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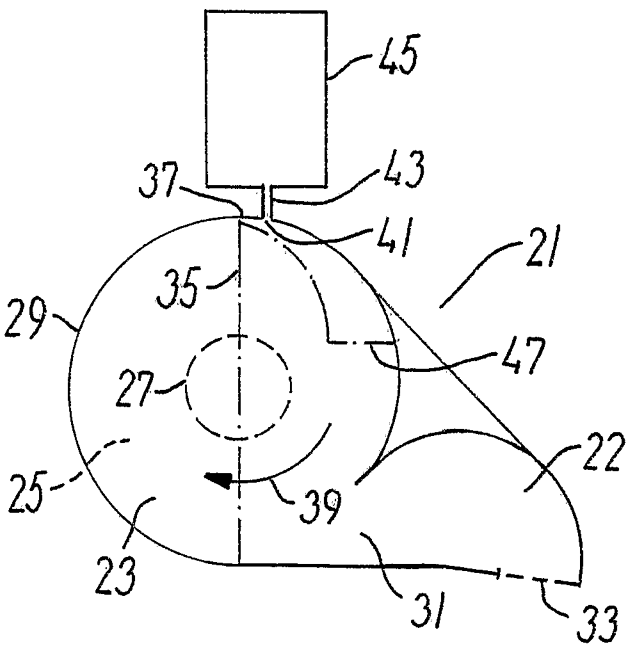

FIG.5

(57) Abstract: A vortex brake for a drain system has a vortex chamber with a curved peripheral side wall (29) surrounding a vortex axis in the vortex chamber, a central outlet (27) from the vortex chamber, a peripheral inlet (31) to the vortex chamber and a vent opening (41) in a wall of the vortex chamber. The vent opening communicates with a compression tank (45) outside the vortex chamber, into which compression tank air from the vortex chamber can be compressed.

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A vortex brake

The present invention relates to a vortex brake or a vortex controller for a drain system, comprising a vortex chamber with a curved peripheral side wall surrounding a vortex axis in the vortex chamber, a central outlet from the vortex chamber, a peripheral inlet to the vortex chamber and a vent opening in a wall of the vortex chamber, the vortex chamber having a rotary direction of a vortex of liquid in the vortex chamber, and the vortex brake having an intended mounted position in which the vortex chamber has a vertex.

Such vortex brakes have been known for many years and are described in, e.g., DE-A-34 35 477, US-A-4 834 142, US-A-5 052 442 and GB-A-2 254 938.

DE-A-34 35 477 describes a vortex brake with a flat, but rounded vortex chamber with a vent opening at the top of the chamber communicating directly with the surroundings.

US-A-4 834 142 also describes a vortex brake with a flat, but rounded vortex chamber with a vent opening at the top of the chamber. This vent opening communicates with the inner one of two vertical concentric pipes mutually interconnected at their upper ends, thereby forming an airlock providing communication with the surroundings.

US-A-5 052 442 describes a vortex brake with a conical vortex chamber with a vent opening located in the end wall of the chamber near the vertex of the curved side wall. The vent opening communicates with a vertical pipe with an airlock at the top providing communication with the surroundings.

GB-A-2 254 938 also describes a vortex brake with a conical vortex chamber. This chamber has a subsidiary chamber extending from the central part of the end wall of the vortex chamber. The subsidiary chamber has been provided to enable clearing of debris, and the subsidiary chamber is provided with a branch extending up from the vortex chamber to allow access from the outside for the insertion of a clearance element in the form of, e.g., a flexible rod. The subsidiary chamber thus communicates upwards with the surroundings.

As appears from, e.g., the above examples, there are various designs of the vortex chamber of a vortex brake.

One example is a flat vortex chamber defined between two opposite, substantially identical walls, *viz.*, a front wall and an end wall. The front wall is provided with a central outlet. The two walls are mutually interconnected by a peripheral wall, which is curved to follow the periphery of the end and front walls. As in the above examples, the peripheral wall may be doubly curved so that it merges with the front and end walls without bends, or it may, e.g., be formed as a cylinder surface with rectilinear generatrices extending between the front and end walls, or it may have an intermediate form. A vortex brake with such flat chamber may be mounted so that the vortex axis is horizontal and extends substantially at right angles to the front wall and centrally relative to the outlet, and the inlet, which is provided in the peripheral wall, is located at the bottom. Alternatively, such vortex brake may be mounted so that the inlet is on a level with the outlet to enable potential surface oil on the water to pass the vortex brake to a downstream oil separator when there is no impounding of water upstream of the vortex brake.

Another well-known design is the conical design with a conical, curved peripheral side wall and an end wall opposite to the apex of the cone. The outlet is located at this apex so that the cone is truncated. This type is normally mounted lying on its side so that the lowermost generatrix is substantially horizontal, possibly with a small slope towards the outlet.

A vortex brake of this type is a hydraulic brake used, e.g., in drain systems to protect the system parts downstream of the brake against hydraulic overload due to excessive flow. Often, the ideal characteristic desired for the brake is one in which the outlet flow from the brake equals the inflow up to a certain limit, whereupon increased inflow and consequent impounding at the brake does not give rise to increased outlet flow from the brake.

However, it is well-known that vortex brakes of the types or designs described here, but without venting, have a characteristic substantially as shown in Fig. 1, that is that, at an increasing pressure head upstream of the vortex brake, the flow increases to a certain point where the curve has a "nose" as the flow drops at further increases of the pressure head because the vortex brake becomes more efficient. This is due to the fact that the vortex in the vortex brake becomes fully developed as the air initially inside the vortex chamber is expelled. When the air has been fully expelled and the vortex is perfect, the curve of the characteristic increases substantially parabolically. At a decreasing pressure head, the characteristic follows a more even curve as the characteristic has a clear hysteresis.

