

5 COMBUSTION FURNACE AND METHOD FOR CONTROLLING
COMBUSTION FURNACE

Technical Field

[0001]

10 The present disclosure relates to a combustion furnace and a method for
controlling a combustion furnace.

Background Art

[0002]

15 A stoker incinerator is used as an incinerator for incinerating matter to
be combusted such as waste. The stoker incinerator includes a stoker (fire
grate) including fixed stages and movable stages that are alternately arranged,
and a hydraulic device is used to reciprocate the movable stages to stir and
transfer, on the stoker, matter to be combusted fed from a hopper, while the
20 matter to be combusted is being dried and combusted. The matter to be
combusted that is dried and combusted is reduced to ashes, which are
discharged from the incinerator.

[0003]

In such a stoker incinerator, determining the state of the matter to be
25 combusted and ashes on the stoker is important for improvement of combustion
efficiency and the like. For the stoker incinerator, for example, Patent
Document 1 is known to determine the state of the matter to be combusted and
the like on the fire grate. Patent Document 1 discloses derivation of the
position of a burnout point corresponding to a boundary between a combustion
30 region where the matter to be combusted is combusted and the ashes, and an
accumulation height of the matter to be combusted or the ashes to adjust the
feed amount of matter to be combusted or a transfer speed for the matter to be
combusted.

35 Citation List

Patent Literature

[0004]

Patent Document 1: JP 2018-155411 A

40 Summary of Invention

Technical Problem

[0005]

5 When the matter to be combusted such as waste is fed to the stoker, the distribution state, in a transfer direction, of the matter to be combusted that is uncombusted and transferred by the stoker varies due to temporal changes in the conveyance speed of a feeder that feeds the matter to be combusted and the nature of moisture and the like contained in the matter to be combusted. For
10 example, in a case where a large amount of matter to be combusted is temporarily fed to the stoker, the matter to be combusted is guided to the stoker and pushed out toward a downstream side in the transfer direction, and a larger amount of matter to be combusted is present in certain regions than in the other regions. In this case, sufficient combustion air is not fed to the regions where a
15 larger amount of matter to be combusted is present than in the other regions, and this may prevent the matter to be combusted from being completely combusted.

[0006]

 However, in Patent Document 1, the feed amount of matter to be
20 combusted and the like are controlled based on local states such as the position of the burnout point and the accumulation height of the matter to be combusted or ashes, and thus the combustion state of the matter to be combusted fails to be appropriately controlled according to the distribution state, in the transfer direction, of the matter to be combusted that is uncombusted and transferred by
25 the stoker.

[0007]

 For example, in a case where the feed amount of matter to be combusted fed to the stoker varies with time, the combustion state of the matter to be combusted in the transfer direction also varies with time. However, the
30 combustion state of the matter to be combusted fails to be controlled in response to the variation.

[0008]

 The present disclosure has been made in view of such circumstances, and an object of the present disclosure is to provide a combustion furnace and a
35 method for controlling the combustion furnace, the combustion furnace being capable of appropriately controlling a combustion state of matter to be combusted according to a distribution state of the matter to be combusted that is uncombusted in a transfer direction, the matter to be combusted that is uncombusted being transferred by a transfer unit.

40

Solution to Problem

[0009]

5 In order to solve the problem described above, the present disclosure adopts the following means.

 A combustion furnace according to an aspect of the present disclosure is a combustion furnace that combusts matter to be combusted while transferring the matter to be combusted along a transfer direction, the combustion furnace
10 including a combustion furnace main body that combusts the matter to be combusted, a matter-to-be-combusted feeding unit that feeds the matter to be combusted to the combustion furnace main body, a transfer unit installed in the combustion furnace main body and transferring, in the transfer direction, the matter to be combusted fed to the combustion furnace main body by the matter-
15 to-be-combusted feeding unit, an air supply unit that supplies combustion air to the combustion furnace main body, a detecting unit that detects a distribution state of the matter to be combusted that is uncombusted in the transfer direction, the matter to be combusted that is uncombusted being transferred by the transfer unit, and a control unit that controls the air supply unit based on the
20 distribution state detected by the detecting unit such that a larger amount of the combustion air is supplied to a first predetermined region than to other regions, the first predetermined region being a region where a larger amount of the matter to be combusted that is uncombusted is present in the transfer direction than in the other regions.

25 [0010]

 A method for controlling a combustion furnace according to an aspect of the present disclosure is a method for controlling a combustion furnace that combusts matter to be combusted while transferring the matter to be combusted along a transfer direction, the combustion furnace including a combustion
30 furnace main body that combusts the matter to be combusted, a matter-to-be-combusted feeding unit that feeds the matter to be combusted to the combustion furnace main body, a transfer unit installed in the combustion furnace main body and transferring, in the transfer direction, the matter to be combusted fed to the combustion furnace main body by the matter-to-be-combusted feeding
35 unit, and an air supply unit that supplies combustion air to the combustion furnace main body, the method including a detecting step of detecting a distribution state of the matter to be combusted that is uncombusted in the transfer direction, the matter to be combusted that is uncombusted being transferred by the transfer unit, and a control step of controlling the air supply
40 unit based on the distribution state detected in the detecting step such that a larger amount of the combustion air is supplied to a first predetermined region than to other regions, the first predetermined region being a region where a

5 larger amount of the matter to be combusted that is uncombusted is present in the transfer direction than in the other regions.

Advantageous Effects of Invention

[0011]

10 According to the present disclosure, a combustion furnace and a method for controlling the combustion furnace can be provided that enable the combustion state of the matter to be combusted to be appropriately controlled according to the distribution state in the transfer direction of the matter to be combusted that is uncombusted and transferred by the transfer unit.

15

Brief Description of Drawings

[0012]

FIG. 1 is a schematic cross-sectional view illustrating a configuration of a stoker incinerator according to an embodiment of the present disclosure.

20 FIG. 2 is a horizontal cross-sectional view of the stoker incinerator illustrated in FIG. 1 at a position where a secondary air supply unit is disposed.

FIG. 3 is a diagram illustrating an example of an image captured by a camera and a distribution state of waste detected by an image processing unit.

25 FIG. 4 is a diagram illustrating an example of an image captured by the camera and the distribution state of waste detected by the image processing unit.

FIG. 5 is a flowchart illustrating a method for controlling the stoker incinerator according to the embodiment of the present disclosure.

30

Description of Embodiments

[0013]

Hereinafter, a stoker incinerator (combustion furnace) 100 according to an embodiment of the present disclosure will be described with reference to the drawings. FIG. 1 is a schematic cross-sectional view illustrating the stoker incinerator 100 according to the embodiment of the present disclosure. FIG. 2 is a horizontal cross-sectional view of the stoker incinerator illustrated in FIG. 1 at a position where a secondary air supply unit is disposed.

[0014]

40 In the following, as an example of a combustion furnace that combusts waste 200, a stoker incinerator 100 will be described, but any other combustion furnace may be employed instead of the stoker incinerator 100. Examples of any other combustion furnace include a pulverized coal boiler and a kiln.

5 [0015]

The stoker incinerator 100 of the present embodiment is a device that combusts the waste 200, corresponding to matter to be combusted, while transferring the waste 200 in a transfer direction TD. As illustrated in FIG. 1, the stoker incinerator 100 includes an incinerator main body (combustion
10 furnace main body) 10, a waste feeding unit (a matter-to-be-combusted feeding unit) 20, a stoker (transfer unit) 30, a primary air supply unit (air supply unit) 40, a secondary air supply unit (air supply unit) 50, a distribution state detecting sensor (detecting unit) 60, a control unit 70, a heat recovery boiler 80, a cooling tower 85, a precipitator 90, and a chimney 95. Here, the waste
15 200 is solid waste, and is, for example, household waste including solid waste formed of paper, plastic, or the like.

[0016]

The incinerator main body 10 is a device that combusts the waste 200 transferred by the stoker 30. In the incinerator main body 10, a combustion
20 space in which the waste 200 is combusted is formed by furnace walls arranged to surround the waste 200 transferred by the stoker 30.

