

5

Description

Title Of The Invention

AIR CONDITIONING SYSTEM CONTROL DEVICE, AIR CONDITIONING
SYSTEM, AIR CONDITIONING SYSTEM CONTROL METHOD, AND
PROGRAM

10

Technical Field

[0001]

The present disclosure relates to an air conditioning system control
device, an air conditioning system, an air conditioning system control method,
15 and a program. This application claims priority based on Japanese Patent
Application No. 2020-009393 filed in Japan on January 23, 2020, the contents
of which are incorporated herein by reference.

Background Art

20 [0002]

With known control for a configuration in which a heat source side
supplies cold and warm water at temperatures according to water supply
temperature setting values while satisfying the amount of load required by a
load side, the total power consumption of heat source side devices (heat source
25 machine, auxiliary machines (cold water pump, cooling water pump, cooling
tower)) is minimized in accordance with characteristics of the heat source
machine varying depending on the balance in outside temperature and humidity.

[0003]

Patent Document 1 discloses an air conditioning system that changes the
30 water supply temperature setting values based on outside temperature and
humidity.

Citation List

Patent Document

35 [0004]

Patent Document 1: Japanese Patent No. 6425750

Summary of Invention

Technical Problem

40 [0005]

On the load side, local control is performed according to the load
required for each area, meaning that the control depends on the load condition.

5 Therefore, for example, even if an operation with a reduced COP of the heat source machine is desirable under a condition where the power of the auxiliary machines, among the load side and heat source side devices, is dominant, control to implement such an operation cannot be performed.

Thus, optimal control over the entirety including both the heat source
10 side and the load side has not been performed.

[0006]

An object of the present disclosure is to provide an air conditioning system control device, an air conditioning system, an air conditioning system control method, and a program capable of achieving the optimal operation of a
15 heat source machine in consideration of power consumption generated on the load side.

Solution to Problem

[0007]

20 According to one aspect of the present disclosure, an air conditioning system control device includes: a setting unit which sets a water supply temperature of a heat source machine; a first calculation unit which calculates an amount of air to be supplied into a room of a load side device according to the water supply temperature; a second calculation unit which calculates a
25 water supply flow rate of the heat source machine according to the water supply temperature; and an estimation unit which estimates total power consumption on the heat source machine side and the load side according to the water supply temperature, the amount of air to be supplied into the room, and the water supply flow rate. The setting unit sets the water supply temperature at
30 which the estimated total power consumption is minimized.

Advantageous Effects of Invention

[0008]

According to each aspect of the above-described invention, it is possible
35 to achieve the optimal operation of the heat source machine in consideration of the power consumption generated on the load side.

Brief Description of Drawings

[0009]

40 FIG. 1 is a diagram illustrating an overview of an air conditioning system according to a first embodiment.

5 FIG. 2 is a diagram illustrating a load configuration of the air conditioning system according to the first embodiment.

 FIG. 3 is a diagram illustrating a load configuration of the air conditioning system according to the first embodiment.

 FIG. 4 is a diagram illustrating a processing flow of a heat source
10 machine control device according to the first embodiment.

 FIG. 5 is a diagram illustrating an overview of an air conditioning system according to another embodiment.

Description of Embodiments

15 [0010]

First Embodiment

A heat source machine control device (air conditioning system control device) according to a first embodiment and an air conditioning system including the same will be described below with reference to FIGS. 1 to 4.

20 [0011]

Overview of Air Conditioning System

FIG. 1 is a diagram illustrating an overview of an air conditioning system according to the first embodiment.

 An air conditioning system 1 according to the first embodiment is a
25 central air conditioning system including a plurality of large chillers (heat source machines 1a), an air handling unit (AHU), and a fan coil unit (FCU) (which will be described in detail with reference to FIG. 2).

[0012]

 As illustrated in FIG. 1, the air conditioning system 1 includes a
30 plurality of heat source machines 1a connected in parallel, a load 2, and cooling towers 3. The air conditioning system 1 includes a heat source machine control device 10 that collectively controls the operation of the plurality of heat source machines 1a.

[0013]

35 Each heat source machine 1a has a typical heat pump configuration (a compressor, a condenser, expansion valves, and an evaporator). Each heat source machine 1a removes heat from cold water flowing toward and coming back from the load 2 (to cool the cold water) and creates cold water at a predetermined temperature.

