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(54) **GAS WATER HEATER AND SECURITY CONTROL SYSTEM AND METHOD THEREFOR**

**GASWASSERERHITZER UND SICHERHEITSSTEUERUNGSVERFAHREN UND -SYSTEM DAFÜR**  
**CHAUFFE-EAU AU GAZ ET SYSTÈME ET PROCÉDÉ DE COMMANDE DE SÉCURITÉ S'Y**  
**RAPPORTANT**

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## Description

### TECHNICAL FIELD

[0001] The present disclosure relates to the water heater technology field, and more particular to, a gas water heater, a safety control method for a gas water heater, and a safety control system for a gas water heater.

### BACKGROUND

[0002] At present, gas water heaters on the market typically include: D type (natural exhaust type) gas water heaters, Q type (forced exhaust type) gas water heaters, P type (natural exhaust and air supply type) gas water heaters, G type (forced exhaust and air supply type) gas water heaters and W type (outside set-up type) gas water heaters and so on. Q type and G type gas water heaters are provided with exhaust fans directly, so as to forcedly exhaust waste gas generated when burning gas, such that the residual gas explosion or the like may be avoided.

[0003] In the related art, the Q type gas water heater mostly adopts a wind pressure detecting unit to detect the wind pressure at an air outlet and controls the exhaust fan and an igniter unit according to the detected wind pressure, so as to ensure that the gas water heater may work normally. Although the combustion operation of the gas water heater in the case of the wind flow backward may be avoided by adopting the wind pressure detecting unit, the device cost is high, and the operation of the gas water heater may be interrupted due to the slight wind pressure, resulting in that the user is unable to use the gas water heater normally.

[0004] WO2009/107897A1 relates to an apparatus and a method for controlling combustion in a boiler. A proportional electronic valve current detection unit for detecting an amount of current flowing through a proportional electronic valve and transmitting the detected amount of current to a control section is installed. When a user sets a temperature in a heating mode or a hot water mode, so that a combustion command signal is outputted from a control section, the control section compares an amount of current actually flowing through the proportional electronic valve that is detected by the proportional electronic valve current detection unit and a current command value from the control section and corrects a current value of the proportional electronic valve by increasing or decreasing the current value of the proportional electronic valve based on the difference between the actual amount of current and the current command value.

[0005] CN102080878A relates to a draught fan control method of gas equipment, comprising the following steps of: A. determining the current working state of the gas equipment; B. controlling the rotation speed of a draught fan according to the current working state of the gas equipment: B 1. judging that the inside combustion air

quantity of the gas equipment in combusting is overlarge in the current working state, reducing the rotation speed of the draught fan; B2. judging that the gas equipment is in a normal combusting working state or passable combusting working state, maintaining the current rotation speed of the draught fan; B3. judging that the gas equipment is in a possible incomplete combusting working state, increasing the rotation speed of the draught fan; and B4. judging that the gas equipment is in an exhaust blockage working state, stopping supplying gas for the gas equipment.

### SUMMARY

[0006] The present disclosure aims to solve at least one of the above technical problems in the related art to at least some extent.

[0007] Accordingly, a first objective of the present disclosure aims to provide a safety control system for a gas water heater. The safety control system may ensure that the gas water heater can have a good combustion condition and operate safely and reliably. Also, the response speed of the system is fast and accurate air volume may be provided, such that the control accuracy is improved.

[0008] A second objective of the present disclosure aims to provide a gas water heater.

[0009] A third objective of the present disclosure aims to provide a safety control method for a gas water heater.

[0010] In order to achieve the above objectives, embodiments of a first aspect of the present disclosure provide a safety control system for a gas water heater as set out in claim 5.

[0011] With the safety control system for a gas water heater according to embodiments of the present disclosure, firstly the power obtaining unit obtains the set value for the output power of the exhaust fan and the rotational speed difference obtaining unit obtains the actual value of the rotational speed of the exhaust fan and the reference value of the rotational speed according to the set value for the output power and calculates the difference between the actual value of the rotational speed and the reference value of the rotational speed, and then the exhaust control unit corrects the rotational speed of the exhaust fan detected by the rotational speed detecting unit according to the difference between the actual value of the rotational speed and the reference value of the rotational speed, determines the wind pressure situation at the air outlet of the exhaust fan according to the corrected rotational speed and the set value for the output power and adjusts the set value for the output power according to the wind pressure situation, such that the adjustment of air volume of the exhaust fan may be realized, and it is guaranteed that a good combustion condition may be achieved after mixing the introduced gas and air during the operation of the gas water heater, thus ensuring that the gas water heater can operate safely and reliably. Meanwhile, the adjustment of the set value for the output power directly based on the rotational speed difference

is an active control, which has a fast response speed and provides more accurate air volume as compared to the passive control on the rotational speed of the exhaust fan, such that the control accuracy is improved.

**[0012]** In addition, the safety control system for a gas water heater according to the above embodiments of the present disclosure may further have following additional technical features.

**[0013]** According to an embodiment of the present disclosure, the exhaust control unit is

According to an embodiment of the present disclosure, the above safety control system further includes a system control unit configured to perform a mutual communication with the exhaust control unit, in which the exhaust control unit is configured to send a shut-off signal to the system control unit such that the system control unit controls the gas water heater to shut off according to the shut-off signal, when the exhaust control unit determines that the wind pressure situation is an extreme high wind pressure situation or the corrected rotational speed is higher than a rotational speed threshold.

**[0014]** According to an embodiment of the present disclosure, the above safety control system further includes a water supply unit, connected to the system control unit; a temperature obtaining unit, connected with the system control unit, and configured to obtain a set temperature for output water of the gas water heater and a cold water temperature of the gas water heater; in which the system control unit is configured to calculate a total heat required by the gas water heater according to a water supply quantity of the water supply unit, the set temperature for the output water and the cold water temperature, and to obtain a current control instruction and an initial set value for the output power according to the total heat.

**[0015]** According to an embodiment of the present disclosure, the above safety control system further includes a gas unit, connected to the system control unit and provided with a proportional valve, in which the system control unit is configured to control the gas unit by controlling the proportional valve according to the current control instruction.

**[0016]** According to an embodiment of the present disclosure, the gas water heater is a forced exhaust type gas water heater.

**[0017]** In order to achieve the above objectives, embodiments of a second aspect of the present disclosure provide a gas water heater as set out in claim 10.

**[0018]** With the above safety control system, the gas water heater according to embodiments of the present disclosure may correct the rotational speed of the exhaust fan according to the difference between the actual value of the rotational speed and the reference value of the rotational speed, determine the wind pressure situation at the air outlet of the exhaust fan according to the corrected rotational speed and the set value for the output power and adjust the set value for the output power according to the wind pressure situation, such that the adjustment of air volume of the exhaust fan may be realized,

and it is guaranteed that a good combustion condition may be achieved after mixing the introduced gas and air during the operation of the gas water heater, thus ensuring the safe and reliable operation of the gas water heater. Meanwhile, the adjustment of the set value for the output power directly based on the rotational speed difference is an active control, which not only has a fast response speed but also provides more accurate air volume when compared to the passive control on the rotational speed of the exhaust fan, such that the control accuracy is improved.

**[0019]** In order to achieve the above objectives, embodiments of a third aspect of the present disclosure provide a safety control method as set out in claim 1.

**[0020]** With the safety control method for a gas water heater according to embodiments of the present disclosure, firstly the set value for the output power of the exhaust fan is obtained and the actual value of the rotational speed of the exhaust fan and the reference value of the rotational speed are obtained according to the set value for the output power and the difference between the actual value of the rotational speed and the reference value of the rotational speed is calculated, and then the rotational speed of the exhaust fan is detected and corrected according to the rotational speed difference, the wind pressure situation at the air outlet of the exhaust fan is determined according to the corrected rotational speed and the set value for the output power, and the set value for the output power is adjusted according to the wind pressure situation, such that the adjustment of air volume of the exhaust fan may be realized, and it is guaranteed that a good combustion condition may be achieved after mixing the introduced gas and air during the operation of the gas water heater, thus ensuring a safe and reliable operation of the gas water heater. Meanwhile, the adjustment of the set value for the output power directly based on the rotational speed difference is an active control, which not only has a fast response speed but also provides more accurate air volume when compared to the passive control on the rotational speed of the exhaust fan, such that the control accuracy is improved.

**[0021]** In addition, the safety control method for a gas water heater according to the above embodiments of the present disclosure may further have following additional technical features.

**[0022]** According to an embodiment of the present disclosure, determining a wind pressure situation at an air outlet of the exhaust fan according to the corrected rotational speed and the set value for the output power and adjusting the set value for the output power according to the wind pressure situation further includes: controlling the gas water heater to shut off, when it is determined that the wind pressure situation is an extreme high wind pressure situation or the corrected rotational speed is higher than a rotational speed threshold.

