

Description

Title of the Invention

ASH DISCHARGER

5 Field of the Invention

[0001]

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

10 Background of the Invention

[0002]

In the related art, an incinerator plant is known as a plant for incinerating an incineration object such as waste. In an incinerator (e.g., a stoker incinerator) in this plant, ash (i.e., incinerated ash) generated by incinerating the incineration object, is dropped from an ash chute into an ash discharger, cooled by stored water in a cooling bath of the ash discharger, and then discharged from the ash discharger to a conveyor. The ash discharger is provided with 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 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 toward 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 that injects water to store water at a predetermined water level in the cooling bath, are disposed.

[0003]

There can be various positional relationships between the water level gauge and the water injection pipe, in the ash discharger. For example, the water level gauge and the water injection pipe are arranged toward a backward direction from a backward end of the scraper in a state where the scraper is moved to the most backward (hereinafter, referred to as a "scraper's rearmost position", and an arrangement in which a water level gauge and a water injection pipe are arranged toward a backward direction from the scraper's rearmost position is referred to as a "backward arrangement"), when the water level gauge and the water injection pipe cannot be arranged in a forward direction from the scraper's rearmost position (hereinafter, an arrangement toward the forward direction from the scraper's rearmost position is referred to

as a "forward arrangement"), due to the arrangement of peripheral devices other than the ash discharger and due to piping.

Regarding the ash discharger, the backward arrangement of the water level gauge and the water injection pipe means that the water level gauge and the water injection pipe are disposed closer to a walkway, and therefore, it is excellent that an operator can easily perform maintenance than the forward arrangement of the water level gauge and the water injection pipe.

[0004]

In addition, the backward arrangement of the water injection pipe is also advantageous in the following respect.

In the ash discharger, a part of the incinerated ash introduced into the introduction port may go toward the drive device through a gap formed between the introduction port and the scraper, when the scraper performs reciprocating movement in the forward direction and in the backward direction, and the incinerated ash (hereinafter referred to as "return ash") may be deposited between a back surface of the scraper and a bottom plate below the drive device. Thus, in order to suppress the deposition of the return ash, a technique of injecting gas between the bottom plate and the back surface of the scraper has been developed (see Patent Document 1). The returned ash can be stirred by injecting the gas so as to prevent the deposition, and the stirred returned ash can be discharged from the gap toward the introduction port. At this time, when the water injection pipe is arranged in the backward arrangement, the discharge of the returned ash can be effectively performed by a water flow generated by water injection from the water injection pipe.

Further, in the case that the water level gauge is also arranged in the backward arrangement in addition to the water injection pipe and that the water level gauge is located near the water injection pipe, when water is injected from the water injection pipe, the water level gauge can be automatically washed by the injected water, and therefore, it is also an advantage that erroneous measurement by the water level gauge can be prevented.

Citation List

Patent Literature

[0005]

Patent Document 1: JP 6718563 B

Summary of the Invention

Issue to be solved by the Invention

[0006]

However, as described above, the incinerated ash goes toward the drive device through the gap formed between the introduction port and the scraper during the reciprocating movement of the scraper. The incinerated ash may include not only powdery or granular ash but also relatively large lumps. When a large lump goes toward the drive device through the gap, the large lump may move with the water flow and hit the water level gauge. When the large lump continues to move with the water flow while being in contact with the water level gauge, the water level gauge may bend beyond a bendable limit, and then, a failure, such as deforming the water level gauge to be bent permanently or breakage of the water level gauge, may occur.

Thus, it is conceivable to surround the entire periphery of the water level gauge with a shield except for the lower part thereof. However, in this case, automatic cleaning of the water level gauge by using water injection from the water injection pipe cannot be performed. Further, because the water flow is obstructed by the shield, there is a possibility that the return ash cannot be smoothly discharged from the gap toward the introduction port.

Therefore, an object of the present invention is to provide an ash discharger that can prevent the failure of a water level gauge without obstructing water flow and that can perform automatic cleaning of the water level gauge, even with a configuration in which the water level gauge and a water injection pipe are arranged in the backward arrangement.

25 Solution to the Issue

[0007]

An ash discharger of the present invention includes
 a cooling bath including an introduction port, having a wall surface which is shaped like a tube 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 a bottom plate to push the incinerated ash toward the discharge port in the cooling bath, and
 a drive device to drive the scraper, disposed 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

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,

5 wherein the stored water is stored in the cooling bath at a predetermined 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
10 movement which is going forward and backward repeatedly along the bottom plate.

