

DESCRIPTION

Title of Invention

OPERATION CONTROL SYSTEM OF CIRCULATING FLUIDIZED BED BOILER

5

Technical Field

[0001]

The present invention relates to an operation control system of a circulating fluidized bed boiler.

10 Background Art

[0002]

In the related art, a steam pressure control device for a circulating fluidized bed boiler described in PTL 1 is known. In this control device, the steam pressure of the circulating fluidized bed boiler is detected, and a deviation of the steam pressure with respect to a prescribed target pressure is calculated. Then, a fuel supply amount to a furnace is controlled based on the deviation value, thereby maintaining the steam pressure to the target pressure.

15

Citation List

Patent Literature

20

[0003]

[PTL 1] Japanese Unexamined Patent Application Publication No. 4-6304

Summary of Invention

Technical Problem

[0004]

25

The circulating fluidized bed boiler has a plurality of index items which are an

index of an operation state. Then, input values to setting items relating to the index items are adjusted such that the plurality of index items are maintained to predetermined target values.

[0005]

5 However, the index items of the circulating fluidized bed boiler and the setting items relating to the index items are related complicatedly. For this reason, for example, when a plurality of control devices, each of which maintains one index item to a predetermined target value, are combined, there is a case where the index items which are a control target can be controlled, and other index items cannot be appropriately
10 controlled. In the control of this kind of circulating fluidized bed boiler, it is desirable to perform control for optimizing a plurality of setting items to simultaneously attain the target values of a plurality of index items.

[0006]

 Accordingly, an object of the invention is to provide an operation control system
15 of a circulating fluidized bed boiler which can perform control for optimizing a plurality of index items of the circulating fluidized bed boiler by a plurality of setting items.

Solution to Problem

[0007]

 An operation control system of a circulating fluidized bed boiler according to an
20 aspect of the invention includes a boiler control unit configured to perform operation of the circulating fluidized bed boiler with an operation amount determined based on comparison between the input values of a plurality of setting items relating to the operation of the circulating fluidized bed boiler and the actual measurement values of a plurality of index items representing the operation state of the circulating fluidized bed
25 boiler, an adjustment value calculation unit configured to select some of the plurality of

setting items and to calculate adjustment values for adjusting the input values of the selected setting items, and an input value adjustment unit configured to transfer adjusted input values which are a function of external input values to be values input from the outside of the selected setting items and the adjustment values obtained by the adjustment value calculation unit, to the boiler control unit as the input values of the selected setting items, in which the adjustment value calculation unit inputs the actual measurement values of the index items to a Bayesian network, in which each of the setting items is a master node and each of the index items is a slave node, and calculates the estimated set values of the setting items, the adjustment value calculation unit inputs the target values of the index items to the Bayesian network and calculates target set values representing the set values of the setting items for attaining the target values of the index items, and the adjustment value calculation unit selects the selected setting items based on the magnitude of the difference between the estimated set values and the target set values and sets the target set values of the selected setting items as the adjustment values of the selected setting items.

[0008]

According to the operation control system, basically, the boiler control unit determines the operation amount based on the external input values of the setting items input from the outside through comparison between the actual measurement values of the index items representing the operation state of the circulating fluidized bed boiler and the external input values, and performs operation of the circulating fluidized bed boiler. Here, the operation control system has the adjustment value calculation unit and the input adjustment unit as means for adjusting the external input values. The adjustment value calculation unit calculates the target set value for attaining the target values from the target values of the index items to be a target by the Bayesian network. The estimated

set values corresponding to the actual measurement values are calculated from the actual measurement values representing the present circumstances of the index items by the Bayesian network. Then, some setting items are selected from the setting items based on the magnitude of the difference between the estimated set values and the target set values, and the target set values are set as the adjustment values for the selected setting items.

[0009]

The input value adjustment unit sets the adjusted input values with the influence of the adjustment values included in the external input values as the input values to the boiler control unit. Here, according to the calculation using the Bayesian network, it is possible to optimize the set values (target set values) for attaining the target values of a plurality of index items in combination. The optimized target set values are set as the adjustment values, and the external input values are adjusted by the adjustment values, whereby it is possible to perform control for optimizing a plurality of index items of the circulating fluidized bed boiler by a plurality of setting items.