40 The heat source machine 1a is, for example, a turbo chiller. In this case, the heat source machine 1a cools a refrigerant at a two-stage compression two-

5 stage expansion subcooling cycle, and cools the cold water with the cooled refrigerant.

The turbo compressor is a centrifugal two-stage compressor, and compresses a gaseous refrigerant. The condenser condenses and liquefies the high temperature high pressure gas refrigerant compressed by the turbo
10 compressor. Provided downstream, in the flow of the refrigerant, of the condenser is a sub-cooler that provides subcooling to the liquid refrigerant condensed by the condenser. A cooling heat transfer tube is inserted into the condenser and the sub-cooler, and cools the refrigerant with cooling water flowing in the tube. The cooling water flowing through the cooling heat
15 transfer tube cools the refrigerant, then has its heat discharged to the outside in the cooling towers, and flows through the cooling heat transfer tube again.

A high pressure expansion valve and a low pressure expansion valve inflate the liquid refrigerant from the sub-cooler. An intercooler cools the liquid refrigerant inflated by the high pressure expansion valve. The evaporator
20 evaporates the liquid refrigerant inflated by the low pressure expansion valve. A cold water heat transfer tube is inserted into the evaporator. The cold water flowing through the cold water heat transfer tube is cooled with the heat of evaporation absorbed when the refrigerant evaporates.

In this manner, the heat source machine 1a cools the cold water and
25 supplies it to the load 2.

The load control of the heat source machine 1a is performed through the rotational speed control for the turbo compressor and the capacity control using an inlet guide vane and a hot gas bypass pipe in the case of a chiller with the compressor on which variable-speed control can be performed.

30 An electric motor drives the turbo compressor. An inverter controls the rotational speed of the turbo compressor by controlling the rotational speed of the electric motor.

The inlet guide vane is provided in a refrigerant suction port of the turbo compressor to control the suctioned refrigerant flow rate, to thereby perform
35 the capacity control for the heat source machine 1a.

The hot gas bypass pipe is provided between the gas phase part of the condenser and the gas phase part of the evaporator, and bypasses the refrigerant gas. A hot gas bypass valve controls the flow rate of the refrigerant flowing in the hot gas bypass pipe. With the hot gas bypass valve adjusting the hot gas
40 bypass flow rate, capacity control can be performed more in detail than the capacity control using the inlet guide vane.

5 Note that in the case of a chiller with a compressor of a fixed-speed control type, the load control is performed through the capacity control using the inlet guide vane and the hot gas bypass pipe.

[0014]

10 A pump P1 is one of the auxiliary machines on the heat source machine side in the air conditioning system 1, and is a water pump capable of adjusting the flow rate of cold water. The heat source machine control device 10 controls the flow rate of the cold water with the pump P1 as described later. In the present embodiment, the pumps P1 are provided on both an outgoing flow path and an incoming flow path of the heat source machine 1a, but other
15 embodiments are not limited to this and the pump P1 may be provided only in any one of the flow paths.

[0015]

20 A pump P2 is one of the auxiliary machines on the heat source machine side in the air conditioning system 1, and is a water pump capable of adjusting the flow rate of cooling water. The heat source machine control device 10 controls the flow rate of the cooling water with the pump P2, as with the pump P1.

[0016]

25 The heat source machine control device 10 collectively controls the operation of the plurality of heat source machines 1a connected in parallel. A known heat source control device operates at an operating point at which the COP (coefficient of performance) of the heat source machine is maximized depending on the size of the load, but the heat source control device 10 according to the present embodiment does not necessarily operate at an
30 operating point at which the COP of the heat source machine 1a is maximized. Specific functions and details of processing of the heat source machine control device 10 according to the present embodiment will be described later.

[0017]

Configuration of Load

35 FIG. 2 is a diagram illustrating a load configuration of the air conditioning system according to the first embodiment.

 Now, with reference to FIG. 2, a detailed description of the configuration of the load 2 will be made.

[0018]

40 As illustrated in FIG. 2, the load 2 according to the present embodiment includes, for example, an air-conditioned space R that is an office room in a building, an air handling unit 20 that controls ventilation and air conditioning

5 of the air-conditioned space R (hereinafter, also referred to as AHU 20), an AHU controller 21 that controls the AHU 20, and various fans F1, F2. The load 2 also includes a fan coil unit 30 (hereinafter also referred to as FCU 30) that performs air conditioning of the air-conditioned space R, an FCU controller 31 that controls the FCU 30, and a fan F11.

