Claims

1. A computer-implemented method of optimizing operating efficiency of an air handling unit (AHU) which regulates airflow to a building space, the method comprising:

regulating a chilled water valve of the AHU to achieve a present temperature of supply airflow being set at a minimum setpoint temperature of supply airflow, wherein the chilled water valve is arranged at a chilled water pipe and configured to control the present temperature of supply airflow by regulating amount of chilled water flowing from the chilled water pipe into coils of the AHU;

operating a fan of the AHU at a present fan speed to achieve a maximum setpoint of total static pressure of supply airflow;

performing iterations of the following steps:

comparing a present temperature of return airflow with an initial setpoint temperature of return airflow;

while the present temperature of return airflow is above the initial setpoint temperature of return airflow, performing:

comparing the present temperature of supply airflow with the minimum setpoint temperature of supply airflow;

while the present temperature of supply airflow is above the minimum setpoint temperature of supply airflow, reducing an initial setpoint temperature of supply airflow, wherein the reduced initial setpoint temperature is to be set as the initial setpoint temperature of supply airflow for a subsequent one of the iterations;

while the present temperature of supply airflow is at the minimum setpoint temperature of supply airflow, increasing an initial setpoint of total static pressure of supply airflow by increasing the present fan speed, wherein the increased initial setpoint of total static pressure of supply airflow is to be set as the initial setpoint of total static pressure of supply airflow for the subsequent one of the iterations, and wherein the increased fan speed is maintained below a maximum fan speed;

while the present temperature of return airflow is below the initial setpoint temperature of return airflow, performing:

comparing a present total static pressure of supply airflow with a minimum setpoint of total static pressure of supply airflow;

while the present total static pressure of supply airflow is above the minimum setpoint of total static pressure of supply airflow, performing:

comparing the present fan speed with a minimum setpoint of fan speed;

while the present fan speed is above the minimum setpoint speed of the AHU, decreasing the initial setpoint of total static pressure of supply airflow by reducing the present fan speed, wherein the decreased setpoint of total static pressure of supply airflow is to be set as the initial setpoint of total static pressure of supply airflow for the subsequent one of the iterations; and

while the present fan speed is at the minimum setpoint speed of AHU, maintaining the present fan speed and comparing a present relative humidity of return airflow / intake entering the AHU with the maximum setpoint of relative humidity of return airflow / intake entering the AHU, and increasing the initial setpoint temperature of the supply airflow when the present relative humidity of return airflow / intake entering the AHU is below the maximum setpoint of relative humidity of return airflow / intake entering the AHU, wherein the increased initial setpoint temperature of supply airflow is to be set as the initial setpoint for the subsequent one of the iterations;

while the present total static pressure of supply airflow is at the minimum setpoint of total static pressure of supply airflow, performing:

comparing the present relative humidity of return airflow / intake entering the AHU with the maximum setpoint of relative humidity of return airflow / intake entering the AHU;

while the present relative humidity of return airflow / intake entering the AHU is below or at the maximum setpoint of relative humidity of return airflow / intake entering the AHU, increasing the initial setpoint temperature of the supply airflow by regulating the chilled water valve, wherein the increased initial setpoint temperature of the supply airflow is set to be the initial setpoint temperature of the supply airflow for the subsequent one of the iterations; and

while the present relative humidity of return airflow / intake entering the AHU is above the maximum setpoint of relative humidity of return airflow / intake entering the AHU, maintaining the present total static pressure of supply airflow.

2. The method as claimed in claim 1, wherein regulating a chilled water valve of the AHU to achieve a present temperature of supply airflow at a minimum setpoint temperature of supply airflow comprises:

measuring the present temperature of supply airflow;

comparing the present temperature of supply airflow with the minimum setpoint temperature of supply airflow;

while the present temperature of supply airflow is above the minimum setpoint temperature of supply airflow, performing:

comparing a present opening of the chilled water valve with a maximum opening limit of the chilled water valve;

while the present opening of the chilled water valve corresponds to the maximum opening of the chilled water valve, maintaining the chilled water valve at the present opening;

while the present opening of the chilled water valve is narrower than the maximum opening of the chilled water valve, enlarging the present opening of the chilled water valve;

while the present temperature of supply airflow is below or equal to the minimum setpoint temperature of supply airflow, performing:

closing the opening of the chilled water valve.