[0010]

An operation control system of a circulating fluidized bed boiler according to another aspect of the invention includes a boiler control unit configured to perform operation of the circulating fluidized bed boiler with an operation amount determined based on comparison between the input values of a plurality of setting items relating to the operation of the circulating fluidized bed boiler and the actual measurement values of a plurality of index items representing the operation state of the circulating fluidized bed boiler, an appropriate set value calculation unit configured to select some of the plurality of setting items and to calculate appropriate set values representing the appropriate set values of the selected setting items, and a warning processing unit configured to give a

warning when there is a setting item for which the difference between external input values to be values input from the outside of the selected setting items and the appropriate set values obtained by the appropriate set value calculation unit exceeds a predetermined threshold value, in which the appropriate set value calculation unit inputs the actual measurement values of the index items to a Bayesian network, in which each of the setting items is a master node and each of the index items is a slave node, and calculates the estimated set values of the setting items, the appropriate set value calculation unit inputs the target values of the index items to the Bayesian network and calculates target set values representing the set values of the setting items for attaining the target values of the index items, and the appropriate set value calculation unit selects the selected setting items based on the magnitude of the difference between the estimated set values and the target set values and sets the target set values of the selected setting items as the appropriate set values of the selected setting items.

[0011]

According to the operation control system, basically, the boiler control unit determines the operation amount based on the external input values of the setting items input from the outside through comparison between the actual measurement values of the index items representing the operation state of the circulating fluidized bed boiler and the external input values, and performs operation of the circulating fluidized bed boiler. Here, the operation control system has the appropriate set value calculation unit and the warning processing unit as means for giving a warning when the external input values are not appropriate. The appropriate set value calculation unit calculates the target set values for attaining the target values from the target values of the index items to be a target by the Bayesian network. The estimated set values corresponding to the measurement values are calculated from the actual measurement values of the index

items by the Bayesian network. Then, some setting items are selected from the setting items based on the magnitude of the difference between the estimated set values and the target set values, and the target set values are set as the appropriate set values for the selected setting items.

5 [0012]

The warning processing unit compares the external input values with the appropriate set values and gives a warning when the difference is large. Here, according to the calculation using the Bayesian network, it is possible to optimize the set values (target set value) for attaining the target values of a plurality of index items in
10 combination. The optimized target set values are set as the appropriate set values and a warning is given based on determination about appropriateness of the external input values through comparison with the appropriate set values, whereby the operator can obtain information with high precision about appropriateness of a plurality of setting items. As a result, it is possible to set the optimum values of a plurality of setting items
15 and to perform control for optimizing a plurality of index items of the circulating fluidized bed boiler.

Advantageous Effects of Invention

[0013]

According to the invention, it is possible to provide an operation control system
20 of a circulating fluidized bed boiler which can perform control for optimizing a plurality of index items of the circulating fluidized bed boiler by a plurality of setting items.

Brief Description of Drawings

[0014]

FIG. 1 is a diagram showing the configuration of a CFB boiler to which an
25 operation control system according to an embodiment of the invention is applied.

FIG. 2 is a block diagram showing an operation control system according to an embodiment of the invention.

FIG. 3 is a diagram showing an example of a Bayesian network model.

FIG. 4 is a block diagram showing an example of the hardware configuration of a computer device of FIG. 2.

FIG. 5 is a flowchart showing processing in the operation control system of FIG. 2.

FIG. 6 is a block diagram showing an operation control system according to another embodiment of the invention.

FIG. 7 is a flowchart showing processing in the operation control system of FIG. 6.

Description of Embodiments

[0015]

Hereinafter, an embodiment of an operation control system of the invention will be described in detail referring to the accompanying drawings. In the description of the drawings, the same elements are represented by the same reference numerals, and overlapping description will be omitted.

[0016]

(Embodiment)

A boiler to which an operation control system of this embodiment is applied will be described referring to FIG. 1. A boiler 2 is an external circulating (Circulating Fluidized Bed) boiler. The boiler 2 includes a fluidized bed furnace 3 having a longitudinal tubular shape. A fuel input port 3a through which fuel is input is provided in the intermediate portion of the furnace 3, and a gas exit 3b through which combustion gas is exhausted is provided in the upper portion of the furnace 3. Fuel supplied from a

fuel input device 5 to the furnace 3 is input into the furnace 3 through the fuel input port 3a.