The characteristic of a vortex brake with a vented vortex chamber has a less pronounced "nose" because the air in the vortex chamber is vented as the impounded level upstream of the vortex brake or the pressure head increases. However, the vortex will only become fully formed when the pressure head corresponds to the level of the vertex of the vortex chamber plus inlet pressure loss, for which reason the characteristic will show a small "nose". The characteristic will be substantially parabolic. For a vented vortex chamber, the hysteresis is less pronounced.

The object of the present invention is to provide a vortex brake whose characteristic is more or less approached to the above ideal, that is that the characteristic from the "tip" of the said "nose" extends more steeply, ideally vertically.

Surprisingly, it has proved possible to influence the characteristic in the desired direction by having the vent opening communicate with a compression tank outside the vortex chamber, into which compression tank air from the vortex chamber can be compressed. When the vent opening is connected with a compression tank, the air can be expelled from the vortex chamber against increasing pressure, as the pressure in the compression tank increases as the air from the vortex chamber is expelled into it. At a decreasing pressure head, the air will re-enter the vortex chamber from the compression chamber.

In one embodiment, the vent opening is located at the vertex or, relative to the rotary direction, located some distance downstream of the vertex. This allows substantially all the air in the vortex chamber to be expelled into the compression tank.

In one embodiment, the compression tank has rigid walls, and in another embodiment the compression tank has a flexible wall. By designing the compression tank with a flexible wall, it becomes possible to change the course of the pressure increase in the compression tank compared with the case of a compression tank with only rigid walls. This makes it possible to absorb a larger volume of air so that a compression tank of relatively small outer dimensions may be applied for a vortex brake with a relatively large vortex chamber, e.g., where space is limited.

The flexible wall may be influenced by forces in a direction towards the inside of the compression tank. This further makes it possible to change the course of the pressure increase in relation to the expulsion of air from the vortex chamber.

It is possible for the vortex chamber to have a second vent opening communicating with the surroundings. Such second vent opening is preferably located upstream of the first vent opening and/or upstream of the vertex of the vortex chamber relative to the rotary direction. Such second vent opening makes it possible to further influence the characteristic as part of the air in the vortex chamber will thus be expelled to the surroundings as is known *per se*. Thereby, the volume of air to be expelled into the compression tank may be limited to the volume necessary to achieve the effect of the invention, which makes it possible to limit the size of the compression tank.

Such second vent opening is preferably connected with an airlock with an opening located at a level above the second vent opening.

In a further embodiment, a compression tank of a vortex brake for submerged mounting has an opening to the surroundings at a level below the vertex of the vortex chamber. The opening of the compression tank to the surroundings is preferably located below a level which is 10 per cent of the vertical extent of the vortex chamber below the vertex. Thereby, water which is impounded around the vortex brake and the compression tank will close the compression tank and trap a volume of air in the compression tank and the vortex chamber.

The vortex chamber preferably communicates through an airlock with the opening of the compression tank to the surroundings. This prevents water from penetrating into the vortex chamber through the compression tank.

In one embodiment a tongue of a flexible material is fastened in the vortex chamber at the peripheral side wall upstream of the vent opening and extends past a vertical plane extending through the outlet opening and in parallel with the vortex axis. The tongue may thereby act as a barrier between a vortex of liquid and an air pocket in the vortex chamber and prevent the air from being carried with the liquid out through the outlet opening.

The invention will now be described in more detail below by means of examples of embodiments and with reference to the schematic drawing, in which

Figs. 1-3 show a vortex brake without venting at different pressure heads,

Fig. 4 shows the characteristic of the vortex brake of Figs. 1-3,

Fig. 5 shows a vortex brake according to the present invention,

Fig. 6 shows the characteristic of the vortex brake of Fig. 5,

Figs. 7 and 8 show further embodiments of the vortex brake shown in Fig. 5,

Fig. 9 shows an embodiment of a compression tank with a flexible wall,

Fig. 10 is a side view of another vortex brake according to the invention,

Fig. 11 is an end view of the vortex brake of Fig. 10,

Fig. 12 is a vortex brake according to the invention with a downwardly open compression tank,

Fig. 13 is a side view of the vortex brake of Fig. 12, and

Fig. 14 is a top plane view of the vortex brake of Fig. 12.

Figs. 1-4 illustrate the characteristic of a prior-art vortex brake without venting. Accordingly, Figs. 1-3 show a flat vortex brake 1 of the general type described in, e.g., the publications DE 34 35 477 and US 4 834 142 mentioned above. Nearest the viewer, the vortex brake has a vertical end wall 3 and behind it a front wall 5 with a central outlet opening 7. A peripheral wall 9 with an inlet opening 11 illustrated by a broken line extends between the front wall and the end wall. The front wall, the end wall and the peripheral wall together define a vortex chamber. The vortex brake is intended for mounting in a well in a drain system.

Fig. 4 shows the characteristic of the vortex brake 1, that is, the ratio between the flow Q [l/s] and the pressure head H [m]. At a small inflow of liquid to the well and a resulting small pressure head, the flow is correspondingly small. At an increasing inflow of liquid to the well, the liquid will start rising in the well due to the flow resistance in the vortex brake, including flow resistance in the inlet to the vortex brake. As the flow through the vortex brake increases, the liquid starts circulating in the vortex brake, cf. Fig. 1. A pocket 13 of air trapped in the vortex chamber of the vortex brake above the outlet opening 7 prevents the liquid in the vortex chamber from forming a fully developed vortex, and therefore the effect of the vortex brake is limited at this time. A broken ring 15 illustrates how the air pocket 13 presses down the end of the vortex opposite to the outlet opening. The situation shown in Fig. 1 corresponds to the point A in the characteristic (Fig. 4).

At a further increasing pressure head, the air in the pocket 13 starts being carried with the water as bubbles out through the outlet opening 7, and the vortex in the vortex chamber develops until point B in the characteristic, at which all air has been expelled, and the vortex is fully developed. This corresponds to the situation in Fig. 3. Fig. 2 shows a stage between points A and B in the characteristic before all air has been expelled. After point B in the characteristic, its curve rises parabolically to point C, which is the highest pressure head.

