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(54) Ventilating apparatus

(57) A ventilation apparatus for ventilation and temperature control in accommodations, e.g. in vessels, comprising an inlet which is connected to a ventilation channel and at least one outlet which is connected to said accommodation. Damper means (17) are located between the inlet and the outlet, for volume control of the air flow to the accommodation via at least two cooperating damper discs (19, 21). The discs are provided with flow passages (30, 32) the flow area of which are variable by rotating at least one of the damper discs (21) around a spindle (20). The damper means (17), heat production means (15) and sensors (27, 28) connected to the control unit (16), are located in a cylindrical channel section (10). Each flow passage (30, 32) in the damper means, form in every position of rotation a funnel which narrows gradually in the direction of flow, so that the damper means (17) in almost completely closed position presents slit-shaped flow openings with wall which converge in the direction of flow. One of the damper discs (19) is thin and located upstream another damper disc (21), and is also provided with a number of vanes (31) corresponding to the number of flow passages (32), which vanes project into the flow passages, to form one side in the flow passage with substantially the same length as the other sides.

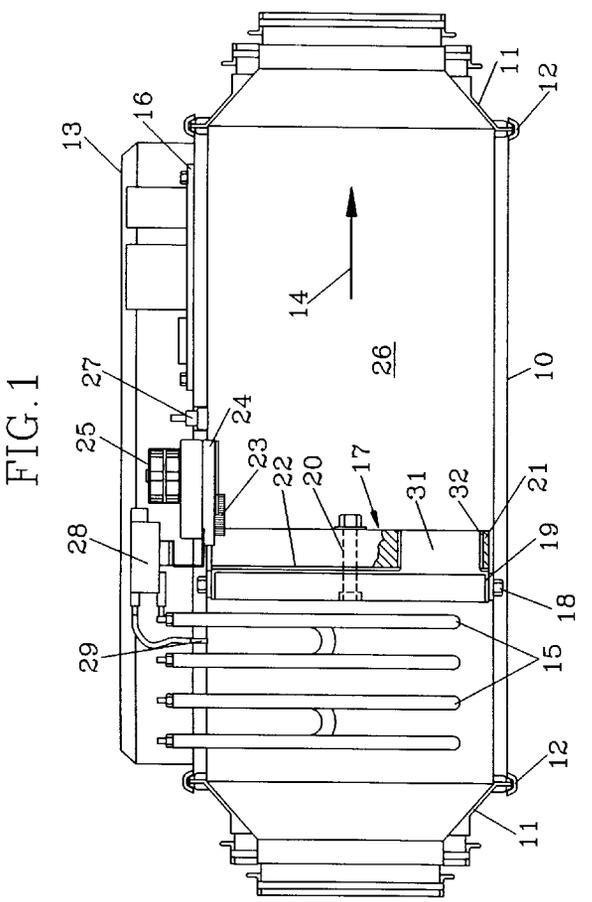

FIG. 1

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Description

TECHNICAL FIELD

The present invention relates to a ventilation apparatus for ventilation and temperature control in accommodations, e.g. in vessels, comprising an inlet which is connected to a ventilation channel, at least one outlet which is connected to said accommodation, damper means located between the inlet and the outlet, for volume control of the air flow to the accommodation via at least two cooperating damper discs having flow passages the flow area of which are variable by rotating at least one of the damper discs around a spindle, and a control unit for controlling the flow and temperature, for adaption to a desired temperature level.

BACKGROUND OF THE INVENTION

On board vessels, air is supplied to accommodation areas like for example cabins. The air is used for controlling the temperature in the accommodation area and for replacing air which is ventilated out from the area.

Several different systems for supply of air and ventilation are known. Usually, 100% fresh air which has been dried and tempered, is supplied to a large number of ventilation apparatuses which at the same time act as diffusors for distributing the air. The supplied air may be heated from a low temperature or be mixed with hot air, so that the temperature in the area will become the desired. Such ventilation apparatuses are adjusted to give the right flow and temperature at the inlet side of the apparatus at the prevailing pressure which in its turn is dependant upon how other ventilation apparatuses in the same ventilation system are adjusted. The adjustment is therefore an iterative process which must be adjusted many times, in order to achieve the desired result. Thus, a malfunctioning ventilation apparatus will affect all other apparatuses within the same system and give rise to inconveniences or repetitive adjustments. Increasing demands for cooling at ships cabins imply that one now has approached the limit for the supplied amount of air which is possible to be supplied to a cabin by a single apparatus, without creating a draft. An increase in the number of ventilation apparatuses would be an uneconomical solution.

