

Description
ASH DISCHARGER

Field of the Invention

5 [0001]

The present invention relates to an ash discharger that cools and discharges incinerated ash.

Background of the Invention

10 [0002]

In the related art, an incinerator plant is known as a plant for incinerating an incineration object such as waste. In an incinerator (for example, a stoker incinerator) in this plant, ash (incinerated ash) generated by incinerating the incineration object is dropped from an ash chute connected to the incinerator to an introduction port of an ash discharger, is cooled by stored
15 water in a cooling bath of the ash discharger, and then is discharged from the ash discharger to a conveyor. The ash discharger has a scraper (also referred to as a "pusher") that pushes out the incinerated ash cooled by the stored water to a discharge port. The scraper is reciprocally moved by a drive device located at
20 a room for the drive device, in a forward direction toward the discharge port and in a backward direction opposite to the forward direction to push out the incinerated ash in the stored water to the discharge port.

In the ash discharger, a water level gauge that measures the water level of the stored water, and a water injection pipe from which water is injected so
25 as to store the water at a predetermined water level in the cooling bath, are disposed in the room for the drive device.

[0003]

There can be various positional relationships between the water level gauge and the water injection pipe installed in the ash discharger. For example,
30 there is an ash discharger in which the water level gauge and the water injection pipe are arranged in a backward direction from a backward end of the scraper in a state where the scraper is moved to the most backward position (hereinafter, referred to as a "scraper's rearmost position") in a room for the drive device (hereinafter, an arrangement in which the water level gauge and
35 the water injection pipe are arranged in the backward direction from the scraper's rearmost position is referred to as a "backward arrangement") (see Patent Document 1). In addition, there is an ash discharger in which the water level gauge and the water injection pipe are arranged in the forward direction

from the scraper's rearmost position in the room for the drive device (hereinafter, an arrangement in which the water level gauge and the water injection pipe are arranged in the forward direction from the scraper's rearmost position is referred to as a "forward arrangement") (see Patent Document 2).

5 [0004]

Note that Patent Document 1 and Patent Document 2 disclose patented techniques by the present inventor. A few part of the incinerated ash introduced into the introduction port may enter the room for the drive device through a gap formed between the introduction port and the scraper, when the scraper
10 performs reciprocating movement in the forward direction and in the backward direction, and the few part of the incinerated ash (hereinafter referred to as "returned ash") may be deposited between a back surface of the scraper and a bottom plate of the room for the drive device. The patented techniques are techniques of injecting gas toward between the bottom plate and the back side
15 of the scraper in order to suppress the deposit of the returned ash.

Citation List Patent Literature

[0005]

20 Patent Document 1: JP 6718563 B
Patent Document 2: JP 6752988 B

Summary of Invention Issue to be solved by Invention

25 [0006]

As a result of research for further developing the patented techniques disclosed in Patent Document 1 and Patent Document 2, the inventor of the present invention has found that it is more effective for the reduction of the "returned ash" when the water injection pipe is arranged in the backward
30 arrangement than when the water injection pipe is arranged in the forward arrangement.

The reason for this is as follows. When the water injection pipe is arranged in the "forward arrangement", the water injected from the water injection pipe pushes back the incinerated ash that has once entered the room
35 for the drive device and the "returned ash" that has been swirled up by the reciprocating movement of the scraper toward the backward direction, and thus it is difficult to discharge the incinerated ash from the room for the drive device toward the introduction port. However, in the case of the "backward

arrangement", the water injected from the water injection pipe pushes the incinerated ash that has once entered the room for the drive device and the "returned ash" that has been swirled up toward the forward direction, and thus it is considered easy to discharge the incinerated ash from the room for the drive device toward the introduction port.

[0007]

On the other hand, the water level gauge is preferably arranged in the "forward arrangement" in order to detect a correct water level. The reason is that, when the scraper is moved to the scraper's rearmost position, a part of an upper plate of the scraper may protrude above the surface of the stored water to temporarily block the stored water on the backward direction to flow, and thus the water level measured by the water level gauge arranged in the "backward arrangement" may be significantly different from the water level on the forward direction, that is, the water level in the major part of the cooling bath.

[0008]

Here, the water injection pipe is typically formed of a straight pipe that is long in the vertical direction, and the water injected from the water injection pipe is discharged immediately below the water injection pipe. Thus, when the water level gauge is installed in the vicinity immediately below the water injection pipe, the water injected from the water injection pipe can hit the water level gauge to automatically clean the water level gauge (hereinafter referred to as "automatic cleaning" of the water level gauge).