At a decreasing pressure head (or level of liquid in the well), the characteristic follows the curve from C to D through B as shown by a broken line. At some stage during the decreasing pressure head, the vortex in the vortex chamber breaks down, and the curve is united with the curve from 0 to A and follows it down to 0.

Fig. 5 shows a vortex brake 21. Like the vortex brake 1, it is of the flat type, but it is provided with an inlet chamber 22 yielding a larger inlet pressure loss. The vortex brake 21 is thus of a design described in Danish patent application No. PA 2006 01583 (as yet unpublished). Like the vortex brake 1, the vortex brake 21 has an end wall 23 nearest the viewer and a front wall 25 behind the end wall. The front wall 25 is provided with an outlet opening 27, and a peripheral wall 29 interconnects the front and the end walls. The said inlet chamber 22, which has its own inlet 33 from the surroundings, is located upstream of an inlet 31 to the vortex chamber of the vortex brake.

The vortex brake 21 is shown in its intended mounted position and has a vertical centre line 35 upwards intersecting the peripheral wall 29 at the vertex 37 of the vortex chamber. A vent opening 41 is provided in the peripheral wall 29 a little downstream of the vertex 37 relative to a vortex (cf. arrow 39) in the vortex chamber.

Through a pipe 43, the vent opening 41 communicates with a compression tank 45, in this case a closed compression tank with rigid walls. Fig. 5 also shows an air pocket 47 in the vortex chamber.

The vortex brake 21 shown in Fig. 5 functions in the following manner, and it should be noted that the maximum impounded level or pressure head is envisaged to be relatively large and the vortex chamber correspondingly large so that the inlet jet will not be strong enough to flush out the trapped air pocket 47.

At an increasing impounded level or pressure head, the flow according to the characteristic (Fig. 6) increases from 0 to A corresponding to the sequence of events according to Fig. 4. However, as mentioned above, the vortex brake 21 is dimensioned so that the flow of liquid is unable to expel the air pocket 47 from the vortex chamber. Instead, the air pocket 47 is pressed up into the compression tank 45 as the pressure rises, until all air has been expelled from the vortex chamber corresponding to the point B′ or B″ in Fig. 6. The two points B′ and B″ correspond to two different compression tanks of different sizes.

B′ thus illustrates an example with a compression tank having a volume of approximately 0.15 times the volume of the vortex chamber, while B″ illustrates an example with a compression tank having a volume of approximately 1.25 times the volume of the vortex chamber.

The pressure in the compression tank 45 rises as air is pressed up into it from the vortex chamber. It is obvious, however, that the pressure increase for a particular volume of air pressed up is larger for the small compression tank than for the large compression tank. It is therefore easier to press all the air up into the large compression tank than into the small one, and therefore the value for the pressure head H is lower at B″ than at B′.

After the point B (B′ or B″), the characteristic for a further increasing pressure head rises to C. At a decreasing pressure head, the characteristic goes from C to D, at which point the vortex breaks down and the air re-enters the vortex chamber from the compression tank.

Fig. 6 shows that a change of the dimensions of the compression tank may make the characteristic approach a vertical course from A to B, as point B approaches point C.

The characteristic in Fig. 6 applies to relatively rapidly increasing and decreasing pressure heads. Presumably, the reason why the curve is not the same at increasing and decreasing pressure heads when the same volume of air as was pressed out of the vortex chamber re-enters it is that the air is compressed during its expulsion from the vortex chamber, whereby the temperature rises and the air fills more, whereupon the air is cooled in the compression tank by the surrounding liquid. At the decreasing pressure, the air is cooled further to a lower temperature than during the expulsion.

Particularly in case of vortex brakes with large vortex chambers relative to inlet and outlet cross-sections, it may be relevant to provide a further possibility for venting of the vortex chamber or to facilitate the expulsion of part of the air from the vortex chamber.

Accordingly, Figs. 7 and 8 show two further embodiments:

The vortex brake 21′ shown in Fig. 7 is constructed in the same way as the vortex brake of Fig. 5, but has a larger vortex chamber relative to its inlet and outlet cross-sections. Like the vortex brake 21, the vortex brake 21′ is provided with a closed compression tank 45′ with rigid walls. In addition, the vortex brake 21′ is provided with a second vent opening 49 communicating with a vent pipe 51 open to the surroundings at its end opposite to the vent opening 49, as is known *per se*. The vent pipe 49 will be submerged in impounded liquid when venting takes place from the vortex chamber, and the vent pipe 51 is shaped like an upside-down V or U and forms an "airlock" preventing water from flowing into the vortex chamber through the vent pipe 51. The second vent opening 49 is located upstream of the first vent opening 41′ relative to the rotary direction 39′ of a vortex in the vortex chamber and upstream of the vertex 37′. Therefore, the second vent opening 49 will only vent part of the air pocket 13′ as indicated in Fig. 7, whereupon the rest of the air pocket will be pressed up into the compression tank 45′.

Fig. 8 shows a vortex brake 21″ with an even larger vortex chamber relative to the inlet and outlet cross-sections. Like the vortex brake 21′, the vortex brake 21″ is provided with two outlet openings connected with a compression tank 45″ and a vent pipe 51′, respectively. However, the compression tank 45″ is provided with a flexible top wall, whereby part of the air pocket can be vented to the compression tank against a different pressure than if the compression tank had rigid walls, as will be explained in further detail below with reference to Fig. 9.