 And the ash discharger of the present invention includes
 a water injection pipe in backward arrangement arranged toward a backward direction from a scraper's rearmost position which is a position of a
15 rear end of the scraper in a state where the scraper is moved to the most backward position, and including a nozzle spraying water at a leading end thereof,

 a water level gauge in the backward arrangement, including a sensor which is shaped like a rod or a plurality of sensors each of which is shaped like
20 a rod, and

 a protector which is shaped like a fence, in which the sensor or each of the sensors is inserted to restrict a movement of a lower part of the sensor or the sensors not to be bending, and including no shielding object in a main passage of the water sprayed toward the sensor or the sensors,

25 wherein the water injection pipe and the water level gauge are penetrating a ceiling plate for the drive device, which is above the second inclined surface and above the drive device,

 wherein the protector is fixed to the ceiling plate, and
 wherein water is sprayed from the nozzle to be injected into the cooling
30 bath, and the sensor or each of the sensors is washed by at least a part of the water sprayed, when the stored water falls below the predetermined water level.

Advantageous Effects of the Invention

[0008]

35 According to the ash discharger of the present invention, the water level gauge and the water injection pipe are arranged in the "backward arrangement" which is in a backward position from the scraper's rearmost position. The

water level gauge is inserted into the protector fixed to the ceiling plate, and therefore, the movement of the lower part of the rod-like sensor of the water level gauge is restricted and the sensor is not bent beyond an allowable degree, even when the incinerated ash moves with water flow and comes in contact with the sensor. Accordingly, the failure of the water level gauge can be prevented.

In addition, because the protector includes no shielding object in the main passage of the water sprayed from the nozzle of the water injection pipe toward the water level gauge protected by the protector, the water level gauge is automatically washed effectively and sufficiently by the sprayed water, and therefore, accurate water level measurement by the water level gauge (i.e., prevention of malfunction) is possible.

Further, because the protector is shaped like a fence, the protector does not obstruct the water flow. Therefore, the return ash can be smoothly discharged from the gap toward the introduction port.

That is, it is possible to provide an ash discharger that can prevent the failure of the water level gauge without obstructing the water flow and automatically wash the water level gauge, even with a configuration in which the water level gauge and the water injection pipe are arranged in the backward arrangement.

Brief Description of Drawings

[0009]

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

FIG. 2 is an enlarged view of a main part near a protector of the ash discharger illustrated in FIG. 1.

FIG. 3 is a side view of a protector 18 illustrated in FIG. 2.

FIG. 4 illustrates cross-sectional views of the protector 18 of FIG. 3 as viewed from arrows A, B and C, respectively.

FIG. 5 is a side view of a protector 18' which is a modification example of the protector 18 illustrated in FIG. 2.

FIG. 6 illustrates cross-sectional views of the protector 18' of FIG. 5 as viewed from arrows A, B and C, respectively.

FIG. 7 illustrates diagrams showing examples in which the arrangement of coupling rods of the protector 18 illustrated in FIG. 2 is changed.

FIG. 8 illustrates diagrams showing examples in which the arrangement of coupling rods of the protector 18' illustrated in FIG. 5 is changed.

FIG. 9 illustrates diagrams showing arrangements of the protector and rod-like sensors of a water level gauge.

5 FIG. 10 illustrates diagrams showing positional relationships between the protector and a nozzle.

Description of Embodiments of the Invention

[0010]

10 Hereinafter, an ash discharger according to an embodiment of the present invention and a protector and the like, which are essential components of the ash discharger, will be described with reference to FIGS. 1 to 10. In each drawing, an orthogonal coordinate system including an X-axis, a Y-axis, and a Z-axis is used for convenience of description.

15 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 elements essential to the present invention, each element of the embodiment can be selected or variously modified as necessary.

20 Hereinafter, the overall configuration of the ash discharger will be described first, and then the configuration of the protector will be described in detail.

 In the following description, an ash discharger using the gas pipe 17 disclosed in Patent Document 1 by the present inventor will be described, but
25 the present invention can also be applied to an ash discharger in which the technique disclosed in Patent Documents is not employed.