THE TECHNICAL PROBLEM

One object of the present invention is to provide a ventilation apparatus with compact installation dimensions, which result in a low intrinsic pressure drop for efficient air supply, with accurate damping over a large flow range, despite pressure variations at the inlet side of the apparatus, and with a small generation of noise over the entire said flow range.

THE SOLUTION

For this purpose, the apparatus according to the invention is characterized in that the damper means, heat production means and sensors connected to the control unit, are located in a cylindrical channel section, that each flow passage in the damper means in every position of rotation form a funnel which narrows gradually in the direction of flow, so that the damper means in almost completely closed position presents slit-shaped flow openings with wall which converge in the direction of flow, and that one of the damper discs is thin and located upstream another damper disc, and is also provided with a number of vanes corresponding to the number of flow passages, which vanes are angled from the disc plane in the direction downstream and projects into the flow passages, to form one side in the flow passage with substantially the same length as the other sides and with a corresponding narrowing in the direction of flow. By this design of the ventilation apparatus, an accurate, silent damping is provided over a large flow range.

Adjustment of the ventilation apparatus is facilitated by the use of pressure dependant flow control.

Preferably, the adjustment is made by means of a differential pressure sensor.

Further variants of the invention appears from the accompanying subclaims.

DESCRIPTION OF THE DRAWINGS

The invention will be described here below with reference to an embodiment shown in the accompanying drawings, in which

Fig. 1	is a longitudinal section through a ventilation apparatus according to the invention,
Fig. 2	is an end view of the ventilation apparatus in Fig. 1, and
Fig. 3-5	show the ventilation apparatus damper in three different positions of use.

DESCRIPTION OF EMBODIMENTS

The ventilation apparatus shown in Fig. 1 and 2 comprises a cylindrical tube housing 10, which is mounted in a ventilation channel via conical end connectors 11. These make it possible to connect the apparatus to channel systems with sealing rings either on the inner or the outer tube. The mounting is made by means of buckle clamps 12, which make it simple to dismount the ventilation apparatus from the channel system as a complete unit for reparation or maintenance. An oblong coupling box 13 for electrical equipment is mounted longitudinally and at the outside of the tube housing 10.

The arrow 14 in Fig. 1 depicts the direction of flow

through the ventilation apparatus which is supplied with fresh air which has been dried and cooled to a comparatively low temperature, e.g. +15 °C.

Two in a double spiral shape coiled heating electrodes 15 are mounted at the inlet side of the tube housing 10 and are each provided with an output of 900W, which output is variable infinitely variable. The output control is done in an electronic control unit 16 with respect to air flow and temperature demands for the area which is served by the ventilation apparatus.

A damper device 17 is mounted downstream the electrodes 15 in the tube housing 10, and will be described more in detail below, but broadly comprises a damper disc 19 which is fixed by means of screws 18 in the tube housing, and is provided with a spindle 20. The spindle 20 carries a turnable journalled damper disc 21 and an also turnable, between the two damper discs 19, 21 journalled slave disc 22. The damper disc 21 is operated via a gearwheel 23, a transmission 24 and a stepping motor 25 which is connected to the control unit 16.

Downstream the damper device 17, there is a comparatively long space 26 in the tube housing 10, which is designed to even out the flow from a number of passages in the damper device, so that turbulence in the flow is evened out before the flow reaches the conical tube section 11 at the downstream end of the tube housing.

Temperature sensors 27 are mounted as lead-throughs in the tube housing 10, both at the upstream and the downstream side of the damper device 17. The temperature sensors 27 are connected to the control unit 16. A differential pressure sensor 28 is mounted together with sensor probes 29 upstream and downstream the damper device 17. The differential pressure sensor 28 is also connected to the control unit 16.

