(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 856 708 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
05.08.1998 Bulletin 1998/32

(51) Int. Cl.[6]: **F24F 11/04**

(21) Application number: **98200156.2**

(22) Date of filing: **21.01.1998**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **31.01.1997 NL 1005147**

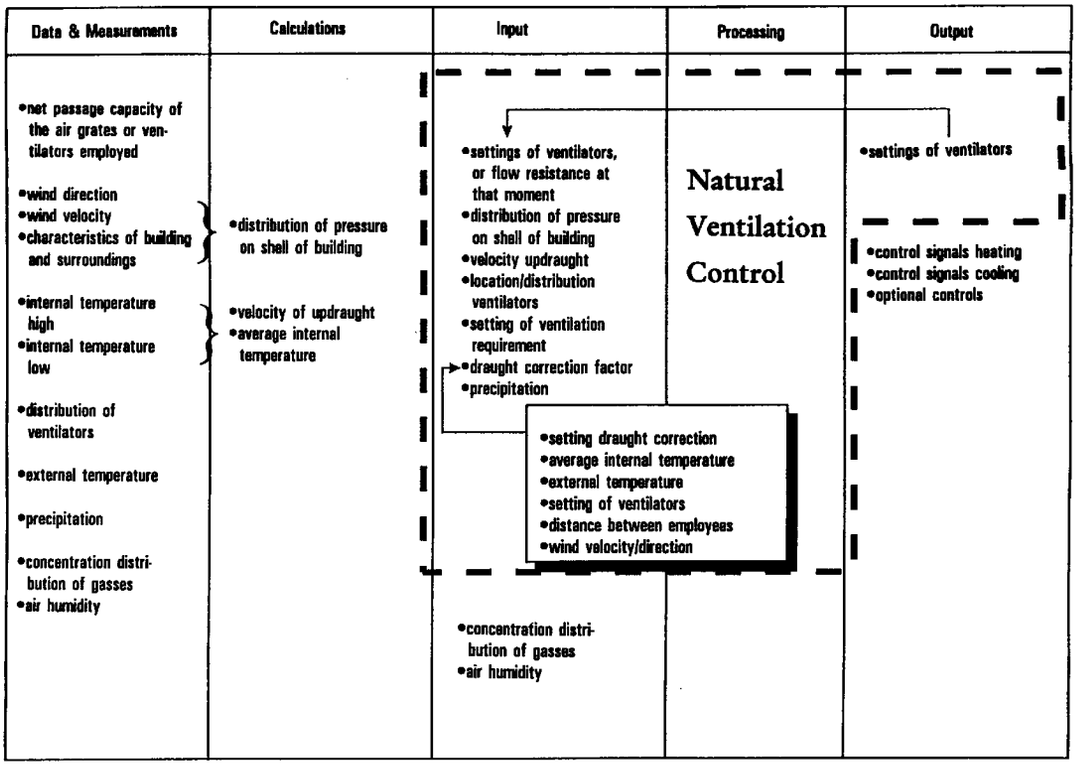
(71) Applicant: **Brakel-Atmos B.V.**
5405 AN Uden (NL)

(72) Inventors:
- **Cleef, Louis Henrie Marie**
  5684 AD Best (NL)
- **Knoll, Bastiaan**
  2671 DR Naaldwijk (NL)

(74) Representative:
Van Breda, Jacobus
Octrooibureau Los & Stigter B.V.,
P.O. Box 20052
1000 HB Amsterdam (NL)

(54) Ventilation for a building

(57) The invention relates to a building comprising rising walls and a roof, wherein the roof as well as at least one of the walls is provided with one or more air grates of the passive kind, and wherein adjustment means are provided for the control of the air grates, which control depends on the input data or measurements for the adjustment of the air ventilation through the air grates. The setting of each of the air grates depends on an air pressure distribution measured around and above the building.



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Description

The invention relates to a building comprising rising walls and a roof, wherein the roof as well as at least one of the walls is provided with one or more air grates of the passive kind, and wherein adjustment means are provided for the control of the air grates, which control depends on the input data or measurements for the adjustment of the air ventilation through the air grates.

From the Dutch patent application 8601406 a system is known for the adjustment of the air ventilation in a space, wherein a thermometer is employed for measuring the outside ambient temperature as well as a humidity meter for measuring the relative humidity in the respective space, wherein the air ventilation in the space can be adjusted depending on said relative humidity and the outside temperature.