**[0023]** According to an embodiment of the present disclosure, the above safety control method further includes: obtaining a water supply quantity of the gas water heater,

a set temperature for output water of the gas water heater and a cold water temperature of the gas water heater; calculating a total heat required by the gas water heater according to the water supply quantity, the set temperature for the output water and the cold water temperature, and obtaining a current control instruction and an initial set value for the output power according to the total heat; and performing a gas burning control by controlling a proportional valve in a gas unit of the gas water heater according to the current control instruction.

## BRIEF DESCRIPTION OF THE DRAWINGS

### [0024]

Fig. 1 is a block diagram of a safety control system for a gas water heater according to an embodiment of the present disclosure;

Fig. 2 is a schematic diagram illustrating a relationship between a set value for output power of an exhaust fan and a rotational speed of the exhaust fan according to an embodiment of the present disclosure;

Fig. 3 is a block diagram of a safety control system for a gas water heater according to another embodiment of the present disclosure;

Fig. 4 is a schematic diagram illustrating a relationship between total heat required by a gas water heater and a controlled quantity of a proportional valve and a set value for output power of an exhaust fan according to an embodiment of the present disclosure;

Fig. 5 is a schematic diagram illustrating a relationship between a set value for output power of an exhaust fan and an actual value of the rotational speed of an exhaust fan and a reference value of the rotational speed of the exhaust fan according to an embodiment of the present disclosure; and

Fig. 6 is a flow chart of a safety control method for a gas water heater according to an embodiment of the present disclosure.

## DETAILED DESCRIPTION

[0025] Embodiments of the present disclosure will be described in detail and examples of the embodiments will be illustrated in the accompanying drawings. The same or similar elements and the elements having same or similar functions are denoted by like reference numerals throughout the descriptions. The embodiments described herein with reference to the drawings are explanatory, which aim to illustrate the present disclosure, but shall not be construed to limit the present disclosure.

[0026] In the following, a gas water heater and a safety control system and method therefor according to embodiments of the present disclosure will be described with reference to the drawings.

[0027] Fig. 1 is a block diagram of a safety control sys-

tem for a gas water heater according to an embodiment of the present disclosure. As shown in Fig. 1, the safety control system for a gas water heater includes an exhaust fan 10, a rotational speed detecting unit 20, a power obtaining unit 30, a rotational speed difference obtaining unit 40 and an exhaust control unit 50.

[0028] The exhaust fan 10 is configured to exhaust waste gas generated when the gas water heater burns gas. The rotational speed detecting unit 20 is configured to detect a rotational speed of the exhaust fan 10. The power obtaining unit 30 is configured to obtain a set value for output power of the exhaust fan. The rotational speed difference obtaining unit 40 is configured to obtain an actual value of the rotational speed of the exhaust fan and a reference value of the rotational speed according to the set value for the output power and to calculate a difference between the actual value of the rotational speed and the reference value of the rotational speed. The exhaust control unit 50 is connected to the exhaust fan 10, the rotational speed detecting unit 20, the power obtaining unit 30 and the rotational speed difference obtaining unit 40 respectively. The exhaust control unit 50 is configured to correct the rotational speed of the exhaust fan according to the difference between the actual value of the rotational speed and the reference value of the rotational speed, to determine a wind pressure situation at an air outlet of the exhaust fan 10 according to the corrected rotational speed of the exhaust fan 10 and the set value for the output power of the exhaust fan 10, and to adjust the set value for the output power of the exhaust fan 10.

[0029] Specifically, during the production stage of the gas water heater, the set value for the output power of the exhaust fan 10 is obtained by the power obtaining unit 30. Under a reference condition, a sampling and comparison program is executed. In other words, the actual value of the rotational speed is obtained by the rotational speed difference obtaining unit 40 according to the set value for the output power of the exhaust fan 10, and the difference between the actual value of the rotational speed and the reference value of the rotational speed is calculated. During an actual operation of the gas water heater, the rotational speed of the exhaust fan 10 is detected by the rotational speed detecting unit 20 in real time, and the exhaust control unit 50 corrects the detected rotational speed of the exhaust fan 10 according to the above difference, determines the wind pressure situation at the air outlet of the exhaust fan 10 in combination with the set value for the output power of the exhaust fan 10, and then adjusts the set value for the output power of the exhaust fan 10 according to the wind pressure situation, such that the adjustment of air volume of the exhaust fan 10 may be realized, and it is guaranteed that a good combustion condition may be achieved after mixing the introduced gas and air during the operation of the gas water heater, thus ensuring the safety and reliability of the gas water heater. Meanwhile, the direct adjustment of the set value for the output power is an

active control, which not only has a fast response speed but also provides more accurate air volume when compared to the passive control on the rotational speed of the exhaust fan, such that the control accuracy is improved and the whole system cost is low.

**[0030]** It can be understood that, the set value for output power of the exhaust fan 10 used for calculating the difference between the actual value of rotational speed and the reference value of the rotational speed may be different from the set value for output power used for determining the wind pressure situation. The set value for output power used for determining the wind pressure situation is the same as the set value for output power to be adjusted.

**[0031]** In an embodiment of the present disclosure, when correcting the rotational speed of the exhaust fan 10 according to the difference between the actual value of the rotational speed and the reference value of the rotational speed, the exhaust control unit 50 makes the corrected rotational speed of the exhaust fan 10 be equal to the sum of the rotational speed of the exhaust fan and the difference between the actual value of rotational speed and the reference value of the rotational speed.

**[0032]** Further, in an embodiment of the present disclosure, when the exhaust control unit 50 determines the wind pressure situation at the air outlet of the exhaust fan 10 according to the corrected rotational speed of the exhaust fan 10 and the set value for the output power and adjusts the set value for the output power of the exhaust fan 10 according to the wind pressure situation of the exhaust fan 10, the set value for the output power of the exhaust fan 10 is controlled to be reduced by a first predetermined value when the exhaust control unit 50 determines that the wind pressure situation of the exhaust fan 10 is a low wind pressure situation; the set value for the output power of the exhaust fan 10 is controlled to keep unchanged when the exhaust control unit 50 determines that the wind pressure situation of the exhaust fan 10 is a medium wind pressure situation; and the set value for the output power of the exhaust fan 10 is controlled to be increased by a second predetermined value when the exhaust control unit 50 determines that the wind pressure situation of the exhaust fan 10 is a high wind pressure situation. The first predetermined value and the second predetermined value may be determined according to actual situations, which may be fixed values or may be adjusted dynamically according to actual situations.

**[0033]** Specifically, as shown in Fig. 2, in the case of a certain set value for output power of the exhaust fan 10, if the corrected rotational speed  $R+dn$  of the exhaust fan 10 is below the first curve R1 (Region I), it indicates that the wind pressure at the air outlet of the exhaust fan 10 is small, then the exhaust control unit 50 controls the set value for output power of the exhaust fan 10 to be reduced by the first predetermined value, i.e., the set value for output power is:  $P=P-\Delta P1$ , such that the output power of the exhaust fan 10 is decreased; if the corrected

rotational speed  $R+dn$  of the exhaust fan 10 is above the first curve R1 but below the second curve R2 (Region II), it indicates that the wind pressure at the air outlet of the exhaust fan 10 is appropriate and the rotational speed of the exhaust fan 10 is naturally increased due to the physical characteristic of the exhaust fan as the wind pressure increases, such that it is unnecessary to adjust the set value for output power of the exhaust fan 10; if the corrected rotational speed  $R+dn$  of the exhaust fan 10 is above the second curve R2 but below the third curve R3 (Region III), it indicates that the wind pressure at the air outlet of the exhaust fan 10 is large, then the exhaust control unit 50 controls the set value for output power of the exhaust fan 10 to be increased by the second predetermined value, i.e., the set value for output power is:  $P=P+\Delta P2$ , such that the output power of the exhaust fan 10 is increased. R is the rotational speed of the exhaust fan detected by the rotational speed detecting unit 20, dn is the difference between the actual value of the rotational speed and the reference value of the rotational speed of the exhaust fan 10. Since there may be difference in the performances of different exhaust fans and performances of whole systems when the gas water heaters are produced in batches, the control accuracy of the gas water heater may be affected. Therefore, the difference correction may be performed on the rotational speed of exhaust fan based on the difference of the actual value of the rotational speed and the reference value of the rotational speed of the exhaust fan 10.

**[0034]** In other words, when the set value for output power of the exhaust fan 10 is P1, if the corrected value of the detected rotational speed of the exhaust fan 10 meets a condition of  $R+dn < C$ , then the set value for output power of the exhaust fan 10 is adjusted to  $P1-\Delta P1$ ; if the corrected value of the detected rotational speed meets a condition of  $C \leq R+dn < B$ , then the set value for output power of the exhaust fan 10 keeps unchanged; if the corrected value of the detected rotational speed meets a condition of  $B \leq R+dn < A$ , then the set value for output power of the exhaust fan 10 is adjusted to  $P1+\Delta P2$ , such that the active control on the rotational speed of the exhaust fan is realized, and it is guaranteed that the air volume of the exhaust fan reaches an equilibrium with the wind pressure at the air outlet and the gas water heater would have a good combustion condition.

