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(72) Inventor: **Svensson, Anders**
271 54 Ystad (SE)

(74) Representative: **Hammar, Ernst**
Albihns Patentbyrå Stockholm AB
P.O.Box 5581
S-114 85 Stockholm (SE)

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(71) Applicant: **Stifab Farex AB**
S-273 35 Tomelilla (SE)

(54) **Ventilation apparatus that includes a cooling and/or heating function**

(57) Ventilation apparatus (10) having a room-air cooling and/or heating function and comprising a high velocity device (11) for mixed ventilation, a low velocity device (12) for displaced ventilation connected to said device (11), and valve means (20) for guiding the air flow either to the high velocity device (11) or to the low velocity device (12). The apparatus includes an ejector part (13) for receiving warm or cold supply air as primary air. The ejector part (13) includes means (17) for sucking room air into the ejector part (13) as secondary air, by means of said primary air, such that a mixture of primary and secondary air will be delivered therefrom as primary air either to the high velocity device (11) or to the low velocity device (12), depending on the setting of the valve means (20). The high velocity device (11), the low velocity device (12) and the ejector part (13) may be combined to form a single unit, with the ejector part (13) placed uppermost and the low velocity device (12) placed lowermost. The high velocity device (11) will preferably be provided with nozzles (16) for distributing the supply/room-air mixture in the room space.

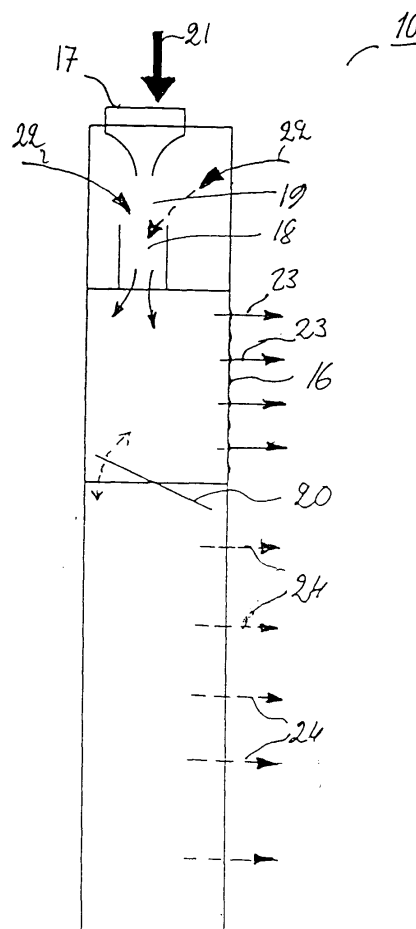


Fig 4

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Description

[0001] The present invention relates to ventilation apparatus having a room-air cooling and/or heating function and including a high velocity device for mixed ventilation low velocity device for displaced-ventilation and positioned beneath said high velocity device, and valve means for controlling the air flow incoming to the high velocity device or the low velocity device.

[0002] Apparatus of the kind defined above is described in EP-B-0521989, which relates to a combination of a displacement-ventilation low velocity device and a mixed-ventilation high velocity device. These two mutually different ventilation principles are combined with the intention of solving known problems associated with low velocity devices when requiring room air to be heated and ventilated at one and the same time. In this case, the air delivered to the room, referred to as supply air, must have a higher temperature than the room air, and consequently the supply air, which has a lower density than the room air, will strive to move upwards in the room. Because a low velocity device has a low injection velocity, the warm air will only displace upwards the air located in the immediate vicinity of the device, instead of spreading the air over the whole of the room, as is desired. This problem is solved with the known apparatus, by combining the low velocity device with a high velocity device the principle function of which is to alone supply air at a high velocity, so as to obtain more uniform heating of the room by mixed ventilation, and together with the low velocity device to supply air at room temperature in another mode when not wishing to heat the room. A switching device (valve) is provided between said devices (possibly outside said devices) and functions to switch between mixed ventilation and displaced ventilation, or at least to adjust the ratio there between.

[0003] A ventilation system that includes a heating and a cooling function requires the input of a certain amount of thermal energy together with the air. It is of interest to limit the air flows so as, in turn, to limit the energy required to distribute the air in a total ventilation system. Thus, when desiring to reduce the air flows through such systems with the intention of saving air distribution energy, it is necessary to increase the temperature difference between supply air and room air to a corresponding extent, in order to deliver the same amount of energy to the system. However, it is important that the differences in temperature between supply air and room air is not too great, since excessively high sub-temperatures will give rise to comfort problems in the form of draughts at floor level, while excessively high over-temperatures will, in turn, prevent the supply air from being used to ventilate occupied zones, i.e. zones that are occupied by people. Instead, the air will still rise up towards the ceiling of the room, as before indicated, and reach the exhaust air device, which is acting in combination with the supply device, without fulfilling its purpose of heating and ventilating the room. The aforede-

scribed known apparatus is thus encumbered with drawbacks with respect to heating or cooling a room.