[0017]

5 A cyclone 7 which functions as a solid-gas separation device is connected to the gas exit 3b of the furnace 3. An exhaust port 7a of the cyclone 7 is connected to a poststage gas processing system through a gas line. A return line 9, called a downcomer, extends downward from the bottom exit of the cyclone 7, and the lower end of the return line 9 is connected to the lateral surface of the intermediate portion of the furnace 3.

[0018]

10 In the furnace 3, a solid substance including fuel input from the fuel input port 3a is fluidized by air for combustion and fluidization introduced from a gas supply line 3c in a lower portion, and fuel is combusted at about 800 to 900°C while being fluidized. Combustion gas generated in the furnace 3 is introduced into the cyclone 7 while being accompanied by solid particles. The cyclone 7 separates solid particles and gas by a centrifugal separation effect, returns the separated solid particles to the furnace 3 through 15 the return line 9, and sends combustion gas with the solid particles removed from the exhaust port 7a to the poststage gas processing system through the gas line.

[0019]

20 In the furnace 3, a solid substance, called "in-furnace bed material", is generated and accumulated on the bottom thereof, and it is necessary to suppress defective operation due to sintering and melting-solidification of the bed material or an incombustible impurity when an impurity (low melting point substance or the like) is concentrated by the in-furnace bed material. For this reason, in the furnace 3, the in-furnace bed material is exhausted from an exhaust port 3d on the bottom thereof to the 25 outside regularly. The exhausted bed material is input to the furnace 3 again after an

inappropriate substance, such as metal, is removed on a circulating line (not shown).

[0020]

The above-described gas processing system includes a gas heat exchange device 13 which is connected to the exhaust port 7a of the cyclone 7 through the gas line, and a
5 bag filter (dust collector) 15 which is connected to an exhaust port 13a of the gas heat exchange device 13 through the gas line. The gas heat exchange device 13 is provided with a boiler tube 13b which fluidizes water to cross the flow channel of exhaust gas. High-temperature exhaust gas sent from the cyclone 7 comes into contact with the boiler tube 13b, whereby heat of exhaust gas is recovered to water in the tube and generated
10 high-temperature steam is sent to a turbine for power generation through the boiler tube 13b. The bag filter 15 removes particulates, such as fly ash, accompanied by combustible gas. Clean gas exhausted from an exhaust port 15a of the bag filter 15 is exhausted from a chimney 19 to the outside through the gas line and a pump 17.

[0021]

15 Subsequently, an operation control system 21 which performs operation control of the circulating fluidized bed boiler 2 will be described referring to FIG. 2.

[0022]

The operation control system 21 shown in FIG. 2 includes a controller 23 and a computer device 25. The controller 23 has a boiler controller (boiler control unit) 27
20 which performs operation of the boiler 2, or the like, and is a part which performs actual operation of the boiler.

[0023]

The controller 23 includes a plurality of sensors 29a which are arranged in the respective units of the boiler 2, a setting item input unit 31, an adjusted input value
25 calculation unit 33, and a boiler controller 27. The sensors 29a include, for example, a

temperature sensor which measures the temperature of a predetermined region of the boiler 2, a flow rate sensor which measures the flow rate of exhaust gas or water, a concentration sensor which measures the concentration of a predetermined substance in exhaust gas, and the like. Hereinafter, a plurality of sensors 29a are collectively
5 referred to as a sensor group 29. Measurement values PV obtained by the sensor group 29 are transmitted to the boiler controller 27 and the computer device 25.

[0024]

The setting item input unit 31 is a part which receives the input of respective setting items for boiler operation. An operator for boiler operation inputs desired input
10 values for the respective setting items through the setting item input unit 31. The setting items include, for example, a blower operation frequency, an air flow rate, a release frequency of an atmosphere release valve, a water injection amount, a valve opening, a coal supply amount (the supply amount of coal supplied to the furnace 3), a sand supply amount, a blow flow rate, and the like. Hereinafter, the input values of the
15 setting items input by the operator through the setting item input unit 31 are referred to as "operator input values SV1".