[0011]

1. Entire Configuration of Ash Discharger

 The entire configuration of an ash discharger 1 of the embodiment will
30 be described in FIG. 1.

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

The stored water and liquid to be sprayed from 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
 5 hydrochloric acid or the like. In the following description, these liquids used as the stored water will be simply referred to as "water".

[0012]

The introduction port 6 of the cooling bath 2 is formed of a wall surface 9 which is shaped like a tube (e.g., a rectangular tube). The wall surface 9
 10 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).

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
 15 the cooling bath 2.

[0013]

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 side, and both side
 20 surfaces connected to the upper plate 4a and the push-out plate 4b (In Fig.1, a side surface 4c on one side of the both side surfaces is illustrated). Because no lower plate corresponding to the upper plate 4a is disposed, the scraper 4 is shaped like a box 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
 25 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 entire width of the bottom plate 8 of the cooling bath 2. A rear end 4e of the scraper 4 indicates the "scraper's rearmost position", and is typically an end of the upper plate 4a toward the +X-axis. The "scraper's rearmost position"
 30 (i.e., the dash-dotted line in FIG. 1) is a position of the rear end 4e of the scraper 4 in a state where the scraper 4 is moved to the most backward position.

Here, the "forward movement" of the scraper 4 means that the scraper 4 moves toward 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
 35 addition, "backward movement" of the scraper 4 means that the scraper 4 moves toward 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 (i.e., Y-axis direction in FIG. 1).

[0014]

The drive device 5 to drive the scraper 4 is disposed on the opposite side of the discharge port 7 with respect to the introduction port 6. The drive device 5 is disposed at a position which is located above a second inclined surface 8b to be described below, and the drive device 5 is not immersed in the stored water (i.e., above the "predetermined water level"). 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.

[0015]

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, toward a lower end in an 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 to gradually increase in height toward the forward direction Df. The second inclined surface 8b is formed 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 (hereinafter, referred to as a "lowermost surface 8c") is the lowest, and the bottom plate 8 has a curved surface 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, the lowermost surface 8c, 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.

[0016]

The ash discharger 1 includes, in a "backward arrangement", a water level gauge 10 that detects a water level of the stored water in the cooling bath 2, and the water injection pipe 11 that increases the stored water in the cooling bath 2 based on the water level detected by the water level gauge 10. The "backward arrangement" refers to an arrangement toward the backward

direction from the "scraper's rearmost position" (i.e., the dash-dotted line in FIG. 1), that is, on the +X-axis direction side of the "scraper's rearmost position".

As an example, only one water level gauge 10 is described here. But
 5 two or more water level gauges may be disposed. For example, in this case, the water level gauge 10 may be used for alarming, and another water level gauge different from the water level gauge 10 is used for detecting water level, and water is injected from the water injection pipe 11 to increase the stored water in the cooling bath 2 when the different water level gauge detects the
 10 water level lower than the predetermined water level.

[0017]

The water level gauge 10 and the water injection pipe 11 are arranged in the backward arrangement. The water level gauge 10 and the water injection pipe 11 penetrate a ceiling plate 12 for the drive device disposed above the
 15 second inclined surface 8b and above the drive device 5, and the water level gauge 10 and the water injection pipe 11 are fixed to the ceiling plate 12.

The water level gauge 10 measures a water level of water stored in the cooling bath 2 and transmits measurement data to a control device 13. The water level gauge 10 is protected by a protector 18 fixed to the ceiling plate 12.
 20 The protector 18 will be described in detail below.

The water injection pipe 11 is connected to a water source (not illustrated), for example, to a water storage tank, and includes a nozzle 11a at the leading end thereof. In order to automatically wash the water level gauge 10 with all or at least a part of the water sprayed from the nozzle 11a of the
 25 water injection pipe 11, the nozzle 11a is disposed near the water level gauge 10, for example, in the vicinity on the backward direction Dr (toward +X-axis direction) of the water level gauge 10 in FIG. 1.

In many cases, the nozzle 11a is installed with a spray port thereof directed downwardly in the vertical direction (i.e., Z-axis direction), which is
 30 desirably a nozzle such as a full-conical nozzle, an empty-conical nozzle, or a fan-shaped nozzle whose spray pattern spreads over a wider area as being away from the spray port, for the water level gauge 10 to be automatically washed. However, the nozzle 11a is not limited to these nozzles, and when the nozzle 11a is installed with the spray port of the nozzle 11a directed to the water level
 35 gauge 10, a nozzle whose spray pattern is a straight pattern may be used depending on the design. In that case, the water level gauge 10 can be automatically washed by using all of the water sprayed from the nozzle 11a.