3. The method as claimed in claim 2, prior to maintaining the chilled water valve at the present opening while the present opening of the chilled water valve corresponds to the maximum opening of the chilled water valve, the method further comprising:

verifying an opening command of the chilled water valve as ascertained by a computer processor against an opening of the chilled water valve as measured;

while the opening command of the chilled water valve as ascertained by a computer processor differs from the opening of the chilled water valve, prompting a user, via an operating interface, to check the present opening of the chilled water valve.

4. The method as claimed in claim 3, further comprising:

displaying, via the operating interface, the setpoint temperature of return airflow, the initial setpoint temperature of supply airflow, the initial setpoint of total static pressure of supply airflow, wherein the initial setpoint temperature of supply airflow and the initial

setpoint of total static pressure of supply airflow are dynamically adjusted during the iterations, and wherein the setpoint of return airflow is fixed.

5. The method as claimed in any one of claims 1 to 4, further comprising:

identifying a baseline total static pressure of supply airflow by tightening a belt pulley of the AHU; and

identifying the belt pulley as being in a loose condition when the present total static pressure of supply airflow is lower than the baseline total static pressure of supply airflow.

6. The method as claimed in any one of claims 1 to 5, further comprising:

recording the initial setpoint of supply airflow and the initial setpoint of total static pressure of supply airflow.

7. The method as claimed in any one of claims 1 to 6, further comprising:

detecting, by a CO_2 sensor, a CO_2 composition in the return airflow;

based on the CO_2 composition relative to a predetermined threshold;

regulating a fresh air composition in the supply airflow.

8. A system for optimizing operating efficiency of an air handling unity (AHU) which is configured to regulate airflow to a building space, the system comprising:

a first thermal sensor arranged at a return airflow duct for measuring a present temperature of return airflow;

a second thermal sensor arranged at a supply airflow duct for measuring a present temperature of supply airflow;

a relative humidity sensor configured to measure a present relative humidity of return airflow or an intake entering the AHU;

a pressure transmitter configured to measure a present total static pressure of supply airflow;

a chilled water valve configured to control the present temperature of supply airflow by regulating amount of chilled water into coils of the AHU;

a variable speed drive configured to modulate a present fan speed of the AHU;

a memory configured to store computer-executable instructions, and data obtained by the first thermal sensor, the second thermal sensor, the humidity sensor, the pressure transmitter, the chilled water valve, the variable speed drive;

a computer processor or controller communicably coupled to the first thermal sensor, the second thermal sensor, the relative humidity sensor, the pressure transmitter, the chilled water valve, the variable speed drive to receive data therefrom, and communicably coupled to the memory and configured to execute the instructions stored in the memory to perform first steps comprising:

regulating a chilled water valve of the AHU to achieve the present temperature of supply airflow being set at a minimum setpoint temperature of supply airflow, wherein the chilled water valve is arranged at a chilled water pipe and configured to control the present temperature of supply airflow by regulating amount of chilled water flowing from the chilled water pipe into coils of the AHU;

operating a fan of the AHU at a present fan speed to achieve a maximum setpoint of total static pressure;

performing iterations of the following second steps:

comparing the present temperature of return airflow with an initial setpoint temperature of return airflow;

while the present temperature of return airflow is above the initial setpoint temperature of return airflow, performing:

comparing the present temperature of supply airflow with the minimum setpoint temperature of supply airflow;

while the present temperature of supply airflow is above the minimum setpoint temperature of supply airflow, reducing an initial setpoint temperature of supply airflow, wherein the reduced initial setpoint temperature is to be set as the initial setpoint temperature of supply airflow for a subsequent one of the iterations;

while the present temperature of supply airflow is at the minimum setpoint temperature of supply airflow, increasing an initial setpoint of total static pressure by increasing the present fan speed, wherein the increased initial setpoint of total static pressure is to be set as the initial setpoint of total static pressure for the subsequent one of the iterations, and wherein the increased fan speed is maintained below a maximum fan speed;