10 The air-conditioned space R has indoor loads such as a person, OA equipment, illumination, and the like. In the air-conditioned space R, the concentration of CO₂ needs to be below a specified upper limit value, and outside air introduction management is performed according to the current concentration of CO₂.

15 [0019]

The AHU 20 includes a cooling coil CC therein. The AHU 20 performs the circulation of indoor air and the introduction of outside air, cools these airs with the cooling coil CC, and supplies them to the air-conditioned space R. In the cooling coil CC, cold water cooled to a predetermined temperature by the 20 heat source machine 1a is circulated. With the indoor air circulated by the AHU 20, heat exchange is performed between the air and cold water via the cooling coil CC. Thus, the cooled air is supplied into the room.

[0020]

The AHU controller 21 performs the outside air introduction as 25 appropriate through the AHU 20 so that the concentration of CO₂ (carbon dioxide) in the air-conditioned space R does not exceed the specified upper limit value. Specifically, the AHU controller 21 regulates the outside air introduction amount by controlling the air flow rates and damper opening degrees of the air supply fan F1 and the return air fan F2, while monitoring the 30 concentration of CO₂ in the air-conditioned space R. Note that the concentration of CO₂ in the air-conditioned space R is acquired, for example, through a CO₂ concentration meter CS installed in the room.

[0021]

The FCU controller 31 determines the amount of air to be supplied into 35 the room so that a target humidity, among indoor target conditions (for example, 26°C/50%) preset for the air-conditioned space R, can be achieved. Specifically, the FCU controller 31 acquires the indoor temperature and humidity in the air-conditioned space R from a temperature and humidity sensor S1, and determines the amount of air to be supplied into the room to 40 achieve the indoor temperature and humidity satisfying the indoor target conditions. For example, when the indoor humidity measured with the temperature and humidity sensor S1 largely exceeds the indoor target condition,

5 the FCU controller 31 increases the amount of air to be supplied into the room in order to decrease the humidity inside the room. On the other hand, when the indoor humidity is close to the indoor target condition, the FCU controller 31 reduces the amount of air to be supplied into the room. Note that the amount of air to be supplied into the room is controlled by the fan F11.

10 [0022]

Functional Configuration of Heat Source Machine Control Device

FIG. 3 is a diagram illustrating a functional configuration of the heat source machine control device according to the first embodiment.

The heat source machine control device 10 according to the present
15 embodiment includes a processor such as a CPU, and operates according to a predetermined program. As illustrated in FIG. 3, the heat source machine control device 10 operates according to a predetermined program and thus functions as a setting unit 100, a first calculation unit 101, a second calculation unit 102, an estimation unit 103, an introduction amount acquisition unit 104,
20 and a total load acquisition unit 105.

[0023]

The setting unit 100 sets the water supply temperature (cold water outlet temperature) of the heat source machine 1a. Here, the setting unit 100 and the estimation unit 103 (described later) estimate the total power consumption
25 generated according to the water supply temperature while changing the setting value of the water supply temperature (the total power consumption that is the sum of power consumption on the heat source machine side and power consumption of the load side), and search for the water supply temperature at which the estimated value of the total power consumption is minimized. In this
30 manner, the setting unit 100 sets the water supply temperature at which the total power consumption is minimized. A method of estimating the total power consumption will be described later.

[0024]

The first calculation unit 101 acquires information required for
35 estimating the power (power consumption) generated mainly on the load side. Specifically, the first calculation unit 101 calculates the amount of air to be supplied into the room of the load according to the water supply temperature set by the setting unit 100.

[0025]

40 The second calculation unit 102 acquires information required for estimating the power (power consumption) generated mainly on the heat source machine side. Specifically, the second calculation unit 102 calculates the water

5 supply flow rate of the heat source machine according to the water supply temperature set by the setting unit 100.

[0026]

The estimation unit 103 estimates the total power consumption on the heat source machine side and the load side according to the water supply
10 temperature, the amount of air to be supplied into the room, and the water supply flow rate.

[0027]

The introduction amount acquisition unit 104 acquires the outside air introduction amount in the load 2.