[0025]

The adjusted input value calculation unit 33 adds the operator input values (external input values) SV1 and the values transferred from a difference calculation unit
20 47 described below to calculate adjusted input values SV3. The calculated adjusted input values SV3 are transmitted to the boiler controller 27. The boiler controller 27 determines an operation amount MV and performs operation of the boiler 2 based on the difference between the adjusted input values SV3 and the measurement values PV from the sensor group 29. That is, for example, the boiler controller 27 calculates the
25 operation amount MV for operation of the boiler 2 such that the difference between the

operation state (the measurement values of the sensor group 29) to be obtained from the adjusted input values SV3 and the measurement value PV actually obtained from the sensor group 29 is reduced, and executes operation. With this, feedback control of the boiler 2 is executed.

5 [0026]

The computer device 25 includes a target value input unit 37, a Bayesian network inference unit (adjustment value calculation unit) 39, and a difference calculation unit 47.

[0027]

10 The target value input unit 37 is a part which receives the input of target values from the operator for a plurality of index items to be an index for the operation state of the boiler 2. The index items include, for example, a pressure deviation, a heat amount, boiler efficiency, a discharge concentration of an environmental load substance, such as CO or NOX, and the like. The values of the index items can be derived from the
15 measurement values PV obtained by the sensor group 29. In the target value input unit 37, for example, a target value A1 of each index item representing an ideal operation state to be a target is input by the operator.

[0028]

The Bayesian network inference unit 39 has a target set value calculation unit 41,
20 an estimated set value calculation unit 43, and an adjustment value derivation unit 45. The Bayesian network inference unit 39 holds a Bayesian network model in which each of the setting items is a master node and each of the index items is a slave node, and performs various calculations using the Bayesian network. The Bayesian network model is created in advance based on previous operation data of the boiler 2 and is stored
25 in advance in the Bayesian network inference unit 39. An example of a Bayesian

network BN is shown in FIG. 3. The Bayesian network BN of FIG. 3 has, as a master node N1, a blower operation frequency, an air flow rate, an atmosphere release valve, a water injection amount, a valve opening, a coal supply amount, a sand supply amount, and a blow flow rate which are the setting items of the boiler 2, and has, as a slave node
5 N2, a pressure deviation, a heat amount, an exhaust gas CO concentration, and boiler efficiency which are index items of the boiler 2.

[0029]

The target set value calculation unit 41 inputs the target value A1 of each of the index items input by the target value input unit 37 as an effect variable of the Bayesian
10 network BN (see FIG. 3). Then, as a cause variable of the Bayesian network BN, a target set value A2 representing the value of each of the setting items for attaining the target value A1 is output. The target set value A2 means, for example, the target value of a setting item necessary for attaining the ideal operation state of the target boiler 2. For example, when the Bayesian network BN illustrated in FIG. 3 is used, the ideal
15 pressure deviation, heat amount, exhaust gas CO concentration, and boiler efficiency to be a target are input as the target values A1, and the values of the blower operation frequency, the air flow rate, the atmosphere release valve, the water injection amount, the valve opening, the coal supply amount, the sand supply amount, and the blow flow rate for attaining these target values A1 are output as the target set values A2. However, it is
20 assumed that the values of input and output are discrete values due to the restriction to the processing ability of the computer.

[0030]

The estimated set value calculation unit 43 calculates the actual measurement values of the index items representing the present operation state of the boiler 2 from the
25 measurement values PV obtained from the sensor group 29, and inputs the actual

measurement values as the effect variable of the Bayesian network BN (see FIG. 3). Then, as the cause variable of the Bayesian network BN, an estimated set value A3 is output. The estimated set value A3 means the value of a setting item which is estimated from the present operation state of the boiler 2. A calculation method in which the effect variable is input to the slave node of the Bayesian network and the cause variable of the master node is output is known, and detailed description thereof will be omitted.

[0031]

The adjustment value derivation unit 45 selects setting items with a large difference between the estimated set value A3 and the target set value A2. Here, the selected setting items are referred to as "selected setting items". For example, setting items for which the difference between the estimated set value A3 and the target set value A2 is greater than a predetermined threshold value may be set as selected setting items. When the setting items are arranged in a descending order of the difference between the estimated set value A3 and the target set value A2, a predetermined number of setting items may be selected from a setting item with a higher order and may be set as selected setting items. Then, the adjustment value derivation unit 45 uses the target set values A2 of the selected setting items as the adjustment values SV2 of the selected setting items.

