipes.

Other embodiments apart from those described are possible without departing from the idea of the invention. The control device may be designed in many different ways as can the sleeve fitting in the surrounding casing pipe. The material in the sleeve may be varied and the characteristics thereof influenced by impregnation, material mixing and other similar measures.

CLAIMS

1. Valve for controlling air flow or other flowing medium, comprising a sleeve (2) of flexible material, the cross-section of which largely corresponds to the duct (1, 22) in which the flow occurs, one end of the sleeve being fixed in relation to the duct and the other end thereof being rotatable with displacement in an axial direction that is controlled in proportion to the rotation, so that the sleeve (2) in the fully opened position has the shape of a straight circular cylinder and when turned assumes a cross-section in the form of a multi-pointed star (13), characterised in that the material in the sleeve (2) is permeable to the sound waves that are carried by the flowing medium, so that a proportion of the flow occurs between the outside of the sleeve and a surrounding air-permeable pipe (1, 22), which is in turn surrounded by sound insulation material

2. Valve according to Claim 1, characterised in that the sleeve has a fixed end and a movable end, the moveable end being displaced inside the surrounding pipe (1, 22) when the valve setting is adjusted, so that the more the valve is constricted, the more the surface of the pipe (1, 22) is exposed for direct permeation of sound waves to the insulating material (23).

