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(54) **Ventilating system**

(57) A ventilating system for a building with several enclosed spaces, each having at least one automatically controlled ventilating device which communicates with the surroundings of the building and, depending on the pressure difference over the ventilating device, passes a specific constant throughput, and having a central mechanical exhaust device with a controllable ventilator, in which system per time block a programmable control unit controls the amount of ventilating air per space depending on a stated number of persons present in this space during that time block by controlling the supply devices and the ventilator, and in which system further a sensor placed near the ventilator is present, with which sensor the amount of air drawn in by the ventilator is to be determined, depending on which a control signal is to be generated with the control unit, which control signal controls the number of revolutions of the ventilator such that, depending on the total number of persons stated to be present in the building, a constant amount of air is exhausted.

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Description

[0001] The invention relates to a ventilating system for a building with several enclosed spaces, at least a number of which are provided with at least one supply device for ventilating air from the surroundings of the building, which ventilating system is further provided with a mechanical exhaust device with a controllable ventilator and a programmable control unit for enabling control per time block of the amount of ventilating air per space depending on a stated number of persons present in this space during that time block, in which system each supply device and ventilator are controllable by the control unit depending on the information stored therein.

[0002] Such a ventilating system is known from DE-A-43 33 195. Depending on signals from the control unit in one or a number of spaces, one or a number of supply devices is or are opened in this system and the mechanical exhaust device is adjusted to an exhaust throughput corresponding to the throughput that can flow in via the open supply devices. Thus, the aim is to achieve optimum control both with respect to fresh air, energy loss via exhaustion and with respect to energy consumption of the system and pressure balance between inside and outside.

[0003] The control, however, can be adversely affected by various factors. For instance, wind pressure or reduced pressure may have the result that an amount of air other than the desired amount flows through the supply devices into the enclosed space. The exhaust device may and will often be located in another space than the supply device. The air to be exhausted must then move from one space to another. This may involve a range of different resistance factors. For instance, between the spaces there may be a door which is, is not, or is partly closed. For an air flow to be possible in the desired manner when a door is closed, arrangements must be made, for instance a slot at the bottom, which slot may considerably differ from the calculated or intended slot by the kind and nature of the floor covering, which, in turn, will influence the amount of air really exhausted. This and other conditions have the result that too much or too little air is supplied or discharged. This may result in too little or too intensive a ventilation or in disturbance of the pressure balance between inside and outside, so that unintended and undesired air flows may occur via all kinds of seams and cracks in the building connections, such as in casing and roof connections.

[0004] It is an object of the invention to provide a ventilating system which always enables optimum ventilation according to need, that is to say dependent on the number of persons present and the space(s) where these persons are and mainly independent of factors which could disturb the balance between air supplied and air discharged, in other words an optimum demand-controlled ventilating system.

[0005] This is achieved according to the invention in a ventilating system of the type described in the opening paragraph if each supply device is automatically controlled, that is to say that, depending on the pressure difference over this supply device, it can control the passage such that a specific constant throughput is obtained, and if further a sensor placed near the ventilator is present, with which sensor the amount of air drawn in by the ventilator is to be determined, depending on which a control signal is to be generated with the control unit, which control signal controls the number of revolutions of the ventilator such that, depending on the total number of persons stated to be present in the building, a constant amount of air is exhausted.

[0006] These measures provide an automatically controlled supply and a mechanical exhaustion controllable in conjunction therewith are provided, which supply and exhaustion are mutually coupled and controlled such that in each space where at least one person is or may be deemed present the desired and standardized amount of ventilating air is ensured. This is achieved because, depending on the stated number of persons and space or spaces where these persons are, automatically controlled ventilating devices are opened in this space or these spaces at appropriate intervals and the exhaustion is adjusted to the total number of persons present in the building. The automatically controlled ventilating devices always provide a correct supply, while the correct discharge is controlled and, if necessary, readjusted by measuring the amount of discharged air. Thus, ventilation is effected accurately according to the real need, without unnecessary ventilation of the spaces where nobody will be present.