From the Dutch patent application 9500205 a system for the automatic adjustment of the setting of an air grate is known, wherein the current passing the grate, is rendered independent of the wind velocity passing over the outside wall of a building in which the grate is fitted.

Generally, for the ventilation of a building of the kind described in the preamble, a mechanical system is used for the ventilation of said building because such a system is easy to control and causes few draught problem. The draw-back of such a mechanical ventilation system is the price with respect to the purchase as well as the maintenance, the energy consumption and the noise production.

A building according to the preamble of claim 1 is known from DE-A-2.915.260. This publication relates to a livestock housing which is characterized in that fresh air is let into the building by means of air vents built-in at the side walls and adjustable depending on the prevailing wind velocity, while the discharge of air is adjusted by means of air vents provided in the roof ridge and dependent on the temperature prevailing in the housing. Such a livestock housing can hardly be compared with a building meant for human accommodation. Moreover, the ventilation requirement is not a priority in such a livestock housing.

It is now the object of the invention to provide a building having a natural ventilation system which, although it is based on the climatological conditions prevailing inside and outside the building, and varying from one moment to the next, is still adjustable to a constant respectively adjustable ventilation requirement.

After years of research in cooperation with the Dutch organization for Applied Scientific Research (Toegepast Natuurwetenschappelijk Onderzoek TNO) and supported by the Dutch organization for Energy and Environment (Nederlandse Organisatie voor Energie en Milieu NOVEM), applicant has succeeded in making this system of natural ventilation adjustable such that the building has a controllable climate without the problems attached to the known natural ventilation systems.

To this end the building according to the invention is equipped such that the setting of each of the air grates depends on an air pressure distribution measured around and above the building.

To this end it is useful that for the adjustment means to be able to determine the air pressure distribution, said adjustment means are provided with data regarding the direction of the wind, the wind velocity and preferably also characterizing data regarding the building and the surroundings of the building. The necessary data may, for instance, be entered by a feed mechanism, but preferably first sensors are connected to the adjustment means, by which at least the air pressure can be measured at strategic positions around and above the building.

In addition, the building should preferably be equipped with a ventilation system, such that the setting of each of the air grates depends on a temperature gradient in the building assessed by the adjustment means, and serving as a measure for the updraught in the building.

It is possible to obtain the velocity of the rising air, or updraught, by calculation, but preferably second sensors are connected to the adjustment means for measuring the velocity of rising air current in the building.

A preferred embodiment of the building according to the invention is characterized in that the setting of each air grate is such that the flow rate of each air grate stays below an adjustable or permanent value. This prevents any possible draughts being felt by the people in the building.

If even then such a draught is felt, the building is equipped to adjust the setting of selected air grates such that the velocity component of air currents passing through said air grates are directed more upward, and that the setting of non-selected air grates is adjusted to meet the ventilation requirement in the building. This may be particularly important when the temperature of the supplied outside air is relatively low, or if the air pressure on any particular side of the building is so high that the threat exists of the air velocities in the building rising too much.

The above measure changes the so-called cast of the incoming air. Said air is introduced into the respective space in such a way that it has the opportunity to warm up before the people present in the building are exposed to said freshly introduced air. This combats the sensation of draught.

It is further desirable, that in case of precipitation, the adjustment means activate every air grate in the roof to close, and that the remaining air grates are set such as to meet the ventilation requirement in the building. This prevents damage to the ventilation system or the building from precipitation coming into the building. Of course, the closed air grates mean, that the ventilation profile of the building changes as a result of which the remaining air grates need to be adjusted in order to continue to meet the ventilation requirement in the building.

The invention will now be explained in more detail

with reference to the diagram presenting a number of important relations between input data and output data of the system according to the invention.

The diagram shown comprises five columns into which are entered the data and measurements used by the ventilation system according to the invention, the calculations carried out by the adjustment means of the ventilation system, the input data which are processed by the adjustment means, that is the natural ventilation control, the natural ventilation control itself, and finally the output data from the natural ventilation control.

Serving as design data respectively precondition within which the natural ventilation control system according to the invention has to function, is the net passage capacity of the air grates or ventilators employed. Within the scope of the invention, the term ventilators does not mean the active kind, that is to say the kind provided with electrically driven ventilator motors; the invention only relates to an embodiment having air grates of the passive kind, that is to say without external power supply.