[0004] One object of the present invention is to provide a ventilation system in which problems of the afore-described kind are essentially eliminated. To this end, the inventive ventilation system includes an ejector part which is adapted to receive warm or cold supply air as primary air and which includes means for sucking into the ejector part room air as secondary air through the medium of the primary air, such that a mixture of primary and secondary air exiting from the ejector part will be delivered as supply air to the high velocity device or to the low velocity device, depending on the setting of the valve means.

[0005] The main components of the inventive apparatus, i.e. the low velocity device, the high velocity device and the ejector part, may be located in mutually separate positions. which may be preferred and even necessary in the case of some localities, although it is preferred in the majority of cases for reasons of space or other practical reasons, primarily flow technical reasons, to combine the low velocity device, the high velocity device and the ejector part to form a single unit, with the ejector part normally placed uppermost and the low velocity device placed lowermost, wherewith the valve means is placed between the high velocity and low velocity devices. The reason for this is because the ejector effect decreases when the flow resistance in the system is excessively high, and consequently it is endeavoured to position the individual components of the apparatus so as to obtain the least possible resistance to flow therebetween and within themselves. The high velocity device is conveniently provided with nozzles for distributing the supply air/room-air mixture to the room. A Stifab nozzle according to Swedish design registration No. 55598 is a suitable nozzle in this respect. The ejector part is preferably designed and configured so that the ratio between primary and secondary air will lie in the range of 0.5-1.0, preferably about 1.0. When the flow of secondary air is equal to the flow of primary air, the temperature difference between the air mixture leaving the apparatus and the room air may be halved in comparison to when solely primary air (supply air) has been delivered. This ratio thus creates far better conditions for overcoming the comfort problems that occur when cold air is supplied, or in solving the ventilation problems that occur when warm air is supplied.

[0006] The invention will now be described in more detail with reference to two different embodiments of the invention and also with reference to the accompanying drawing, in which Figures 1 and 2 illustrate apparatus that include mutually separated devices, Figure 1 being a front view and Figure 2 a side view of said apparatus, and in which Figures 3 and 4 illustrate an apparatus in which all component parts are combined in one unit, wherein Figure 3 is a front view and Figure 4 is a sectioned view taken through the centre of the apparatus and illustrating the operating principles of the apparatus.

[0007] Figure 1 illustrates an inventive ventilation apparatus 10 that includes a freestanding high velocity device 11 arranged on the left of the Figure. and a free-standing low velocity device 12 arranged on the right of the Figure. An ejector part 13 that includes a supply air inlet 14 is positioned above the devices 11, 12. At least those parts or that part of the ejector part 13 that shall face towards the room have/has perforated walls 15 that allow room air to pass from the room and into the interior of the ejector part 13. The devices 11, 12 and the ejector part 13 are interconnected by means of a three-path air duct 25 in which a valve means 20 is arranged. In the illustrated case, the valve means 20 is shown in a position 20A in which the duct 25 is closed for passage of air from the ejector part 13 to the low velocity device 12. In the broken-line position 20B, the duct 25 is closed for passage of air from the ejector part 13 to the high velocity device 11, which is provided with nozzles 16 for ejecting air mixture into the room, at least on those parts or that part thereof that shall face towards the room. A low velocity device 12 is placed to the right of the high velocity device 11. Those parts or that part of the low velocity device 12 that shall face towards the room include or includes perforated walls 15 that allow air mixture to flow from the device 12 into the room.

[0008] In addition to the aforescribed components, the side view of Figure 2 also shows, in section, an ejector device arranged in the ejector part 13. The ejector device includes an inlet part 17 that has an upper, first part of constant cross-section for the inflow of primary air, a lower, second part of decreasing cross-section for increasing the velocity of primary air, an air mixture outlet part 18, and a room air suction gap 19 positioned therebetween. The duct 25 includes between the ejector part 13 and the high velocity device 11 and the low velocity device 12 a valve means 20 which causes the air mixture exiting from the ejector part 13 to pass either to the high velocity device 11 or to the low velocity device 12.