[0007] By ensuring that actually just as much air is supplied as discharged, the desired pressure balance between inside and outside is always maintained. This has the result, inter alia, that undesired air flows through seams and cracks largely do not take place. A further great advantage is that intervention by an occupant, for instance, manual closure of a supply device in the space where he is, can be met by the ventilating system without any problem by opening another supply device, for instance in another space. Such a disturbance of the control system also has no influence because of the combination of automatically controlled supply devices with a ventilator adjusted according to need with respect to its discharge throughput.

[0008] In spite of the fact that various buildings have another and variable internal air resistance in the discharge duct and line system, a separate ventilator calculation for each building can be omitted, irrespective of whether the arrangement of these buildings is mutually equal or different. The fact that a multiplication of the number of revolutions of the ventilator does not mean a similar multiplication of the throughput has no influence either. Besides, the numbers of revolutions of various, essentially equal motors may be different, which has corresponding disadvantageous consequences for the

efforts toward a specific constant throughput, namely in particular at low numbers of revolutions, that is to say when one or two persons are present in the building. Another factor which may have less desirable consequences in this respect is a variable reduced pressure on the roof of the building as a result of changing winds (chimney effect).

[0009] All these problems are effectively dealt with by providing, according to the invention, a sensor with which the real throughput of the ventilator can be directly measured and adjusted to the desired constant value by means of this measurement by changing the number of revolutions of the ventilator, which not only results in an optimally operating system with reduction of energy losses, but which, by ensuring that the ventilator really discharges the desired amount of air, also ensures that the desired amount of ventilating air can also flow in via the automatically controlled supply devices.

[0010] For the measurement of the sensor to be as reliable as possible, it is preferred according to a further embodiment of the invention that the sensor is placed in a supply line to the ventilator. Contrary to the line part after the ventilator where turbulences may occur, the air flow in the supply line to the ventilator is as uniform as possible and the measurement, and the related volume flow control, is therefore most accurate.

[0011] According to a further embodiment of the invention it is preferred that the sensor is arranged to measure the air velocity. Because the passage area of the line at the sensor is known and constant, the volume flow through the ventilator can thus be simply determined.

[0012] A ventilating system according to the invention can be used in many types of buildings with various purposes of use. Hereinafter, the ventilating system will be further discussed, by way of example, for use in a house.

[0013] If such a house is designed for a family of four persons, ventilation facilities for four persons considered, in which, for instance, ventilation grilles and the like can provide the supply of ventilating air and a central mechanical exhaustion for the discharge. If, however, the house is occupied by only two persons or, as often occurs, by less than four persons for a part of the day, overventilation continuously or partly appears. In addition, supply and discharge are often not adjusted to each other. For ventilation grilles and the like, $7 \text{ dm}^3/\text{s}$ ($= 25 \text{ m}^3/\text{h}$) are considered per person, while a mechanical exhaustion is nearly always carried out with a static ventilator with only three fixed positions.

[0014] To meet this problem and those mentioned before, a system with a demand-controlled ventilation is provided according to the invention. In this system, automatically controlled ventilation facilities are used for the supply of ventilating air, that is to say ventilation grilles and the like which can continuously provide a supply of a constant amount of ventilating air and the

discharge of a mechanical exhaustion with a controllable ventilator, more in particular a ventilator having appreciably more adjusting positions, such as, for instance, a steplessly adjustable ventilator, than is the case with a simple, but hitherto often standard-used three-position control comprising a control unit which, depending on the information supplied and inputted, controls both the supply and the discharge of ventilating air in a demand-controlled manner.

[0015] To this end, each space to be ventilated is provided with ventilation facilities, the throughput of which is to be adjusted to the need during a specific part of the day. The discharge via the mechanical exhaust device can, as is hitherto conventional, take place from, for instance, the kitchen, the toilet and the bathroom. The control unit is provided with a number of standard programs, but can also be programmed individually. To enable demand-controlled control, the control unit must be fed with data about how many persons are in which space during which part of the day. For instance, one or more persons will not be present during the day and those present will mainly be in the living room and the kitchen, while at night those present will often be in the bedrooms.