However, for the above-described reason, in manufacturing the ash discharger in which the water injection pipe is in the "backward arrangement" and the water level gauge is arranged in the "forward arrangement", the water level gauge cannot be arranged in the vicinity immediately below the water injection pipe, and thus the automatic cleaning of the water level gauge is difficult.

Then, when a branched pipe branched from the water injection pipe is arranged immediately above the water level gauge so as to enable the automatic cleaning of the water level gauge, water is injected from the branch pipe at the same time as water injected from the water injection pipe, and thus the automatic cleaning of the water level gauge can be performed. However, it is not always possible to arrange the branched pipe immediately above the water level gauge due to the arrangement of devices and pipes installed around the ash discharger. In addition, it is not desirable to newly install the branched pipe because the manufacturing cost increases.

[0009]

Therefore, an object of the present invention is to provide an ash discharger that is able to discharge the incinerated ash in a room for the drive device and performs automatic cleaning of the water level gauge to enable appropriate and accurate measurement of a water level with a simple configuration.

Solution to the Issue

[0010]

An ash discharger of the present invention comprises

10 a cooling bath including an introduction port, having a wall surface which is a tubular shape to introduce incinerated ash, and a discharge port to discharge the incinerated ash cooled by stored water,

a scraper having a leading end in contact with an entire width of the bottom plate to push the incinerated ash toward the discharge port in the

15 cooling bath, and

a drive device to drive the scraper in a room for the drive device, where is in an opposite side of the discharge port with respect to the introduction port,

wherein the bottom plate of the cooling bath includes a first inclined surface being inclined upward from immediately below the introduction port

20 toward an opening end at which the discharge port is formed, and includes a second inclined surface having a width equal to a width of the first inclined surface and being inclined upward from immediately below the introduction port toward an opposite side of the first inclined surface,

wherein the stored water is stored in the cooling bath at a predetermined

25 water level above a lower end of the wall surface and below the discharge port, and

wherein the drive device includes a drive shaft disposed above the second inclined surface and rotates the drive shaft, such that an arm connected to the drive shaft and to the scraper causes the scraper to perform reciprocating

30 movement which is going forward and backward repeatedly along the bottom plate.

The ash discharger of the present invention further comprises

a water injection pipe in a backward arrangement arranged toward a backward direction from a scraper's rearmost position which is a position of a

35 rear end of the scraper in a state where the scraper is moved to the most backward position, in the room for the drive device, and

a water level gauge including a sensor unit having a rod shape and being disposed such that at least a lower end of the sensor unit is in a forward

arrangement arranged toward a forward direction from the scraper's rearmost position, in the room for the drive device,

wherein the water injection pipe includes a wide-angle nozzle at a leading end of the water injection pipe,

5 wherein the wide-angle nozzle sprays water at a wide angle to inject the water into the cooling bath, when the water level gauge detects that the stored water is at a level below the predetermined water level, and

wherein more than half of the water sprayed drops toward the backward direction from the scraper's rearmost position, and at least a part of water,

10 which is a part of the water dropping in the forward direction from the scraper's rearmost position, cleans the water level gauge.

Advantageous Effects of Invention

[0011]

15 According to the ash discharger of the present invention, the water injection pipe is in the backward arrangement arranged in the backward direction from the scraper's rearmost position, and more than half of the water sprayed from the wide-angle nozzle disposed at the leading end of the water injection pipe drops in the backward direction from the scraper's rearmost
20 position. Therefore, the incinerated ash that has once entered in the room for the drive device and the returned ash can be pushed in the forward direction of the scraper by the water flow caused by more than half of the water, such that the incinerated ash and the returned ash are discharged from the room for the drive device toward the introduction port. Further, because at least the lower
25 end of the sensor unit having a rod shape of the water level gauge is arranged in the forward arrangement, the water level can be appropriately detected.

When water is injected from the water injection pipe into the cooling bath, automatic cleaning of the water level gauge can be performed by at least a part of the water sprayed from the wide-angle nozzle. Thus, malfunction of the
30 water level gauge can be prevented, and the water level can be permanently and accurately detected by the water level gauge.

As described above, it is possible to provide an ash discharger that facilitates the discharge of the incinerated ash in the room for the drive device and that performs automatic cleaning of the water level gauge to enable
35 appropriate and accurate detection of a water level with a simple configuration.

Brief Description of Drawings

[0012]

FIG. 1 is a cross-sectional view of an ash discharger according to an embodiment.

FIG. 2 is a partially enlarged schematic diagram of the vicinity of a water level gauge and a water injection pipe in FIG. 1.