**[0035]** It should be stated that, the relationship between the set value for output power of the exhaust fan and each of the first curve R1, the second curve R2 and the third curve R3 shown in Fig. 2 is given in advance.

**[0036]** According to an embodiment of the present disclosure, as shown in Fig. 3, the above safety control system for a gas water heater further includes a system control unit 60. The system control unit 60 is configured to perform a mutual communication with the exhaust control unit 50. If the exhaust control unit 50 determines the wind pressure situation at the air outlet is an extreme high wind pressure situation or the corrected rotational speed of the exhaust fan 10 is higher than a rotational speed

threshold, the exhaust control unit 50 sends a shut-off signal to the system control unit 60, such that the system control unit 60 controls the gas water heater to shut off according to the shut-off signal.

**[0037]** Specifically, as shown in Fig. 2, in a case of a certain set value for output power of the exhaust fan 10, if the corrected rotational speed  $R+dn$  of the exhaust fan 10 is above the third curve R3 (Region IV), it indicates that the wind pressure at the air outlet of the exhaust fan 10 is too high, then it is necessary to control the gas water heater to shut off. For example, when the set value for output power of the exhaust fan 10 is P1, if the corrected rotational speed of the exhaust fan 10 meets a condition of  $R+dn \geq A$ , then the gas water heater is controlled to shut off. Alternatively, if the corrected rotational speed of the exhaust fan 10 is higher than a predetermined rotational speed threshold (upper limit for the rotational speed), then the gas water heater is controlled to shut off. In this way, the safety of the gas water heater is guaranteed.

**[0038]** According to an embodiment of the present disclosure, as shown in Fig. 3, the above safety control system for a gas water heater further includes a water supply unit 70 and a temperature obtaining unit (not shown). The water supply unit 70 is connected to the system control unit 60, and the temperature obtaining unit is also connected to the system control unit 60. The temperature obtaining unit is configured to obtain set temperature for output water of the gas water heater and a cold water temperature of the gas water heater. The system control unit 60 is configured to calculate a total heat required by the gas water heater according to a water supply quantity of the water supply unit 70, the set temperature for the output water and the cold water temperature, and to obtain a current control instruction and an initial set value for the output power of the exhaust fan 10 according to the total heat.

**[0039]** Further, as shown in Fig. 3, the above safety control system for a gas water heater further includes a gas unit 80 connected to the system control unit 60 and provided with a proportional valve (not shown). The system control unit 60 is configured to control the gas unit 80 by controlling the proportional valve according to the current control instruction.

**[0040]** Specifically, after the gas water heater is energized, the system control unit 60 firstly calculates the total heat required by the gas water heater for warming the cold water to the set temperature for output water according to the set temperature for output water set by the user, the water supply quantity of the water supply unit 70 and the cold water temperature. And then, as shown in Fig. 4, the system control unit 60 obtains the control quantity of the proportional valve in the gas unit 80 and the set value for output power to be configured as an initial set value for output power according to the total heat required by the gas water heater. Finally, the system control unit 50 controls the proportional valve according to the obtained control quantity so as to control the gas

unit 80, and sends the initial set value for output power to the exhaust control unit 50 via the CAN bus or the like. It should be noted that, as shown in Fig. 5, during the production stage of the gas water heater, the reference value for the rotational speed of the exhaust fan 10 may be obtained according to the set value for output power of the exhaust fan 10, and a sampling and comparison program is executed, i.e., the actual value of the rotational speed corresponding to the set value for output power is detected, so as to obtain the difference between the actual value of the rotational speed and the reference value of the rotational speed.

**[0041]** It may be understood that, the set value for output power obtained according to the total heat required by the gas water heater is the same as the set value for output power used to determine the wind pressure situation at the air outlet and the set value for output power to be adjusted.

**[0042]** After receiving the initial set value for output power, the actual value of the rotational speed and the reference value of the rotational speed, the exhaust control unit 50 controls the exhaust fan 10 according to the initial set value for output power and detects the rotational speed of the exhaust fan 10 through the rotational speed detecting unit 30 in real time. If the corrected value of the detected rotational speed is located in region I, then set value for output power of the exhaust fan 10 is  $P=P_{\text{initial}}-\Delta P1$ .  $P_{\text{initial}}$  represents the initial set value for output power. If the corrected value of the detected rotational speed is located in region II, then set value for output power of the exhaust fan 10 is  $P=P_{\text{initial}}$ . If the corrected value of the detected rotational speed is located in region III, then set value for output power of the exhaust fan 10 is  $P=P_{\text{initial}}+\Delta P2$ . And so on, if the corrected rotational speed of the exhaust fan 10 under a certain set value for output power is located in region IV, or the corrected rotational speed of the exhaust fan 10 is higher than the rotational speed threshold, or a shut-off instruction is received from the user, then the gas water heater is controlled to shut off.

**[0043]** During the operation of the gas water heater, if the set temperature for output water is changed, or the water supply quantity of the water supply unit 70 is changed, then the system control unit 60 obtains the control quantity of the proportional valve and the set value for output power again, and controls the gas water heater based on the above-mentioned procedure.

**[0044]** In an embodiment of the present disclosure, the gas water heater may be a forced exhaust type gas water heater, which is not limited herein.

**[0045]** With the safety control system for a gas water heater according to embodiments of the present disclosure, firstly the set value for the output power of the exhaust fan 10 is obtained by the power obtaining unit, a sampling comparison program is executed so as to obtain the actual value of the rotational speed by the rotational speed difference obtaining unit according to the set value for the output power of the exhaust fan, and

the difference between the actual value of the rotational speed and the reference value of the rotational speed is calculated. And then, the exhaust control unit corrects the rotational speed of the exhaust fan according to the difference between the actual value of the rotational speed and the reference value of the rotational speed, determines the wind pressure situation at the air outlet of the exhaust fan according to the corrected rotational speed and the set value for the output power of the exhaust fan, and further adjusts the set value for the output power of the exhaust fan according to the wind pressure situation, such that the adjustment of air volume of the exhaust fan may be realized, and it is guaranteed that a good combustion condition may be achieved after mixing the introduced gas and air during the operation of the gas water heater, thus ensuring the safe and reliable operation of the gas water heater. Meanwhile, the adjustment of the set value for the output power directly based on the corrected rotational speed is an active control, which not only has a fast response speed but also provides more accurate air volume when compared to the passive control on the rotational speed of the exhaust fan, such that the control accuracy is improved.

**[0046]** Fig. 6 is a flow chart of a safety control method for a gas water heater according to an embodiment of the present disclosure. As shown in Fig. 6, the safety control method includes following steps.

**[0047]** In step S1, a set value for output power of the exhaust fan is obtained and a reference value of rotational speed of the exhaust fan corresponding to the set value for output power is obtained.

**[0048]** In step S2, an actual value of the rotational speed of the exhaust fan is obtained according to the set value for output power, and a difference between the actual value of the rotational speed and the reference value of the rotational speed is calculated.

**[0049]** In step S3, the rotational speed of the exhaust fan is detected.

**[0050]** In step S4, the rotational speed of the exhaust fan is corrected according to the difference between the actual value of the rotational speed and the reference value of the rotational speed, a wind pressure situation at an air outlet of the exhaust fan is determined according to the corrected rotational speed and the set value for output power, and the set value for output power is adjusted according to the wind pressure situation.

**[0051]** Specifically, during the production stage of the gas water heater, the set value for the output power of the exhaust fan is obtained. Under a reference condition, a sampling and comparison program is executed. In other words, the actual value of the rotational speed is obtained by the rotational speed difference obtaining unit according to the set value for the output power of the exhaust fan, and the difference between the actual value of the rotational speed and the reference value of the rotational speed is calculated. During an actual operation of the gas water heater, the rotational speed of the exhaust fan is detected in real time, and the detected rotational speed

of the exhaust fan is corrected according to the difference between the actual value of the rotational speed and the reference value of the rotational speed, the wind pressure situation at the air outlet of the exhaust fan is determined in combination with the set value for the output power of the exhaust fan, and then the set value for the output power of the exhaust fan is adjusted according to the wind pressure situation, such that the adjustment of air volume of the exhaust fan may be realized, and it is guaranteed that a good combustion condition may be achieved after mixing the introduced gas and air during the operation of the gas water heater, so as to ensure the safety and reliability of the gas water heater. Meanwhile, the direct adjustment of the set value for the output power is an active control, which not only has a fast response speed but also provides more accurate air volume when compared to the passive control on the rotational speed of the exhaust fan, such that the control accuracy is improved. It can be understood that, the above set value for output power of the exhaust fan 10 used for calculating the difference between the actual value of rotational speed and the reference value of the rotational speed may be different from the set value for output power used for determining the wind pressure situation. The set value for output power used for determining the wind pressure situation is the same as the set value for output power to be adjusted.