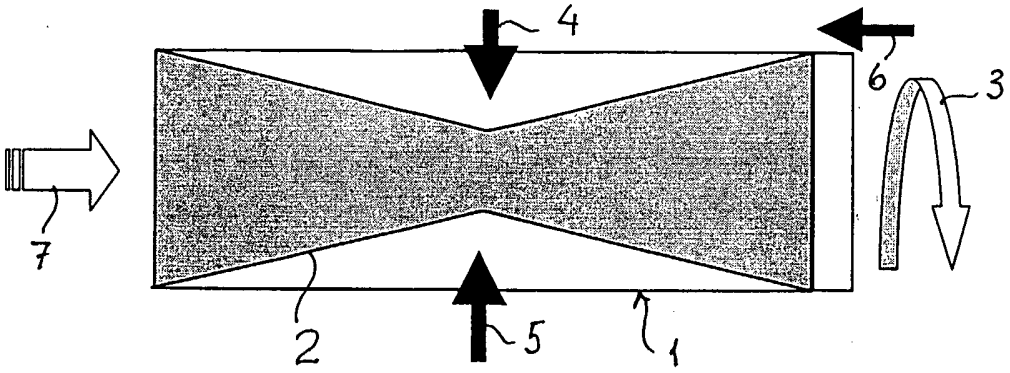

FIG 1

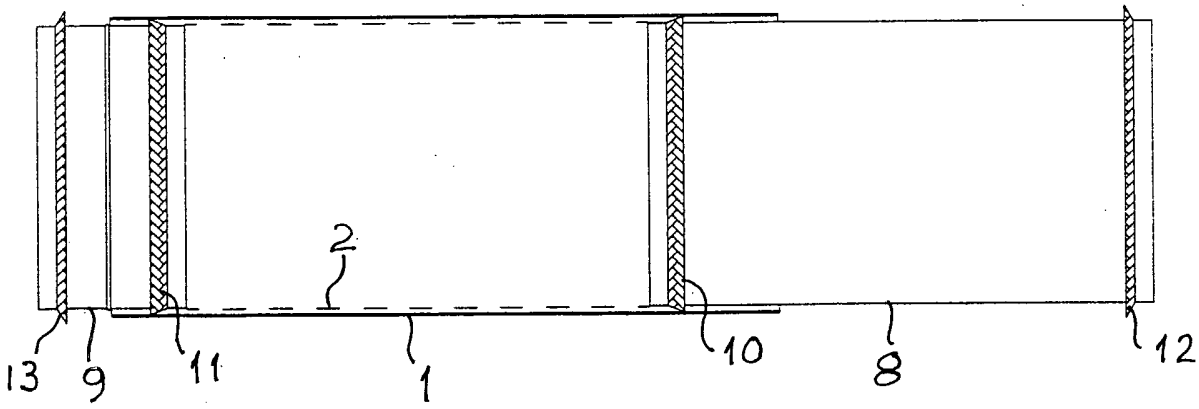

FIG 2

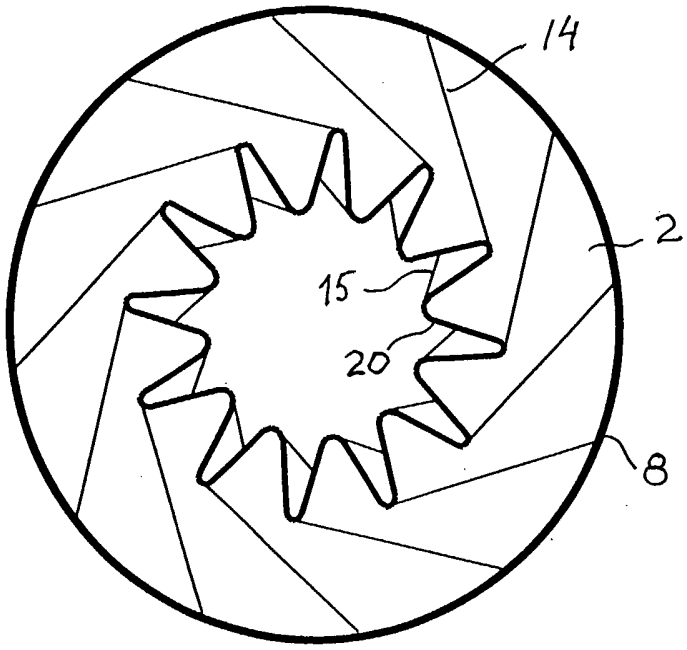

FIG 3

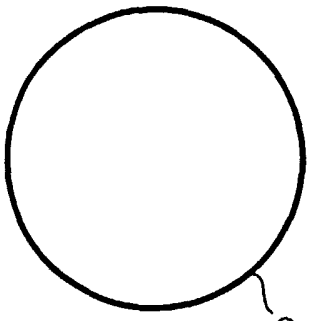

FIG 4A

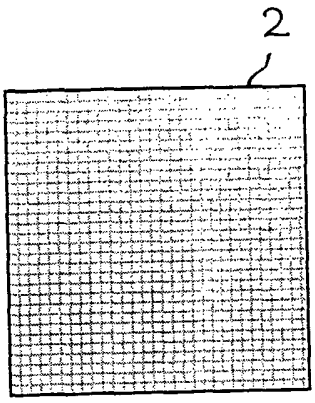

FIG 4B

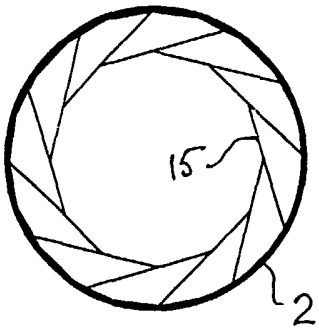

FIG 5A

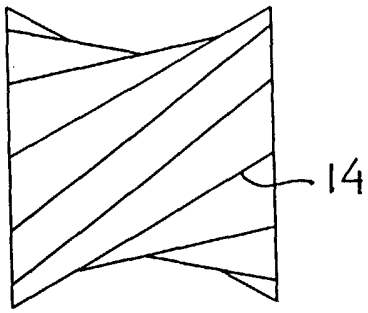

FIG 5B

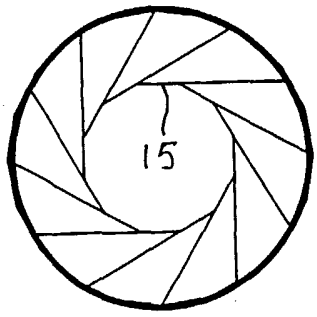

FIG 6A

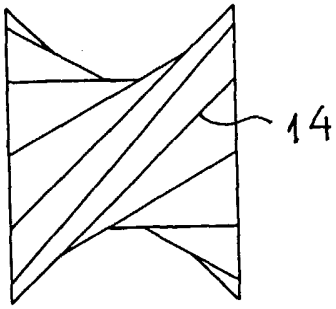

FIG 6B

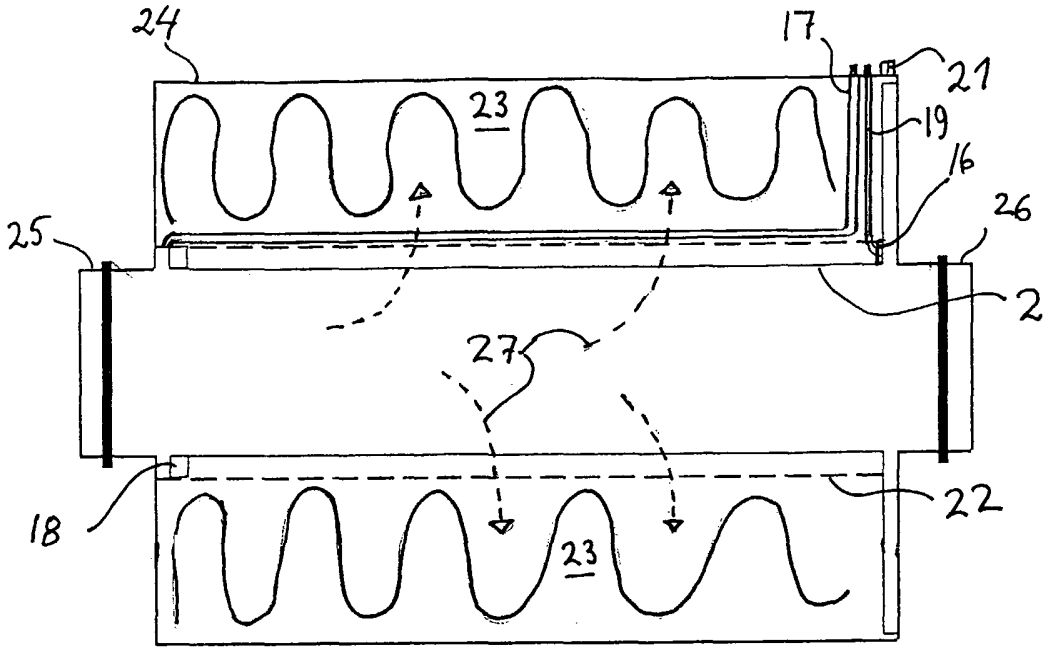
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FIG 7