[0017]

The waste feeding unit (matter-to-be-combusted feeding unit) 20 is a device that feeds the waste 200 to the incinerator main body 10. The waste
25 feeding unit 20 includes a feeding hopper 21 that receives the waste 200 and a feeder 22 that feeds the waste 200 fed into the feeding hopper 21 to the incinerator main body 10. For example, a push-in feeder 22 can be used as the feeder 22. The push-in feeder 22 is a device that repeats an operation of pushing the waste 200 toward the incinerator main body 10 using a push-in
30 member (not illustrated) and an operation of pulling the push-in member away from the incinerator main body 10.

[0018]

The stoker 30 is a device installed in the incinerator main body 10 and transferring, along the transfer direction TD, the waste 200 fed to the
35 incinerator main body 10 by the waste feeding unit 20. The stoker 30 includes a metal fire grate (not illustrated) that transfers the waste 200 in the transfer direction TD while mixing and stirring the waste 200, thus drying and combusting the waste 200. The fire grate includes fixed stages (not illustrated) and movable stages (not illustrated) alternately arranged, and a hydraulic
40 device (not illustrated) is used to reciprocate the movable stages to transfer the waste 200.

[0019]

5 The primary air supply unit 40 is a device that supplies combustion air to the incinerator main body 10. The primary air supply unit 40 includes a plurality of primary air supply ports 41a, 41b, 41c, 41d, and 41e, a plurality of dampers 42a, 42b, 42c, 42d, and 42e, and a blower 43. The plurality of primary air supply ports 41a, 41b, 41c, 41d, and 41e are arranged at intervals from an upstream side toward a downstream side along the transfer direction TD.
10 [0020]

 The plurality of dampers 42a, 42b, 42c, 42d, and 42e adjust the air blowing amounts of primary air supplied to the plurality of primary air supply ports 41a, 41b, 41c, 41d, 41e from the blower 43, respectively. The degree of
15 opening of each of the dampers 42a, 42b, 42c, 42d, and 42e is controlled by a control signal transmitted from the control unit 70.
[0021]

 The blower 43 is configured to blow air in the atmosphere, but may have another aspect. For example, the blower 43 may blow air the temperature of
20 which is adjusted by an air preheater (not illustrated), a combustion gas generated by the incinerator main body 10, an oxygen-enriched gas, and a mixed gas of the gases described above.
[0022]

 The secondary air supply unit 50 is a device that supplies combustion air
25 to the incinerator main body 10. The secondary air supply unit 50 includes a plurality of upstream-side air supply ports 51, a plurality of downstream-side air supply ports 52, a plurality of dampers 53, a plurality of dampers 54, and a blower 55.
[0023]

30 The blower 55 is configured to blow air in the atmosphere, but may have another aspect. For example, the blower 55 blows air the temperature of which is adjusted by an air preheater (not illustrated), a combustion gas generated by the incinerator main body 10, a combustion gas discharged from the precipitator 90, an oxygen-enriched gas, and a mixed gas obtained by freely
35 combining the gases described above.
[0024]

 As illustrated in FIG. 1, each upstream-side air supply port 51 is a device disposed above the stoker 30 and supplying combustion air from the upstream side toward the downstream side in the transfer direction TD. Each
40 downstream-side air supply port 52 is a device disposed above the stoker 30 and supplying combustion air from the downstream side toward the upstream side in the transfer direction TD. The upstream-side air supply port 51 is

5 disposed upstream of the downstream-side air supply port 52 in the transfer direction TD so as to face the downstream-side air supply port 52.
[0025]

As illustrated in FIG. 2, the secondary air supply unit 50 includes a plurality of upstream-side air supply ports 51 (51a, 51b, and 51c) arranged at
10 intervals along a width direction WD orthogonal to the transfer direction TD, and a plurality of downstream-side air supply ports 52 (52a, 52b, and 52c) arranged at intervals along the width direction WD orthogonal to the transfer direction TD.
[0026]

15 The plurality of dampers 53a, 53b, and 53c adjust the air blowing amounts of secondary air supplied from the blower 55 to the plurality of upstream-side air supply ports 51a, 51b, and 51c, respectively. Similarly, the plurality of dampers 54a, 54b, and 54c adjust the air blowing amounts of secondary air supplied from the blower 55 to the plurality of downstream-side
20 air supply ports 52a, 52b, and 52c, respectively. The degree of opening of each of the dampers 53 and 54 is controlled by a control signal transmitted from the control unit 70.
[0027]

The distribution state detecting sensor 60 is a device that detects the
25 distribution state in the transfer direction TD of the waste 200 that is uncombusted and transferred by the stoker 30. The distribution state detecting sensor 60 includes a camera 61 that captures an image and an image processing unit 62 that processes the image captured by the camera 61.
[0028]

30 The camera 61 is an imaging device that can capture visible light or infrared light, and is attached to the wall of an upper part of the incinerator main body 10. From above the stoker 30, the camera 61 captures, as a visible image or an infrared image, an image of the waste 200 and the state of a flame generated by combustion of a volatile gas volatilized from the waste 200, over
35 a predetermined range of the stoker 30 in the transfer direction TD.
[0029]

Based on the image of the waste 200 and the state of the flame captured from above the stoker 30 by the camera 61, the image processing unit 62 detects the distribution state (the first distribution state) of the waste 200 that is
40 uncombusted in the transfer direction TD and the distribution state (second distribution state) of the waste 200 that is uncombusted in the width direction WD.

5 [0030]

Referring now to FIGS. 3 and 4, processing will be described in which the image processing unit 62 detects the first distribution state of the uncombusted waste 200 in the transfer direction TD and the second distribution state of the uncombusted waste 200 in the width direction WD based on the image captured by the camera 61. FIGS. 3 and 4 are diagrams illustrating examples of the image captured by the camera 61 and the distribution state of the waste 200 detected by the image processing unit 62. The positions P0, P2, and P4 in FIG. 2 correspond to positions P0, P2, and P4 in FIGS. 3 and 4.

[0031]

15 FIG. 3 illustrates the distribution state in a case where the amount of the waste 200 fed to the stoker 30 is within a specified range. In contrast, FIG. 4 illustrates the distribution state in a case where the amount of the waste 200 fed to the stoker 30 exceeds the specified range. In FIG. 4, a region where an image with a high luminance is present has moved further downstream in the transfer direction TD than in FIG. 3. This indicates that the position where the most intense flame is generated in FIG. 3 has moved downstream in the transfer direction TD due to a large amount of the waste 200 fed to the stoker 30.

[0032]

25 The images illustrated in FIGS. 3 and 4 illustrate the luminance of each pixel captured by the camera 61 by shading. FIGS. 3 and 4 indicate that the luminance value decreases as the color is darker and that the luminance value increases as the color is lighter. In the images illustrated in FIGS. 3 and 4, regions in which pixels with high luminance values are densely packed is indicative of regions where a volatile gas generated from the waste 200 is combusted, generating a flame. In the images illustrated in FIGS. 3 and 4, the regions where pixels with high luminance values are densely packed are indicative of regions with a small amount of waste 200.

[0033]

35 For example, the image processing unit 62 extracts pixels having a predetermined luminance value or greater from the image captured by the camera 61, and extracts the region in which the extracted pixels are densely packed as an extraction region A. Additionally, the image processing unit 62 calculates the center of gravity position Pc of the luminance values in the extraction region A from the luminance values of all the pixels included in the extraction region A.

40 [0034]

5 In FIGS. 3 and 4, an axis X is a straight line extending parallel with the transfer direction TD, and an axis Y is a straight line extending parallel with the width direction WD orthogonal to the transfer direction TD. The positions P0, P1, P2, P3, P4, and Pc illustrated in FIG. 3 indicate positions on an XY plane defined by the axis X and the axis Y. The positions of the positions P0, P1, and P2 on the axis Y are Y0, and the positions of the positions P0, P3, and P4 on the axis X are X0. The position P1 is a midpoint between the position P0 and the position P2. The position P3 is a midpoint between the position P0 and the position P4. The position P5 and the position P1 are at the same position of X1 on the axis X, and the position P5 and the position P3 are at the same position of Y1 on the axis Y.