while the present temperature of return airflow is below the initial setpoint temperature of return airflow, performing:

comparing the present total static pressure with a minimum setpoint of total static pressure;

while the present total static pressure is above the minimum setpoint of total static pressure, performing:

comparing the present fan speed with a minimum setpoint of fan speed;

while the present fan speed is above the minimum setpoint speed of the AHU, decreasing the initial setpoint of total static pressure by reducing the present fan speed, wherein the decreased setpoint of total static pressure is to be set as the initial setpoint of total static pressure for the subsequent one of the iterations; and

while the present fan speed is at the minimum setpoint speed of AHU, maintaining the present fan speed and comparing a present relative humidity of return airflow or an intake entering the AHU with the maximum setpoint of relative humidity of return airflow or an intake entering the AHU, and increasing the initial setpoint temperature of the supply airflow when the present relative humidity of return airflow or an intake entering the AHU is below the maximum setpoint of relative humidity of return airflow or an intake entering the AHU, wherein the increased initial setpoint temperature of supply airflow is to be set as the initial setpoint for the subsequent one of the iterations;

while the present total static pressure is at the minimum setpoint of total static pressure, performing:

comparing the present relative humidity of return airflow or an intake entering the AHU with the maximum setpoint of relative humidity of return airflow or an intake entering the AHU;

while the present relative humidity of return airflow or an intake entering the AHU is below or at the maximum setpoint of relative humidity of return airflow or an intake entering the AHU, increasing the initial setpoint temperature of the supply airflow by regulating the chilled water valve, wherein the increased initial setpoint temperature of the supply airflow is set to be the initial setpoint temperature of the supply airflow for the subsequent one of the iterations; and

while the present relative humidity of return airflow or an intake entering the AHU is above the maximum setpoint of relative humidity of return airflow or an intake entering the AHU, maintaining the present total static pressure.

9. The system as claimed in claim 8, wherein the first steps of regulating a chilled water valve of the AHU to achieve a present temperature of supply airflow at a minimum setpoint temperature of supply airflow include:

measuring the present temperature of supply airflow;

comparing the present temperature of supply airflow with the minimum setpoint temperature of supply airflow;

while the present temperature of supply airflow is above the minimum setpoint temperature of supply airflow, performing:

comparing a present opening of the chilled water valve with a maximum opening limit of the chilled water valve;

while the present opening of the chilled water valve corresponds to the maximum opening of the chilled water valve, maintaining the chilled water valve at the present opening;

while the present opening of the chilled water valve is narrower than the maximum opening of the chilled water valve, enlarging the present opening size of the chilled water valve;

while the present temperature of supply airflow is below or equal to the minimum setpoint temperature of supply airflow, performing:

closing the opening of the chilled water valve.

10. The system as claimed in claim 9, wherein prior to maintaining the chilled water valve at the present opening while the present opening of the chilled water valve corresponds to the maximum opening of the chilled water valve, the second steps further comprise:

verifying a computer-regulated opening of the chilled water valve against a measured opening of the chilled water valve;

while the computer-regulated opening of the chilled water valve differing from the measured opening of the chilled water valve, the method prompting a user, via an operating interface, to check the actual present opening of the chilled water valve.

11. The system as claimed in claim 10, wherein the operating interface comprises display of the setpoint temperature of return airflow, and the initial setpoint temperature of supply airflow, the initial setpoint of total static pressure, wherein the initial setpoint temperature

of supply airflow and the initial setpoint of total static pressure are dynamically adjusted, and wherein the setpoint of return airflow is fixed.

12. The system as claimed in any one of claims 8 to 11, further comprising:

a belt pully of the AHU configured to establish a baseline total static pressure, wherein the first steps further comprise:

identifying the baseline total static pressure by tightening the belt pulley of the AHU; and

identifying the belt pully as in a loose condition when the present total static pressure is lower than the minimum setpoint of total static pressure.

13. The system as claimed in any one of claims 8 to 12, wherein the first steps further comprise:

recording the initial setpoint of supply airflow and the initial setpoint of total static pressure.