The fixed damper disc 19 of the damper device 17 has a normal thin plate thickness and is provided with five flow openings 30, which are distributed with equal spacing along the circumference on the circular disc. Each of the passages 30 designed as a circular sector with a truncated point. Each of said sectors has an angular measurement of about 36°. One of the angle sides of each sector is provided with one from the disc plane, in almost right angle to the direction of flow bent vane 31. The vanes 31 protrude a good 25 mm from the disc plane.

The turnable damper disc 21 of the damper device 17 has in its turn a thickness of about 25 mm. Five flow passages 32 are in the same way distributed with equal spacing along the circumference of the disc 21. Each of the passages 32 is designed as a circular sector with a truncated point. Each of said sectors has an angular measurement of about 36°, wherein the angle sides incline somewhat conically in the direction of flow, so that the flow opening tapers gradually with a few degrees of angle in said direction. The vanes 31 on the fixed damper disc 19 project down into the passages 32, so that their end edges 33 are in parallel with one of the downstream located angle edges of these passages.

The damper disc 21 is influenced by a not shown torsion spring, the object of which is to exert a turning force which absorbs any possible backlash in the gear mesh with the gear 23. Because the torsion spring strives to turn the disc 21 in the direction towards the fully open position, the spring is in its maximum tensioned state when the damper is fully closed. This is convenient because the damper is from the point of view with regard to adjustability most sensitive in the vicinity of the fully closed position.

The slave disc 22 is also manufactured from sheet and is provided with flow openings 34 which fully correspond to the shape of the passages 30 in the fixed damper disc 19.

As is disclosed in Fig. 3-5 which show the two end positions of the damper and an intermediate position, the slave disc 22 is affected by the rotation of the turnable damper disc 21, so that it is brought along during the end phase of this rotation, i.e. during turning from fully open to fully closed position. For this object, the arms 35 which delimit the openings 34 are used for shielding the flow passages 30 of the fixed damper disc 19, so that these do not expose the next following passage 32 in the turnable damper disc 21.

When the damper 17 is almost fully closed, the flow through the damper occurs via long and narrow, funnel-shaped, radially arranged slit openings, each of which is delimited by walls which converge in the direction of flow to form a passage the length of which is substantially larger than the width of the slit opening. Preferably, this length corresponds to at least one eighth of the largest circumference of the flow passage.

This design has proven to provide a substantial reduction of the noise which is produced when the air passes through the damper. Otherwise, this control condition normally produces noise producing turbulence in a damper.

When the damper is fully closed, the slit openings are closed. During operation to the fully open position, the slave disc 22 is brought along by the turnable damper disc 21, until the arms 35 of the slave disc again are overlapped by the arms which delimit the openings 30 of the damper fixed disc 19.

By using temperature sensors 27 and a differential pressure gauge which registers both the differences in temperature and pressure upstream and downstream the damper 17, it is possible for the control unit to work very precisely and reliable. For example, the control unit may compensate for variations in supplied pressure in the channel system, which may be caused by variations in air consumption at the rest of the connected apparatuses, by variations in wind pressure at inlets/outlets of the fans which serve the system, etcetera. These pressure changes can otherwise produce inertia and problems in the entire control system during the transient period, which in its turn will lead to temperature variations in the area and to an unnecessary high consumption of

energy and wear on means for control of volume flow.

This is avoided by also supplying the control unit 13 with information about characteristics for the means for volume flow control with regard to position - supply pressure - received volume flow, so that alterations in position can be performed more rapidly and more precisely.

By means of the above described sensors and the control unit 16 it is possible to create different conditions of reliability which therefore will be physically built into the ventilation apparatus. This makes the ventilation apparatus according to the invention function much more intelligently than previously known apparatuses which only work in interaction with a monitoring central. For example, it is possible to stipulate that no electric power may be supplied to the heating elements 15 if there is not a certain minimal flow through the damper.

The material of damper is selected out of consideration for till that the apparatus should be able to function as a fire damper.

The invention is not limited to the above described embodiment, but several variations are possible within the scope of the accompanying claims. For example, the damper 17 may be provided with different openings than shown.