[0009] Figure 3 illustrates an inventive ventilation apparatus 10 constructed as a single unit and including a high velocity device 11 which is placed above and connected directly to a low velocity device 12. Arranged above the high velocity device 11 is an ejector part 13 that includes a supply air inlet 14. At least those parts or that part of the ejector part 13 that shall face towards the room have/has perforated walls 15 which permit room air to pass from the room and into the interior of the ejector part 13. Positioned beneath the ejector part 13 is a high velocity device 11 of which at least those parts or that part that shall face towards the room are/is provided with nozzles 16 for ejecting air mixture into the room. The low velocity device 12 is positioned beneath the high velocity device 11. At least those parts or that part of the low velocity device 12 that shall face towards the room are/is provided with perforated walls that allow air mixture to pass from the device 12 into the room.

[0010] In addition to illustrating the aforescribed components, the side view of Figure 4 also shows, in section, an ejector device 14 provided in the ejector part 13 and comprising an inlet part 17 that includes an upper, first part of constant cross-section for the inflow of primary air, a lower, second part of decreasing cross-section for increasing the velocity of the primary air, an air mixture outlet part 18, and a room air suction gap 19 therebetween. Arranged between the high velocity device 11 and the low velocity device 12 is a valve means 20 which, when closed, prevents air mixture exiting from the ejector part 13 from flowing down to the low velocity device 12, while when open allows full passage of this mixture to the low velocity device 12.

[0011] When using the inventive apparatus or system, warm or cold supply air 21 is delivered to the ejector inlet 17 and a subpressure is generated in the suction gap 19 as a result of the increase in air velocity, so that room air 21 will be drawn by suction in through the perforated walls 15 and into the gap 19, so as to mix with the primary air 21 in the ejector outlet 18. In the embodiment illustrated in Figures 1 and 2, the air mixture will be guided to and into the high velocity device 11 via the duct 25 when the valve means 20 is in the illustrated position 20A, and to and into the low velocity device 12 when the valve means 20 is in its reverse position 20B.

[0012] When warm air or at least air which is warmer than the room air, is supplied as primary air to the ejector part 13, the valve means 20 will be in position 20A, said valve means being set to this position by automatic means which functions to detect or sense the temperatures in the system, such as in the manner described in EP-B 0 521 989, or in some other way, wherein the warmer air mixture will be delivered to the room solely through the high velocity device 11, which delivers said air through the nozzles 16 during mixed ventilation. Because the warm supply air (primary air) is diluted with room air, the difference in temperature between the supply air and the room air will decrease proportionally with the degree of said dilution and the ventilation drawbacks caused by temperature differences between supply air and room air will thus be markedly reduced.

[0013] When cold air or at least air which is colder than the room air is supplied as primary air to the ejector part 13, the valve means 20 will be in position 20B. With the valve in this position, the colder air mixture will pass directly from the ejector part 13 through the duct 25 and into the low velocity device 12, from where it exists into the room through the perforated walls 15 of said device 12.

[0014] When the apparatus used has the combined, unit form of Figures 3 and 4, the valve means 20 will be closed in the first case in which warm air is supplied, wherewith the warm air mixture will be delivered to the room solely through the nozzles 16 on the high velocity device 11, as indicated by arrows 23. In the second case in which cold air is supplied, the valve means 20 will be open and the major part of the colder air mixture will flow

from the ejector part 13, for reasons of a flow technical nature, and pass down through the high velocity device 11 and into the low velocity device 12. from where it exits into the room as illustrated by arrows 25. A minor part of the cold air mixture may flow out into the room through the nozzles 16 in the high velocity device 11, although this minor air flow will have no negative effect on the ventilation of the room nor present any disadvantage.

Claims

1. Ventilation apparatus (10) having a room-air cooling and/or heating function and comprising a mixed-ventilation high velocity device (11), a displaced-ventilation low velocity device (12) connected thereto, and valve means (20) for guiding incoming air flow to either the high velocity device (11) or to the low velocity device (12), **characterised** by an ejector part (13) which is adapted to receive warm or cold supply air as primary air and which includes means (17) for sucking room air as secondary air into the ejector part (13) by means of said primary air, such as to deliver a mixture of primary and secondary air to either the high velocity device (11) or the low velocity device (12) as supply air, depending on the setting of the valve means (20).
2. Ventilation apparatus according to Claim 1, **characterised** in that the high velocity device (11), the low velocity device (12) and the ejector part (13) are combined into a single unit with the ejector part (13) placed uppermost and the low velocity device (12) placed lowermost, said valve means (20) being placed between the high velocity device (11) and the low velocity device (12).
3. Ventilation apparatus according to Claim 1 and 2, **characterised** in that the high velocity device (11) is provided with nozzles (16) for distributing the supply/room-air mixture to the room.
4. Ventilation apparatus according to Claims 1-3, **characterised** in that the ejector part (13) is designed and configured so that the ratio between primary and secondary air will lie in the range of 0.5-1.0, preferably about 1.0.