[0032]

The difference calculation unit 47 takes the difference between the adjustment values SV2 input from the adjustment value derivation unit 45 and the operator input values SV1 input from the setting item input unit 31, multiplies a weight α (for example, α is a value satisfying $0 \leq \alpha \leq 1$), and transmits the result to the adjusted input value calculation unit 33. As described above, the adjusted input value calculation unit 33

adds the operator input values SV1 and the values of $\alpha(SV2 - SV1)$ transferred from the difference calculation unit 47 to calculate the adjusted input values SV3. That is, the adjusted input values SV3 are expressed as follows.

$$SV3 = SV1 + \alpha(SV2 - SV1)$$

5 In this way, the difference calculation unit 47 and the adjusted input value calculation unit 33 are combined to constitute an input value adjustment unit 51. That is, the input value adjustment unit 51 has a function of transferring the adjusted input values SV3, which are the function of the operator input values SV1 and the adjustment values SV2, to the boiler controller 27. The value of the weight α is set in advance and is
10 stored in, for example, the storage region of the computer device 25.

[0033]

For the setting items (unselected setting items) which have not been derived as the selected setting items by the adjustment value derivation unit 45, adjustment by the input value adjustment unit 51 is not executed. Accordingly, for the unselected setting
15 items, the operator input values SV1 are input to the boiler controller 27 directly.

[0034]

A computer 100 shown in FIG. 4 is an example of hardware constituting the computer device 25 of this embodiment. The computer 100 includes various data processing devices, such as a server device or a personal computer which includes a CPU
20 and performs processing or control by software. The computer 100 is constituted as a computer system including a CPU 101, a RAM 102 and a ROM 103 which are a main storage device, an input device 104, such as a keyboard and a mouse as an input device, an output device 106, such as a display, a communication module 107 which is a data transmission and reception device, such as a network card, an auxiliary storage device

108, such as a hard disk, and the like.

[0035]

The functional constituent elements of the computer device 25 shown in FIG. 2 are realized by reading predetermined computer software on hardware, such as the CPU 101 or the RAM 102 shown in FIG. 4, operating the input device 104, the output device 106, and the communication module 107 under the control of the CPU 101, and performing reading and writing of data in the RAM 102 or the auxiliary storage device 108. The boiler controller 27, the adjusted input value calculation unit 33, and the setting item input unit 31 in the controller 23 (FIG. 2) may be realized by software by operating hardware, such as the computer 100, according to a program.

[0036]

Subsequently, processing in the operation control system 21 will be described referring to FIG. 5. First, the target values A1 by the operator are input from the target value input unit 37, and the weight coefficient α for use in the difference calculation unit 47 is input and set in advance (S101). Next, the Bayesian network inference unit 39 acquires the measurement values PV from the sensor group 29, and the difference calculation unit 47 acquires the operator input values SV1 from the setting item input unit 31 (S103). Next, the Bayesian network inference unit 39 calculates the adjustment values SV2 based on the target values A1 and the measurement values PV (S105). Then, the adjusted input values SV3 are calculated by the difference calculation unit 47 and the adjusted input value calculation unit 33, and are transmitted to the boiler controller 27 (S107). In the boiler controller 27, the adjusted input values SV3 are set as new set values, and feedback control based on the measurement values PV from the sensor group 29 is performed (S109). Thereafter, the processing of S103 to S109 is repeated until a predetermined end condition is satisfied (S111).

[0037]

The functional effects of the operation control system 21 described above will be described.

[0038]

5 According to the operation control system 1, basically, the boiler controller 27 determines the operation amount MV based on the operator input values SV1 of the setting items input from the outside (operator) through comparison between the actual measurement values of the index items representing the operation state of the boiler 2 and the external input values SV, and performs operation of the boiler 2. Here, the
10 operation control system 1 has a Bayesian network inference unit (adjustment value calculation unit) 39 and an input value adjustment unit 51 as means for adjusting the operator input values SV1. The Bayesian network inference unit 39 calculates the target set values A2 for attaining the target values A1 from the target values A1 of the index items to be a target by Bayesian network calculation. The estimated set values A3
15 corresponding to the actual measurement values are calculated from the actual measurement values (derived from the measurement values PV) of the index items by Bayesian network calculation. Then, some setting items are selected from the setting items based on the magnitude of the difference between the estimated set values A3 and the target set values A2, and the target set values A2 are set as the adjustment values SV2
20 for the selected setting items.

