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(54) Fan

(57) A fan for a ventilation system comprising inner and outer air-flow channels to remove excess heat/humidity primarily from cattle sheds, comprises a rotor having fixed blades 14 on the outside of a frame and reversible blades 13 between the intermediate frame and a hub 11. When the rotor rotates in one direction, both sets of blades displace air in the same direction, (from indoors out) through both inner and outer channels and when the rotational direction of the rotor is reversed, the pitch of the inner blades is automatically reversed so that while the fixed blades 14 then draw air in through the outermost channels, the reversible blades 13 continue to suck the air out from indoors through the innermost channel.

The reversible blades 13 are mounted by means of axles 12 so that they always cause the air to flow in the same direction, regardless of the direction of rotation of the rotor. The reversible blades can alternatively be located on the outside of the intermediate frame with the fixed blades located on the inside. When flow through the channels is in opposite directions a heat-exchange effect is produced.

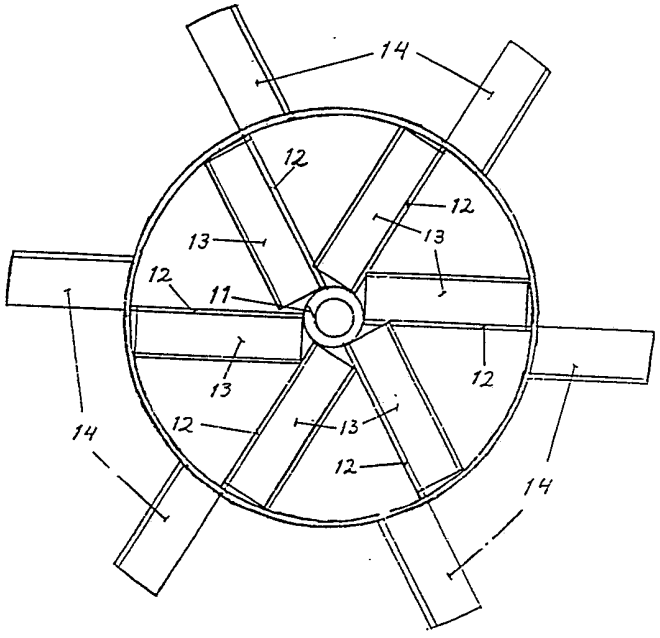

FIG. 3

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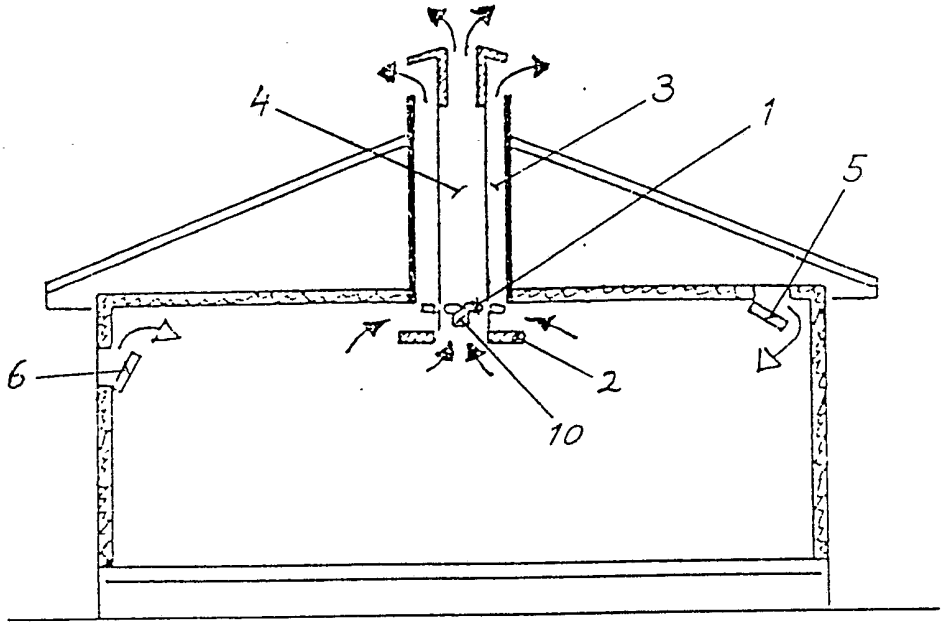