[0018]

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

5 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.

10 Then, the control device 13 controls the opening and the closing of a solenoid valve 15 interposed in the middle of the water injection pipe 11, based on measurement data regarding a water level (e.g., an actual water level of the stored water in the cooling bath 2) received from the water level gauge 10. When the measurement data received from the water level gauge 10 indicates
15 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 nozzle 11a of the water injection pipe 11 to spray water, and then, the water is injected into the cooling bath 2. On the other hand, when the measurement data indicates that the water level of the stored water is equal to or higher than the
20 predetermined water level, the control device 13 closes the solenoid valve 15 to stop the water injection into the cooling bath 2.

[0019]

As described above, the ash discharger 1 of FIG. 1 is the ash discharger that employs the patented technique of Patent Document 1 (JP 6718563 B)
25 acquired by the inventor of the present invention. Therefore, a gas pipe 17 suppresses deposition of return 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 is not applied. A more favorable effect can be achieved when the technique of Patent Document
30 1 is also used, and thus the above-described point will be described as an example.

[0020]

35 The gas pipe 17 is disposed at a position where is located above the second inclined surface 8b, where is toward the +X-axis direction from the scraper's rearmost position, and where 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., a lower end) to another end 17b (i.e., an 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 toward the substantially horizontal direction (i.e., -X-axis direction).

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

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

[0021]

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 toward 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 scraper 4 at a reduced speed, or swirl without hitting the back sides. Therefore, the return 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 the return ash being about to deposit in the space 16 and the return ash separated by the bubbles are stirred by the water flow.

Then, the return 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 upward to the water surface from the back side of the scraper 4 and the vicinity of the second inclined surface 8b is generated.

[0022]

When the control device 13 performs the control of the gas injection from the gas injection port 17c and the control of the water injection from the nozzle 11a of the water injection pipe 11 simultaneously, water flow toward the introduction port generated by the water injection, and water flow flowing

upward and toward the introduction port generated by the gas in an area of the backward arrangement, are combined. Therefore, the incinerated ash can be more smoothly discharged toward the introduction port 6 from the above-described gap formed between the scraper 4 and the wall surface on the most +X-axis direction in the wall surface 9, as compared with a case that the gas is not injected.

[0023]

2. Detailed Description of Protector

The protector will be described in detail.

10 The protector 18 protects the water level gauge 10 including one or a plurality of rod-like sensors arranged in the backward arrangement. The protector 18 is shaped like a fence, in which the sensor of the water level gauge 10 is inserted, includes no shielding object in a main passage of the water sprayed from the nozzle 11a of the water injection pipe 11 toward the sensor, and is configured to restrict the movement of a lower part of the sensor to prevent the sensor from bending.

An example of a configuration in which the protector 18 is embodied will be described below.

[0024]

20 Before describing the protector 18, the sensor of the water level gauge 10 protected by the protector 18 will be described first. Here, as illustrated in FIG. 2, an example, in which a plurality of rod-like sensors, for example, four electrodes 10a to 10d (i.e., a plurality of electrodes) having a rod-like shape, are each disposed as the sensors, is explained.

25 The upper end of each of the electrodes 10a to 10d of the water level gauge 10 is attached to a base portion 10e fixed above the ceiling plate 12 for the drive device 5. Each of the electrodes 10a to 10d extends downward and toward the vertical direction (i.e., Z-axis direction) from the base portion 10e.

A separator 19, having an electrical insulating property, includes openings corresponding to the thicknesses and to the positions of the electrodes 10a to 10d on the XY plane. By inserting the electrodes 10a to 10d into the openings of the separator 19 having the insulating property, the electrodes 10a to 10d are prevented from contacting with each other. The separator 19 is disposed above a second annular section 18b, in order that the separator 19 is not hit by the water sprayed from the nozzle 11a of the water injection pipe 11.

The base portion 10e is fixed to the upper surface of the ceiling plate 12 by bolts and nuts, for example. The base portion 10e accommodates a circuit for generating the above-described measurement data and the like.

Among the electrodes 10a to 10d, the first electrode 10a, the second
 5 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.