Claims

1. A ventilation apparatus for ventilation and temperature control in accommodations, e.g. in vessels, comprising an inlet which is connected to a ventilation channel, at least one outlet which is connected to said accommodation, damper means (17) located between the inlet and the outlet, for volume control of the air flow to the accommodation via at least two cooperating damper discs (19, 21) having flow passages (30, 32) the flow area of which are variable by rotating at least one of the damper discs (21) around a spindle (20), and a control unit (16) for controlling the flow and temperature, for adaption to a desired temperature level,
characterized in that the damper means (17), heat production means (15) and sensors (27, 28) connected to the control unit (16), are located in a cylindrical channel section (10),
that each flow passage (30, 32) in the damper means, in every position of rotation, form a funnel which narrows gradually in the direction of flow, so that the damper means (17) in almost completely closed position presents slit-shaped flow openings with wall which converge in the direction of flow, and that one of the damper discs (19) is thin and located upstream another damper disc (21), and is also provided with a number of vanes (31) corresponding to the number of flow passages (32), which vanes are angled from the disc plane in the direction downstream and projects into the flow passages, to form one side in the flow passage with substantially the same length as the other sides and with a corresponding narrowing in the direction of flow.

2. A ventilation apparatus according to claim 1, **characterized** in that the flow passages (30, 32) extend with a length which corresponds to at least one eighth of the largest circumference of the flow passage, in the longitudinal direction of the channel section (10).

3. A ventilation apparatus according to claim 1, **characterized** in that there are two damper discs, of which one disc (21) is composed of a disc with a certain material thickness and with a number of segment-shaped flow passages (32) extending substantially in parallel through the disc in the longitudinal direction of the channel section (10).

4. A ventilation apparatus according to claim 3, **characterized** in that a slave disc (22) is placed between the two damper discs (19, 21), and arranged to be brought along by the rotatable damper disc (21).

5. A ventilation apparatus according to claim 1, **characterized** in that the cylindric channel section (10) is provided with means (12) which enable a simple detachable mounting at tube ends (11).

6. A ventilation apparatus according to claim 1, **characterized** in that the power output of the heat production means (15) is controlled by the control unit (16) by means of a feedback coupling of a sensor signal which characterizes the flow through the apparatus, independent of pressure variations in the ventilation channel.