FIG. 1

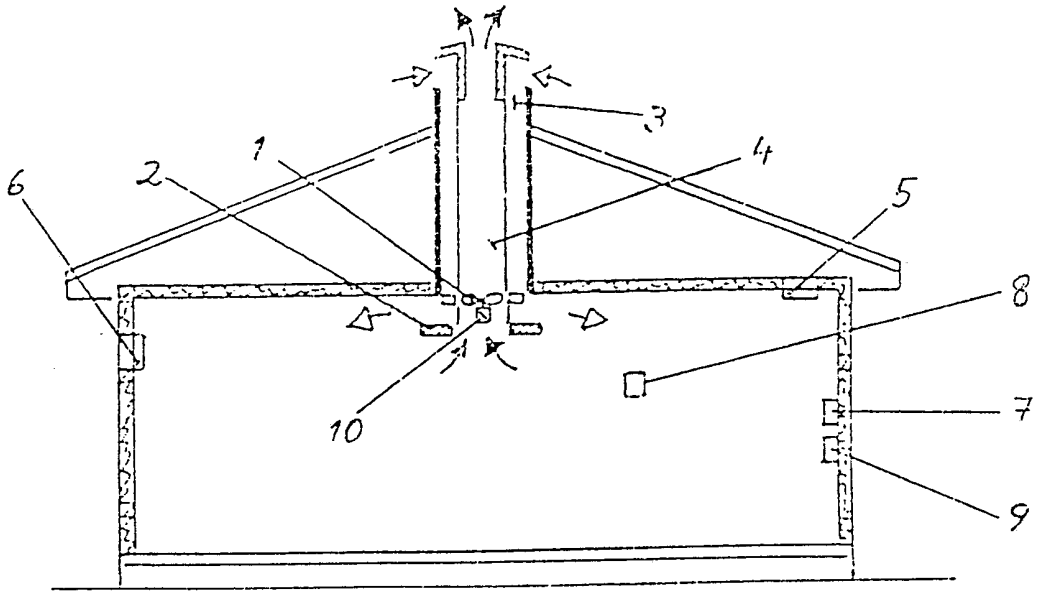

FIG. 2

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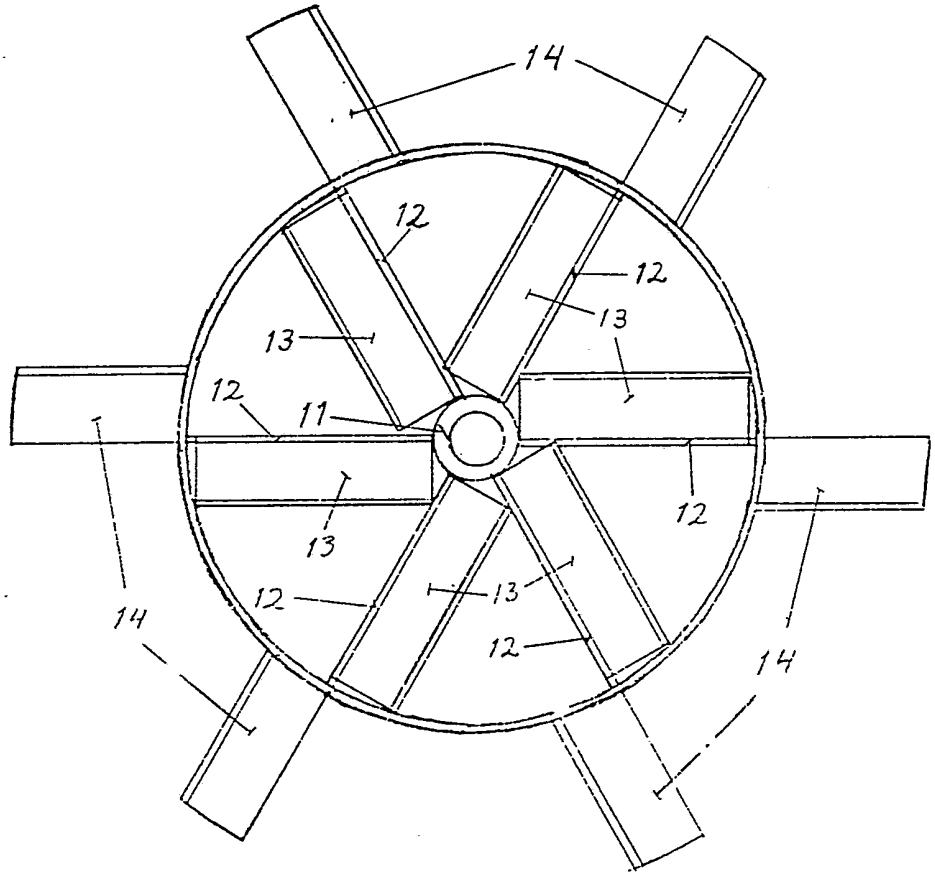

FIG. 3

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Vacuum fan - heat exchanger

Particularly in cattle sheds, a ventilation system is required which is capable of removing excess heat during the warm season and excess humidity during the cold season.