10 The lower end of the common electrode 10d is arranged below the lower end of the second electrode 10b.

[0025]

The water (i.e., stored water) stored in the cooling bath 2 of the ash
 discharger 1, is an electric conductor. When the common electrode 10d is not
 15 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 the water level gauge 10 generates measurement data.

When the common electrode 10d is electrically connected to only the
 20 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 the water level gauge 10 generates measurement data.

When the common electrode 10d is electrically connected to only the
 25 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 the water level gauge 10 generates measurement data.

30 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 the water level gauge 10 generates measurement data.

35 [0026]

An example, in which four electrodes are provided as the plurality of rod-like sensors, has been described here, but the number of sensors may be

three or less or five or more, corresponding to the design of the water level gauge 10.

In addition, for example, when a detection method by electrostatic capacitance or a detection method by pulse wave reflection is employed, instead of the detection method by electrical connection between the 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 (e.g., see a rod-like sensor 10f in FIG. 9(3)). That is, the water level gauge 10 may include a plurality of rod-like sensors or a single rod-like sensor.

[0027]

A configuration example of the protector 18 will be described.

As illustrated in FIG. 2, the protector 18 includes a first annular section 18a which is an annular metal member disposed at an upper portion, the second annular section 18b which is an annular metal member disposed at a lower portion, and a plurality of coupling rods 18c which are rod-shaped or linear metal members coupling the first annular section 18a and the second annular section 18b to each other. Here, for convenience of description, the first annular section 18a and the second annular section 18b have a circular shape. But the first annular section 18a and the second annular section 18b may have an elliptical shape or a polygonal shape such as a rectangular shape, as long as the shape follows the gist of the following description.

The inner diameters of the first annular section 18a and the second annular section 18b are set to dimensions, with which the first annular section 18a and the second annular section 18b can surround the electrodes 10a to 10d without contacting with the electrodes 10a to 10d.

The outer diameters of the first annular section 18a and the second annular section 18b are set to substantially the same dimension.

"Substantially the same dimension" means the same dimension or dimensions that can be regarded as the same dimension. "Dimensions that can be regarded as the same dimension" means dimensions that are slightly different in size from each other and that can be generally regarded as substantially the same dimension.

[0028]

The dimension in the vertical direction (i.e., Z-axis direction) of the first annular section 18a, is set to be larger than that of the second annular section 18b, and therefore, the first annular section 18a can be easily fixed to the ceiling plate 12 by welding or the like.

At least three or more coupling rods 18c are provided on the XY plane (i.e., the horizontal plane). The cross-sectional shape of the coupling rod 18c in the horizontal plane may be a circular shape or a polygonal shape (e.g., a rectangular shape) corresponding to the design thereof. FIG. 2 illustrates the protector 18 including three coupling rods 18cA, 18cB, and 18cC (although one of these coupling rods is not visible in FIG. 2 because it overlaps another coupling rod, which will become clear in the description of FIGS. 3 and 4 below).

One end of each of the coupling rods 18c is fixed (for example, welded) to the outer periphery of the first annular section 18a, and the other end of each of the coupling rods 18c is fixed (for example, welded) to the outer periphery of the second annular section 18b. Accordingly, the protector 18 has a fence-like shape formed by the first annular section 18a whose central axis is directed in the Z-axis direction, by the second annular section 18b whose central axis is directed in the Z-axis direction, and by the plurality of coupling rods 18c whose longitudinal directions are along the Z-axis direction on the XY plane.

The protector 18 has a fence-like shape, and thus does not obstruct the flow of the stored water (e.g., flow of water containing incinerated ash such as return ash) flowing in the vicinity of the protector 18.

[0029]

The length of each of the coupling rods 18c is set in order that the second annular section 18b is located slightly above the third electrode 10c which is the shortest sensor, in a state that the electrodes 10a to 10d, which are rod-like sensors, are properly inserted in the protector 18, that the protector 18 is fixed to the ceiling plate 12, and that the electrodes 10a to 10d are attached and fixed to the base portion 10e as illustrated in FIG. 2.

More specifically, the protector 18 is designed in order that the second annular section 18b is located at a position of about one seventh to one third of the lengths of the electrodes 10a to 10d respectively from the lower ends of the electrodes 10a to 10d having different lengths each other, in a state where the protector 18 is installed as illustrated in FIG. 2.