5 FIG. 3 is a modification example of an arrangement state of the water level gauge in FIG. 2.

Description of Embodiments of Invention

[0013]

10 An ash discharger according to an embodiment of the present invention will be described below. In each drawing used for the description, an orthogonal coordinate system including an X-axis, a Y-axis, and a Z-axis is used for convenience of the description.

15 The ash discharger of the embodiment is merely an example, and there is no intention to exclude various modifications and applications of technologies that are not explicitly described. Except for configurations essential to the present invention, each configuration of the embodiment can be selected or variously modified as necessary.

20 In the following description, an ash discharger using the gas pipe disclosed in Patent Documents 1 and 2 by the present inventor will be described, but the present invention can also be applied to an ash discharger in which the techniques disclosed in Patent Documents 1 and 2 are not employed.

[0014]

25 First, the entire configuration of an ash discharger 1 of the embodiment will be described with reference to FIG. 1. However, a water level gauge 10 will be described in detail below with reference to FIGS. 2 and 3.

30 The ash discharger 1 includes a cooling bath 2 in which stored water for cooling incinerated ash is stored at a predetermined water level (a broken line in FIG. 1), and a scraper 4 and a drive device 5 which are disposed in the cooling bath 2. The cooling bath 2 is provided with an introduction port 6 from which the incinerated ash is introduced and a discharge port 7 from which the cooled incinerated ash is discharged.

35 The stored water and liquid to be sprayed from a wide-angle nozzle 11a of a water injection pipe 11, which will be described below, may be any liquid whose main component is water, and may be tap water, industrial water, recycled water (which has been used in a plant and then treated), or may be mixed water neutralized by mixing hydrochloric acid or the like. In the

following description, these liquids used as the stored water will be simply referred to as "water".

[0015]

The introduction port 6 of the cooling bath 2 is formed of a wall surface 9 having a tubular shape (e.g., a rectangular tube shape). The wall surface 9 having a tubular shape is directly connected to an ash chute (not illustrated). The upper end of the ash chute is connected to an incinerator (not illustrated) (e.g., a post-incineration stage of a stoker incinerator).

In order to form a so-called "water seal" configuration, the lower end of the wall surface 9 is located below the predetermined water level of the stored water in the cooling bath 2.

[0016]

The scraper 4 is a device that pushes out the cooled incinerated ash toward the discharge port 7. The scraper 4 includes an upper plate 4a facing upward, a push-out plate 4b facing the discharge port 7, and both side plates connected to the upper plate 4a and the push-out plate 4b (of the both side plates, a side plate 4c on one side is illustrated in FIG. 1). No lower surface corresponding to the upper plate 4a is disposed, the scraper 4 has a box-like shape opened to the side of a bottom plate 8 of the cooling bath 2.

The scraper 4 is connected to an arm 5b to be described below and moves forward and backward along the bottom plate 8, while the lower end of the push-out plate 4b (i.e., a leading end 4d of the scraper 4) is in contact with the bottom plate 8 of the cooling bath 2 over the entire width of the bottom plate 8. A trailing end 4e of the scraper 4 is the endmost portion of the upper plate 4a in +X-axis direction, and is a portion serving as an indicator of the "scraper's rearmost position". Here, the "scraper's rearmost position" (the dash-dotted line in the vertical direction in FIG. 1) is a position of the trailing end 4e of the upper plate 4a of the scraper 4 in a state where the scraper 4 is moved to the most backward position.

Note that "forward movement" of the scraper 4 means that the scraper 4 moves in a direction (the -X-axis direction, i.e., a forward direction Df in FIG. 1) of pushing out the incinerated ash toward the discharge port 7. In addition, "backward movement" of the scraper 4 means that the scraper 4 moves in a direction (the +X-axis direction, i.e., a backward direction Dr in FIG. 1) opposite to the "forward movement". Further, the "entire width" of the bottom plate 8 of the cooling bath 2 means a dimension of the interior of the cooling bath 2 in a width direction (a direction orthogonal to the paper surface of FIG. 1, i.e., the Y-axis direction).

[0017]

The drive device 5 is a device driving the scraper 4 and is disposed in a room 12 for the drive device located on the opposite side of the discharge port 7 with respect to the introduction port 6. The room 12 for the drive device is partitioned from the outside by a wall in the most +X-axis direction among the side walls of the introduction port 6, a second inclined surface 8b in the +X-axis direction of the wall, and a ceiling plate 12a.