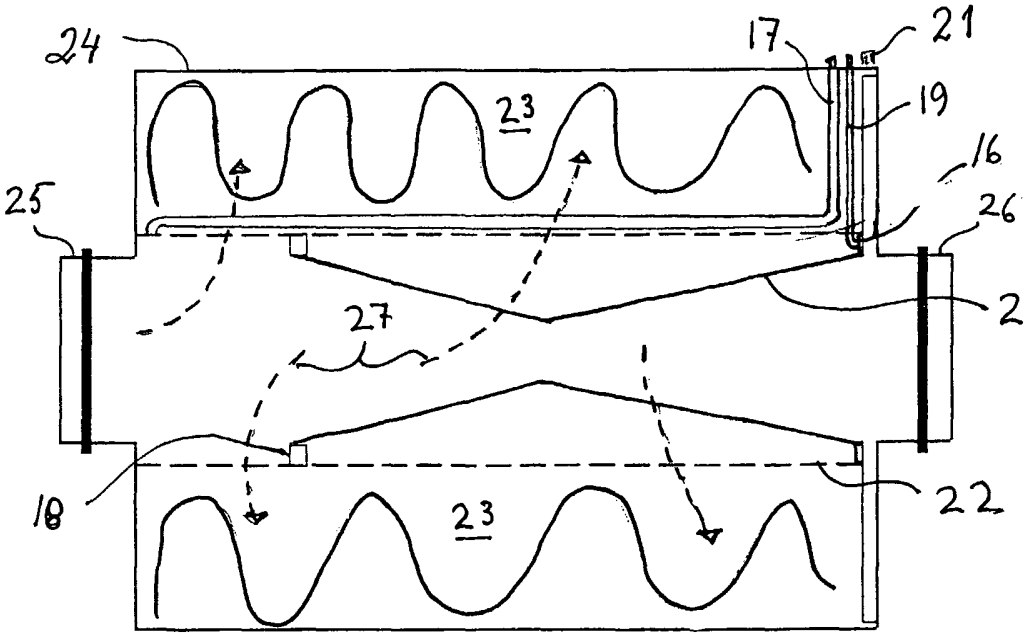
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FIG 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 02/01595

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F24F 13/10, F16K 7/08
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)

IPC7: F24F, F16K

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

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, 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.
E,X	SE 0100797 A (J. BORANDER), 9 Sept 2002 (09.09.02), see the application, claims --	1-2
Y	EP 0334519 A2 (NORMAN, L.D. ET AL), 27 Sept 1989 (27.09.89), column 2, line 37 - line 56; column 3, line 1 - line 21, figure 1 --	1
Y	US 4523737 A (M.R. WENTWORTH), 18 June 1985 (18.06.85), figures 1-2 --	1
A	GB 1379772 A (MUCON ENGINEERING COMPANY LIMITED), 8 January 1975 (08.01.75), figures 1,3 --	1-2

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
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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	Date of mailing of the international search report
20 February 2003	21 -03- 2003
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Heléne Eliasson / MRo Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 02/01595

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DATABASE WPI Week 198620 Derwent Publications Ltd.; London, GB; Class Q66, AN 1986-129848 & SU 1185006 A (SUKHAREV L N), 15 October 1985 (1985-10-15) see figures, abstract -- --------	1-2

INTERNATIONAL SEARCH REPORT

Information on patent family members

30/12/02

International application No.
PCT/SE 02/01595

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
SE 0100797 A	09/09/02	AU 5071501 A	23/10/01
		EP 1274613 A	15/01/03
		SE 518776 C	19/11/02
EP 0334519 A2	27/09/89	GB 8806553 D	00/00/00
US 4523737 A	18/06/85	NONE	
GB 1379772 A	08/01/75	NONE	