**[0052]** In an embodiment of the present disclosure, when correcting the rotational speed of the exhaust fan according to the difference between the actual value of the rotational speed and the reference value of the rotational speed, the corrected rotational speed of the exhaust fan is controlled to be equal to the sum of the rotational speed of the exhaust fan and the difference.

**[0053]** Further, in an embodiment of the present disclosure, determining a wind pressure situation at an air outlet of the exhaust fan according to the corrected rotational speed and the set value for the output power and adjusting the set value for the output power according to the wind pressure situation includes: controlling the set value for the output power to be reduced by a first predetermined value when it is determined that the wind pressure situation is a low wind pressure situation; controlling the set value for the output power to keep unchanged when it is determined that the wind pressure situation is a medium wind pressure situation; and controlling the set value for the output power to be increased by a second predetermined value when it is determined that the wind pressure situation is a high wind pressure situation.

**[0054]** Specifically, as shown in Fig. 2, in the case of a certain set value for output power of the exhaust fan, if the corrected rotational speed  $R+dn$  of the exhaust fan is below the first curve R1 (Region I), it indicates that the wind pressure at the air outlet of the exhaust fan 10 is small, then the set value for output power of the exhaust fan is controlled to be reduced by the first predetermined value, i.e., the set value for output power is:  $P=P-\Delta P1$ ,

such that the output power of the exhaust fan is decreased; if the corrected rotational speed  $R+dn$  of the exhaust fan is above the first curve R1 but below the second curve R2 (Region II), it indicates that the wind pressure at the air outlet of the exhaust fan is appropriate and the rotational speed of the exhaust fan is naturally increased due to the physical characteristic of the exhaust fan as the wind pressure increases, such that it is unnecessary to adjust the set value for output power of the exhaust fan; if the corrected rotational speed  $R+dn$  of the exhaust fan is above the second curve R2 but below the third curve R3 (Region III), it indicates that the wind pressure at the air outlet of the exhaust fan is large, then the set value for output power of the exhaust fan is controlled to be increased by the second predetermined value, i.e., the set value for output power is:  $P=P+\Delta P2$ , such that the output power of the exhaust fan is increased. R is the detected rotational speed of the exhaust fan,  $dn$  is the difference between the actual value of the rotational speed and the reference value of the rotational speed of the exhaust fan. Since there may be difference in the performances of different exhaust fans and performances of whole systems when the gas water heaters are produced in batches, the control accuracy of the gas water heater may be affected. Therefore, the difference correction may be performed on the rotational speed of exhaust fan based on the difference of the actual value of the rotational speed and the reference value of the rotational speed of the exhaust fan.

**[0055]** In other words, when the set value for output power of the exhaust fan is  $P1$ , if the corrected value of the detected rotational speed of the exhaust fan meets a condition of  $R+dn < C$ , then the set value for output power of the exhaust fan is adjusted to  $P1-\Delta P1$ ; if the corrected rotational speed meets a condition of  $C \leq R+dn < B$ , then the set value for output power of the exhaust fan is unchanged; if the corrected rotational speed meets a condition of  $B \leq R+dn < A$ , then the set value for output power of the exhaust fan is adjusted to  $P1+\Delta P2$ , such that the active control on the rotational speed of the exhaust fan is realized, and it is guaranteed that the air volume of the exhaust fan reaches an equilibrium with the wind pressure at the air outlet and the gas water heater would have a good combustion condition.

**[0056]** It should be stated that, the relationship between the set value for output power of the exhaust fan and each of the first curve R1, the second curve R2 and the third curve R3 shown in Fig. 2 is given in advance.

**[0057]** Further, determining a wind pressure situation at an air outlet of the exhaust fan according to the corrected rotational speed and the set value for the output power and adjusting the set value for the output power according to the wind pressure situation further includes: controlling the gas water heater to shut off, when it is determined that the wind pressure situation is an extreme high wind pressure situation or the corrected rotational speed is higher than a rotational speed threshold.

**[0058]** Specifically, as shown in Fig. 2, in a case of a

certain set value for output power of the exhaust fan, if the corrected rotational speed  $R+dn$  of the exhaust fan is above the third curve R3+ $dn$  (Region IV), it indicates that the wind pressure at the air outlet of the exhaust fan is too high, then it is necessary to control the gas water heater to shut off. For example, when the set value for output power of the exhaust fan is  $P1$ , if the corrected rotational speed of the exhaust fan meets a condition of  $R+dn \geq A$ , then the gas water heater is controlled to shut off. Alternatively, if the corrected rotational speed of the exhaust fan is higher than a predetermined rotational speed threshold (upper limit for the rotational speed), then the gas water heater is controlled to shut off. In this way, the safety of the gas water heater is guaranteed.

**[0059]** According to an embodiment of the present disclosure, the above safety control method further includes: obtaining a water supply quantity of the gas water heater, a set temperature for output water of the gas water heater and a cold water temperature of the gas water heater; calculating a total heat required by the gas water heater according to the water supply quantity, the set temperature for the output water and the cold water temperature, and obtaining a current control instruction and the set value for the output power according to the total heat; and performing a gas burning control by controlling a proportional valve in a gas unit of the gas water heater according to the current control instruction.

**[0060]** Specifically, after the gas water heater is energized, firstly the total heat required by the gas water heater for warming the cold water to the set temperature for output water is calculated according to the set temperature for output water set by the user, the water supply quantity and the cold water temperature. And then, as shown in Fig. 4, the control quantity of the proportional valve in the gas unit and the set value for output power are obtained according to the total heat required by the gas water heater, and the reference value of the rotational speed and the actual value of the rotational speed are obtained according to the set value for output power. Finally, the proportional valve is controlled according to the obtained control quantity so as to control the gas unit, and the exhaust fan is controlled according to the set value for output power.

**[0061]** The rotational speed of the exhaust fan is detected in real time, and is determined. In the case of the set value for output power  $P_{initial}$ , if the corrected value of the detected rotational speed is located in region I, then set value for output power of the exhaust fan 10 is  $P=P_{initial}-\Delta P1$ ; if the corrected value of the detected rotational speed is located in region II, then set value for output power of the exhaust fan 10 is  $P=P_{initial}$ ; if the corrected value of the detected rotational speed is located in region III, then set value for output power of the exhaust fan 10 is  $P=P_{initial}+\Delta P2$ . And so on, if the corrected rotational speed of the exhaust fan 10 under a certain set value for output power is located in region IV, or the corrected rotational speed of the exhaust fan 10

is higher than the rotational speed threshold, or a shut-off instruction is received from the user, then the gas water heater is controlled to shut off.

**[0062]** During the operation of the gas water heater, if the set temperature for output water is changed, or the water supply quantity is changed, the control quantity of the proportional valve and the set value for output power are obtained again, and the gas water heater is controlled based on the above-mentioned procedure.

**[0063]** With the safety control method for a gas water heater according to embodiments of the present disclosure, firstly the set value for output power of the exhaust fan is obtained and the reference value of the rotational speed corresponding to the set value for output power is obtained, the actual value of the rotational speed is obtained according to the set value for the output power of the exhaust fan, and the difference between the actual value of the rotational speed and the reference value of the rotational speed is calculated. And then, the rotational speed of the exhaust fan is detected, the rotational speed of the exhaust fan is corrected according to the difference between the actual value of the rotational speed and the reference value of the rotational speed, the wind pressure situation at the air outlet of the exhaust fan is determined according to the corrected rotational speed and the set value for the output power of the exhaust fan, and further the set value for the output power of the exhaust fan is adjusted according to the wind pressure situation, such that the adjustment of air volume of the exhaust fan may be realized, and it is guaranteed that a good combustion condition may be achieved after mixing the introduced gas and air during the operation of the gas water heater, thus ensuring the safe and reliable operation of the gas water heater. Meanwhile, the adjustment of the set value for the output power directly based on the corrected rotational speed is an active control, which not only has a fast response speed but also provides more accurate air volume when compared to the passive control on the rotational speed of the exhaust fan, such that the control accuracy is improved.

**[0064]** In addition, there is provided a gas water heater according to embodiments of the present disclosure, which includes the above safety control system for a gas water heater.