The compression tank 45″ with a flexible wall shown in Fig. 9 is constructed in the following way: It consists of a vertical cylindrical chamber 53 with a bottom 55 with a connecting pipe 43′ to the vortex chamber. Apart from the connection through the connecting pipe 43′ to the vortex chamber, the compression tank 45″ is closed to the surroundings. At the top, a membrane 57 is mounted between a collar 59 on the top of the cylinder and a convex, dome-shaped cover 60 with a vent opening 61 at the top. Above the dome-shaped cover 60 and with a height distance for venting (see arrow 62) above the membrane 57, yet another dome-shaped cover 63 is arranged with a tubular spring housing 65. A weight 67 may be suspended from the lower surface of the membrane, and a spring 69 may be provided on the upper surface. If desired, both weight and spring may be used at the same time to achieve the desired effect. The compression tank functions in the manner that, when air penetrates from the vortex chamber, the membrane will initially lift against the pressure from the weight 67 and/or the spring 69, which pressure can thus be adjusted through adjustment of the size of the weight and/or the rigidity of the spring. When the membrane 57 abuts the dome-shaped cover 59, it cannot move further, and the compression tank 45" then acts like a compression tank with rigid walls. It is undesired that liquid from the surroundings penetrates to the upper surface of the membrane 57 as this may cause an uncontrolled pressure that might be able to press the membrane downwards and change the volume of the compression tank below the membrane. The vent 62 may therefore be designed so that the pressure from the surroundings meets a smaller surface than the inside surface. Alternatively, the compression tank 45" may be located substantially above the vortex chamber, e.g., at such height that the top of the compression tank is above the highest water level that will occur.

Figs. 10 and 11 show a compression tank 70 according to the present invention arranged on a vortex brake 71 with a conical vortex chamber, e.g., a vortex brake of the type described in WO 2006/069574. The vortex brake 71 has a conical, curved, peripheral side wall 75, an end wall 77 and an inlet 79 in the end wall. An outlet 81 is provided at the apex of the cone shape. A vertical centre line 83 intersects the edge of the end wall 77 at the vertex 85 of the vortex chamber. On the end wall 77 near the vertex 85, but slightly downstream thereof relative to a vortex in the vortex chamber, the compression tank 70 is mounted above a vent opening.

As appears, different measures have been provided according to the invention, which can be used to control how an air pocket in a vortex chamber is vented relative to the impounded level or the pressure head at the inlet to the vortex brake. In this way, the characteristic for the vortex brake can be controlled, as a more gradual venting provides a more vertical characteristic from "A" through "B" to "C", cf. Figs. 4 and 6.

The compression tanks described with reference to Figs. 5-11, may be used for all types of vortex brakes, including both submerged brakes and brakes mounted in dry or semi-dry conditions.

Figs. 12-14 show a vortex brake 101 with an end wall 102, a front wall 103, a peripheral wall 104, a vortex chamber, an inlet opening 105 and an outlet opening 106. The vortex brake 101 is provided with a compression tank 107 shaped like a diving bell with a downwardly open side 109 encircled by lower rims 111 of side walls 113 of the compression tank 107. The compression tank 107 moreover has a top wall 115, from which a pipe 117 extends upwards. The pipe 117 is closed at its upper end 119. A second pipe 121 with a smaller external diameter than the internal diameter of the pipe 117 is connected to a vent opening 123 at the vertex of the vortex chamber of the vortex brake 101 and extends upwards into the first pipe 117. The two pipes 117 and 121 thereby provide communication through an airlock between the vortex chamber and the inside of the compression tank.

The rims 111 are located at a level which, in the embodiment shown, is approximately 23 per cent of the vertical extent of the vortex chamber below the vertex of the vortex chamber.

With its downwardly open compression tank 107, the vortex brake 101 is intended for submerged mounting in, e.g., a well in which liquid may be impounded when the vortex brake 101 becomes active due to a large flow. As the compression tank 107 is downwardly open, it will act as a vent until the liquid in the well has risen to the level of the opening. At a subsequent rise of the liquid around the vortex brake 101 and the compression tank 107, the liquid will trap the air in the compression tank and the communicating upper part of the vortex chamber. By placing the open side 109 of the compression tank at different levels, it is possible to trap a larger or smaller volume of air in the upper end of the vortex chamber. It is intended thereby to trap a volume of air resulting in a substantially constant outflow over the greatest possible variation of the impounded level.

The function is as follows: For a specific point in time at a constant impounded level and after a balance has been arrived at between the water level in the compression tank and the aggregate outlet pressure loss (that is, the inlet pressure loss of the vortex brake plus the pressure loss in the vortex chamber), a reduction of the flow will indicate that part of the trapped volume of air has been carried with the flowing liquid out through the outlet opening 106, whereby the braking effect has increased. Due to the increased braking effect in the vortex chamber, the inlet pressure loss in the vortex brake 101 will drop, and further air will be expelled into the compression tank 107, whereby the braking effect increases further. Thereby, the impounded level around the vortex brake will rise. The liquid around the vortex brake will then, through the open side of the compression tank, press air from the compression tank back into the vortex chamber, thus compensating for the air volume carried along through the outlet, and the balance will be restored.

The vortex brake 101 is moreover provided with a flexible tongue 125, which is fastened to the peripheral wall 104 and extends between the front wall 103 and the end wall 102. Relative to a vortex in the vortex chamber, the tongue is fastened upstream of the vent opening 123 and extends past a vertical plane 127 extending through the outlet opening 106 and in parallel with the vortex axis, that is, at right angles to the front and end walls. Due to its weight, the tongue will hang down and form a barrier between the water in an incipient vortex in the vortex chamber and an air pocket. The tongue will thereby counteract air in the air pocket being carried out of the outlet opening 106 by the eddying liquid. Because of its flexibility, the tongue will be pressed upwards towards the peripheral wall as the vortex in the vortex chamber grows, and the air in the air pocket will be pressed up into the compression tank.