15 [0028]

The total load acquisition unit 105 acquires the total load of the load 2 (sum of the outside air introduction load and the indoor load).

[0029]

The recording medium 106 is a large-capacity auxiliary storage device
20 such as a so-called HDD (hard disk drive) or an SSD (solid state drive). Various types of information required for the processing by the heat source machine control device 10 are recorded in the recording medium 106 in advance.

Specifically, a first power consumption table TB1 and a second power consumption table TB2 are recorded in the recording medium 106. The first
25 power consumption table TB1 is an information table used in estimating the power consumption generated on the load side, and is an information table indicating the correspondence relationship between the amount of air to be supplied into the room and the power consumption generated on the load side. The second power consumption table TB2 is an information table used in
30 estimating the power consumption generated for the auxiliary machines (the pumps P1, P2, the cooling towers 3, and the like) on the heat source machine side, and is an information table indicating the correspondence relationship between the water supply flow rate of cold water and the power consumption generated for the auxiliary machines on the heat source machine side.

35 [0030]

Processing Flow of Heat Source Machine Control Device

FIG. 4 is a diagram illustrating a processing flow of the heat source machine control device according to the first embodiment.

The processing flow illustrated in FIG. 4 is a processing flow for
40 determining the optimal temperature (water supply temperature setting value) of cold water to be obtained by the heat source machine 1a. During the

5 operation of the air conditioning system 1, the processing flow is routinely repeated at a constant time interval.

[0031]

First of all, the introduction amount acquisition unit 104 of the heat source machine control device 10 acquires the outside air introduction amount
10 in the load 2 (step S01). Here, the introduction amount acquisition unit 104 acquires the concentration of CO₂ in the air-conditioned space R through the CO₂ concentration meter CS. The introduction amount acquisition unit 104 acquires the outside air introduction amount according to the concentration of CO₂ acquired through the CO₂ concentration meter CS. Here, the introduction
15 amount acquisition unit 104 acquires the outside air introduction amount in the same manner as the method by which the AHU controller 21 determines the outside air introduction amount. For example, if the AHU controller 21 introduces more outside air as the amount of change in the moving average of the concentration of CO₂ is larger, the introduction amount acquisition unit 104
20 also acquires the outside air introduction amount depending on the amount of change in the moving average of the concentration of CO₂.

[0032]

Next, the total load acquisition unit 105 of the heat source machine control device 10 acquires the total load in the load 2 (step S02). Here, the
25 "total load" is a value indicating the total load amount of the load 2, and in the present embodiment, is a sum of the outside air introduction load, which is a load according to the outside temperature and humidity and the outside air introduction amount, and the indoor load described above. Here, the total load acquisition unit 105 acquires the outside air introduction amount, which is
30 specified in step S01, and the outside temperature and humidity (for example, 30°C/70%) measured with a temperature and humidity sensor S2, and calculates the outside air introduction load.

Next, the total load acquisition unit 105 acquires, for example, information such as the number of employees or the like in the air-conditioned
35 space R, OA equipment that is powered on, and illumination devices and the like that are turned on, and calculates the indoor load. To acquire the number of employees and other people in the air-conditioned space R, for example, the total load acquisition unit 105 may refer to entry and exit management information of the air-conditioned space R and the like.

40 [0033]

Next, the setting unit 100 of the heat source machine control device 10 tentatively determines the temperature (water supply temperature setting value)

5 of cold water to be supplied by the heat source machine 1a as one of a plurality of different candidate values.

When the water supply temperature setting value of the heat source machine 1a is set to be the one thus tentatively determined, the first calculation unit 101 of the heat source machine control device 10 calculates the amount of
10 air to be supplied into the room controlled by the AHU 20, the AHU controller 21, the FCU 30, and the FCU controller 31 for the total load calculated in step S02 (step S03). Specifically, the first calculation unit 101 calculates the amount of air to be supplied into the room to be achieved by the AHU 20, the AHU controller 21, the FCU 30, and the FCU controller 31 with reference to an AHU
15 heat exchange amount that is the amount of heat exchanged by the cooling coil CC of the AHU 20, an FCU heat exchange amount that is the amount of heat exchanged by the cooling coil CC of the FCU 30, and the indoor target temperature condition (for example, 26°C/50%).