The drive device 5 includes a drive shaft 5a that is rotatable in two directions, and the arm 5b connecting the scraper 4 and the drive shaft 5a. The drive device 5 drives the arm 5b by rotating the drive shaft 5a, and as a result, causes the scraper 4 connected to the arm 5b to perform reciprocating movement going forward and backward repeatedly. Except for the arm 5b, the drive device 5 is disposed at a position which is located above the second inclined surface 8b to be described below and is not immersed in the stored water (above the "predetermined water level").

[0018]

The bottom plate 8 of the cooling bath 2 includes a first inclined surface 8a that is inclined upward from immediately below the introduction port 6 toward the discharge port 7 (specifically, a lower end (opening end) of the discharge port 7 in the vertical direction), and the second inclined surface 8b that is inclined upward from immediately below the introduction port 6 toward the opposite side of the first inclined surface 8a.

That is, the first inclined surface 8a is formed so as to gradually increase in height toward the forward direction Df. The second inclined surface 8b is formed so as to gradually increase in height toward the backward direction Dr.

In the cooling bath 2, a portion of the bottom plate 8 immediately below the introduction port 6 is the lowest, and the bottom plate 8 has a curved surface shape that is convex downward. The cross-sectional shape of the cooling bath 2 is uniform in the width direction, and the width dimensions of the first inclined surface 8a and the second inclined surface 8b (the dimensions in the direction orthogonal to the paper surface of FIG. 1, i.e., the dimensions in the Y-axis direction) are all the same.

[0019]

The ash discharger 1 includes, in a "backward arrangement", the water injection pipe 11 that increases the stored water in the cooling bath 2 based on a water level detected by the water level gauge 10 which will be in detail below with reference to FIG. 2 or 3. The "backward arrangement" refers to an arrangement toward the backward direction from the "scraper's rearmost

position" (indicated as the dash-dotted line in FIG. 1), that is, on the +X-axis direction side of the "scraper's rearmost position". Note that at least a part of a rod-like sensor unit of the water level gauge 10 to be described below, specifically, the lower end of the sensor unit is arranged in a "forward arrangement". Here, the "forward arrangement" refers to an arrangement toward the forward direction from the "scraper's rearmost position" (indicated as the dash-dotted line in FIG. 1), that is, on the -X-axis direction side of the "scraper's rearmost position".

The water injection pipe 11 is arranged in the backward arrangement so as to penetrate the ceiling plate 12a disposed above the second inclined surface 8b and above the drive device 5, and the water injection pipe 11 is fixed to the ceiling plate 12a.

The water injection pipe 11 is connected to a water source (not illustrated), for example, a water storage tank, and includes a wide-angle nozzle 11a at the leading end thereof. The wide-angle nozzle 11a is a nozzle, such as a full-conical nozzle, an empty-conical nozzle, or a fan-shaped nozzle, whose spray pattern expands wider as being away from a spray port.

[0020]

The amount of the stored water in the cooling bath 2 is controlled by a control device 13 and a drainage pipe 14 so as to be maintained at the "predetermined water level".

The drainage pipe 14 is a pipe that drains the stored water when the water level of the stored water exceeds the predetermined water level. An opening at the upper end of the drainage pipe 14 is arranged above and near the predetermined water level. Thus, the excessive stored water automatically overflows to be drained from the drainage pipe 14 without valve control.

[0021]

Then, the control device 13 controls the opening and closing of a solenoid valve 15 interposed in the middle of the water injection pipe 11, based on measurement data (i.e., a detection result) regarding a water level (e.g., an actual water level which is an actual water level of the stored water stored in the cooling bath 2) received from the water level gauge 10 to be described below. That is, when the measurement data (i.e., the detection result) received from the water level gauge 10 indicates that the water level of the stored water is lower than the predetermined water level, the control device 13 opens the solenoid valve 15 to cause the wide-angle nozzle 11a of the water injection pipe 11 to spray water so that the water is injected into the cooling bath 2.

At this time, more than half of the sprayed water, for example, more than 50% and 80% or less of the total amount of the water is designed to drop toward the backward direction from the scraper's rearmost position, and at least a part of the remaining water is designed to drop toward the forward direction from the scraper's rearmost position after hitting the rod-like sensor unit of the water level gauge 10 to be described below. The incinerated ash that has once entered the room for the drive device and the returned ash can be pushed out in the forward direction of the scraper 4 by the water flow caused when the more than half of the water drops toward the backward direction from the scraper's rearmost position, and therefore, these incinerated ashes can be discharged from the room 12 for the drive device toward the introduction port 6.

On the other hand, when the measurement data indicates that the water level of the stored water is equal to or higher than the predetermined water level, the control device 13 closes the solenoid valve 15 to stop the water injection into the cooling bath 2.