**[0065]** With the above safety control system, the a gas water heater according to embodiments of the present disclosure may correct the rotational speed of the exhaust fan according to the difference between the actual value of the rotational speed and the reference value of the rotational speed, determine the wind pressure situation at the air outlet of the exhaust fan according to the corrected rotational speed and the set value for the output power and adjust the set value for the output power according to the wind pressure situation, such that the adjustment of air volume of the exhaust fan may be realized, and it is guaranteed that a good combustion condition may be achieved after mixing the introduced gas and air during the operation of the gas water heater, thus ensur-

ing the safe and reliable operation of the gas water heater. Meanwhile, the adjustment of the set value for the output power directly based on the rotational speed difference is an active control, which not only has a fast response speed but also provides more accurate air volume when compared to the passive control on the rotational speed of the exhaust fan, such that the control accuracy is improved.

**[0066]** In the specification, it is to be understood that terms such as "central", "longitudinal", "lateral", "length", "width", "thickness", "upper", "lower", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inner", "outer", "clockwise", "counterclockwise", "axial", "radial", and "circumferential" should be construed to refer to the orientation or the position as then described or as shown in the drawings under discussion. These relative terms are only used to simplify description of the present disclosure, and do not indicate or imply that the device or element referred to must have a particular orientation, or constructed or operated in a particular orientation. Thus, these terms cannot be constructed to limit the present disclosure.

**[0067]** In addition, terms such as "first" and "second" are used herein for purposes of description and are not intended to indicate or imply relative importance or significance or to imply the number of indicated technical features. Thus, the feature defined with "first" and "second" may comprise one or more of this feature. In the description of the present disclosure, "a plurality of" means two or more than two, unless specified otherwise.

**[0068]** In the present disclosure, unless specified or limited otherwise, the terms "mounted", "connected", "coupled", "fixed" and the like are used broadly, and may be, for example, fixed connections, detachable connections, or integral connections; may also be mechanical or electrical connections; may also be direct connections or indirect connections via intervening structures; may also be inner communications of two elements, which can be understood by those skilled in the art according to specific situations.

**[0069]** In the present disclosure, unless specified or limited otherwise, a structure in which a first feature is "on" or "below" a second feature may include an embodiment in which the first feature is in direct contact with the second feature, and may also include an embodiment in which the first feature and the second feature are not in direct contact with each other, but are contacted via an additional feature formed therebetween. Furthermore, a first feature "on", "above", or "on top of" a second feature may include an embodiment in which the first feature is right or obliquely "on", "above", or "on top of" the second feature, or just means that the first feature is at a height higher than that of the second feature; while a first feature "below", "under", or "on bottom of" a second feature may include an embodiment in which the first feature is right or obliquely "below", "under", or "on bottom of" the second feature, or just means that the first feature is at a height lower than that of the second feature.

[0070] Reference throughout this specification to "an embodiment," "some embodiments," "an example," "a specific example," or "some examples," means that a particular feature, structure, material, or characteristic described in connection with the embodiment or example is included in at least one embodiment or example of the present disclosure. Thus, the appearances of the above phrases throughout this specification are not necessarily referring to the same embodiment or example of the present disclosure. Furthermore, the particular features, structures, materials, or characteristics may be combined in any suitable manner in one or more embodiments or examples.

[0071] Although embodiments of the present disclosure have been shown and described, it would be appreciated by those skilled in the art that changes, modifications, alternatives and variations can be made in the embodiments without departing from the scope of the present disclosure.

## Claims

1. A safety control method for a gas water heater, comprising:

obtaining (S1) a set value for output power of an exhaust fan (10) in the gas water heater;  
obtaining (S2) an actual value of a rotational speed of the exhaust fan (10) and a reference value of the rotational speed according to the set value for the output power, and calculating a difference between the actual value of the rotational speed and the reference value of the rotational speed;

detecting (S3) the rotational speed of the exhaust fan (10); and

correcting (S4) the rotational speed according to the difference, determining a wind pressure situation at an air outlet of the exhaust fan (10) according to the corrected rotational speed and the set value for the output power, and adjusting the set value for the output power according to the wind pressure situation, wherein correcting the rotational speed according to the difference comprises

controlling the corrected rotational speed to be equal to a sum of the rotational speed of the exhaust fan (10) and the difference;

the safety control method being **characterised in that** determining a wind pressure situation at an air outlet of the exhaust fan (10) according to the corrected rotational speed and the set value for the output power and adjusting the set value for the output power according to the wind pressure situation comprises:

controlling the set value for the output power

to be reduced by a first predetermined value when it is determined that the wind pressure situation is a low wind pressure situation; controlling the set value for the output power to keep unchanged when it is determined that the wind pressure situation is a medium wind pressure situation; and controlling the set value for the output power to be increased by a second predetermined value when it is determined that the wind pressure situation is a high wind pressure situation.

2. The safety control method according to any of claims 1, wherein determining a wind pressure situation at an air outlet of the exhaust fan (10) according to the corrected rotational speed and the set value for the output power and adjusting the set value for the output power according to the wind pressure situation further comprises:

controlling the gas water heater to shut off, when it is determined that the wind pressure situation is an extreme high wind pressure situation or the corrected rotational speed is higher than a rotational speed threshold.

3. The safety control method according to claim 1, further comprising:

obtaining a water supply quantity of the gas water heater, a set temperature for output water of the gas water heater and a cold water temperature of the gas water heater; and calculating a total heat required by the gas water heater according to the water supply quantity, the set temperature for the output water and the cold water temperature, and obtaining a current control instruction and an initial set value for the output power according to the total heat.

4. The safety control method according to claim 3, further comprising:

performing a gas burning control by controlling a proportional valve in a gas unit of the gas water heater according to the current control instruction.

5. A safety control system for a gas water heater, comprising:

an exhaust fan (10), configured to exhaust waste gas generated when the gas water heater burns gas;

a rotational speed detecting unit (20), configured to detect a rotational speed of the exhaust fan (10);

a power obtaining unit (30), configured to obtain a set value for output power of the exhaust fan (10);

- a rotational speed difference obtaining unit (40), configured to obtain an actual value of the rotational speed and a reference value of the rotational speed according to the set value for the output power of the exhaust fan (10), and to calculate a difference between the actual value of the rotational speed and the reference value of the rotational speed; and  
 an exhaust control unit (50), connected to the exhaust fan (10), the rotational speed detecting unit (20) and the power obtaining unit (30) respectively, and comprising processing means configured to perform the method of claim 1.
6. The safety control system according to claim 5, further comprising a system control unit (60) configured to perform a mutual communication with the exhaust control unit (50), wherein the exhaust control unit (50) is configured to send a shut-off signal to the system control unit (60) such that the system control unit (60) controls the gas water heater to shut off according to the shut-off signal, when the exhaust control unit (50) determines that the wind pressure situation is an extreme high wind pressure situation or the corrected rotational speed is higher than a rotational speed threshold.
7. The safety control system according to claim 6, further comprising:
- a water supply unit (70), connected to the system control unit (60); and  
 a temperature obtaining unit, connected with the system control unit (60), and configured to obtain a set temperature for output water of the gas water heater and a cold water temperature of the gas water heater,  
 wherein, the system control unit (60) is configured to calculate a total heat required by the gas water heater according to a water supply quantity of the water supply unit (70), the set temperature for the output water and the cold water temperature, and to obtain a current control instruction and an initial set value for the output power according to the total heat.
8. The safety control system according to claim 7, further comprising:
- a gas unit (80), connected to the system control unit (60) and provided with a proportional valve, wherein  
 the system control unit (60) is configured to control the gas unit by controlling the proportional valve according to the current control instruction.
9. The safety control system according to claim 5,

wherein the gas water heater is a forced exhaust type gas water heater.

10. A gas water heater, comprising the safety control system for a gas water heater according to any of claims 5-9.

#### Patentansprüche

1. Sicherheitssteuerungsverfahren für ein Gas-Wasser-Heizgerät, umfassend:

Erlangen (S1) eines Sollwertes für Ausgangsleistung eines Abluftventilators (10) in dem Gas-Wasser-Heizgerät,  
 Erlangen (S2) eines Istwertes einer Drehzahl des Abluftventilators (10) und eines Referenzwertes der Drehzahl gemäß dem Sollwert für die Ausgangsleistung und Berechnen einer Differenz zwischen dem Istwert der Drehzahl und dem Referenzwert der Drehzahl,  
 Ermitteln (S3) der Drehzahl des Abluftventilators (10) und  
 Korrigieren (S4) der Drehzahl gemäß der Differenz, Bestimmen einer Winddrucksituation an einem Luftauslass des Abluftventilators (10) gemäß der korrigierten Drehzahl und dem Sollwert für die Ausgangsleistung und Justieren des Sollwertes für die Ausgangsleistung gemäß der Winddrucksituation,  
 wobei das Korrigieren der Drehzahl gemäß der Differenz Folgendes umfasst:

Steuern der korrigierten Drehzahl derart, dass sie gleich einer Summe der Drehzahl des Abluftventilators (10) und der Differenz ist,  
 wobei das Sicherheitssteuerungsverfahren **dadurch gekennzeichnet ist, dass** das Bestimmen einer Winddrucksituation an einem Luftauslass des Abluftventilators (10) gemäß der korrigierten Drehzahl und dem Sollwert für die Ausgangsleistung und das Justieren des Sollwertes für die Ausgangsleistung gemäß der Winddrucksituation Folgendes umfasst:

Steuern des Sollwertes für die Ausgangsleistung derart, dass er um einen ersten vorbestimmten Wert verringert wird, wenn bestimmt wird, dass die Winddrucksituation eine Situation mit geringem Winddruck ist,  
 Steuern des Sollwertes für die Ausgangsleistung derart, dass er unverändert bleibt, wenn bestimmt wird, dass die Winddrucksituation eine Situation

mit mittlerem Winddruck ist, und Steuern des Sollwertes für die Ausgangsleistung derart, dass er um einen zweiten vorbestimmten Wert erhöht wird, wenn bestimmt wird, dass die Winddrucksituation eine Situation mit hohem Winddruck ist.