FIG. 1

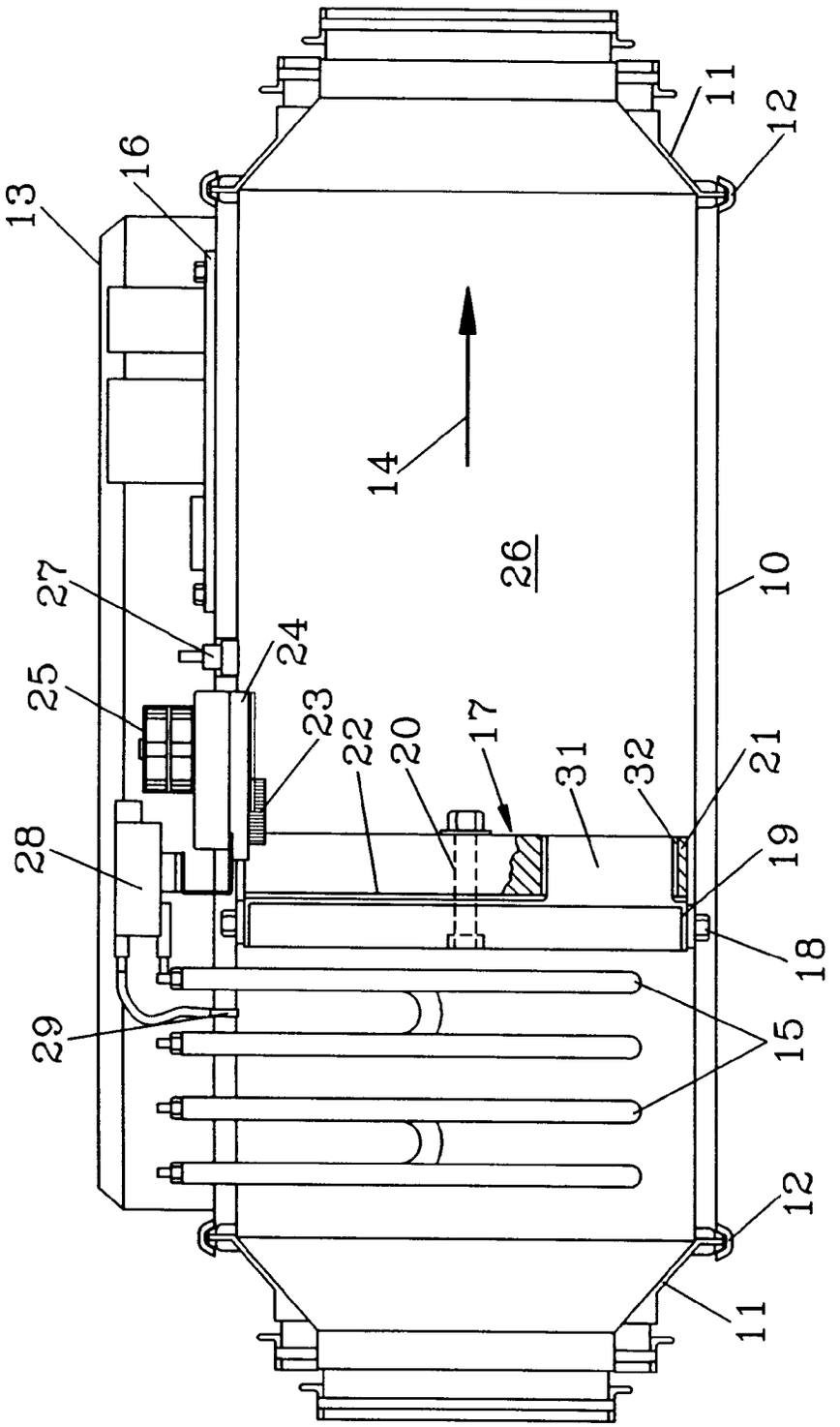

FIG.2

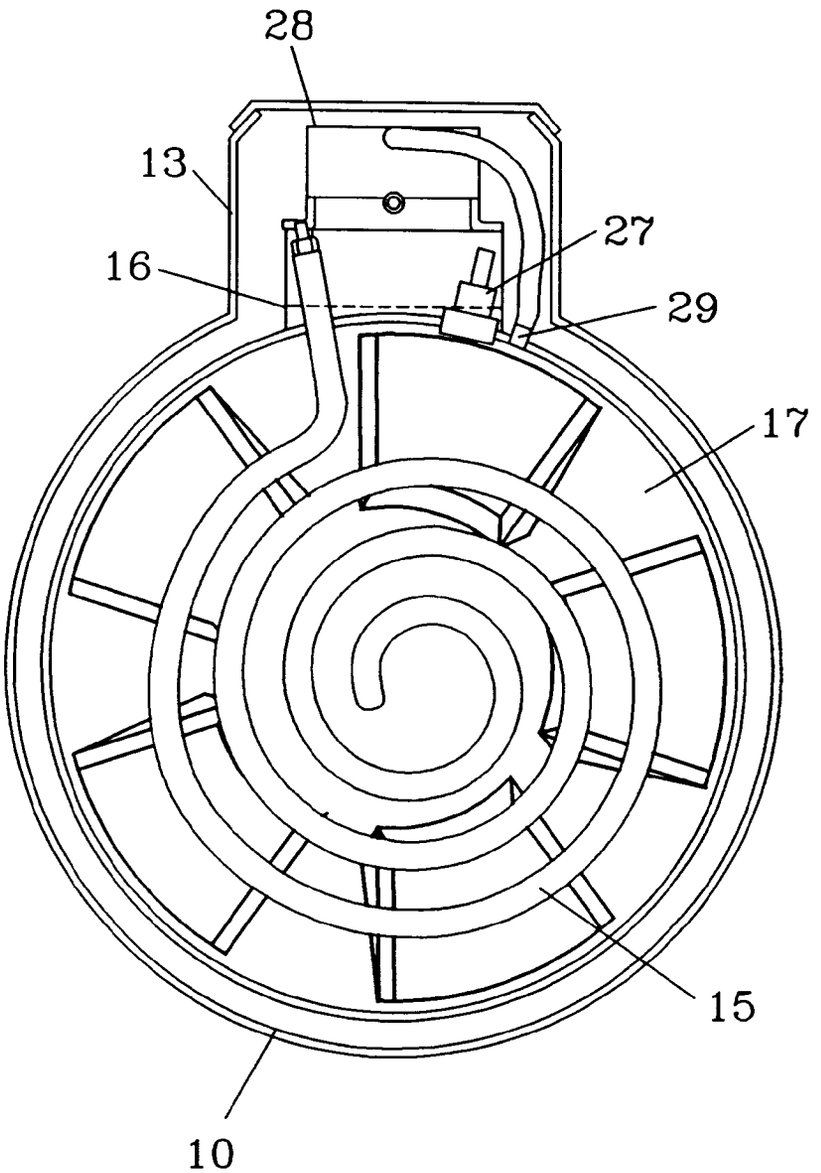