10 [0035]

 The image processing unit 62 calculates the center of gravity position Pc, and identifies the position on the axis X as Xc and the position on the axis Y as Yc. Then, the image processing unit 62 identifies a region R about the center of gravity position Pc (Xc, Yc). The region R includes a first predetermined region r1 in the axis X direction, and includes a second predetermined region r2 in the axis Y direction.

20 [0036]

 The region R identified from the center of gravity position Pc of the luminance values in the extraction region A indicates a region in which the largest number of flames are generated by combustion of a volatile gas generated from the waste 200. The first predetermined region r1 detected by the image processing unit 62 indicates the distribution state (first distribution state) of the uncombusted waste 200 in the transfer direction TD. Additionally, the second predetermined region r2 detected by the image processing unit 62 indicates the distribution state (second distribution state) of the uncombusted waste 200 in the width direction WD.

30 [0037]

 The distribution state indicated by the region R involves a combustion state in which the region R has a greater oxygen concentration and more volatile contents (e. g., CH₄ and CO) generated from the waste 200 than the other regions. Additionally, since the oxygen concentration is greater in the region R than in the other regions, the distribution state indicated by the region R indicates a combustion state in which the region R has a greater nitrogen oxide concentration than the other regions.

40 [0038]

5 In the above description, the distribution state detecting sensor 60 is configured to detect the distribution state of the uncombusted waste 200 in the transfer direction TD and the distribution state of the uncombusted waste 200 in the width direction WD based on the image of the waste 200 and the state of the flame captured from above the stoker 30 by the camera 61. However, the
10 distribution state detecting sensor 60 may have another aspect.
[0039]

 For example, the distribution state detecting sensor 60 may detect a temperature distribution in the transfer direction TD as the distribution state in the transfer direction TD. Specifically, the distribution state detecting sensor 60
15 acquires a temperature distribution in the transfer direction TD from temperature sensors (not illustrated) disposed at a plurality of locations along the transfer direction TD above the stoker 30, and may detect a region having the highest temperature as the first predetermined region r1. In this case, the distribution state indicated by the first predetermined region r1 is a combustion
20 state in which the first predetermined region r1 has a higher temperature than the other regions.
[0040]

 Additionally, the distribution state detecting sensor 60 may detect a temperature distribution in the width direction WD as the distribution state in the width direction WD. Specifically, the distribution state detecting sensor 60
25 may acquire a temperature distribution in the width direction WD from temperature sensors (not illustrated) disposed at a plurality of locations along the width direction WD above the stoker 30, and may detect a region with the highest temperature as the second predetermined region r2.
[0041]
30

 Additionally, the distribution state detecting sensor 60 may employ a laser CT instead of the temperature sensor, detect a gas composition distribution in the transfer direction TD as the distribution state in the transfer direction TD, and detect a gas composition distribution in the width direction
35 WD as the distribution state in the width direction WD. In this case, the distribution state detecting sensor 60 detects, as the first predetermined region r1 and the second predetermined region r2, regions with a large amount of a predetermined gas indicating the presence of a large amount of uncombusted waste 200.
[0042]
40

 The control unit 70 is a device that controls the primary air supply unit 40 and the secondary air supply unit 50 based on the distribution state detected

5 by the distribution state detecting sensor 60. Here, the control unit 70 includes,
for example, a central processing unit (CPU), a random access memory (RAM),
a read only memory (ROM), a computer readable storage medium, and the like.
A series of processes for implementing various functions is stored in a storage
medium or the like in the form of a program, for example, and the CPU reads
10 the program into the RAM or the like and executes information processing and
computation processing, thereby implementing various functions.
[0043]

The control unit 70 controls the primary air supply unit 40 based on the
distribution state in the transfer direction TD detected by the distribution state
15 detecting sensor 60 such that a larger amount of combustion air is supplied to
the first predetermined region r1 than to the other regions, the first
predetermined region r1 being a region where a larger amount of the
uncombusted waste 200 is present in the transfer direction TD than in the other
regions.
20 [0044]

In the example illustrated in FIG. 3, the control unit 70 controls the
primary air supply unit 40 such that a first flow rate of combustion air supplied
from the primary air supply ports 41b and 41c disposed at positions close to the
first predetermined region r1 is greater than a second flow rate of combustion
25 air supplied from the primary air supply ports 41a, 41d, and 41e disposed at
positions close to the other regions.
[0045]

Regions ra, rb, rc, rd, and re along the axis X illustrated in FIG. 3
indicate regions in which the primary air supply ports 41a, 41b, 41c, 41d, and
30 41e are disposed in the transfer direction TD, respectively. In FIG. 3, the image
processing unit 62 detects a region including the region rb and the region rc as
the first predetermined region r1.
[0046]

When the first flow rate of combustion air supplied from the primary air
35 supply ports 41b and 41c supplying primary air to the regions rb and rc is
greater than the second flow rate of combustion air supplied from the primary
air supply ports 41a, 41d, and 41e disposed at positions close to the other
regions, the combustion of the waste 200 present in the regions rb and rc can be
promoted.
40 [0047]

On the other hand, in the example illustrated in FIG. 4, the control unit
70 controls the primary air supply unit 40 such that the first flow rate of

5 combustion air supplied from the primary air supply ports 41c and 41d disposed at positions close to the first predetermined region r1 is greater than the second flow rate of combustion air supplied from the primary air supply ports 41a, 41b, and 41e disposed at positions close to the other regions.

[0048]

10 In FIG. 4, the image processing unit 62 detects a region including the region rc and the region rd as the first predetermined region r1. When the first flow rate of combustion air supplied from the primary air supply ports 41c and 41d supplying primary air to the regions rc and rd is greater than the second flow rate of combustion air supplied from the primary air supply ports 41a,
15 41b, and 41e disposed at positions close to the other regions, the combustion of the waste 200 present in the regions rc and rd can be promoted.

[0049]

Additionally, based on the distribution state in the transfer direction TD detected by the distribution state detecting sensor 60, the control unit 70
20 controls the secondary air supply unit 50 such that a larger amount of combustion air is supplied to the first predetermined region r1 than to the other regions, a larger amount of the uncombusted waste 200 being present in the transfer direction TD in the first predetermined region r1 than in the other regions.

25 [0050]

In the example illustrated in FIG. 3, because the first predetermined region r1 is present at a position closer to the upstream-side air supply ports 51 than to the downstream-side air supply ports 52 in the transfer direction TD, the control unit 70 controls the secondary air supply unit 50 such that the flow rate
30 of combustion air supplied from the downstream-side air supply ports 52 is greater than the flow rate of combustion air supplied from the upstream-side air supply ports 51.

[0051]

More specifically, the control unit 70 controls the dampers 53 and 54
35 such that a position in the transfer direction TD where the combustion air supplied from the upstream-side air supply ports 51 joins the combustion air supplied from the downstream-side air supply ports 52 matches the position Xc, corresponding to an X-axis position of the center of gravity position Pc.

[0052]

40 In the example illustrated in FIG. 3, the flow rate of combustion air supplied from the downstream-side air supply ports 52 at a long distance from the center of gravity position Pc in the transfer direction TD is greater than the

5 flow rate of combustion air supplied from the upstream-side air supply ports 51. This allows the flame near the center of gravity position Pc to be drawn downstream in the transfer direction TD to provide a retention time for the volatile gas, thus promoting mixture of the volatile gas near the center of gravity position Pc and the volatile gas on the downstream side.

10 [0053]

Additionally, in the example illustrated in FIG. 3, the flow rate of combustion air supplied from the upstream-side air supply ports 51 at a short distance from the center of gravity position Pc in the transfer direction TD is less than the flow rate of combustion air supplied from the downstream-side air supply ports 52. By reducing the penetration force of the combustion air supplied from the upstream-side air supply ports 51, the oxygen concentration is high at a position close to the upstream-side air supply ports 51, allowing the uncombusted volatile gas to be restrained from being directed upward without being combusted.