[0034]

20 Furthermore, when the water supply temperature setting value of the heat source machine 1a is set to be the one thus tentatively determined, the second calculation unit 102 of the heat source machine control device 10 calculates the flow rate (water supply flow rate) to be supplied by the heat source machine 1a for the total load calculated in step S02 (step S04). Here, the
25 second calculation unit 102 calculates the water supply flow rate of the heat source machine 1a by referring to the candidate value of the water supply temperature setting value tentatively determined by the setting unit 100 and the total load described above.

[0035]

30 Next, the estimation unit 103 estimates the total power consumption corresponding to the tentatively determined candidate value of the water supply temperature setting value. Here, the estimation unit 103 first calculates (1) an estimated value of the power consumption generated on the load side, and then calculates (2) an estimated value of the power consumption generated on the
35 heat source machine side. The total power consumption is a sum of (1) and (2) described above.

[0036]

In calculating (1) the estimated value of the power consumption generated on the load side, the estimation unit 103 refers to the amount of air to
40 be supplied into the room, calculated in step S03, and the first power consumption table TB1 (FIG. 3). As described above, the total power consumption of various fans (the air supply fan F1, the return air fan F2, and

5 the like (see FIG. 2)) is recorded in the first power consumption table TB1,
which varies depending on the amount of air to be supplied into the room to be
achieved by the load side (the AHU 20, the AHU controller 21, the FCU 30,
and the FCU controller 31). The estimation unit 103 identifies the power
consumption on the load side corresponding to the amount of air to be supplied
10 into the room, calculated in step S03, with reference to the first power
consumption table TB1.

[0037]

Next, in calculating (2) the estimated value of the power consumption
generated on the heat source machine side, the estimation unit 103 calculates
15 (2a) the power consumption generated for the heat source machine 1a and (2b)
the power consumption generated for the auxiliary machines (the pumps P1,
P2, the cooling towers 3, and the like) on the heat source machine side.

The estimation unit 103 identifies (2a) the power consumption generated
for the heat source machine 1a, based on the water supply temperature setting
20 value tentatively determined by the setting unit 100. In general, the heat source
machine 1a tends to have a higher power consumption with a lower water
supply temperature, and have a lower power consumption with a higher water
supply temperature. The estimation unit 103 recognizes in advance the
relationship between the water supply temperature setting value and the power
25 consumption in the heat source machine 1a, and acquires (2a) the power
consumption generated for the heat source machine 1a based on the
relationship.

The estimation unit 103 identifies (2b) the power consumption generated
for the auxiliary machines on the heat source machine side, with reference to
30 the water supply flow rate calculated in step S04 and the second power
consumption table TB2 (FIG. 3). As described above, the total power
consumption of various pumps (the pumps P1, P2, and the like (see FIG. 1))
and the cooling towers 3 is recorded in the second power consumption table
TB2, which varies depending on the water supply flow rate to be achieved by
35 the auxiliary machines on the heat source machine side. The estimation unit
103 identifies the power consumption of the auxiliary machines on the heat
source machine side corresponding to the water supply flow rate calculated in
step S04, with reference to the second power consumption table TB2.

The estimation unit 103 obtains (2) the estimated value of the power
40 consumption generated on the heat source machine side by calculating a sum of
(2a) the power consumption generated for the heat source machine 1a and (2b)

5 the power consumption generated for the auxiliary machines on the heat source machine side.

[0038]

The estimation unit 103 calculates the estimated value of the total power consumption corresponding to the tentatively determined candidate value of the
10 water supply temperature setting value by calculating a sum of (1) the estimated value of the power consumption generated on the load side and (2) the estimated value of the power consumption generated on the heat source machine side.

[0039]

15 The setting unit 100 performs processing of steps S03 to S05 for each candidate value of a plurality of different water supply temperature setting values, and calculates estimated values of the total power consumption. Then, the setting unit 100 determines a candidate value of the water supply temperature setting value with which the smallest total power consumption is
20 obtained, among the plurality of candidate values, as the optimal water supply temperature setting value (step S06).