[0022]

As described above, the ash discharger 1 of FIG. 1 is an ash discharger that employs the patented technique of Patent Document 1 (JP 6718563 B) or Patent Document 2 (JP 6752988 B) acquired by the inventor of the present invention, that is, a gas pipe 17 that suppresses deposit of the returned ash, and thus this point will also be briefly described below. The present invention can also be applied to an ash discharger to which the technique of Patent Document 1 or Patent Document 2 is not applied. However, a more favorable effect can be achieved when the technique of Patent Document 1 or Patent Document 2 is also used, and thus the above-described point will be described as an example.

[0023]

The gas pipe 17 is disposed at a position which is located above the second inclined surface 8b and toward the +X-axis direction from the scraper's rearmost position, that is, a position that does not come into contact with the scraper 4 and the arm 5b that perform reciprocating movement. The gas pipe 17 is linearly arranged in the vertical direction (i.e., Z-axis direction) from one end 17a (i.e., the lower end) to another end 17b (i.e., the upper end) of the gas pipe 17.

In the gas pipe 17, the one end 17a disposed below the predetermined water level has an L-shape with a corner portion bent in the substantially horizontal direction, and the corner portion is disposed in contact with the second inclined surface 8b. The one end 17a is provided with a gas injection

port 17c opening in the substantially horizontal direction (i.e., -X-axis direction).

A compressor 17d is provided at the other end 17b disposed above the ceiling plate 12a. Gas injected from the gas injection port 17c of the gas pipe
 5 17 is, for example, compressed air compressed by the compressor 17d.

A solenoid valve 17e for the gas is installed at the gas pipe 17. When the control device 13 opens the solenoid valve 17e at a predetermined timing, the gas is injected from the gas injection port 17c.

[0024]

10 The water flow and bubbles generated by the gas injected from the gas injection port 17c in the vicinity of the second inclined surface 8b travel to the forward direction Df (i.e., -X-axis direction) between the second inclined surface 8b and the scraper 4, and eventually rebound by gently hitting the back side of the push-out plate 4b or the back side of the upper plate 4a of the
 15 scraper 4 at a reduced speed, or swirl without hitting the back side. Accordingly, the returned ash deposited in a space 16 on the upper side of the second inclined surface 8b in the cooling bath 2 (for example, the space above the second inclined surface 8b or the space on the back side of the scraper 4) is separated by the bubbles of the gas, and not only the separated returned ash but
 20 also the returned ash about to deposit in the space 16 is stirred by the water flow.

Then, the returned ash is pushed upward to the water surface from the back side of the scraper 4 and the vicinity of the second inclined surface 8b by the buoyancy of the bubbles and dispersed. That is, a water flow, pushed
 25 upward to the water surface from the back side of the scraper 4 and the vicinity of the second inclined surface 8b, is generated.

[0025]

Accordingly, in the case that the control device 13 performs the control of gas injection from the gas injection port 17c, when the control device 13
 30 performs the control of water injection from the wide-angle nozzle 11a of the water injection pipe 11, the water flow toward the introduction port 6 generated by the water injection and the water flow flowing upward and toward the introduction port generated by the gas in a backward arrangement, are combined, and therefore, the incinerated ash can be more smoothly discharged
 35 toward the introduction port 6 from the above-described gap formed between the scraper 4 and the wall surface of the wall surface 9 on the most +X-axis direction side, as compared with the case where the gas is not injected.

[0026]

Next, the water level gauge 10 will be described in detail with reference to FIG. 2. FIG. 2 is a partially enlarged schematic diagram of the vicinity of the water level gauge 10 and the water injection pipe 11 illustrated in FIG. 1. FIG. 2 is a schematic diagram, and therefore, not all of the components in the vicinity illustrated in FIG. 1 are illustrated in FIG. 2.

The water level gauge 10 includes at least a base portion 10e and a rod-like sensor unit. The base portion 10e accommodates a circuit for generating the above-described measurement data (i.e., the detection result) and the like.

Here, FIG. 2 illustrates an example of the water level gauge 10 in which a plurality of rod-like sensors, for example, four rod-like electrodes 10a to 10d (a plurality of electrodes) serving as sensors are disposed as the rod-like sensor unit.

[0027]

A flanged inclined pipe 19 is disposed in the backward arrangement in the vicinity of the scraper's rearmost position, and fixed to the ceiling plate 12a of the room 12 for the drive device. The flanged inclined pipe 19 is inclined from the Z axis (i.e., vertical direction) to the +X-axis direction (to the backward direction Dr) by about 30° to about 60°.