20 [0054]

In the example illustrated in FIG. 4, because the first predetermined region r1 is present at a position closer to the downstream-side air supply ports 52 than to the upstream-side air supply ports 51 in the transfer direction TD, the control unit 70 controls the secondary air supply unit 50 such that the flow rate of combustion air supplied from the upstream-side air supply ports 51 is greater than the flow rate of combustion air supplied from the downstream-side air supply ports 52.

[0055]

More specifically, the control unit 70 controls the dampers 53 and 54 such that a position in the transfer direction TD where the combustion air supplied from the upstream-side air supply ports 51 joins the combustion air supplied from the downstream-side air supply ports 52 matches the position Xc, corresponding to an X-axis position of the center of gravity position Pc.

[0056]

35 Additionally, based on the distribution state in the width direction WD detected by the distribution state detecting sensor 60, the control unit 70 controls the secondary air supply unit 50 such that a larger amount of combustion air is supplied to the second predetermined region r2 than to the other regions, a larger amount of the uncombusted waste 200 being present in the width direction WD in the second predetermined region r2 than in the other regions.

40 [0057]

Regions rf, rg, and rh along the axis Y illustrated in FIG. 3 indicate regions in which the upstream-side air supply ports 51a, 51b, and 51c are disposed in the width direction WD, respectively. Similarly, the regions rf, rg, and rh indicate regions in which the downstream-side air supply ports 52a, 52b, and 52c are disposed in the width direction WD, respectively.

[0058]

In FIG. 3, the image processing unit 62 detects a region including the regions rf and rg as the second predetermined region r2. Thus, in the example illustrated in FIG. 3, the control unit 70 controls the dampers 53 such that the amount of combustion air supplied from the upstream-side air supply ports 51a and 51b is greater than the amount of combustion air supplied from the upstream-side air supply port 51c. Further, in the example illustrated in FIG. 3, the control unit 70 controls the dampers 54 such that the amount of combustion air supplied from the downstream-side air supply ports 52a and 52b is greater than the amount of the combustion air supplied from the downstream-side air supply port 52c.

[0059]

The heat recovery boiler 80 is a device that generates steam by combustion gas generated by the incinerator main body 10. The combustion gas generated in the incinerator main body 10 exchanges heat with feed water flowing through a plurality of heat transfer tubes (not illustrated) installed in the heat recovery boiler 80. The combustion gas having finished heat exchange with the feed water flowing through the heat transfer tubes is guided from the heat recovery boiler 80 to the cooling tower 85.

[0060]

The cooling tower 85 is a device that lowers the temperature of combustion gas guided from the heat recovery boiler 80. The cooling tower 85 reduces the temperature of the combustion gas by, for example, spraying the combustion gas with water. The combustion gas with the temperature reduced by the cooling tower 85 is guided to the precipitator 90.

[0061]

The precipitator 90 is a device that removes soot contained in the combustion gas guided from the cooling tower 85. The combustion gas from which the soot is removed by the precipitator 90 is guided to the chimney 95 and released into the atmosphere.

[0062]

Now, the method for controlling the stoker incinerator 100 according to the present embodiment will be described with reference to FIG. 5. FIG. 5 is a

5 flowchart illustrating a method for controlling the stoker incinerator 100 in accordance with an embodiment of the present disclosure.
[0063]

In step S101 (detecting step), the distribution state detecting sensor 60 detects the distribution states, in the transfer direction TD and in the width
10 direction WD, of the uncombusted waste 200 transferred by the stoker 30. The distribution state detecting sensor 60 transmits, to the control unit 70, the distribution state in the transfer direction TD and the distribution state in the width direction WD.

[0064]

15 Specifically, the distribution state detecting sensor 60 detects, as the distribution state in the transfer direction TD, the first predetermined region r1 where the largest number of flames are generated by combustion of the volatile gas generated from the waste 200. In addition, the distribution state detecting
20 sensor 60 detects, as the distribution state in the width direction WD, the second predetermined region r2 in which the largest number of flames are generated by combustion of the volatile gas generated from the waste 200.

[0065]

In step S102 (control step), based on the distribution state in the transfer direction TD detected in step S101, the control unit 70 controls the primary air
25 supply unit 40 such that a larger amount of combustion air is supplied to the first predetermined region r1 than to the other regions, a larger amount of the uncombusted waste 200 being present in the transfer direction TD in the first predetermined region r1 than in the other regions.

[0066]

30 Specifically, the control unit 70 controls the primary air supply unit 40 such that the first flow rate of combustion air supplied from the primary air supply port (at least any of the primary air supply ports 41a, 41b, 41c, 41d, or 41e) disposed at a position close to the first predetermined region r1 is greater
35 than the second flow rate of combustion air supplied from the primary air supply port (at least any of the primary air supply ports 41a, 41b, 41c, 41d, or 41e) disposed at a position close to the other regions.

[0067]

Additionally, in step S102 (control step), based on the distribution state in the width direction WD detected in step S101, the control unit 70 controls
40 the secondary air supply unit 50 such that a larger amount of combustion air is supplied to the second predetermined region r2 than to the other regions, a

5 larger amount of the uncombusted waste 200 being present in the width
direction WD in the second predetermined region r2 than in the other regions.
[0068]

Specifically, the control unit 70 controls the dampers 53 such that the
amount of combustion air supplied from the upstream-side air supply port 51
10 (at least any of the upstream-side air supply ports 51a, 51b, or 51c) present in
close proximity to the second predetermined region r2 is greater than the
amount of combustion air supplied from the upstream-side air supply port (at
least any of the upstream-side air supply ports 51a, 51b, or 51c) present in the
other regions.

15 [0069]

Similarly, the control unit 70 controls the dampers 54 such that the
amount of combustion air supplied from the downstream-side air supply port 52
(at least any of the downstream-side air supply ports 52a, 52b, or 52c) present
in close proximity to the second predetermined region r2 is greater than the
20 amount of combustion air supplied from the downstream-side air supply port
(at least any of the downstream-side air supply ports 52a, 52b, or 52c) present
in the other regions.

[0070]

In step S103 (control step), based on the distribution state in the transfer
25 direction TD detected by step S101, the control unit 70 controls the secondary
air supply unit 50 such that a larger amount of combustion air is supplied to the
first predetermined region r1 than to the other regions, a larger amount of the
uncombusted waste 200 being present in the transfer direction TD in the first
predetermined region r1 than in the other regions.

30 [0071]

Specifically, the control unit 70 controls the dampers 53 and 54 such
that the position in the transfer direction TD where the combustion air supplied
from the upstream-side air supply ports 51 joins the combustion air supplied
from the downstream-side air supply ports 52 matches the first predetermined
35 region r1.

[0072]

In step S104, the control unit 70 determines whether to end the
processing for detecting the distribution states, in the transfer direction TD and
in the width direction WD, of the uncombusted waste 200 transferred by the
40 stoker 30. In a case where the determination result is NO, the control unit 70
executes the processing from step S101 to step S103 again, and in a case where

5 the determination result is YES, the control unit 70 ends the processing of the flowchart.

[0073]

The actions and effects exhibited by the stoker incinerator 100 according to the present embodiment described above will now be described.

10 According to the stoker incinerator 100 according to the present embodiment, the distribution state detecting sensor 60 detects the distribution state of the uncombusted waste 200 in the transfer direction TD, the uncombusted waste 200 being fed to the incinerator main body 10 by the waste feeding unit 20 and transferred by the stoker 30. Then, based on the distribution
15 state of the uncombusted waste 200 in the transfer direction TD detected by the distribution state detecting sensor 60, the control unit 70 controls the primary air supply unit 40 and the secondary air supply unit 50 such that a larger amount of combustion air is supplied to the first predetermined region r1 than to the other regions, a larger amount of the uncombusted waste 200 being
20 present in the transfer direction TD in the first predetermined region r1 than in the other regions.

[0074]

Because the combustion of the uncombusted waste 200 in the first predetermined region r1 is promoted compared to the combustion in the other
25 regions, the combustion state of the waste 200 in each region in the transfer direction TD can be appropriately controlled such that the waste 200 is completely combusted according to the distribution state of the uncombusted waste 200 in the transfer direction TD. Because the supply amount of combustion air in the transfer direction TD is appropriately controlled,
30 generation of CO due to local air shortage and generation of NOx due to local air excess can be suppressed.