2. Sicherheitssteuerungsverfahren nach Anspruch 1, wobei das Bestimmen einer Winddrucksituation an einem Luftauslass des Abluftventilators (10) gemäß der korrigierten Drehzahl und dem Sollwert für die Ausgangsleistung und das Justieren des Sollwertes für die Ausgangsleistung gemäß der Winddrucksituation ferner Folgendes umfasst:

Steuern des Gas-Wasser-Heizgerätes derart, dass es sich abschaltet, wenn bestimmt wird, dass die Winddrucksituation eine Situation mit extrem hohem Winddruck ist oder die korrigierte Drehzahl höher als ein Drehzahl-Grenzwert ist.

3. Sicherheitssteuerungsverfahren nach Anspruch 1, ferner umfassend:

Erlangen einer Wasserzufuhrmenge des Gas-Wasser-Heizgerätes, einer Solltemperatur für Ausgangswasser des Gas-Wasser-Heizgerätes und einer Kaltwassertemperatur des Gas-Wasser-Heizgerätes und Berechnen einer Gesamtwärme, die von dem Gas-Wasser-Heizgerät gemäß der Wasserzufuhrmenge, der Solltemperatur für das Ausgangswasser und der Kaltwassertemperatur benötigt wird, und Erlangen einer aktuellen Steuerungsanweisung und eines Anfangssollwertes für die Ausgangsleistung gemäß der Gesamtwärme.

4. Sicherheitssteuerungsverfahren nach Anspruch 3, ferner umfassend:  
Durchführen einer Gasverbrennungssteuerung durch Steuern eines Proportionalventils in einer Gaseinheit des Gas-Wasser-Heizgerätes gemäß der aktuellen Steuerungsanweisung.

5. Sicherheitssteuerungssystem für ein Gas-Wasser-Heizgerät, umfassend:

einen Abluftventilator (10), der dazu gestaltet ist, Abgas abzulüften, das erzeugt wird, wenn das Gas-Wasser-Heizgerät Gas verbrennt, eine Drehzahl-Ermittlungseinheit (20), die dazu gestaltet ist, eine Drehzahl des Abluftventilators (10) zu ermitteln, eine Leistungserlangungseinheit (30), die dazu gestaltet ist, einen Sollwert für Ausgangsleistung des Abluftventilators (10) zu erlangen, eine Drehzahldifferenz-Erlangungseinheit (40),

die dazu gestaltet ist, einen Istwert der Drehzahl und einen Referenzwert der Drehzahl gemäß dem Sollwert für die Ausgangsleistung des Abluftventilators (10) zu erlangen und eine Differenz zwischen dem Istwert der Drehzahl und dem Referenzwert der Drehzahl zu berechnen, und

eine Abluftsteuerungseinheit (50), die mit dem Abluftventilator (10), der Drehzahl-Ermittlungseinheit (20) beziehungsweise der Leistungserlangungseinheit (30) verbunden ist und Verarbeitungsmittel umfasst, die dazu gestaltet sind, das Verfahren nach Anspruch 1 durchzuführen.

6. Sicherheitssteuerungssystem nach Anspruch 5, ferner eine Systemsteuerungseinheit (60) umfassend, die dazu gestaltet ist, eine wechselseitige Kommunikation mit der Abluftsteuerungseinheit (50) durchzuführen, wobei

die Abluftsteuerungseinheit (50) dazu gestaltet ist, ein Abschaltsignal an die Systemsteuerungseinheit (60) zu senden, sodass die Systemsteuerungseinheit (60) das Gas-Wasser-Heizgerät derart steuert, dass es sich gemäß dem Abschaltsignal abschaltet, wenn die Abluftsteuerungseinheit (50) bestimmt, dass die Winddrucksituation eine Situation mit extrem hohem Winddruck ist oder die korrigierte Drehzahl höher als ein Drehzahl-Grenzwert ist.

7. Sicherheitssteuerungssystem nach Anspruch 6, ferner umfassend:

eine Wasserzufuhreinheit (70), die mit der Systemsteuerungseinheit (60) verbunden ist, und eine Temperaturerlangungseinheit, die mit der Systemsteuerungseinheit (60) verbunden ist und dazu gestaltet ist, eine Solltemperatur für Ausgangswasser des Gas-Wasser-Heizgerätes und eine Kaltwassertemperatur des Gas-Wasser-Heizgerätes zu erlangen, wobei die Systemsteuerungseinheit (60) dazu gestaltet ist, eine Gesamtwärme zu berechnen, die von dem Gas-Wasser-Heizgerät gemäß einer Wasserzufuhrmenge der Wasserzufuhreinheit (70), der Solltemperatur für das Ausgangswasser und der Kaltwassertemperatur benötigt wird, und eine aktuelle Steuerungsanweisung und einen Anfangssollwert für die Ausgangsleistung gemäß der Gesamtwärme zu erlangen.

8. Sicherheitssteuerungssystem nach Anspruch 7, ferner umfassend:

eine Gaseinheit (80), die mit der Systemsteuerungseinheit (60) verbunden ist und mit einem Proportionalventil ausgestattet ist, wobei die Systemsteuerungseinheit (60) dazu gestaltet ist, die Gaseinheit durch Steuern des Pro-

portionalventils gemäß der aktuellen Steuerungsanweisung zu steuern.

9. Sicherheitssteuerungssystem nach Anspruch 5, wobei das Gas-Wasser-Heizgerät ein Gas-Wasser-Heizgerät des Typs mit Zwangsentlüftung ist. 5
10. Gas-Wasser-Heizgerät, umfassend das Sicherheitssteuerungssystem für ein Gas-Wasser-Heizgerät nach einem der Ansprüche 5 bis 9. 10

## Revendications

1. Procédé de commande de sécurité pour un chauffe-eau au gaz, comprenant : 15
  - l'obtention (S1) d'une valeur de consigne pour une puissance de sortie d'un ventilateur d'échappement (10) dans le chauffe-eau au gaz ; 20
  - l'obtention (S2) d'une valeur réelle d'une vitesse de rotation du ventilateur d'échappement (10) et d'une valeur de référence de la vitesse de rotation selon la valeur de consigne pour la puissance de sortie, et le calcul d'une différence entre la valeur réelle de la vitesse de rotation et la valeur de référence de la vitesse de rotation ; 25
  - la détection (S3) de la vitesse de rotation du ventilateur d'échappement (10) ; et 30
  - la correction (S4) de la vitesse de rotation selon la différence, la détermination d'une situation de pression de vent au niveau d'une évacuation d'air du ventilateur d'échappement (10) selon la vitesse de rotation corrigée et la valeur de consigne pour la puissance de sortie, et le réglage de la valeur de consigne pour la puissance de sortie selon la situation de pression de vent, dans lequel la correction de la vitesse de rotation selon la différence comprend 35
  - la commande de la vitesse de rotation corrigée pour qu'elle soit égale à une somme de la vitesse de rotation du ventilateur d'échappement (10) et de la différence ; 40
  - le procédé de commande de sécurité étant **caractérisé en ce que** la détermination de la situation de pression de vent au niveau d'une évacuation d'air du ventilateur d'échappement (10) selon la vitesse de rotation corrigée et la valeur de consigne pour la puissance de sortie et le réglage de la valeur de consigne pour la puissance de sortie selon la situation de pression de vent comprennent : 45

la commande de la valeur de consigne pour la puissance de sortie pour qu'elle soit réduite d'une première valeur prédéterminée lorsqu'il est déterminé que la situation de 55

pression de vent est une situation de pression de vent faible ;

la commande de la valeur de consigne pour la puissance de sortie pour qu'elle reste inchangée lorsqu'il est déterminé que la situation de pression de vent est une situation de pression de vent moyenne ; et

la commande de la valeur de consigne pour la puissance de sortie pour qu'elle soit augmentée d'une seconde valeur prédéterminée lorsqu'il est déterminé que la situation de pression de vent est une situation de pression de vent élevée.