CLAIMS

1. A vortex brake for a drain system, comprising a vortex chamber with a curved peripheral side wall (29; 75) surrounding a vortex axis in the vortex chamber, a central outlet (27; 81) from the vortex chamber, a peripheral inlet (31; 79) to the vortex chamber and a vent opening (41) in a wall of the vortex chamber, the vortex chamber having a rotary direction (39) of a vortex of liquid in the vortex chamber, and the vortex brake having an intended mounted position in which the vortex chamber has a vertex (37), characterized in that the vent opening communicates with a compression tank (45; 70) outside the vortex chamber, into which compression tank air from the vortex chamber can be compressed.

2. A vortex brake according to claim 1, characterized in that the vent opening (41) is located at the vertex (37) or, relative to the rotary direction (39), located some distance downstream of the vertex (37).

3. A vortex brake according to claim 1 or 2, characterized in that the compression tank (45) has rigid walls.

4. A vortex brake according to claim 1 or 2, characterized in that the compression tank (45") has a flexible wall (57).

5. A vortex brake according to claim 4, characterized in that the flexible wall is influenced by forces (67; 69) in a direction towards the inside of the compression tank (45").

6. A vortex brake according to any one of claims 1 to 5, characterized in that the vortex chamber has a second vent opening (49) communicating with the surroundings.

7. A vortex brake according to claim 6, characterized in that, relative to the rotary direction (39), the second vent opening (49) is located upstream of the first vent opening (41).

8. A vortex brake according to claim 6 or 7, characterized in that, relative to the rotary direction (39), the second vent opening (49) is located upstream of the vertex (37').

9. A vortex brake according to any one of claims 6 to 8, characterized in that the second vent opening (49) is

connected with an airlock (51) with an opening located at a level above the second vent opening.

10. A vortex brake according to claim 1 or 2, characterized in that the compression tank (107) has an opening (109) to the surroundings at a level below the vertex of the vortex chamber.

11. A vortex brake according to claim 10, characterized in that the opening (109) of the compression tank to the surroundings is located below a level which is 10 per cent of the vertical extent of the vortex chamber (101) below the vertex.

12. A vortex brake according to claim 10 or 11, characterized in that the vortex chamber (101) communicates through an airlock (117; 121) with the opening (109) of the compression tank to the surroundings.

13. A vortex brake according to any one of claims 1 to 12, characterized in that a tongue (125) of a flexible material is fastened in the vortex chamber at the peripheral side wall (104) upstream of the vent opening (123) and extends past a vertical plane (127) extending through the outlet opening and in parallel with the vortex axis.