For this reason, even when the incinerated ash hits any of the electrodes 10a to 10d which are rod-like sensors and continues to move with the water flow of the stored water while the incinerated ash is kept in contact with the electrodes, although the electrode with which the incinerated ash is in contact is bent to some extent, the electrode is restricted by the second annular section 18b so as not to be further bent.

Because the second annular section 18b of the protector 18 prevents the electrodes 10a to 10d from being bent beyond a bendable limit, it is possible to prevent a failure such as permanent bending or breakage of the electrodes 10a to 10d.

5 At this time, when the incinerated ash, attached to the electrode among the electrodes 10a to 10d, is separated from the electrode by the water flow because of the reciprocating movement of the scraper 4 or the like, the electrode can naturally return to a rod-like shape or a linear shape.

[0030]

10 Next, a description will be given with reference to FIGS. 3 and 4 about the fact that the three coupling rods 18cA, 18cB, 18cC included in the protector 18 illustrated in FIG. 2 are not present in the main passage of the water sprayed from the nozzle 11a of the water injection pipe 11 toward the electrodes 10a to 10d which are the rod-like sensors of the water level gauge 10. That is, each
15 of the coupling rods 18c is not a shielding object that prevents the sprayed water from directly hitting each of the electrodes 10a to 10d.

FIG. 3 is a side view of the protector 18 illustrated in FIG. 2 as viewed from the XZ plane. FIG. 4(A) is a cross-sectional view taken along the line AA in FIG. 3 (i.e., a cross-sectional view at the first annular section 18a on the
20 XY plane), FIG. 4(B) is a cross-sectional view taken along the line BB in FIG. 3 (i.e., a cross-sectional view at a position between the first annular section 18a and the second annular section 18b on the Z-axis), and FIG. 4(C) is a cross-sectional view taken along the line CC in FIG. 3 (i.e., a cross-sectional view at the second annular section 18b on the XY plane). As described above, the
25 three coupling rods 18cA, 18cB, 18cC are fixed to be sequentially in contact with the outer peripheries of the first annular section 18a and the second annular section 18b both having a circular shape.

[0031]

Hereinafter, for convenience of description, it is assumed that the
30 plurality of coupling rods 18c (here, the coupling rods 18cA, 18cB, 18cC) are sequentially fixed to the outer peripheries of the first annular section 18a and the second annular section 18b both having a circular shape, in the order of large letters of alphabets on the rightmost side of the reference signs in the counterclockwise direction on the XY plane. The coupling rod 18c with "A"
35 as the large letter (here, the coupling rod 18cA) is referred to as the "head coupling rod", and the coupling rod 18c with the final large letter of alphabet (e.g., the coupling rod 18cC among the three coupling rods included in the

protector 18 illustrated in FIGS. 3 and 4, and a coupling rod 18cD among four coupling rods included in a modification example 18' of the protector illustrated in FIGS. 5 and 6) is referred to as the "end coupling rod". The "head coupling rod" and the "end coupling rod" are "adjacent coupling rods at both ends of a line of coupling rods".

[0032]

Among the plurality of coupling rods 18c, a region in the -X-axis direction from a first virtual line 21 on which the head coupling rod and the end coupling rod are located and which is parallel to the Y-axis, is defined as a first region 20A, and a region in the +X-axis direction is defined as a second region 20B.

On the XY plane, a second virtual line 22, passing through the centers of the first annular section 18a and the second annular section 18b, is perpendicular to the first virtual line 21. The nozzle 11a of the water injection pipe 11 is disposed on the second virtual line 22 and in the second region 20B.

As will be described in detail below with reference to FIG. 9, because the electrodes 10a to 10d, which are rod-like sensors, are disposed near the centers of the first annular section 18a and the second annular section 18b and inside the first annular section 18a and the second annular section 18b on the XY plane, the "main passage" of the water sprayed from the nozzle 11a of the water injection pipe 11 toward the electrodes 10a to 10d, which are rod-like sensors of the water level gauge 10, is a passage of the water along the second virtual line 22 from the nozzle 11a of FIG. 4 toward the centers in the -X-axis direction on the XY plane.

The "main passage" is a passage passing through the "inside of a frame" to be described below on the YZ plane. Thus, the "main passage" is a passage of water along the second virtual line 22 from the nozzle 11a of FIG. 4 toward the -X-axis direction through the "inside of the frame" on the YZ plane.