A flange included in the base portion 10e and a flange included in the flanged inclined pipe 19 are fastened together by bolts and nuts via a gasket or an O-ring. The electrodes 10a to 10d are the rod-like sensors of the water level gauge 10, and the upper end of each of the electrodes 10a to 10d is inserted through a through-hole formed in the ceiling plate 12a and attached to the base portion 10e.

Because the flanged inclined pipe 19 is inclined as described above, the lower end of each of the electrodes 10a to 10d can be arranged in the forward arrangement, while the base portion 10e is arranged in the backward arrangement. That is, each of the rod-like electrodes 10a to 10d is disposed with an inclination such that the upper end thereof is arranged in the backward arrangement and the lower end thereof is arranged in the forward arrangement.

[0028]

As described above, when the scraper 4 is moved to the most rearward position, the rear end of the upper plate 4a of the scraper 4 may protrude above the surface of the stored water and temporarily block the stored water on the backward direction side of the rear end. However, because the lower end of each of the electrodes 10a to 10d is arranged in the forward arrangement, the water level measured by the water level gauge 10 is the same as the water level

in a major part of the cooling bath 2. That is, the water level can be appropriately measured by the water level gauge 10.

Both the base portion 10e of the water level gauge 10 and the water injection pipe 11 are arranged in the backward arrangement, that is, both are disposed near a walkway. Thus, there is an advantage that an operator can easily perform maintenance.

[0029]

In addition, as described above, the wide-angle nozzle 11a is disposed such that, when water is sprayed from the wide-angle nozzle 11a of the water injection pipe 11, more than half of the sprayed water drops in the backward direction with respect to the scraper's rearmost position, and at least part of the remaining water hits each of the inclined electrodes 10a to 10d. Therefore, the wide-angle nozzle 11a is desirably disposed so as to be inclined from the water injection pipe 11.

In this way, each of the electrodes 10a to 10d is automatically cleaned with the water sprayed from the wide-angle nozzle 11a, when the water is injected from the water injection pipe 11. Accordingly, by this automatic cleaning, malfunction of the water level gauge 10 during the operation of the ash discharger 1 is prevented, and the water level gauge 10 can accurately measure or detect the water level.

In FIG. 2, the wide-angle nozzle 11a is disposed such that a spraying direction is obliquely downward in the -X-axis direction (i.e., in the forward direction Df) with respect to the water injection pipe 11 disposed along the vertical direction. The water having hit each of the electrodes 10a to 10d flows down, along the respective electrodes with cleaning the respective electrodes, to the lower ends thereof, and drops into the stored water toward the -X-axis direction (i.e., toward the forward direction Df) from the scraper's rearmost position.

[0030]

A separator 18 having an electrical insulating property includes openings provided in accordance with the thicknesses and the positions of the electrodes 10a to 10d on the XZ plane. By inserting the electrodes 10a to 10d into the openings of the separator 18 having the insulating property, the electrodes 10a to 10d are prevented from coming into contact with each other. The separator 18 is disposed upward in order for the separator 18 not to be hit by the water sprayed from the wide-angle nozzle 11a of the water injection pipe 11.

The electrodes 10a to 10d, which are fixed by the separator 18 so as not to come into contact with each other, are disposed at positions slightly different

from each other in the Y-axis direction so as not to overlap with each other, thus the electrodes 10a to 10d are easily hit by the water sprayed from the wide-angle nozzle 11a.

In addition, although not illustrated, in order to prevent the deflection of the rod-like electrodes 10a to 10d disposed in an obliquely inclined manner, the electrodes are preferably supported above the separator 18 by an L-shaped insulating support member having one end fixed to the ceiling plate 12a.
[0031]

Among the electrodes 10a to 10d, the first electrode 10a, the second electrode 10b, and the third electrode 10c are detection electrodes. The lower end of the first electrode 10a is arranged at a height of the predetermined water level. The lower end of the second electrode 10b is arranged at a height lower than the predetermined water level. The lower end of the third electrode 10c is arranged at a height above the predetermined water level. The lower end of the common electrode 10d is arranged below the lower end of the second electrode 10b.

The water (i.e., the stored water) stored in the cooling bath 2 of the ash discharger 1 is an electric conductor. Thus, when the common electrode 10d is not electrically connected to any of the first electrode 10a, the second electrode 10b, and the third electrode 10c, the water level gauge 10 determines that the water level of the stored water is lower than the lower end of the second electrode 10b, and generates the corresponding measurement data (i.e., the detection result).