[0016] The automatically controlled ventilation grilles to be used must close when the air flow moves from inside to outside so as to prevent energy loss as a result of transverse ventilation. When the ventilation grille is deliberately closed by the occupant by hand, the control unit is programmed such that a search is made for ventilation grilles that can be opened to thus achieve the desired throughput. Preferably, this is done in spaces where according to the stored data no persons are. Another or additional possibility is to adjust ventilation grilles that can be opened to a higher throughput. Depending on the desired amount of air, it is also possible to open and close the ventilation grilles alternately. It is also possible, for instance when the occupants are on holiday, to open and close the ventilation grilles in the various spaces by turns so as to maintain an optimum air quality in the building.

[0017] Furthermore, the occupant must be able to intervene when special conditions occur, for instance a visit or the use of cooking or bathing facilities. To this end, switches are provided, for instance in the kitchen and/or the bathroom, so that the system can be temporarily overruled.

[0018] To enable optimum demand-controlled control in all the conditions described above, a further control is necessary to always supply and discharge the desired amount of ventilating air. The starting-point is that the control takes place pressure-neutrally, that is to say that supply and discharge are equal, so that no disadvantageous infiltrated ventilation can take place via all kinds of slits, cracks and building connections. To realize this, a further control of the central mechanical exhaustion is chosen in the ventilating system according to the invention. By readjusting the number of revo-

lutions of the ventilator depending on the measuring data of a sensor placed at the ventilator, the correct adjusted amount of air is always exhausted, while the system ensures that the various ventilation grilles are adjusted such that exactly this exhausted amount of air can be replaced by fresh open air. The automatically controlled supply devices for ventilating air are then adjusted by the control unit to a specific throughput position, while the automatic control function of these supply devices ensures that in this throughput position a constant amount of air is passed continuously. This effects a very effective elimination of the many and various factors which potentially disorder the demand-controlled control, such as varying resistances in exhaust lines and supply devices at varying adjustments and alternative adjustments, an outside pressure which is variable and varies at different places around the building, tolerances in the number of revolutions of the sensor of the exhaust ventilator, building deviations between mutually equal houses, etc.

[0019] It is self-evident that within the scope of the invention many modifications and variants are possible. For instance, reference has been made above to a house designed for a family of four persons, but this may of course also be another number of persons. Furthermore, it need not be a house, but the ventilating system may also be used in an office building or a building with another purpose of use. Moreover, the system can be made even more energy saving by, for instance, withdrawing heat from the exhausted ventilating air by means of a heat pump. The recovered heat can be used to heat tap water or for other heating purposes. Here, too, the control unit plays a controlling part. During the time the heat pump is operative, it needs a minimum throughput. The control unit can ensure that at least the minimum requirements are met. In the example discussed above, the exhaustion takes place from specific spaces, namely kitchen, bath, and toilet. Moreover, other spaces or all the spaces to be ventilated can be directly connected to the exhaustion, for which there may further be considered a space connected to the exhaustion without direct ventilation of this space from outside.

Claims

1. A ventilating system for a building with several enclosed spaces, at least a number of which are provided with at least one supply device for ventilating air from the surroundings of the building, which ventilating system is further provided with a mechanical exhaust device with a controllable ventilator and a programmable control unit for enabling control per time block of the amount of ventilating air per space depending on a stated number of persons present in this space during that time block, and in which system each supply device and ventilator are controllable by the control unit depending

on the information stored therein, characterized in that each supply device is automatically controlled, that is to say that, depending on the pressure difference over this supply device, it can control the passage such that a specific constant throughput is obtained, and further a sensor placed near the ventilator is present, with which sensor the amount of air drawn in by the ventilator is to be determined, depending on which a control signal is to be generated with the control unit, which control signal controls the number of revolutions of the ventilator such that, depending on the total number of persons stated to be present in the building, a constant amount of air is exhausted.

2. A ventilating system according to claim 1, characterized in that the sensor is placed in a supply line to the ventilator.
3. A ventilating system according to claim 1 or 2, characterized in that the sensor is arranged to measure the air velocity.