Just in case, the "main passage" does not necessarily mean the passage, through which the largest amount of the water sprayed from the nozzle 11a, flows, but merely means the passage of water passing through the "inside of the frame". For example, when a nozzle, whose spray pattern spreads over a wider area as being away from the spray port, is used as the nozzle 11a, there may be a passage of water toward the centers on the XY plane, not passing through the "inside of the frame" but also passing through the "outside of the frame" on the YZ plane. However, here, the passage passing through the "outside of the frame" is not considered as the "main passage".

[0033]

At least a part of the water sprayed from the nozzle 11a of the water injection pipe 11 (i.e., indicated by the dash-dotted lines in FIG. 2) passes between the first annular section 18a and the second annular section 18b in the Z-axis direction and falls on the electrodes 10a to 10d, which are rod-like sensors disposed inside the protector 18.

On the other hand, in the protector 18 illustrated in FIGS. 4(A) to 4(C), the first virtual line 21 and the second virtual line 22 pass through the centers of the first annular section 18a and the second annular section 18b both having a circular shape on the XY plane. Among the three coupling rods 18cA, 18cB, 18cC, the coupling rod other than the head coupling rod (i.e., the coupling rod 18cA) and the end coupling rod (i.e., the coupling rod 18cC) disposed on the first virtual line 21, that is, the coupling rod 18cB is disposed in the first region 20A on the opposite side of the second region 20B in which the nozzle 11a is disposed.

Thus, there is no obstruction including the coupling rods 18c in the main passage of the water along the second virtual line 22 toward the centers in the -X-axis direction. In other words, the large "inside of the frame", surrounded by the head coupling rod (i.e., the coupling rod 18cA), the end coupling rod (i.e., the coupling rod 18cC), the first annular section 18a, and the second annular section 18b, is open, and there is no shielding object in the main passage of water passing through the inside of the frame toward the centers in the -X-axis direction.

Accordingly, the water sprayed from the nozzle 11a passes through the inside of the frame without being blocked at all and directly hits the electrodes 10a to 10d, and therefore, the electrodes are reliably cleaned.

[0034]

The protector 18 is not limited to including three coupling rods 18c and may include four or more coupling rods 18c. The strength of the protector 18 can be increased by increasing the number of the coupling rods 18c, as long as it is possible to maintain the fence-like shape in which the interval between the adjacent coupling rods 18c is appropriately ensured not to obstruct the water flow.

FIGS. 5 and 6 illustrate the protector 18' as a modification example of the protector 18. The protector 18' is different from the protector 18 only because the protector 18' includes four coupling rods 18c (18cA, 18cB, 18cC, 18cD), and the protector 18' has similar elements to the protector 18 in other

aspects. Thus, description of the same configuration between the protectors will be omitted.

FIG. 5 is a side view of the protector 18' as viewed from the XZ plane. FIG. 6(A) is a cross-sectional view taken along the line AA in FIG. 5 (i.e., a cross-sectional view at the first annular section 18a on the XY plane), FIG. 6(B) is a cross-sectional view taken along the line BB in FIG. 5 (i.e., a cross-sectional view at a position between the first annular section 18a and the second annular section 18b on the Z-axis), and FIG. 6(C) is a cross-sectional view taken along the line CC in FIG. 5 (i.e., a cross-sectional view at the second annular section 18b on the XY plane).

In the protector 18', the head coupling rod 18c and the end coupling rod 18c disposed on the first virtual line 21 are the coupling rod 18cA and the coupling rod 18cD, respectively.

The coupling rods other than the head coupling rod (i.e., the coupling rod 18cA) and the end coupling rod (i.e., the coupling rod 18cD), that is, the coupling rod 18cB and the coupling rod 18cC are disposed in the first region 20A on the opposite side of the second region 20B in which the nozzle 11a is disposed.

Thus, the large inside of the frame surrounded by the head coupling rod (i.e., the coupling rod 18cA), the end coupling rod (i.e., the coupling rod 18cD), the first annular section 18a, and the second annular section 18b, is open and includes no shielding object.

Therefore, the water sprayed from the nozzle 11a directly hits the electrodes 10a to 10d without being blocked at all, and the electrodes can be reliably cleaned.