Excess heat is most conveniently removed by a vacuum fan, since it can transfer large quantities of air with minimal power consumption. To decrease humidity, a heat exchanger can be used as follows: the cold air drawn in is warmed by the humid discharge air. Thus, the need for ventilation is low enough to permit the use of the previously mentioned low-effect vacuum fan. On the other hand, sufficient heating is obtained in Southern and Central Finland, if the air drawn in is heated to a degree corresponding to a fourth of the temperature difference between the indoor and outdoor air; e.g. if the temperature difference is 40 ^{o}C, a heating of 10^{o}C suffices.

It is known that in cattle shed ventilation, fans with propeller blades divided radially into two sections operative in the inner and outer channels are used. It is also known that the propeller blade pitch can be altered independently of each other in the inner and outer channels.

The ventilation effect of this type of fan is regulated by altering the propeller blade pitch. The regulator mechanism is, however, rather complicated and costly. It is considerably easier to regulate the fan by altering the voltage at constant propeller blade pitch. In addition, provided that the pitch of the propeller blades can be reserved so that the air flows in the opposite direction, such a device can be used as a heat exchanger. However, in case of adjustable pitch, the system regulating the pitch is extremely complicated.

In the invention described here, these drawbacks have been eliminated. It is known mainly for the factors

mentioned in the patent application.
In the following, an application of the invention is described in detail by means of figures 1, 2 and 3.
In figure 1, a conventionaal low pressure ventilation system without a heat exchanger is illustrated.
Figure 2 illustrates a conventional low pressure ventilation system equipped with a heat exchanger.
In Figures 1 and 2,

Pos. 1 is the fan rotor
Pos. 2 is the grille controlling the direction of air flow
Pos. 3, 4 are air channels for discharge air/heat exchanger
Pos. 5, 6 valves for replacement air in low pressure ventilation
Pos. 7, 8, 9 motor regulator equipment: clutch, thermostat, rpm regulator, switch for altering the direction of rotation
Pos. 10 motor

In the application of the invention as illustrated in Fig. 3.

Pos. 11 is the fan rotos hub
Pos. 12 are axkes on one edge of reversible blades pos. 13
Pos 14 are fixed blades outside the frame surrounding the tips of the reversible blades pos. 13.

The control axles pos. 12 of the reversible blades pos. 13 are located at the lower edges of blades pos. 13, the edges being nearly in alignment with the radius. Thus, these blades always cause a flow of air in channel 4 from below upwards, or from inside out, regardless of the direction of motor pos. 10 rotation. Since the blades pos. 14 are fixed, the direction of air flow is reversed in channel 3, when the rotation direction of the motor pos. 10 or fan is changed. Thus the fan described in the invention changes from a vacuum fan as

illustrated in Fig. 1 into a heat exchanger as illustrated in Fig. 2 by only reversing the rotation direction of the motor pos. 10 or fan.

In case it iws desirable to keep constant the direction of flow in the outer channel 3, from inside out, the reversible blades are mounted on the outer side of the intermediateframe and the fixed blades on the inside of this frame. When the rotation direction of the motor pos. 10 is changed, the vacuum fan system thus operates according to the principle illustrated in Fig. 1 with the air flow in the outer channel 4 directed from inside out, and the heat exchanger system operates according to the principle illustrated in Fig. 2 with the air flow in channel 4 directed from outside in. Fig. 2 with the air flow in channel 4 directed from outside in.

It is obvious that the reversible blades can be mounted on the inside/outside of the intermediate frame and the fixed blades mounted on the outside/inside.

CLAIMS

1. A vacuum fan-heat exchanger, which has two coaxial blade frames (pos. 13 and 14), which move air in two channels, one inside the other, characterized in that the blades pos. 14 of the fixed blade frame alter blowing direction when the rotation direction of the fan is reversed, and the blades pos. 13 of the other blade frame reverse, thus keeping the blowing direction constant regardless of the changed rotating direction.

2. A vacuum fan-heat exchanger according to claim 1 characterized in that one of the blade frames of an axial fan is equipped with fixed blades (pos. 14) and the other blade frame comprises blades (pos. 13), which turn freely on their axles (pos. 12) as forced by the air flow, the direction of which is determined by the rotation direction of the fan.

3. A vacuum fan-heat exchanger according to claim 1 or 2 characterized in that the bearing axles (pos. 12) of the fan blades with adjustable pitch (pos. 13) are located near one edge of the fan blades, the edge always being the leading edge in relation to the rotating direction.

4. A vacuum fan-heat exchanger according to claim 1...3 characterized in that the reversible blades (pos. 13) are on the inside of the intermediate frame, and the fixed blades (pos. 14) are on the outside of the said frame.

5. A vacuum fan-heat exchanger according to claim 1...4 characterized in that the reversible blades (pos.13) are on the outside of the intermediate frame, and the fixed blades (pos. 14) are on the inside of the said frame.

6. A vacuum fan-heat exchanger constructed and arranged to operate substantially as herein described with reference to and as illustrated in the accompanying drawings.

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