[0039]

The input value adjustment unit 51 sets the adjusted input values SV3 with the influence of the adjustment values SV2 included in the operator input values SV1 as the input values of the boiler controller 27. Here, according to the calculation using the
25 Bayesian network, it is possible to optimize the set values (target set values A2) for

attaining the target values A1 of a plurality of index items in combination. Since the optimized target set values A2 are set as the adjustment values SV2, and the operator input values SV1 are adjusted by the adjustment values SV2, as a result, according to the operation control system 21, it is possible to perform control for optimizing a plurality of index items of the boiler 2 by a plurality of setting items.

[0040]

(Another Embodiment)

An operation control system 221 according to another embodiment of the invention will be described referring to FIG. 6. In the operation control system 221, the same or similar constituent elements as those in the operation control system 21 of the above-described embodiment are represented by the same reference numerals, and overlapping description will be omitted.

[0041]

A controller 223 of the operation control system 221 does not include the adjusted input value calculation unit 33 (see FIG. 2), and the operator input values SV1 input from the operator through the setting item input unit 31 are input directly to the boiler controller 27.

[0042]

A computer device 225 of the operation control system 221 has a difference determination unit (warning processing unit) 226 and a warning output unit (warning processing unit) 228, instead of the difference calculation unit 47 (see FIG. 2). The adjustment values SV2 of the selected setting items from the Bayesian network inference unit 39 and the operator input values SV1 of the setting items from the setting item input unit 31 are input to the difference determination unit 226. Here, considering the meaning of the adjustment values SV2, it can be said that the adjustment values SV2 are

the set values of the selected setting items appropriate for attaining the target values A1. Accordingly, hereinafter, the adjustment values SV2 output from the Bayesian network inference unit 39 are referred to as "appropriate set values SV2". In other words, the Bayesian network inference unit 39 has a function as an appropriate set value calculation unit which calculates the appropriate set values SV2 of the selected setting items for attaining the target values A1 of the index items.

[0043]

The difference determination unit 226 transmits a warning signal to the warning output unit 228 when there is a setting item among the selected setting items for which the difference between the appropriate set values SV2 and the operator input values SV1 exceeds a predetermined threshold value. The warning output unit 228 gives a warning to the operator according to the warning signal. As a method of giving a warning, display of a warning screen on a display monitor in the computer device 225, generation of warning sound from a speaker, or the like is used.

[0044]

Subsequently, processing in the operation control system 21 will be described referring to FIG. 7. First, the target values A1 by the operator are input and set from the target value input unit 37 (S201). Next, the Bayesian network inference unit 39 acquires the measurement values PV from the sensor group 29, and the difference determination unit 226 acquires the operator input values SV1 from the setting item input unit 31 (S103). Next, the Bayesian network inference unit 39 calculates the appropriate set values SV2 based on the target values A1 and the measurement values PV (S205).

[0045]

The difference determination unit 226 calculates the difference between the appropriate set values SV2 and the operator input values SV1 (S207), and performs

determination about whether or not the value of the difference exceeds a predetermined threshold value (S209). When it is determined to be Yes in S209, the difference determination unit 226 transmits a warning signal, and the warning output unit 228 gives a warning to the operator (S211). When it is determined to be No in S209, the warning
5 signal processing is not performed. Thereafter, the processing of S203 to S211 is repeated until a predetermined end condition is satisfied (S213).

[0046]

The functional effects of the operation control system 221 described above will be described.

10 [0047]

According to the operation control system 21, basically, the boiler controller 27 determines the operation amount MV based on the operator input value SV1 of the setting items input from the outside (operator) through comparison between the actual measurement values of the index items representing the operation state of the boiler 2
15 and the operator input values SV1, and performs operation of the boiler 2. Here, the operation control system 221 has the Bayesian network inference unit (appropriate set value calculation unit) 39 and the warning processing unit as means for giving a warning when the operator input values SV1 are not appropriate. The Bayesian network inference unit 39 calculates the target set values A2 for attaining the target values A1
20 from the target values A1 of the index items to be a target by the Bayesian network. The estimated set values A3 corresponding to the actual measurement values are calculated from the actual measurement values (derived from the measurement values PV) of the index items by the Bayesian network. Then, some setting items are selected from the setting items based on the magnitude of the difference between the estimated set
25 values A3 and the target set values A2, and the target set values are set as the appropriate

set values SV2 for the selected setting items.