FIG.3

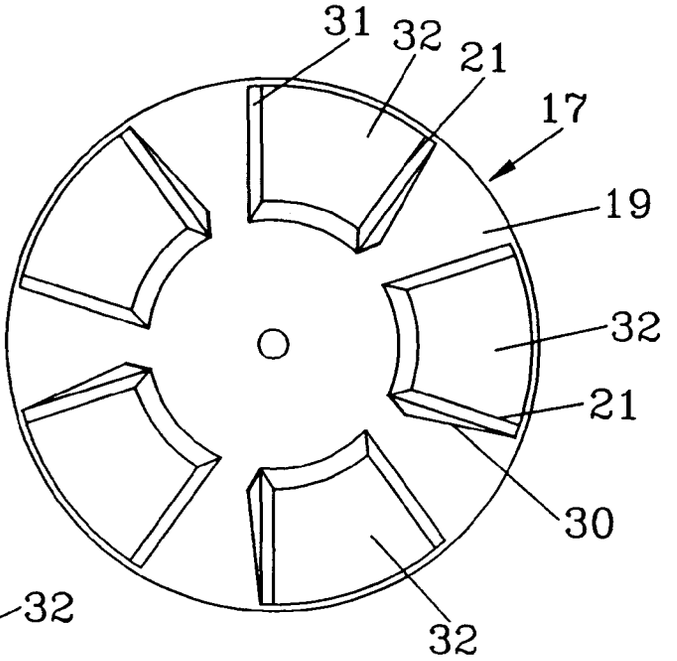

FIG.4

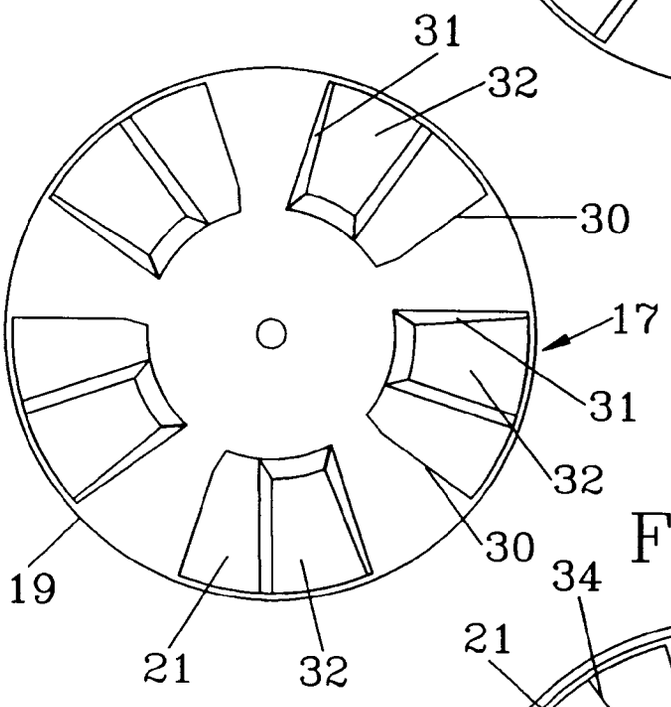

FIG.5