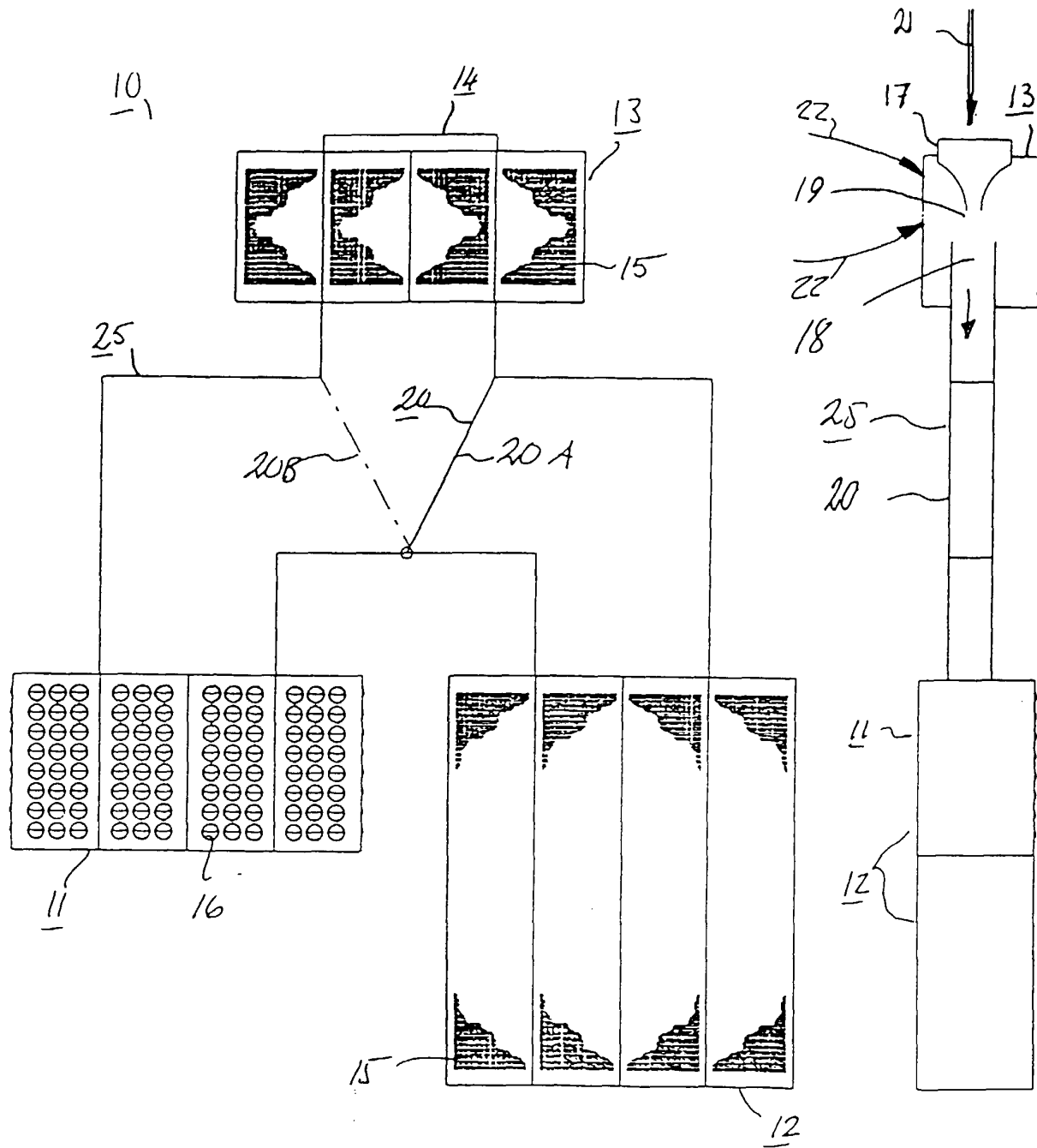


Fig 1

Fig 2

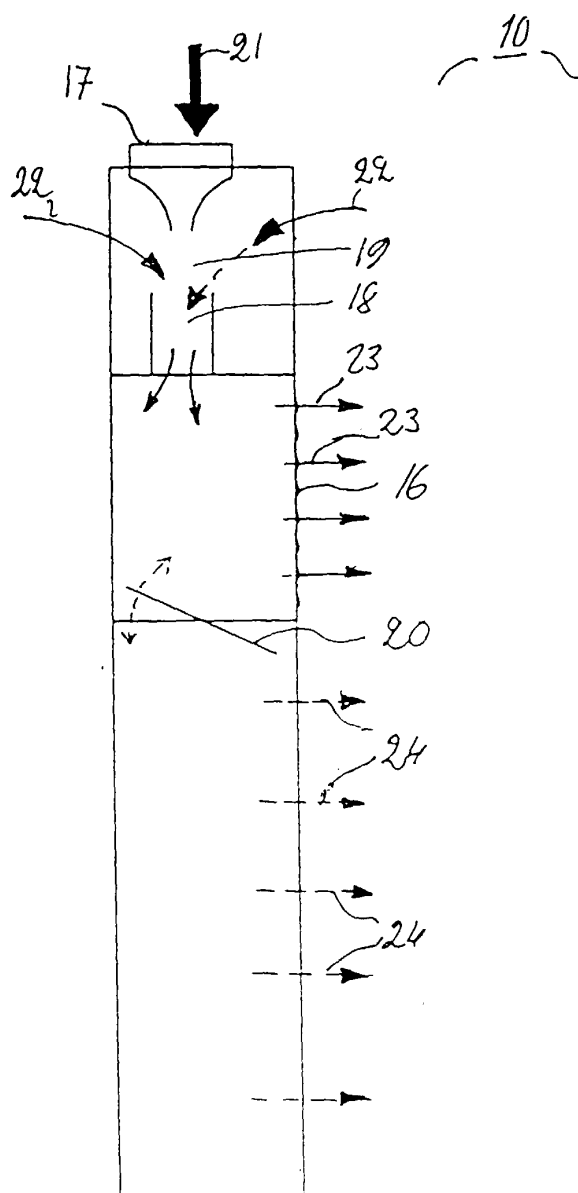