[0075]

Additionally, according to the stoker incinerator 100 according to the present embodiment, the distribution state of the uncombusted waste 200 in the
35 width direction WD orthogonal to the transfer direction TD can be detected, and the combustion state of the waste 200 in each region in the width direction WD can be appropriately controlled such that the waste 200 is completely combusted. Because the supply amount of combustion air in the width direction WD is appropriately controlled, generation of CO due to local air shortage and
40 generation of NOx due to local air excess can be suppressed.

[0076]

5 According to the stoker incinerator 100 according to the present
embodiment, in a case where the first predetermined region r1 where a larger
amount of the uncombusted waste 200 is present in the transfer direction TD
than in the other regions is present at a position closer to the downstream-side
air supply ports 52 than to the upstream-side air supply ports 51 in the transfer
10 direction TD, the secondary air supply unit 50 is controlled such that the first
flow rate of combustion air supplied from the upstream-side air supply ports 51
is greater than the second flow rate of combustion air supplied from the
downstream-side air supply ports 52.

[0077]

15 Due to the first flow rate being greater than the second flow rate, the
combustion air supplied from the upstream-side air supply ports 51 joins the
combustion air supplied from the downstream-side air supply ports 52 at a
position closer to the downstream-side air supply ports 52 than to the
intermediate point between the upstream-side air supply ports 51 and the
20 downstream-side air supply ports 52. Accordingly, a larger amount of
combustion air is supplied to the first predetermined region r1 than to the other
regions, and the combustion of the uncombusted waste 200 in the first
predetermined region r1 can be promoted.

[0078]

25 Additionally, due to the first flow rate being greater than the second
flow rate, an uncombusted volatile gas present in the vicinity of the first
predetermined region r1 is drawn to the flow of combustion air supplied to the
incinerator main body 10 from the upstream-side air supply ports 51, and
migrates from the first predetermined region r1 toward the upstream-side air
30 supply ports 51. Thus, the volatile gas generated from the waste 200 is
dispersed in the transfer direction TD, and the combustion of the waste 200 can
be promoted over a wide range of regions of the incinerator main body 10.

[0079]

35 According to the stoker incinerator 100 of the present embodiment, the
primary air supply unit 40 is controlled such that the first flow rate of
combustion air supplied from the primary air supply port disposed at a position
close to the first predetermined region r1 where a larger amount of the
uncombusted waste 200 is present than in the other regions is greater than the
second flow rate of combustion air supplied from the primary air supply port
40 disposed at a position close to the other regions in the transfer direction TD.
Due to the first flow rate being greater than the second flow rate, a larger
amount of combustion air is supplied to the first predetermined region r1 than

5 to the other regions, allowing the combustion of the uncombusted waste 200 in the first predetermined region r1 to be promoted.

[0080]

The combustion furnace described above in the embodiment is understood as follows, for example.

10 A combustion furnace according to the present disclosure includes a combustion furnace (100) that combusts matter to be combusted while transferring the matter to be combusted along a transfer direction, the combustion furnace including a combustion furnace main body (10) that combusts the matter to be combusted, a matter-to-be-combusted feeding unit
15 (20) that feeds the matter to be combusted to the combustion furnace main body, a transfer unit (30) installed in the combustion furnace main body (10) and transferring, in the transfer direction, the matter to be combusted fed to the combustion furnace main body by the matter-to-be-combusted feeding unit, an air supply unit (40, 50) that supplies combustion air to the combustion furnace
20 main body, a detecting unit (60) that detects a distribution state of the matter to be combusted that is uncombusted in the transfer direction, the matter to be combusted that is uncombusted being transferred by the transfer unit, and a control unit (70) that controls the air supply unit based on the distribution state detected by the detecting unit such that a larger amount of the combustion air is
25 supplied to a first predetermined region than to other regions, the first predetermined region being a region where a larger amount of the matter to be combusted that is uncombusted is present in the transfer direction than in the other regions.

[0081]

30 According to the combustion furnace according to the present disclosure, the detecting unit detects the distribution state of the matter to be combusted that is uncombusted in the transfer direction, the matter to be combusted that is uncombusted being fed to the combustion furnace main body by the matter-to-be-combusted feeding unit and transferred by the transfer unit.
35 Then, based on the distribution state of the matter to be combusted that is uncombusted in the transfer direction, the distribution state being detected by the detecting unit, the control unit controls the air supply unit such that a larger amount of the combustion air is supplied to the first predetermined region (r1) than to the other regions, the first predetermined region (r1) being a region
40 where a larger amount of the matter to be combusted that is uncombusted is present in the transfer direction than in the other regions.

[0082]

5 Because the combustion of the matter to be combusted that is
uncombusted in the first predetermined region is promoted compared to the
combustion in the other regions, the combustion state of the matter to be
combusted in each region in the transfer direction can be appropriately
controlled such that the matter to be combusted is completely combusted
10 according to the distribution state of the matter to be combusted that is
uncombusted in the transfer direction. Because the supply amount of the
combustion air in the transfer direction is appropriately controlled, generation
of CO due to local air shortage and generation of NO_x due to local air excess
can be suppressed.

15 [0083]

In the combustion furnace according to the present disclosure, the
detecting unit may be configured to detect the distribution state based on an
image of the matter to be combusted captured from above the transfer unit.

20 According to the combustion furnace of the present configuration, the
distribution state is detected based on the image of the matter to be combusted
captured from above the transfer unit, allowing the combustion state of the
matter to be combusted in each region in the transfer direction to be
appropriately controlled to completely combust the matter to be combusted.
[0084]

25 In the combustion furnace according to the present disclosure, the
detecting unit may be configured to detect the distribution state based on a
temperature distribution in the transfer direction.

 According to the combustion furnace of the present configuration, the
distribution state is detected based on the temperature distribution in the
30 transfer direction, allowing the combustion state of the matter to be combusted
in each region in the transfer direction to be appropriately controlled to
completely combust the matter to be combusted.
[0085]

 In the combustion furnace according to the present disclosure, the
35 detecting unit may be configured to detect the distribution state of the matter to
be combusted that is uncombusted in a width direction orthogonal to the
transfer direction, and the control unit may be configured to control the air
supply unit based on the distribution state in the width direction detected by the
detecting unit such that a larger amount of the combustion air is supplied to a
40 second predetermined region (r2) than to other regions, the second
predetermined region (r2) being a region where a larger amount of the matter to

5 be combusted that is uncombusted is present in the width direction than in the other regions.

[0086]

According to the combustion furnace of the present configuration, the distribution state of the matter to be combusted that is uncombusted in the width direction orthogonal to the transfer direction is detected, allowing the combustion state of the matter to be combusted in each region in the width direction to be appropriately controlled to completely combust the matter to be combusted. Because the supply amount of the combustion air in the width direction is appropriately controlled, generation of CO due to local air shortage and generation of NOx due to local air excess can be suppressed.

[0087]

In the combustion furnace according to the present disclosure, the air supply unit may include an upstream-side air supply port (51) disposed above the transfer unit and supplying the combustion air from an upstream side toward a downstream side in the transfer direction, and a downstream-side air supply port (52) disposed above the transfer unit and supplying the combustion air from the downstream side toward the upstream side in the transfer direction, the upstream-side air supply port may be disposed more upstream than the downstream-side air supply port in the transfer direction such that the upstream-side air supply port faces the downstream-side air supply port, and the control unit may be configured to control the air supply unit such that in a case where the first predetermined region is present at a position closer to the downstream-side air supply port than to the upstream-side air supply port in the transfer direction, a first flow rate of the combustion air supplied from the upstream-side air supply port is greater than a second flow rate of the combustion air supplied from the downstream-side air supply port.

[0088]

According to the combustion furnace of the present configuration, in a case where the first predetermined region where a larger amount of the matter to be combusted that is uncombusted is present than in the other regions in the transfer direction is present at a position closer to the downstream-side air supply port than to the upstream-side air supply port in the transfer direction, the air supply unit is controlled such that the first flow rate of the combustion air supplied from the upstream-side air supply port is greater than the second flow rate of the combustion air supplied from the downstream-side air supply port.