Other data that are important for the ventilation system are the wind direction, the wind velocity, and the building and the characteristics typical for the surroundings. Based on the just-mentioned data an actual distribution of pressure on the shell of the building is determined. The shell of the building is understood to be the outline of the building, including the walls and the roof. Other important data are the so-called internal temperature high and internal temperature low. These are the temperatures in the building at a relatively high location and a relatively low location. Based on these data the velocity of the rising air current, or updraught, is determined as well as an average temperature prevailing in the building. Of further importance is the location or distribution of the air grates in the roof and the outside walls, the external temperature, and whether or not there is any precipitation. On the basis of the distribution of pressure on the shell of the building and the velocity of rising air in the building, the positioning respectively the distribution of the ventilators over the roof and walls, and the ventilation requirement as adjusted by the users of the building, the natural ventilation control determines at every moment the settings of the ventilators, that is to say the actual flow resistance. In turn, this setting of the ventilators serves as input data as this, in combination with the pressure distribution on the shell of the building, determines the total air inlet, and by this the extent of natural ventilation. The ventilators are adjusted such that the flow velocity through each air grate remains below an adjustable or permanent value. This depends on a set draught correction, the average internal temperature, the external temperature, the actual settings of the air grates, the wind velocity and wind direction, and as uncontrollable variable the distance between those present in the building. Adjusting the air grates in such a manner that said flow velocity stays below the adjustable or permanent value, ensures that the natural ventilation control adjusts the remaining air grates such that they continue to comply with the settings of the ventilation requirements in the building.

By means of the adjustable draught correction, the position of selected air grates may be adjusted such that the velocity component of air currents passing through said air grates are directed more upward, and the setting of non-selected air grates is adjustable such as to meet the ventilation requirement in the building. On the basis of possible measurements of precipitation, the natural ventilation control will intervene, as a result of which every air grate in the roof is activated to close and the remaining air grates are set such as to continue to meet the ventilation requirement in the building.

The ventilation system of the building according to the invention may be further extended with devices for heating or cooling the building, taking into account the composition of the air or the concentration distribution of gasses in the building and the air humidity.

For the person skilled in the art it is obvious that sundry variants of embodiments are possible which are all deemed to be within the scope of the appended claims.

Claims

1. A building comprising rising walls and a roof, wherein the roof as well as at least one of the walls is provided with one or more air grates of the passive kind, and wherein adjustment means are provided for the control of the air grates, which control depends on the input data or measurements for the adjustment of the air ventilation through the air grates, **characterized** in that the setting of each of the air grates depends on an air pressure distribution measured around and above the building.

2. A building according to claim 1, **characterized** in that for the adjustment means to be able to determine the air pressure distribution, said adjustment means are provided with data regarding the direction of the wind, the wind velocity and preferably also characterizing data regarding the building and the surroundings of the building.

3. A building according to claim 1 or 2, **characterized** in that first sensors are connected to the adjustment means, for measuring the air pressure.

4. A building according to one of the claims 1-3, **characterized** in that the setting of each of the air grates depends on a temperature gradient in the building assessed by the adjustment means, and serving as a measure for the updraught in the building.