[0040]

Operational Effects

As described above, the power consumption of the heat source machine
25 1a itself increases as the water supply temperature setting value is lowered. However, with the load (total load) maintained, the water supply flow rate on the heat source machine side can be reduced proportionally to a drop in the water supply temperature of the heat source machine 1a. Thus, the power consumption of the auxiliary machines on the heat source machine side can be
30 reduced by lowering the water supply temperature setting value of the heat source machine 1a. In addition, in the AHU 20 and the FCU 30, the amount of heat exchange in the AHU 20 and the FCU 30 increases proportionally to a drop in the water supply temperature of the heat source machine 1a, whereby the ability to cool the indoor air is enhanced. Thus, the amount of air to be
35 supplied into the room on the load side is reduced proportionally to a drop in the water supply temperature of the heat source machine 1a, and the power consumption generated on the load side is reduced accordingly.

Thus, in a case where the ratio of the sum of the power consumption of the auxiliary machines on the heat source machine side and the power
40 consumption generated on the load side (the AHU 20 and the FCU 30) to the power consumption of the heat source machine 1a itself is high, the heat source machine control device 10 according to the present embodiment determines the

5 water supply temperature setting value so that the total power consumption for the entire system can be minimized even if the power consumption generated for the heat source machine 1a slightly increases.

[0041]

10 With the heat source machine control device 10 according to the first embodiment, it is possible to achieve the optimal operation of the heat source machine in consideration of the power consumption generated on the load side.

[0042]

15 The second calculation unit 102 of the heat source machine control device 10 according to the first embodiment calculates the water supply flow rate of the heat source machine 1a according to the water supply temperature based on the total load including the outside air introduction amount on the load side. With this configuration, the total load amount in consideration of the outside air introduction amount in the air-conditioned space R can be accurately estimated.

20 [0043]

The estimation unit 103 of the heat source machine control device 10 according to the first embodiment calculates the power consumption of the fans F1, F2, F11, and the like according to at least the amount of air to be supplied into the room as the power consumption on the load side, and calculates the power consumption of the auxiliary machines (the pumps P1, P2, the cooling towers 3, and the like) according to at least the water supply flow rate as the power consumption on the heat source machine side.

25 With this configuration, the power consumption generated on the load side and the power consumption generated on the heat source machine side according to the water supply temperature setting values (each of the plurality of candidate values) can be more accurately estimated.

[0044]

Other Embodiments

35 Note that the introduction amount acquisition unit 104 according to the first embodiment is described as obtaining the outside air introduction amount according to the amount of change in the moving average of the concentration of CO₂, but is not limited to this in other embodiments. For example, the introduction amount acquisition unit 104 according to another embodiment may calculate the outside air introduction amount based on a tendency of change in deviation from a management target value of the concentration of CO₂.

40 With this configuration, in a case where a further deviation between the current concentration of CO₂ and the management target value is tolerable, the

5 operation time with a reduced load can be extended by reducing the outside air introduction amount.

[0045]

The heat source machine control device 10 according to the first embodiment has been described as acquiring the concentration of CO₂ in the air-conditioned space R through the CO₂ concentration meter CS installed in the air-conditioned space R, but other embodiments are not limited to this aspect. The heat source machine control device 10 according to another embodiment may estimate the concentration of CO₂ based on the number of people in the space, for example, instead of measuring the concentration of CO₂. With this configuration, if the CO₂ concentration meter is not affordable, an equivalent estimate can be achieved using the number of people in the room, which is separately managed by a building management system or the like.

[0046]

The outside air introduction amount may be set in a table in advance, rather than being sequentially calculated, whereby a situation where it takes time to calculate a solution can be avoided. With this configuration, even when the calculation time becomes a bottleneck or the calculation result is multimodal, a pre-intended operation can be performed.

[0047]

Since the tendency of change in the concentration of CO₂ cannot be identified when the introduction of outside air is completely stopped, a minimum outside air introduction amount may be set so that the concentration of CO₂ will not deviate from the management target value even in an unmanned situation. With this configuration, even when the status shifts from "no person in the room" to "person present in the room" at an operating start of the office building and the like, a situation where the concentration of CO₂ significantly exceeds the management target value can be avoided.

[0048]

The tendency of change in the concentration of CO₂ may be learned, and the outside air introduction amount may be determined based on a predicted value of the concentration of CO₂. While the outside air introduction amount based only on the tendency of change can rapidly increase, controlling the amount of ventilation according to the pattern of the tendency of change can avoid an unwanted increase in the amount of ventilation.