[0089]

5 Due to the first flow rate being greater than the second flow rate, the
combustion air supplied from the upstream-side air supply port joins the
combustion air supplied from the downstream-side air supply port at a position
closer to the downstream-side air supply port than to an intermediate point
10 port. Thus, a larger amount of the combustion air is supplied to the first
predetermined region than to the other regions, and the combustion of the
matter to be combusted that is uncombusted in the first predetermined region
can be promoted.

[0090]

15 Additionally, due to the first flow rate being greater than the second
flow rate, an uncombusted volatile gas present in the vicinity of the first
predetermined region is drawn to a flow of the combustion air supplied to the
combustion furnace main body from the upstream-side air supply port, and
migrates from the first predetermined region toward the upstream-side air
20 supply port. Thus, the volatile gas generated from the matter to be combusted is
dispersed in the transfer direction, allowing combustion of the matter to be
combusted to be promoted over a wide range of regions of the combustion
furnace main body.

[0091]

25 In the combustion furnace according to the present disclosure, the air
supply unit may include an upstream-side air supply port (51) disposed above
the transfer unit and supplying the combustion air from an upstream side
toward a downstream side in the transfer direction, and a downstream-side air
supply port (52) disposed above the transfer unit and supplying the combustion
30 air from the downstream side toward the upstream side in the transfer direction,
the upstream-side air supply port may be disposed more upstream than the
downstream-side air supply port in the transfer direction such that the
upstream-side air supply port faces the downstream-side air supply port, and
the control unit may be configured to control the air supply unit such that in a
35 case where the first predetermined region is present at a position closer to the
upstream-side air supply port than to the downstream-side air supply port in the
transfer direction, a first flow rate of the combustion air supplied from the
downstream-side air supply port is greater than a second flow rate of the
combustion air supplied from the upstream-side air supply port.

40 [0092]

 According to the combustion furnace of the present configuration, in a
case where the first predetermined region where a larger amount of the matter

5 to be combusted that is uncombusted is present than in the other regions in the
transfer direction is present at a position closer to the upstream-side air supply
port than to the downstream-side air supply port in the transfer direction, the
air supply unit is controlled such that the first flow rate of the combustion air
supplied from the downstream-side air supply port is greater than the second
10 flow rate of the combustion air supplied from the upstream-side air supply port.
[0093]

Due to the first flow rate being greater than the second flow rate, the
combustion air supplied from the downstream-side air supply port joins the
combustion air supplied from the upstream-side air supply port at a position
15 closer to the upstream-side air supply port than to the intermediate point
between the downstream-side air supply port and the upstream-side air supply
port. Thus, a larger amount of the combustion air is supplied to the first
predetermined region than to the other regions, and the combustion of the
matter to be combusted that is uncombusted in the first predetermined region
20 can be promoted.
[0094]

Additionally, due to the first flow rate being greater than the second
flow rate, an uncombusted volatile gas present in the vicinity of the first
predetermined region is drawn to a flow of the combustion air supplied to the
combustion furnace main body from the downstream-side air supply port, and
25 migrates from the first predetermined region toward the downstream-side air
supply port. Thus, the volatile gas generated from the matter to be combusted is
dispersed in the transfer direction, allowing combustion of the matter to be
combusted to be promoted over a wide range of regions of the combustion
furnace main body.
30 [0095]

In the combustion furnace according to the present disclosure, the air
supply unit may include a plurality of primary air supply ports (41a to 41e) that
supply the combustion air from below the transfer unit toward the matter to be
35 combusted transferred by the transfer unit, the plurality of primary air supply
ports may be disposed along the transfer direction, and the control unit may be
configured to control the air supply unit such that a first flow rate of the
combustion air supplied from a primary air supply port of the plurality of
primary air supply ports that is disposed at a position close to the first
40 predetermined region is greater than a second flow rate of the combustion air
supplied from a primary air supply port of the plurality of primary air supply
ports that is disposed at a position close to the other regions.

5 [0096]

According to the combustion furnace of the present configuration, the air supply unit is controlled such that the first flow rate of the combustion air supplied from the primary air supply port disposed at the position close to the first predetermined region where a larger amount of the matter to be combusted
10 that is uncombusted is present in the transfer direction than in the other regions is greater than the second flow rate of the combustion air supplied from the primary air supply port disposed at the position close to the other regions. Due to the first flow rate being greater than the second flow rate, a larger amount of the combustion air is supplied to the first predetermined region than to the
15 other regions, allowing promotion of the combustion of the matter to be combusted that is uncombusted in the first predetermined region.

[0097]

The method for controlling the combustion furnace, which has been described in the embodiment described above, is understood as follows, for
20 example.

A method for controlling a combustion furnace according to the present disclosure is a method for controlling a combustion furnace that combusts matter to be combusted while transferring the matter to be combusted along a transfer direction, the combustion furnace including a combustion furnace main
25 body that combusts the matter to be combusted, a matter-to-be-combusted feeding unit that feeds the matter to be combusted to the combustion furnace main body, a transfer unit installed in the combustion furnace main body and transferring, in the transfer direction, the matter to be combusted fed to the combustion furnace main body by the matter-to-be-combusted feeding unit, and
30 an air supply unit that supplies combustion air to the combustion furnace main body, the method including a detecting step of detecting a distribution state of the matter to be combusted that is uncombusted in the transfer direction, the matter to be combusted that is uncombusted being transferred by the transfer unit, and a control step of controlling the air supply unit based on the
35 distribution state detected in the detecting step such that a larger amount of the combustion air is supplied to a first predetermined region than to other regions, the first predetermined region being a region where a larger amount of the matter to be combusted that is uncombusted is present in the transfer direction than in the other regions.

40 [0098]

According to the combustion furnace according to the present disclosure, the distribution state of the matter to be combusted that is

5 uncombusted in the transfer direction is detected in the detecting step, the
matter to be combusted that is uncombusted being fed to the combustion
furnace main body by the matter-to-be-combusted feeding unit and transferred
by the transfer unit. Then, in the control step, the air supply unit is controlled
based on the distribution state of the matter to be combusted that is
10 uncombusted in the transfer direction, which is detected in the detecting step,
such that a larger amount of the combustion air is supplied to the first
predetermined region than to other regions, the first predetermined region being
a region where a larger amount of the matter to be combusted that is
uncombusted is present in the transfer direction than in the other regions.

15 [0099]

Because the combustion of the matter to be combusted that is
uncombusted is promoted in the first region compared to the combustion in the
other regions, the combustion state of the matter to be combusted in each
region in the transfer direction can be appropriately controlled such that the
20 matter to be combusted is completely combusted according to the distribution
state of the matter to be combusted that is uncombusted in the transfer
direction. Because the supply amount of the combustion air in the transfer
direction is appropriately controlled, generation of CO due to local air shortage
and generation of NOx due to local air excess can be suppressed.

25 [0100]

In the control of the combustion furnace according to the present
disclosure, the detecting step may include detecting the distribution state based
on an image of the matter to be combusted captured from above the transfer
unit.

30 According to the method for controlling the combustion furnace of the
present configuration, the distribution state is detected based on the image of
the matter to be combusted captured from above the transfer unit, allowing the
combustion state of the matter to be combusted in each region in the transfer
direction to be appropriately controlled to completely combust the matter to be
35 combusted.

[0101]

In the method for controlling the combustion furnace according to the
present disclosure, the detecting step may include detecting a temperature
distribution in the transfer direction as the distribution state.

40 According to the method for controlling the combustion furnace
according to the present configuration, the temperature distribution in the
transfer direction is detected as the distribution state, allowing the combustion

5 state of the matter to be combusted in each region in the transfer direction to be
appropriately controlled to completely combust the matter to be combusted.
[0102]

In the method for controlling the combustion furnace according to the
present disclosure, the detecting step may include detecting the distribution
10 state of the matter to be combusted that is uncombusted in a width direction
orthogonal to the transfer direction, and the control step may include
controlling the air supply unit based on the distribution state in the width
direction detected in the detecting step such that a larger amount of the
combustion air is supplied to a second predetermined region than to other
15 regions, the second predetermined region being a region where a larger amount
of the matter to be combusted that is uncombusted is present in the width
direction than in the other regions.