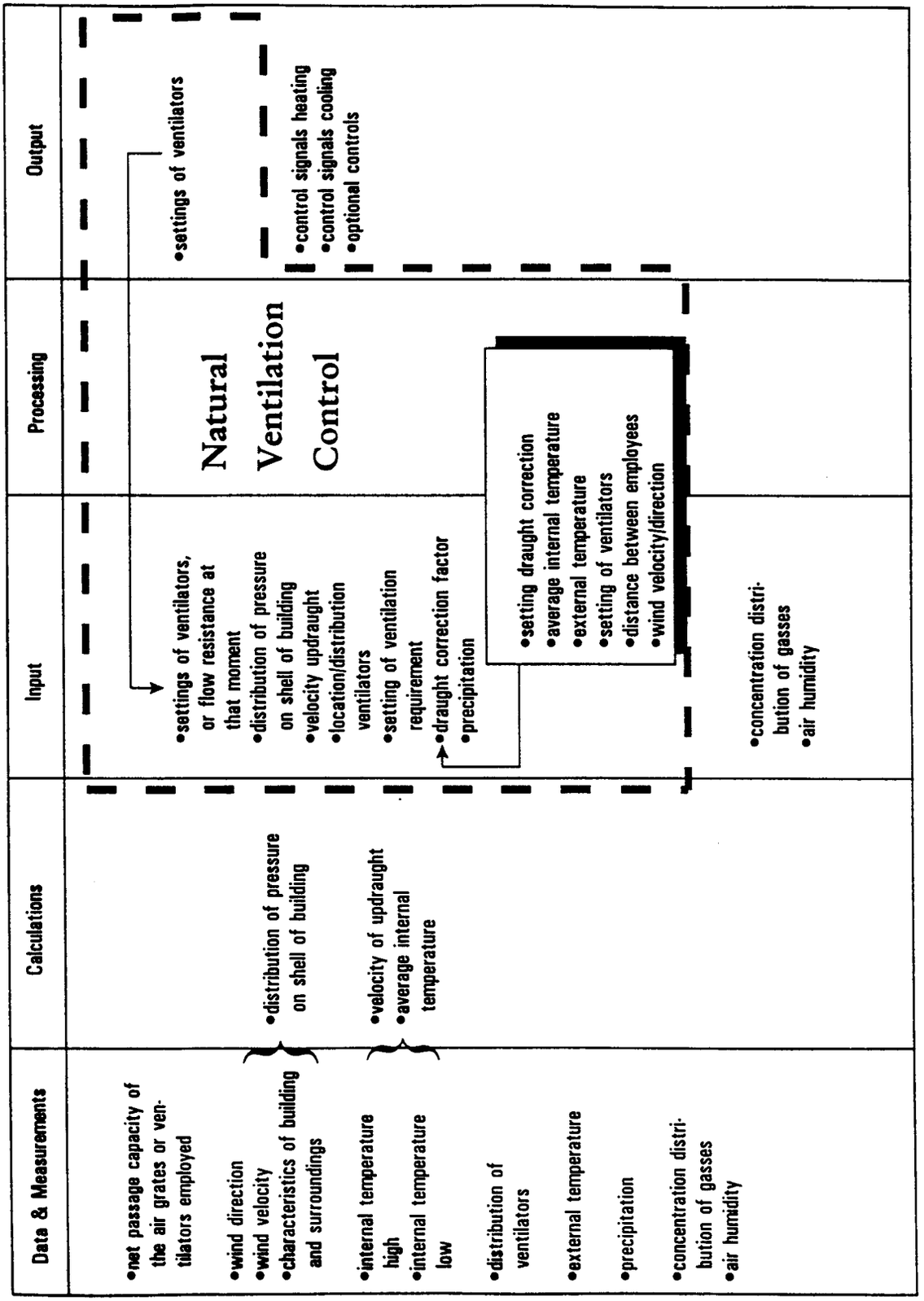
5. A building according to claim 4, **characterized** in that second sensors are connected to the adjust-

ment means for measuring the velocity of rising air current in the building.

6. A building according to one of the preceding claims, **characterized** in that the setting of each air grate is such that the flow rate of each air grate stays below an adjustable or permanent value.

7. A building according to one of the preceding claim, **characterized** in that the setting of selected air grates such that the velocity component of air currents passing through said air grates are directed more upward, and that the setting of non-selected air grates is adjusted to meet the ventilation requirement in the building.

8. A building according to one of the claims 1-7, **characterized** in that, in case of precipitation, the adjustment means activate every air grate in the roof to close, and that the remaining air grates are set such as to meet the ventilation requirement in the building.


Data & Measurements
Calculations
Input
Processing
Output
•net passage capacity of the air grates or ventilators employed
•wind direction
•wind velocity
•characteristics of building and surroundings
•internal temperature high
•internal temperature low
•distribution of ventilators
•external temperature
•precipitation
•concentration distribution of gasses
•air humidity
•distribution of pressure on shell of building
•velocity of updraught
•average internal temperature
•settings of ventilators, or flow resistance at that moment
•distribution of pressure on shell of building
•velocity updraught
•location/distribution ventilators
•setting of ventilation requirement
•draught correction factor
•precipitation
•concentration distribution of gasses
•air humidity
Natural Ventilation Control
•setting draught correction
•average internal temperature
•external temperature
•setting of ventilators
•distance between employees
•wind velocity/direction
•settings of ventilators
•control signals heating
•control signals cooling
•optional controls