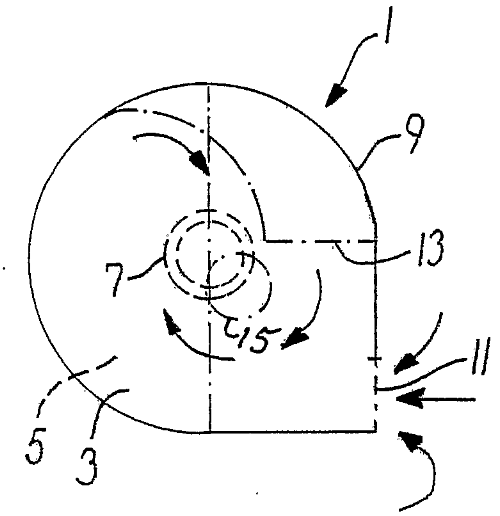

FIG.1

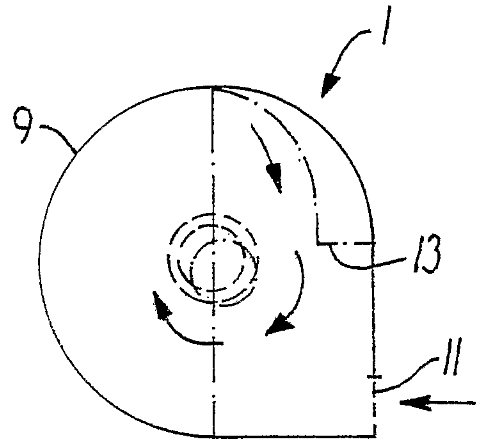

FIG.2

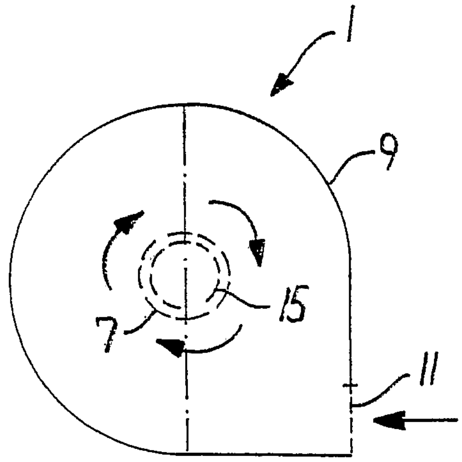

FIG.3

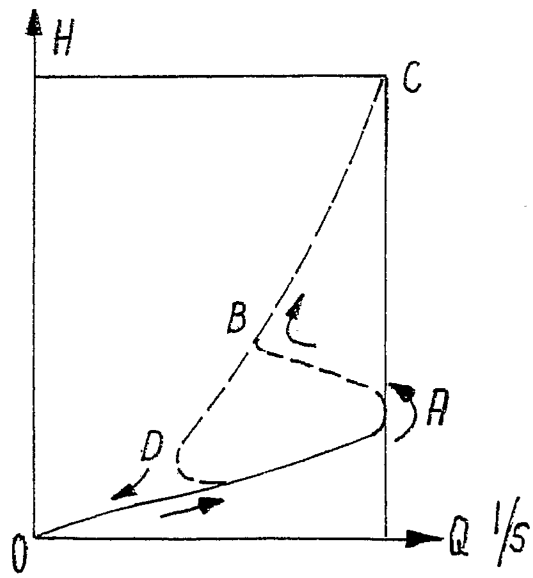

FIG.4

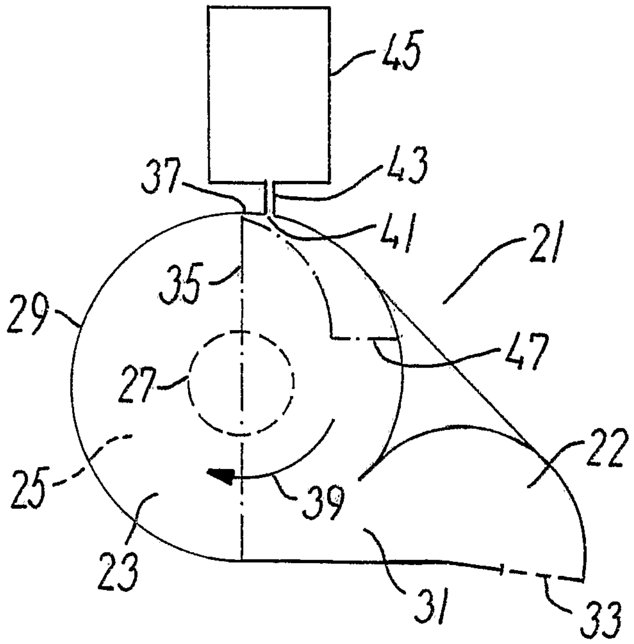

FIG.5

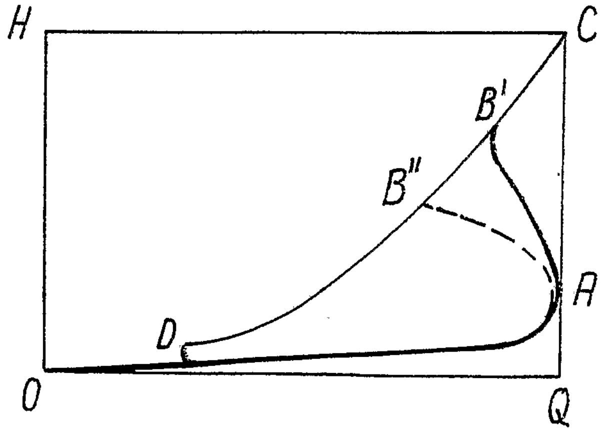

FIG.6

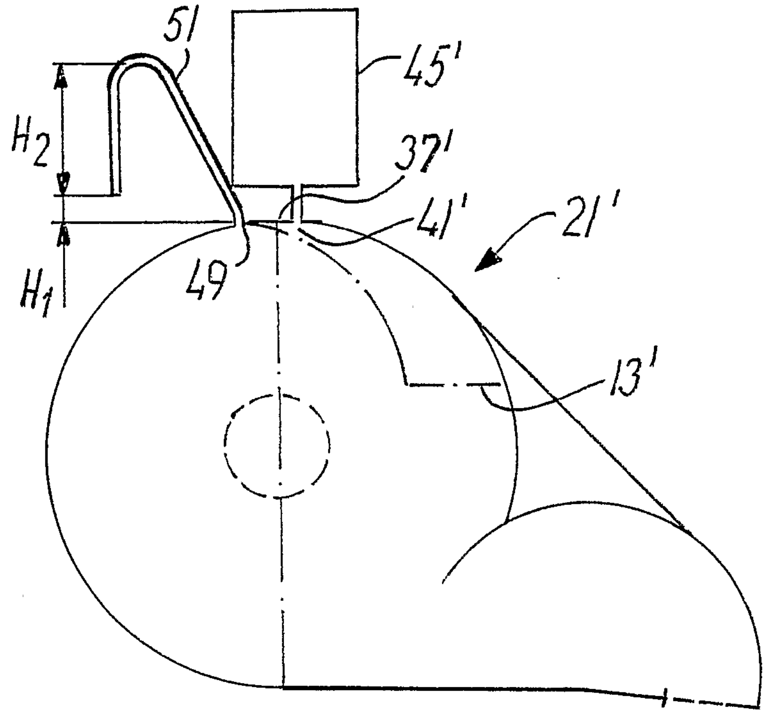

FIG.7

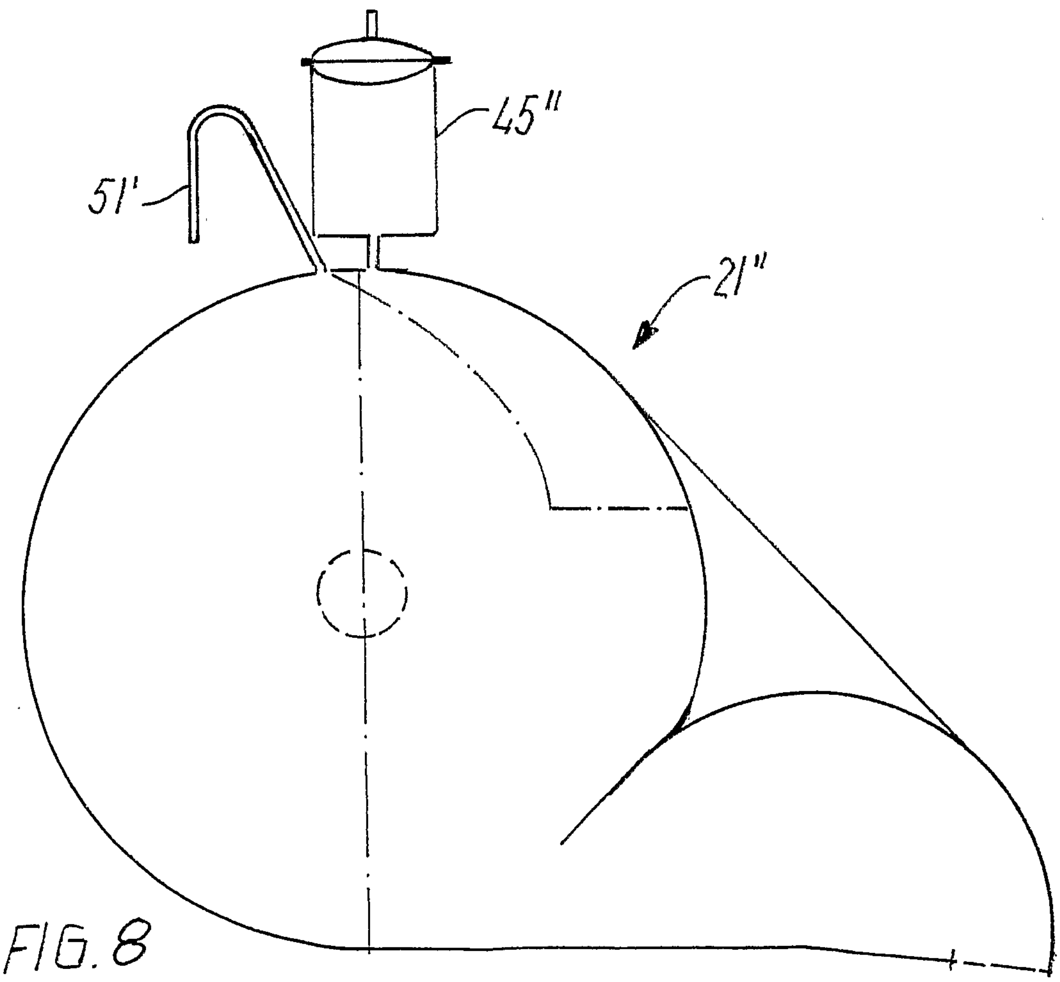

FIG.8

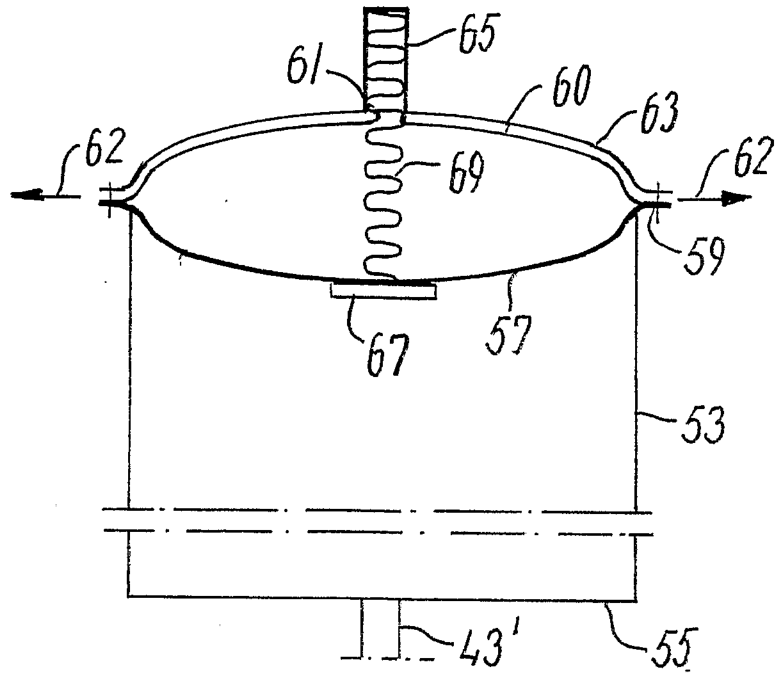

FIG. 9

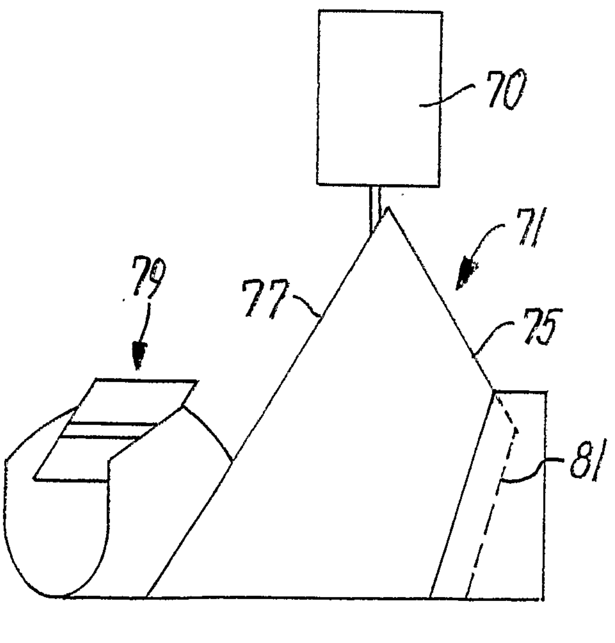

FIG.10

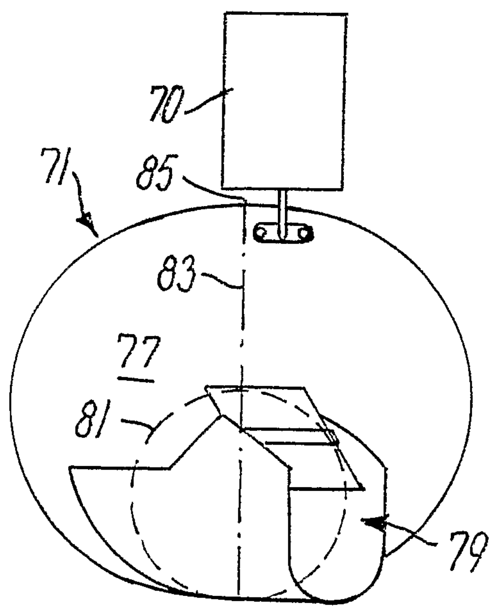

FIG.11

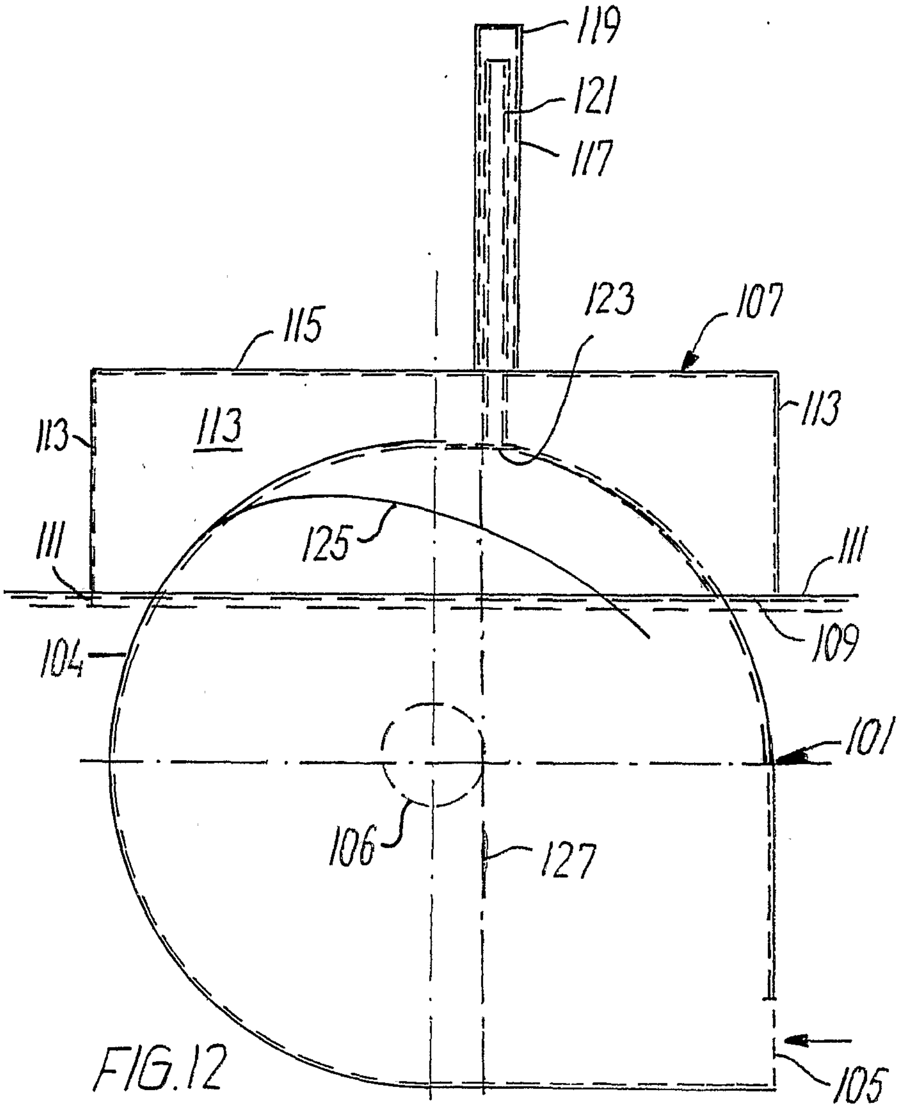

FIG.12