[0103]

According to the method for controlling the combustion furnace of the
20 present configuration, the distribution state of the matter to be combusted that
is uncombusted in the width direction orthogonal to the transfer direction is
detected, allowing the combustion state of the matter to be combusted in each
region in the width direction to be appropriately controlled to completely
combust the matter to be combusted. Because the supply amount of the
25 combustion air in the width direction is appropriately controlled, generation of
CO due to local air shortage and generation of NO_x due to local air excess can
be suppressed.

[0104]

In the method for controlling the combustion furnace according to the
30 present disclosure, the air supply unit may include an upstream-side air supply
port disposed above the transfer unit and supplying the combustion air from an
upstream side toward a downstream side in the transfer direction, and a
downstream-side air supply port disposed above the transfer unit and supplying
the combustion air from the downstream side toward the upstream side in the
35 transfer direction, the upstream-side air supply port may be disposed more
upstream than the downstream-side air supply port in the transfer direction such
that the upstream-side air supply port faces the downstream-side air supply
port, and the control step may include controlling the air supply unit such that
in a case where the first predetermined region is present at a position closer to
40 the downstream-side air supply port than to the upstream-side air supply port in
the transfer direction, a first flow rate of the combustion air supplied from the

5 upstream-side air supply port is greater than a second flow rate of the
combustion air supplied from the downstream-side air supply port.
[0105]

According to the method for controlling the combustion furnace of the
present configuration, in a case where the first predetermined region where a
10 larger amount of the matter to be combusted that is uncombusted is present
than in the other regions in the transfer direction is present at a position closer
to the downstream-side air supply port than to the upstream-side air supply port
in the transfer direction, the air supply unit is controlled such that the first flow
rate of the combustion air supplied from the upstream-side air supply port is
15 greater than the second flow rate of the combustion air supplied from the
downstream-side air supply port.
[0106]

Due to the first flow rate being greater than the second flow rate, the
combustion air supplied from the upstream-side air supply port joins the
20 combustion air supplied from the downstream-side air supply port at a position
closer to the downstream-side air supply port than to an intermediate point
between the upstream-side air supply port and the downstream-side air supply
port. Thus, a larger amount of the combustion air is supplied to the first
predetermined region than to the other regions, and the combustion of the
25 matter to be combusted that is uncombusted in the first predetermined region
can be promoted.
[0107]

Additionally, due to the first flow rate being greater than the second
flow rate, an uncombusted volatile gas present in the vicinity of the first
30 predetermined region is drawn to a flow of the combustion air supplied to the
combustion furnace main body from the upstream-side air supply port, and
migrates from the first predetermined region toward the upstream-side air
supply port. Thus, the volatile gas generated from the matter to be combusted is
dispersed in the transfer direction, allowing combustion of the matter to be
35 combusted to be promoted over a wide range of regions of the combustion
furnace main body.
[0108]

In the method for controlling the combustion furnace according to the
present disclosure, the air supply unit may include an upstream-side air supply
40 port disposed above the transfer unit and supplying the combustion air from an
upstream side toward a downstream side in the transfer direction, and a
downstream-side air supply port disposed above the transfer unit and supply the

5 combustion air from the downstream side toward the upstream side in the
transfer direction, the upstream-side air supply port may be disposed more
upstream than the downstream-side air supply port in the transfer direction such
that the upstream-side air supply port faces the downstream-side air supply
port, and the control step may include controlling the air supply unit such that
10 in a case where the first predetermined region is present at a position closer to
the upstream-side air supply port than to the downstream-side air supply port in
the transfer direction, a first flow rate of the combustion air supplied from the
downstream-side air supply port is greater than a second flow rate of the
combustion air supplied from the upstream-side air supply port.

15 [0109]

According to the method for controlling the combustion furnace of the
present configuration, in a case where the first predetermined region where a
larger amount of the matter to be combusted that is uncombusted is present
than in the other regions in the transfer direction is present at a position closer
20 to the upstream-side air supply port than to the downstream-side air supply port
in the transfer direction, the air supply unit is controlled such that the first flow
rate of the combustion air supplied from the downstream-side air supply port is
greater than the second flow rate of the combustion air supplied from the
upstream-side air supply port.

25 [0110]

Due to the first flow rate being greater than the second flow rate, the
combustion air supplied from the downstream-side air supply port joins the
combustion air supplied from the upstream-side air supply port at a position
closer to the upstream-side air supply port than to the intermediate point
30 between the downstream-side air supply port and the upstream-side air supply
port. Thus, a larger amount of the combustion air is supplied to the first
predetermined region than to the other regions, and the combustion of the
matter to be combusted that is uncombusted in the first predetermined region
can be promoted.

35 [0111]

Additionally, due to the first flow rate being greater than the second
flow rate, an uncombusted volatile gas present in the vicinity of the first
predetermined region is drawn to a flow of the combustion air supplied to the
combustion furnace main body from the downstream-side air supply port, and
40 migrates from the first predetermined region toward the downstream-side air
supply port. Thus, the volatile gas generated from the matter to be combusted is
dispersed in the transfer direction, allowing combustion of the matter to be

5 combusted to be promoted over a wide range of regions of the combustion furnace main body.

[0112]

In the method for controlling the combustion furnace according to the present disclosure, the air supply unit may include a plurality of primary air
 10 supply ports that supply the combustion air from below the transfer unit toward the matter to be combusted transferred by the transfer unit, the plurality of primary air supply ports may be disposed along the transfer direction, and the control step may include controlling the air supply unit such that a first flow rate of the combustion air supplied from a primary air supply port of the
 15 plurality of primary air supply ports that is disposed at a position close to the first predetermined region is greater than a second flow rate of the combustion air supplied from a primary air supply port of the plurality of primary air supply ports that is disposed at a position close to the other regions.

[0113]

20 According to the method for controlling the combustion furnace of the present configuration, the air supply unit is controlled such that the first flow rate of the combustion air supplied from the primary air supply port disposed at the position close to the first predetermined region where a larger amount of the matter to be combusted that is uncombusted is present in the transfer
 25 direction than in the other regions is greater than the second flow rate of the combustion air supplied from the primary air supply port disposed at the position close to the other regions. Due to the first flow rate being greater than the second flow rate, a larger amount of the combustion air is supplied to the first predetermined region than to the other regions, allowing promotion of the
 30 combustion of the matter to be combusted that is uncombusted in the first predetermined region.

Reference Signs List

[0114]

- 35 10 Incinerator main body (combustion furnace main body)
- 20 Waste feeding unit (matter-to-be-combusted feeding unit)
- 21 Feeding hopper
- 22 Feeder
- 30 Stoker (transfer unit)
- 40 40 Primary air supply unit
- 41a, 41b, 41c, 41d, 41e Primary air supply port
- 42a, 42b, 42c, 42d, 42e Damper

- 5 43 Blower
- 50 Secondary air supply unit
- 51 Upstream-side air supply port
- 52 Downstream-side air supply port
- 53, 54 Damper
- 10 55 Blower
- 60 Distribution state detecting sensor
- 61 Camera
- 62 Image processing unit
- 70 Control unit
- 15 80 Heat recovery boiler
- 85 Cooling tower
- 90 Precipitator
- 95 Chimney
- 100 Stoker incinerator (combustion furnace)
- 20 200 Waste
- A Extraction region
- Pc Center of gravity position
- R Region
- TD Transfer direction
- 25 D Width direction
- r1 First predetermined region
- r2 Second predetermined region

5 Claims

[Claim 1]

A combustion furnace that combusts matter to be combusted while transferring the matter to be combusted along a transfer direction, the

10 combustion furnace comprising:

a combustion furnace main body configured to combust the matter to be combusted;

a matter-to-be-combusted feeding unit configured to feed the matter to be combusted to the combustion furnace main body;

15 a transfer unit installed in the combustion furnace main body and configured to transfer, in the transfer direction, the matter to be combusted fed to the combustion furnace main body by the matter-to-be-combusted feeding unit;

20 an air supply unit configured to supply combustion air to the combustion furnace main body;

a detecting unit configured to detect a distribution state of the matter to be combusted that is uncombusted in the transfer direction, the matter to be combusted that is uncombusted being transferred by the transfer unit; and

25 a control unit configured to control the air supply unit based on the distribution state detected by the detecting unit such that a larger amount of the combustion air is supplied to a first predetermined region than to other regions, the first predetermined region being a region where a larger amount of the matter to be combusted that is uncombusted is present in the transfer direction than in the other regions.