[0048]

The warning processing unit compares the operator input values SV1 with the appropriate set values SV2, and gives a warning when the difference is large. Here, according to the calculation using the Bayesian network, it is possible to optimize the set values (target set values A2) for attaining the target values A1 of a plurality of index items in combination. The optimized target set values A2 are set as the appropriate set values SV2 and a warning is given based on determination about appropriateness of the operator input values SV1 through comparison with the appropriate set values SV2, whereby the operator can obtain information with high precision about appropriateness of a plurality of setting items. As a result, it is possible to set the optimum values of a plurality of setting items and to perform control for optimizing a plurality of index items of the boiler 2.

[0049]

Although an embodiment of the invention has been described, the invention is not limited to the embodiment and may be modified within the scope without changing the concept described in the appended claims.

Industrial Applicability

[0050]

According to the operation control system of a circulating fluidized bed boiler, it is possible to perform control for optimizing a plurality of index items of the circulating fluidized bed boiler by a plurality of setting items.

Reference Signs List

[0051]

2: circulating fluidized bed boiler, 21, 221: operation control system, 27:

boiler controller (boiler control unit), 39: Bayesian network inference unit (set value calculation unit, appropriate set value calculation unit), 51: input value adjustment unit, 226: difference determination unit (warning processing unit), 228: warning output unit (warning processing unit), A1: target value, A2: target set value, A3: estimated set value, BN: Bayesian network, PV: measurement value, MV: operation amount, 5 SV1: operator input value (external input value), SV2: control value, SV3: adjusted input value.

CLAIMS

1. An operation control system of a circulating fluidized bed boiler comprising:

5 a boiler control unit configured to perform operation of the circulating fluidized bed boiler with an operation amount determined based on comparison between the input values of a plurality of setting items relating to the operation of the circulating fluidized bed boiler and the actual measurement values of a plurality of index items representing the operation state of the circulating fluidized bed boiler;

10 an adjustment value calculation unit configured to select some of the plurality of setting items and to calculate adjustment values for adjusting the input values of the selected setting items; and

an input value adjustment unit configured to transfer adjusted input values which are a function of external input values to be values input from the outside of the
15 selected setting items and the adjustment values obtained by the adjustment value calculation unit, to the boiler control unit as the input values of the selected setting items,

wherein the adjustment value calculation unit inputs the actual measurement values of the index items to a Bayesian network, in which each of the setting items is a master node and each of the index items is a slave node, and calculates the estimated set
20 values of the setting items,

the adjustment value calculation unit inputs the target values of the index items to the Bayesian network and calculates target set values representing the set values of the setting items for attaining the target values of the index items, and

the adjustment value calculation unit selects the selected setting items based on
25 the magnitude of the difference between the estimated set values and the target set values

and sets the target set values of the selected setting items as the adjustment values of the selected setting items.

2. An operation control system of a circulating fluidized bed boiler
5 comprising:

a boiler control unit configured to perform operation of the circulating fluidized
bed boiler with an operation amount determined based on comparison between the input
values of a plurality of setting items relating to the operation of the circulating fluidized
bed boiler and the actual measurement values of a plurality of index items representing
10 the operation state of the circulating fluidized bed boiler;

an appropriate set value calculation unit configured to select some of the
plurality of setting items and to calculate appropriate set values representing the
appropriate set values of the selected setting items; and

a warning processing unit configured to give a warning when there is a setting
15 item for which the difference between external input values to be values input from the
outside of the selected setting items and the appropriate set values obtained by the
appropriate set value calculation unit exceeds a predetermined threshold value,

wherein the appropriate set value calculation unit inputs the actual measurement
values of the index items to a Bayesian network, in which each of the setting items is a
20 master node and each of the index items is a slave node, and calculates the estimated set
values of the setting items,

the appropriate set value calculation unit inputs the target values of the index
items to the Bayesian network and calculates target set values representing the set values
of the setting items for attaining the target values of the index items, and

25 the appropriate set value calculation unit selects the selected setting items based

on the magnitude of the difference between the estimated set values and the target set values and sets the target set values of the selected setting items as the appropriate set values of the selected setting items.