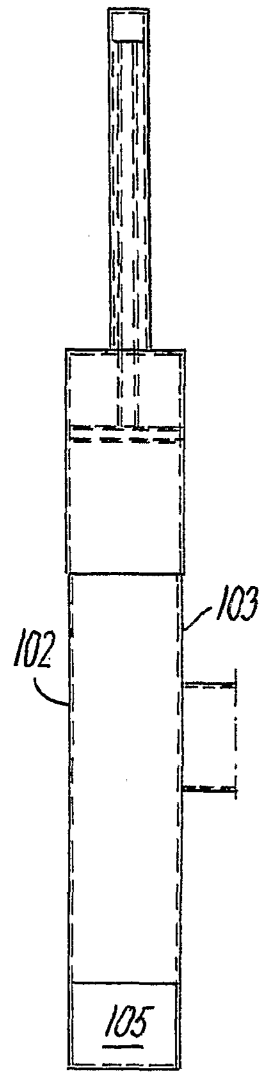

FIG.13

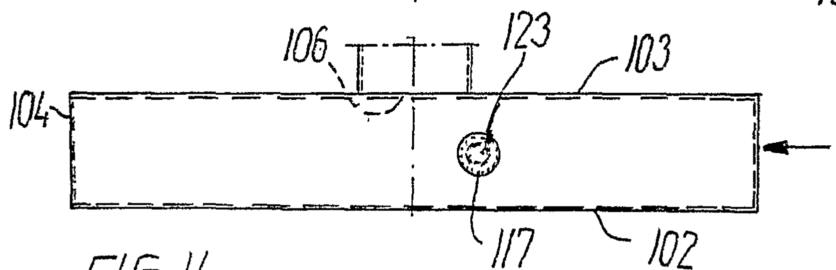

FIG.14

INTERNATIONAL SEARCH REPORT

International application No
PCT/DK2008/050104

A. CLASSIFICATION OF SUBJECT MATTER
INV. E03F5/10 F15D1/00

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)
E03F F15D

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 206 783 A (BROMBACH HANSJOERG [DE]) 10 June 1980 (1980-06-10) figures 7,17 column 7, line 50 - line 54	1
A	DE 34 35 477 A1 (BROMBACH HANSJOERG) 27 March 1986 (1986-03-27) page 8, paragraph 4; figure 1	1

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

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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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
10 September 2008	22/09/2008

Name and mailing address of the ISA/	Authorized officer
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	Flygare, Esa

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/DK2008/050104

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4206783 A	10-06-1980	AT 378132 B	25-06-1985
		CH 626430 A5	13-11-1981
		DE 2712443 A1	28-09-1978
DE 3435477 A1	27-03-1986	CH 667122 A5	15-09-1988