Fig 4

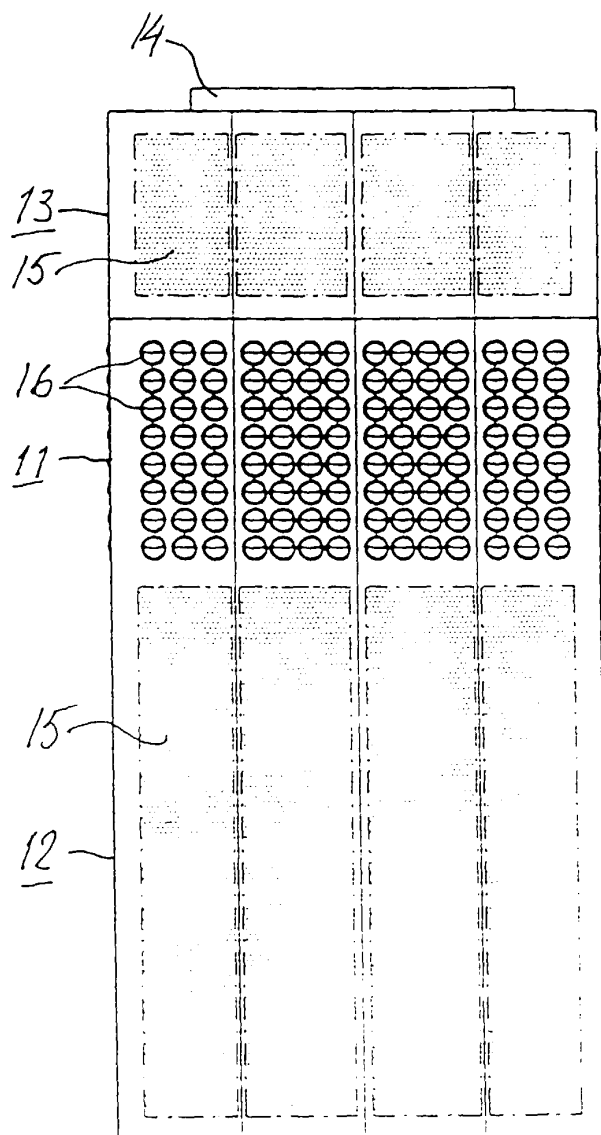


Fig 3