40 [0049]

The heat source machine control device 10 according to another embodiment may estimate the total load based on the product of the

5 temperature difference between the cold water outlet temperature and the cold water inlet temperature in the heat source machine 1a and the cold water flow rate, rather than estimating the indoor load and the outside air introduction load and calculating a sum of them.

[0050]

10 Instead of only the plurality of heat source machines 1a performing the supply of cold water in the heat source side device, the supply of cold water may be performed by heat storage tanks 4 installed as illustrated in FIG. 5 and the heat source machines 1a. In this case, when a time period for heat storage is changed according to a power fee structure and thus the equivalent amount of
15 power consumption is achieved, the running cost can be reduced.

[0051]

In the forgoing embodiments, various processes of the heat source machine control device 10 are stored as programs in a computer readable recording medium, and each of the programs is read and executed by a
20 computer such that a corresponding one of the various processes is performed. The computer readable recording medium refers to a magnetic disk, a magneto-optical disk, a CD-ROM, a DVD-ROM, a semiconductor memory, or the like. Also, this computer program may be distributed to the computer on a communication circuit, and the computer that receives this distribution may
25 execute the program.

[0052]

The program may be a program for implementing some of the functions described above. Furthermore, the program may be a so-called differential file (differential program) that can implement the above-described functions in
30 combination with a program already recorded in the computer system.

[0053]

In the foregoing, certain embodiments of the present disclosure have been described, but all of these embodiments are merely illustrative and are not intended to limit the scope of the invention. These embodiments may be
35 implemented in various other forms, and various omissions, substitutions, and alterations may be made without departing from the gist of the invention. These embodiments and modifications are included in the scope and gist of the invention and are also included in the scope of the invention described in the claims and equivalents thereof.

40 [0054]

Notes

5 The air conditioning system control device (heat source machine control device 10) according to each of the embodiments is understood as follows, for example.

[0055]

10 (1) An air conditioning system control device according to a first aspect includes: a setting unit 100 which sets a water supply temperature of a heat source machine 1a; a first calculation unit 101 which calculates an amount of air to be supplied into a room of a load 2 according to the water supply temperature; a second calculation unit 102 which calculates a water supply flow rate of the heat source machine 1a according to the water supply
15 temperature; and an estimation unit 103 which estimates total power consumption on the heat source machine side and the load side according to the water supply temperature, the amount of air to be supplied into the room, and the water supply flow rate. The setting unit 100 sets the water supply temperature at which the estimated total power consumption is minimized.

20 [0056]

 (2) With an air conditioning system control device according to a second aspect, the first calculation unit 101 calculates the amount of air to be supplied into the room within a range where a concentration of CO₂ does not exceed a specified upper limit value.

25 [0057]

 (3) With an air conditioning system control device according to a third aspect, the first calculation unit 101 calculates the amount of air to be supplied into the room within a range where a relative humidity of indoor air does not exceed a specified upper limit value.

30 [0058]

 (4) With an air conditioning system control device according to a fourth aspect, the second calculation unit 102 calculates the water supply flow rate of the heat source machine according to the water supply temperature based on a total load including an outside air introduction amount on the load side.

35 [0059]

 (5) With a heat source machine control device 10 according to a fifth aspect, the estimation unit 103 calculates power consumption of fans (air supply fan F1, return air fan F2, and the like) according to at least the amount of air to be supplied into the room as the power consumption on the load side, and calculates power consumption of an auxiliary machine (pumps P1, P2, cooling towers 3, and the like) according to at least the water supply flow rate as the power consumption on the heat source machine side.

40

5 [0060]

(6) An air conditioning system 1 according to a sixth aspect includes the air conditioning system control device described in any one of (1) to (5) described above, and includes a heat storage tank 4 in addition to the heat source machine 1a as a device constituting the heat source machine side.

10 [0061]

(7) An air conditioning system control method according to a seventh aspect includes: a step of setting a water supply temperature of a heat source machine 1a; a step of calculating an amount of air to be supplied into a room of a load 2 according to the water supply temperature; a step of calculating a water supply flow rate of the heat source machine 1a according to the water supply temperature; and a step of estimating total power consumption on the heat source machine side and the load side according to the water supply temperature, the amount of air to be supplied into the room, and the water supply flow rate. In the step of setting the water supply temperature of the heat source machine 1a, the water supply temperature at which the estimated total power consumption is minimized is set.