2. Procédé de commande de sécurité selon la revendication 1, dans lequel la détermination d'une situation de pression de vent au niveau d'une évacuation d'air du ventilateur d'échappement (10) selon la vitesse de rotation corrigée et la valeur de consigne pour la puissance de sortie et le réglage de la valeur de consigne pour la puissance de sortie selon la situation de pression de vent comprennent en outre : la commande du chauffe-eau au gaz pour sa fermeture, lorsqu'il est déterminé que la situation de pression de vent est une situation de pression de vent élevée extrême ou que la vitesse de rotation corrigée est supérieure à un seuil de vitesse de rotation.

3. Procédé de commande de sécurité selon la revendication 1, comprenant en outre : 30

l'obtention d'une quantité d'alimentation en eau du chauffe-eau au gaz, d'une température de consigne pour la sortie d'eau du chauffe-eau au gaz et d'une température d'eau froide du chauffe-eau au gaz ; et

le calcul d'une chaleur totale requise par le chauffe-eau au gaz selon la quantité d'alimentation en eau, la température de consigne pour la sortie d'eau et la température d'eau froide, et l'obtention d'une instruction de commande de courant et d'une valeur de consigne initiale pour la puissance de sortie selon la chaleur totale.

4. Procédé de commande de sécurité selon la revendication 3, comprenant en outre : 45
  - la réalisation d'une commande de combustion de gaz par la commande d'une soupape proportionnelle dans une unité de gaz du chauffe-eau au gaz selon l'instruction de commande de courant.
5. Système de commande de sécurité pour un chauffe-eau au gaz, comprenant : 50

un ventilateur d'échappement (10), configuré pour l'échappement d'un gaz résiduaire généré lorsque le chauffe-eau au gaz réalise une combustion de gaz ; 55

- une unité de détection de vitesse de rotation (20), configurée pour détecter une vitesse de rotation du ventilateur d'échappement (10) ;  
 une unité d'obtention de puissance (30), configurée pour obtenir une valeur de consigne pour une puissance de sortie du ventilateur d'échappement (10) ;  
 une unité d'obtention de différence de vitesse de rotation (40), configurée pour obtenir une valeur réelle de la vitesse de rotation et une valeur de référence de la vitesse de rotation selon la valeur de consigne pour la puissance de sortie du ventilateur d'échappement (10), et pour calculer une différence entre la valeur réelle de la vitesse de rotation et la valeur de référence de la vitesse de rotation ; et  
 une unité de commande d'échappement (50), connectée au ventilateur d'échappement (10), à l'unité de détection de vitesse de rotation (20) et à l'unité d'obtention de puissance (30) respectivement, et comprenant des moyens de traitement configurés pour réaliser le procédé selon la revendication 1.
6. Système de commande de sécurité selon la revendication 5, comprenant en outre une unité de commande de système (60) configurée pour réaliser une communication mutuelle avec l'unité de commande d'échappement (50), dans lequel l'unité de commande d'échappement (50) est configurée pour envoyer un signal de fermeture à l'unité de commande de système (60) de sorte que l'unité de commande de système (60) commande le chauffe-eau au gaz pour sa fermeture selon le signal de fermeture, lorsque l'unité de commande d'échappement (50) détermine que la situation de pression de vent est une situation de pression de vent élevée extrême ou que la vitesse de rotation corrigée est supérieure à un seuil de vitesse de rotation.
7. Système de commande de sécurité selon la revendication 6, comprenant en outre :
- une unité d'alimentation en eau (70), connectée à l'unité de commande de système (60) ; et  
 une unité d'obtention de température, connectée à l'unité de commande de système (60), et configurée pour obtenir une température de consigne pour la sortie d'eau du chauffe-eau au gaz et une température d'eau froide du chauffe-eau au gaz,  
 dans lequel, l'unité de commande de système (60) est configurée pour calculer une chaleur totale requise par le chauffe-eau au gaz selon une quantité d'alimentation en eau de l'unité d'alimentation en eau (70), la température de consigne pour la sortie d'eau et la température d'eau froide, et pour obtenir une instruction de
- commande de courant et une valeur de consigne initiale pour la puissance de sortie selon la chaleur totale.
8. Système de commande de sécurité selon la revendication 7, comprenant en outre :
- une unité de gaz (80), connectée à l'unité de commande de système (60) et dotée d'une soupape proportionnelle, dans lequel l'unité de commande de système (60) est configurée pour commander l'unité de gaz par la commande de la soupape proportionnelle selon l'instruction de commande de courant.
9. Système de commande de sécurité selon la revendication 5, dans lequel le chauffe-eau au gaz est un chauffe-eau au gaz du type à échappement forcé.
10. Chauffe-eau au gaz, comprenant le système de commande de sécurité pour un chauffe-eau au gaz selon l'une quelconque des revendications 5-9.