30

[Claim 2]

The combustion furnace according to claim 1, wherein

the detecting unit detects the distribution state based on an image of the matter to be combusted captured from above the transfer unit.

35

[Claim 3]

The combustion furnace according to claim 1, wherein

the detecting unit detects the distribution state based on a temperature distribution in the transfer direction.

40

[Claim 4]

The combustion furnace according to any one of claims 1 to 3, wherein

5 the detecting unit detects the distribution state of the matter to be combusted that is uncombusted in a width direction orthogonal to the transfer direction, and

 the control unit controls the air supply unit based on the distribution state in the width direction detected by the detecting unit such that a larger
10 amount of the combustion air is supplied to a second predetermined region than to other regions, the second predetermined region being a region where a larger amount of the matter to be combusted that is uncombusted is present in the width direction than in the other regions.

15 [Claim 5]

 The combustion furnace according to any one of claims 1 to 4, wherein the air supply unit includes:

 an upstream-side air supply port disposed above the transfer unit and configured to supply the combustion air from an upstream side toward a
20 downstream side in the transfer direction; and

 a downstream-side air supply port disposed above the transfer unit and configured to supply the combustion air from the downstream side toward the upstream side in the transfer direction,

 the upstream-side air supply port is disposed more upstream than the
25 downstream-side air supply port in the transfer direction such that the upstream-side air supply port faces the downstream-side air supply port, and

 the control unit controls the air supply unit such that, in a case where the first predetermined region is present at a position closer to the downstream-side air supply port than to the upstream-side air supply port in the transfer
30 direction, a first flow rate of the combustion air supplied from the upstream-side air supply port is greater than a second flow rate of the combustion air supplied from the downstream-side air supply port.

 [Claim 6]

35 The combustion furnace according to any one of claims 1 to 4, wherein the air supply unit includes:

 an upstream-side air supply port disposed above the transfer unit and configured to supply the combustion air from an upstream side toward a
 downstream side in the transfer direction; and

40 a downstream-side air supply port disposed above the transfer unit and configured to supply the combustion air from the downstream side toward the upstream side in the transfer direction,

5 the upstream-side air supply port is disposed more upstream than the downstream-side air supply port in the transfer direction such that the upstream-side air supply port faces the downstream-side air supply port, and
 the control unit controls the air supply unit such that, in a case where the first predetermined region is present at a position closer to the upstream-side
 10 air supply port than to the downstream-side air supply port in the transfer direction, a first flow rate of the combustion air supplied from the downstream-side air supply port is greater than a second flow rate of the combustion air supplied from the upstream-side air supply port.

15 [Claim 7]

 The combustion furnace according to any one of claims 1 to 5, wherein the air supply unit includes a plurality of primary air supply ports configured to supply the combustion air from below the transfer unit toward the matter to be combusted transferred by the transfer unit,
 20 the plurality of primary air supply ports are disposed along the transfer direction, and
 the control unit controls the air supply unit such that a first flow rate of the combustion air supplied from a primary air supply port of the plurality of primary air supply ports that is disposed at a position close to the first
 25 predetermined region is greater than a second flow rate of the combustion air supplied from a primary air supply port of the plurality of primary air supply ports that is disposed at a position close to the other regions.

 [Claim 8]

30 A method for controlling a combustion furnace that combusts matter to be combusted while transferring the matter to be combusted along a transfer direction, the combustion furnace including:

 a combustion furnace main body configured to combust the matter to be combusted;

35 a matter-to-be-combusted feeding unit configured to feed the matter to be combusted to the combustion furnace main body;

 a transfer unit installed in the combustion furnace main body and configured to transfer, in the transfer direction, the matter to be combusted fed to the combustion furnace main body by the matter-to-be-combusted feeding
 40 unit; and

 an air supply unit configured to supply combustion air to the combustion furnace main body, the method comprising:

5 a detecting step of detecting a distribution state of the matter to be
combusted that is uncombusted in the transfer direction, the matter to be
combusted that is uncombusted being transferred by the transfer unit; and
 a control step of controlling the air supply unit based on the distribution
state detected in the detecting step such that a larger amount of the combustion
10 air is supplied to a first predetermined region than to other regions, the first
predetermined region being a region where a larger amount of the matter to be
combusted that is uncombusted is present in the transfer direction than in the
other regions.

15 [Claim 9]

The method for controlling the combustion furnace according to claim 8,
wherein

the detecting step includes detecting the distribution state based on an
image of the matter to be combusted captured from above the transfer unit.

20

[Claim 10]

The method for controlling the combustion furnace according to claim 8,
wherein

the detecting step includes detecting a temperature distribution in the
25 transfer direction as the distribution state.

[Claim 11]

The method for controlling the combustion furnace according to any one
of claims 8 to 10, wherein

30 the detecting step includes detecting the distribution state of the matter
to be combusted that is uncombusted in a width direction orthogonal to the
transfer direction, and

 the control step includes controlling the air supply unit based on the
distribution state in the width direction detected in the detecting step such that
35 a larger amount of the combustion air is supplied to a second predetermined
region than to other regions, the second predetermined region being a region
where a larger amount of the matter to be combusted that is uncombusted is
present in the width direction than in the other regions.

40 [Claim 12]

The method for controlling the combustion furnace according to any one
of claims 8 to 11, wherein

5 the air supply unit includes:

 an upstream-side air supply port disposed above the transfer unit and configured to supply the combustion air from an upstream side toward a downstream side in the transfer direction; and

 a downstream-side air supply port disposed above the transfer unit and
10 configured to supply the combustion air from the downstream side toward the upstream side in the transfer direction,

 the upstream-side air supply port is disposed more upstream than the downstream-side air supply port in the transfer direction such that the upstream-side air supply port faces the downstream-side air supply port, and

15 the control step includes controlling the air supply unit such that in a case where the first predetermined region is present at a position closer to the downstream-side air supply port than to the upstream-side air supply port in the transfer direction, a first flow rate of the combustion air supplied from the upstream-side air supply port is greater than a second flow rate of the
20 combustion air supplied from the downstream-side air supply port.

[Claim 13]

 The method for controlling the combustion furnace according to any one of claims 8 to 11, wherein

25 the air supply unit includes:

 an upstream-side air supply port disposed above the transfer unit and configured to supply the combustion air from an upstream side toward a downstream side in the transfer direction; and

 a downstream-side air supply port disposed above the transfer unit and
30 configured to supply the combustion air from the downstream side toward the upstream side in the transfer direction,

 the upstream-side air supply port is disposed more upstream than the downstream-side air supply port in the transfer direction such that the upstream-side air supply port faces the downstream-side air supply port, and

35 the control step includes controlling the air supply unit such that in a case where the first predetermined region is present at a position closer to the upstream-side air supply port than to the downstream-side air supply port in the transfer direction, a first flow rate of the combustion air supplied from the downstream-side air supply port is greater than a second flow rate of the
40 combustion air supplied from the upstream-side air supply port.

[Claim 14]

- 5 The method for controlling the combustion furnace according to any one of claims 8 to 12, wherein
- the air supply unit includes a plurality of primary air supply ports configured to supply the combustion air from below the transfer unit toward the matter to be combusted transferred by the transfer unit,
- 10 the plurality of primary air supply ports are disposed along the transfer direction, and
- the control step includes controlling the air supply unit such that a first flow rate of the combustion air supplied from a primary air supply port of the plurality of primary air supply ports that is disposed at a position close to the
- 15 first predetermined region is greater than a second flow rate of the combustion air supplied from a primary air supply port of the plurality of primary air supply ports that is disposed at a position close to the other regions.