When the common electrode 10d is electrically connected to only the second electrode 10b, the water level gauge 10 determines that the water level of the stored water is equal to or higher than the lower end of the second electrode 10b and lower than the lower end of the first electrode 10a, and generates the corresponding measurement data.

When the common electrode 10d is electrically connected to only the second electrode 10b and the first electrode 10a, the water level gauge 10 determines that the water level of the stored water is equal to or higher than the lower end (i.e., the predetermined water level) of the first electrode 10a and lower than the lower end of the third electrode 10c, and generates the corresponding measurement data.

When the common electrode 10d is electrically connected to all of the second electrode 10b, the first electrode 10a, and the third electrode 10c, the water level gauge 10 determines that the water level of the stored water is equal

to or higher than the lower end of the third electrode 10c, and generates the corresponding measurement data.

[0032]

Note that an example in which four electrodes are provided as the plurality of rod-like sensors has been described here, but the number of sensors
5 may be three or less or five or more, depending on the design.

In addition, for example, when a detection method by electrostatic capacitance or a detection method by pulse wave reflection is employed in substitution for the detection method by electrical connection between the
10 common electrode and the detection electrodes, it is possible to configure the water level gauge 10 that can measure different water levels with only one rod-like sensor. That is, the water level gauge 10 may include a plurality of rod-like sensors or a single rod-like sensor.

[0033]

As described above, when the scraper 4 is moved to the most rearward position, the trailing end 4e of the upper plate 4a of the scraper 4 and a part of the vicinity thereof may protrude above the surface of the stored water. The electrodes 10a to 10d of the water level gauge 10, disposed with an inclination illustrated in FIG. 2, intersect the vertical direction (i.e., Z-axis) at the
15 scraper's rearmost position on the XZ plane, and therefore, it is necessary to precisely design the electrodes so as not to come into contact with the part of the upper plate 4a protruding above.

Thus, as illustrated in FIG. 3, it is possible to avoid the precise design that may increase cost by disposing the entirety of the water level gauge 10 in the forward arrangement in the vicinity of the scraper's rearmost position, for
20 example, at a distance of about 10 cm to 50 cm toward the -X-axis direction (i.e., toward the forward direction Df) from the scraper's rearmost position.

[0034]

FIG. 3 is a modification example of an arrangement state of the water level gauge 10 in FIG. 2. FIG. 3 differs from the configuration illustrated in FIG. 2 only in that the flanged inclined pipe 19 is not provided, and that the entirety of the water level gauge 10 is disposed in the forward arrangement in the vicinity of the scraper's rearmost position and is fixed in the vertical direction as a whole, and the other components are the same. Thus, description
30 of the same components is omitted.

In the water level gauge 10 of FIG. 3, the flange included in the base portion 10e is fixed to the ceiling plate 12a with bolts and nuts. For this reason, each of the rod-like electrodes 10a to 10d serving as the rod-like sensor unit is

disposed such that the length direction thereof coincides with the vertical direction.

Even with such a configuration, when water is sprayed from the wide-angle nozzle 11a of the water injection pipe 11, more than half of the sprayed water drops toward the backward direction from the scraper's rearmost position, at least a part of the remaining water hits each of the electrodes 10a to 10d disposed in the forward arrangement, and therefore, the electrodes can be automatically cleaned.

[0035]

As described above, with the simple configurations illustrated in FIGS. 1 to 3, the ash discharger 1 can help the discharge of the incinerated ash in the room 12 for the drive device and automatically clean the water level gauge 10 to enable appropriate and accurate measurement of the water level.

In the ash discharger 1, the water injection pipe 11 is desirably disposed in the backward arrangement as much as possible, but the water injection pipe 11 can be appropriately adjusted in the X-axis direction in accordance with the spray pressure and the spray angle of the wide-angle nozzle 11a as long as the gist of the present invention is not violated. Further, the lower end of the rod-like sensor unit of the water level gauge 10 arranged in the forward arrangement is desirably arranged in the vicinity of the scraper's rearmost position as much as possible, but, similarly, can be appropriately adjusted in the X-axis direction in accordance with the spray pressure and the spray angle of the wide-angle nozzle 11a as long as the gist of the present invention is not violated.