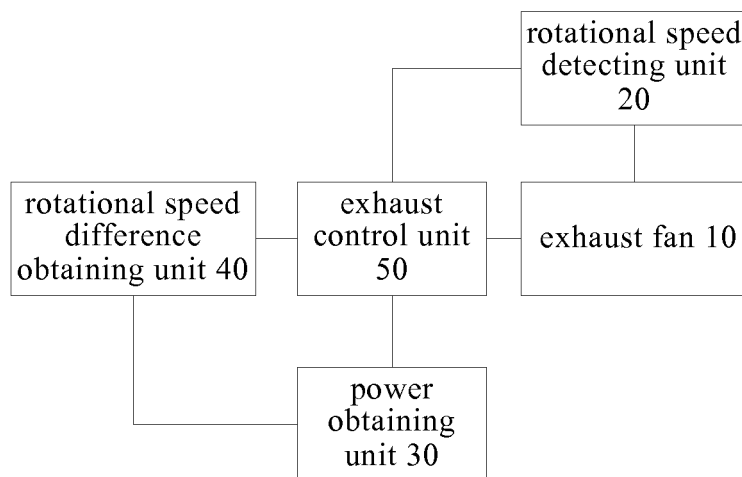


Fig. 1

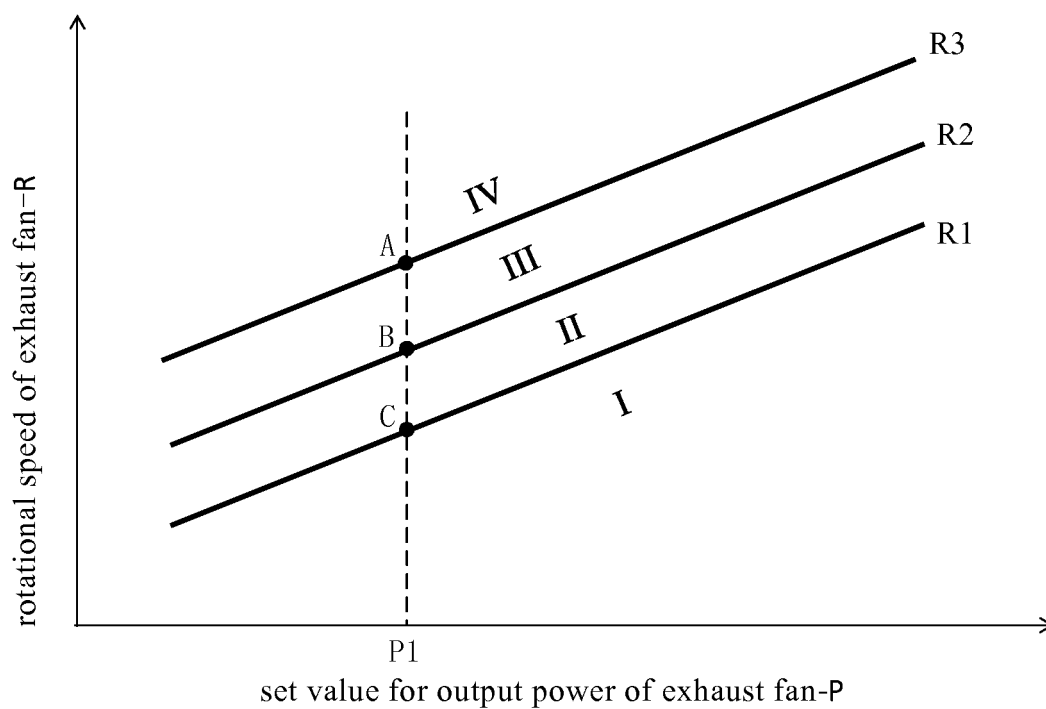


Fig. 2

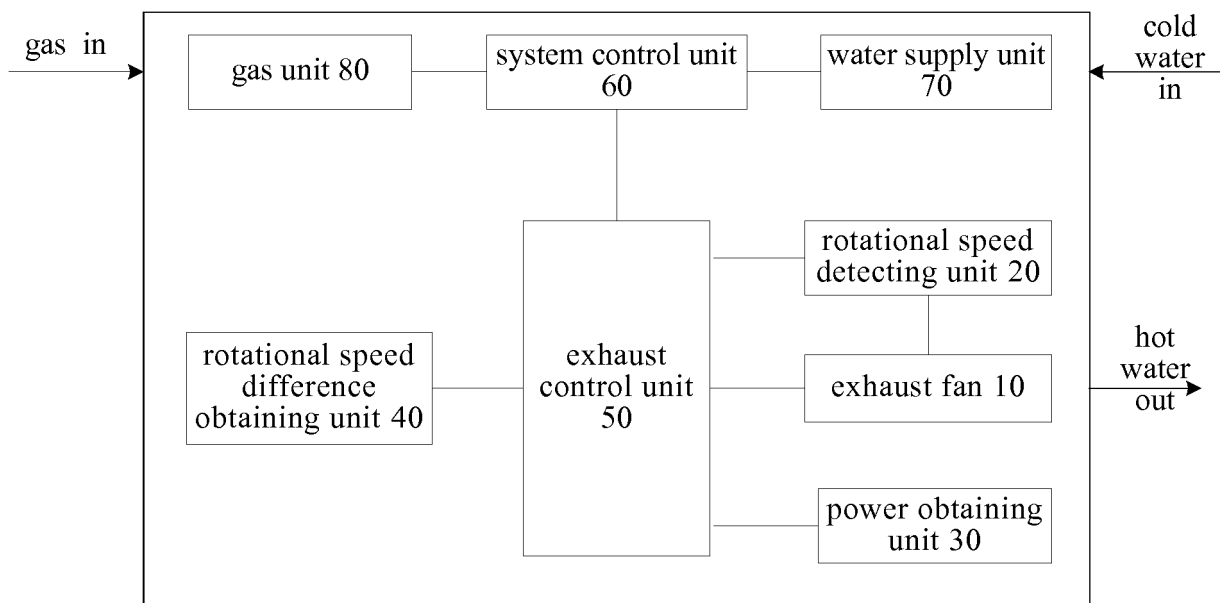


Fig. 3

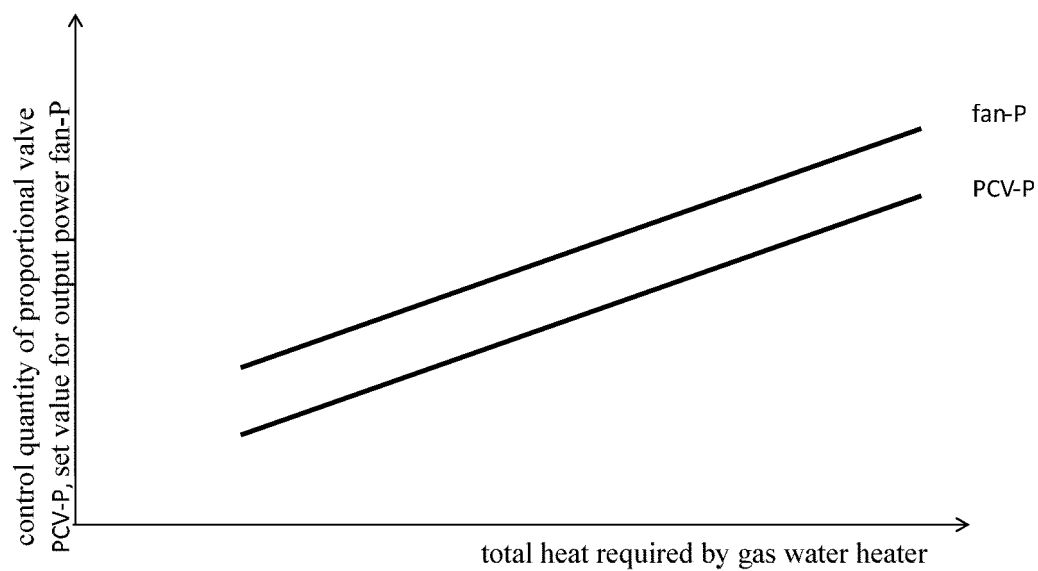


Fig. 4

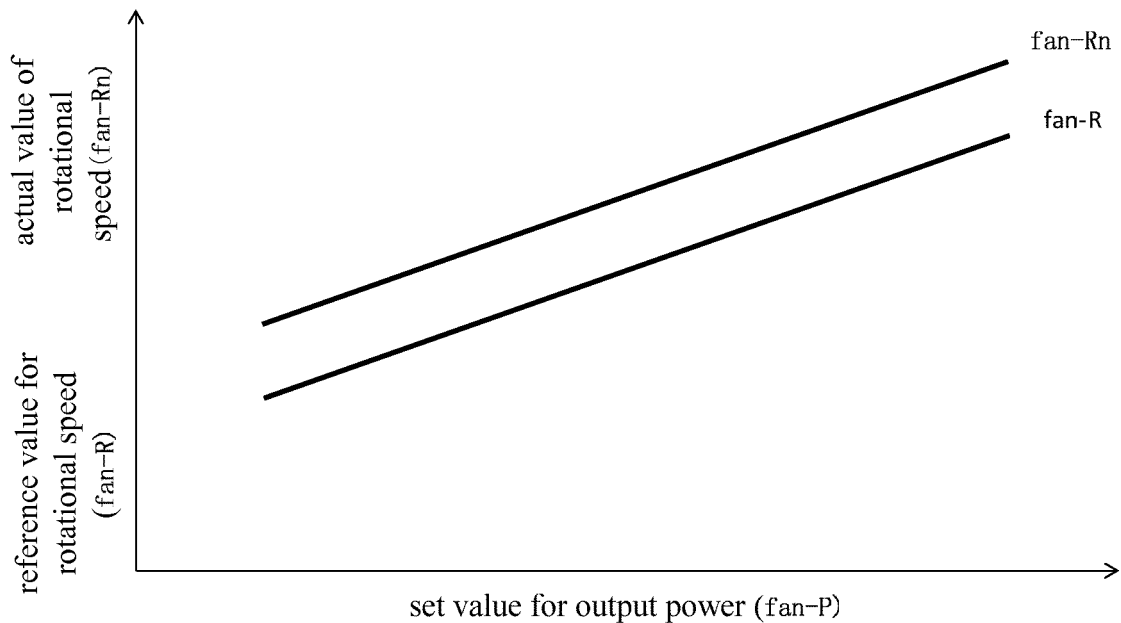


Fig. 5

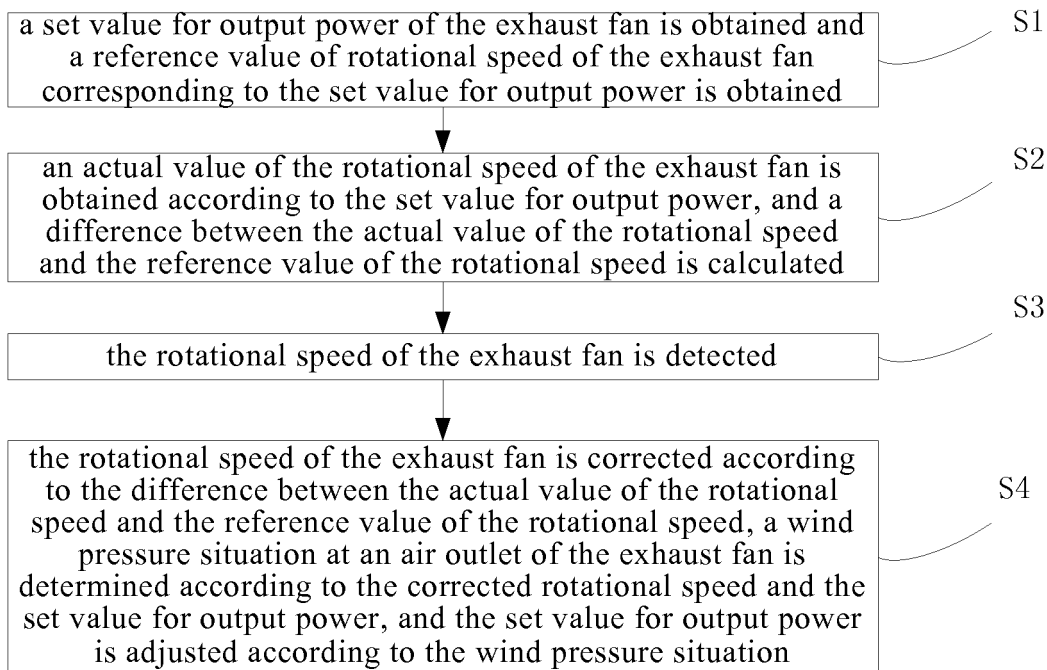


Fig. 6

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

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- CN 102080878 A [0005]