[0062]

(8) A program according to an eighth aspect causes a computer of an air conditioning system control device to execute: a step of setting a water supply temperature of a heat source machine 1a; a step of calculating an amount of air to be supplied into a room of a load 2 according to the water supply temperature; a step of calculating a water supply flow rate of the heat source machine 1a according to the water supply temperature; and a step of estimating total power consumption on the heat source machine side and the load side according to the water supply temperature, the amount of air to be supplied into the room, and the water supply flow rate. In the step of setting the water supply temperature of the heat source machine 1a, the water supply temperature at which the estimated total power consumption is minimized is set.

35 Industrial Applicability

[0063]

According to each aspect of the above-described invention, it is possible to achieve the optimal operation of the heat source machine in consideration of the power consumption generated on the load side.

40

Reference Signs List

[0064]

- 5 1 Air conditioning system
 - 10 Heat source machine control device (air conditioning system control device)
 - 100 Setting unit
 - 101 First calculation unit
 - 102 Second calculation unit
- 10 103 Estimation unit
 - 104 Introduction amount acquisition unit
 - 105 Total load acquisition unit
 - 106 Recording medium
- 2 Load
- 15 20 Air handling unit (AHU)
 - 21 AHU controller
 - 30 Fan coil unit (FCU)
 - 31 FCU controller
- 4 Heat storage tank
- 20 TB1 First power consumption table
- TB2 Second power consumption table

5

Claims

[Claim 1]

An air conditioning system control device, comprising:
a setting unit configured to set a water supply temperature of a heat
10 source machine;
a first calculation unit configured to calculate an amount of air supplied
into a room of a load according to the water supply temperature;
a second calculation unit configured to calculate a water supply flow
rate of the heat source machine according to the water supply temperature; and
15 an estimation unit configured to estimate total power consumption on a
heat source machine side and a load side according to the water supply
temperature, the amount of air supplied into the room, and the water supply
flow rate, wherein
the setting unit sets the water supply temperature at which the estimated
20 total power consumption is minimized.

[Claim 2]

The air conditioning system control device according to claim 1,
wherein
25 the first calculation unit calculates the amount of air supplied into the
room, within a range where a concentration of CO₂ does not exceed a specified
upper limit value.

[Claim 3]

The air conditioning system control device according to claim 1 or 2,
wherein
the first calculation unit calculates the amount of air supplied into the
room, within a range where a relative humidity of indoor air does not exceed a
specified upper limit value.

35

[Claim 4]

The air conditioning system control device according to any one of
claims 1 to 3, wherein
the second calculation unit calculates the water supply flow rate of the
40 heat source machine according to the water supply temperature, based on a
total load including an outside air introduction amount on the load side.

5 [Claim 5]

The air conditioning system control device according to any one of claims 1 to 4, wherein

the estimation unit calculates power consumption of fans according to at least the amount of air supplied into the room as the power consumption on the load side, and calculates power consumption of an auxiliary machine according to at least the water supply flow rate as the power consumption on the heat source machine side.

[Claim 6]

15 An air conditioning system, comprising:

the air conditioning system control device according to any one of claims 1 to 5; and

a heat storage tank in addition to the heat source machine, as a device included in the heat source machine side.

20

[Claim 7]

A method for controlling an air conditioning system, the method comprising:

setting a water supply temperature of a heat source machine;

25 calculating an amount of air supplied into a room of a load according to the water supply temperature;

calculating a water supply flow rate of the heat source machine according to the water supply temperature; and

30 estimating total power consumption on a heat source machine side and a load side according to the water supply temperature, the amount of air supplied into the room, and the water supply flow rate, wherein

in the setting of the water supply temperature of the heat source machine, the water supply temperature at which the estimated total power consumption is minimized is set.

35

[Claim 8]

A program causing a computer of an air conditioning system control device to execute:

setting a water supply temperature of a heat source machine;

40 calculating an amount of air supplied into a room of a load according to the water supply temperature;

- 5 calculating a water supply flow rate of the heat source machine according to the water supply temperature; and
- estimating total power consumption on a heat source machine side and a load side according to the water supply temperature, the amount of air supplied into the room, and the water supply flow rate, wherein
- 10 in the setting of the water supply temperature of the heat source machine, the water supply temperature at which the estimated total power consumption is minimized is set.