Reference Signs List

[0036]

1 Ash discharger

2 Cooling bath

3 Conveyor

4 Scraper

4a Upper plate

4b Push-out plate

4c Side plate

4d Leading end

4e Trailing end

5 Drive device

5a Drive shaft

- 5b Arm
- 6 Introduction port
- 7 Discharge port
- 8 Bottom plate
- 5 8a First inclined surface
- 8b Second inclined surface
- 9 Wall surface
- 10 Water level gauge
- 10a to 10d Rod-like sensor unit (detection electrodes, common electrode)
- 10 10e Base portion
- 11 Water injection pipe
- 11a Wide-angle nozzle
- 12 Room for drive device
- 12a Ceiling plate
- 15 13 Control device
- 14 Drainage pipe
- 15 Solenoid valve
- 16 Space
- 17 Gas pipe
- 20 17a One end of gas pipe
- 17b Another end of gas pipe
- 17c Gas injection port
- 17d Compressor
- 17e Solenoid valve for gas
- 25 18 Separator
- 19 Flanged inclined pipe
- Df Forward direction
- Dr Backward direction

Claims

[Claim 1]

- An ash discharger comprising
- 5 a cooling bath including an introduction port, having a wall surface which is a tubular shape to introduce incinerated ash, and a discharge port to discharge the incinerated ash cooled by stored water,
- a scraper having a leading end in contact with an entire width of the bottom plate to push the incinerated ash toward the discharge port in the
- 10 cooling bath, and
- a drive device to drive the scraper in a room for the drive device, where is in an opposite side of the discharge port with respect to the introduction port,
- wherein the bottom plate of the cooling bath includes a first inclined surface being inclined upward from immediately below the introduction port
- 15 toward an opening end at which the discharge port is formed, and includes a second inclined surface having a width equal to a width of the first inclined surface and being inclined upward from immediately below the introduction port toward an opposite side of the first inclined surface,
- wherein the stored water is stored in the cooling bath at a predetermined
- 20 water level above a lower end of the wall surface and below the discharge port,
- wherein the drive device includes a drive shaft disposed above the second inclined surface and rotates the drive shaft, such that an arm connected to the drive shaft and to the scraper causes the scraper to perform reciprocating movement which is going forward and backward repeatedly along the bottom
- 25 plate,
- and comprising
- a water injection pipe in a backward arrangement arranged toward a backward direction from a scraper's rearmost position which is a position of a rear end of the scraper in a state where the scraper is moved to the most backward position,
- 30 in the room for the drive device, and
- a water level gauge including a sensor unit having a rod shape and being disposed such that at least a lower end of the sensor unit is in a forward arrangement arranged toward a forward direction from the scraper's rearmost position, in the room for the drive device,
- 35 wherein the water injection pipe includes a wide-angle nozzle at a leading end of the water injection pipe,

wherein the wide-angle nozzle sprays water at a wide angle to inject the water into the cooling bath, when the water level gauge detects that the stored water is at a level below the predetermined water level, and

wherein more than half of the water sprayed drops toward the backward
 5 direction from the scraper's rearmost position, and at least a part of water, which is a part of the water dropping in the forward direction from the scraper's rearmost position, cleans the water level gauge.

[Claim 2]

10 The ash discharger according to claim 1,
 wherein the water injection pipe and the water level gauge are disposed so as to penetrate a ceiling plate disposed above the second inclined surface and above the drive device, and
 wherein the water level gauge is disposed with an upper portion thereof
 15 arranged in the backward arrangement and a lower portion thereof arranged in the forward arrangement, so as to be inclined as a whole.

[Claim 3]

The ash discharger according to claim 1,
 20 wherein the water injection pipe and the water level gauge are disposed so as to penetrate a ceiling plate disposed above the second inclined surface and above the drive device, and
 wherein the water level gauge is arranged in the forward arrangement as a whole.

25

[Claim 4]

The ash discharger according to claim 2 or 3,
 wherein the sensor unit includes
 a common electrode having a rod-like shape,
 30 a first electrode having a rod-like shape and configured to detect that the stored water is at the predetermined water level,
 a second electrode having a rod-like shape and configured to detect that the stored water is below the predetermined water level,
 a third electrode having a rod-like shape and configured to detect that
 35 the stored water is above the predetermined water level, and
 a separator that prevents the electrodes from coming into contact with each other.

[Claim 5]

The ash discharger according to claim 4, further comprising
a gas pipe disposed so as to extend from one end to another end at a
position which is located above the second inclined surface and is not in
5 contact with the scraper performing the reciprocating movement and the arm,
wherein the one end of the gas pipe is arranged below the predetermined
water level and is provided with a gas injection port from which the gas
introduced from the other end is injected between the second inclined surface
and the scraper, and
10 returned ash about to deposit on the second inclined surface is stirred by
water flow of the stored water caused by the gas injected from the gas injection
port and bubbles due to the gas.