[0035]

In the protector 18 and the protector 18', the frame surrounded by the head coupling rod, the end coupling rod, the first annular section 18a, and the second annular section 18b can form the largest frame on the XY plane, because the first virtual line 21 passes through the centers of the circles of the first annular section 18a and the second annular section 18b.

However, depending on the arrangement of the electrodes 10a to 10d, which are rod-like sensors disposed inside the protector 18, 18', the electrodes may be sufficiently washed even when the frame is smaller than "the largest frame" described above.

In that case, for example, as illustrated in FIGS. 7(1) and 7(2) for the protector 18 and in FIGS. 8(1) and 8(2) for the protector 18', the first virtual

line 21 may be disposed closer to the nozzle 11a from the centers on the XY plane.

In addition, in the protector 18 and the protector 18', the coupling rod(s) 18c other than the head coupling rod and the end coupling rod is (are) disposed in the first region 20A so as to be symmetric with respect to the second virtual line on the XY plane, but may be disposed to be asymmetric as illustrated in FIG. 7(2) for the protector 18 and in FIG. 8(2) for the protector 18', depending on the design.

[0036]

Here, for both cases that one rod-like sensor or each of a plurality of rod-like sensors is inserted into the protector 18, 18', the positional relationship between the sensor(s) and the second virtual line 22 will be described with reference to FIG. 9. Because it makes no difference between the protectors illustrated in FIGS. 2 to 8, the protector 18 illustrated in FIGS. 3 and 4 will be used for this description.

FIGS. 9(1) and 9(2) are diagrams illustrating two different examples in which a plurality of, to be specific, four electrodes 10a to 10d as rod-like sensors are inserted into the protector 18. FIG. 9(3) is a diagram illustrating an example in which only one rod-like sensor is inserted into the protector 18.

In FIGS. 9(1) and 9(2), the separator 19, which is not disposed inside the frame surrounded by the head coupling rod (i.e., the coupling rod 18cA), the end coupling rod (i.e., the coupling rod 18cC), the first annular section 18a, and the second annular section 18b, is virtually illustrated to easily understand the description of angles. The electrodes 10a to 10d, which are the plurality of rod-like sensors, are arranged along a straight line in the separator 19 having a rectangular shape. On the XY plane, this straight line, passing through the centers of the circles of the first annular section 18a and the second annular section 18b, is defined as a third virtual line 23. The third virtual line 23 is a virtual line connecting the plurality of the electrodes arranged along the straight line.

Here, the description is given on the assumption that the main direction of the water flow generated by the reciprocating movement of the scraper 4 on the XY plane is the X-axis direction (i.e., $\pm X$ -axis direction).

[0037]

In FIG. 9(1), the row of the four electrodes 10a to 10d arranged along the straight line, that is, the third virtual line 23 is arranged to be inclined at a right angle (i.e., 90°) with respect to the second virtual line 22 on the XY

plane. In this case, there is an advantage in that the water sprayed from the nozzle 11a passes through the frame surrounded by the head coupling rod (i.e., the coupling rod 18cA), the end coupling rod (i.e., the coupling rod 18cC), the first annular section 18a, and the second annular section 18b, and in that the water sprayed from the nozzle 11a is likely to reliably hit the electrodes 10a to 10d.

On the other hand, when the water level of the stored water in the cooling bath 2 is higher than the predetermined water level, the plurality of electrodes is immersed in the stored water, and thus the arrangement at the angle of 90° is an arrangement in which the force received from the water flow of the stored water is the largest. Further, this arrangement can be an arrangement in which the plurality of electrodes immersed receives the incinerated ash flowing with the water flow above the second inclined surface 8b. This may cause a disadvantage of reducing the product life of the electrodes.

Thus, the arrangement at the angle of 90° can be employed when the water level of the stored water rarely becomes higher than the predetermined water level and when the amount of the incinerated ash flowing above the second inclined surface 8b is small.

[0038]

In FIG. 9(2), the third virtual line 23 is arranged to be inclined at an angle smaller than 90° with respect to the second virtual line 22 on the XY plane. As long as water sprayed from the nozzle 11a hits each of the electrodes, the angle can be set to about 10° or more and 45° or less with respect to the second virtual line 22 in accordance with the distance between the adjacent electrodes.

In this arrangement, unlike the arrangement illustrated in FIG. 9(1), even when the water level of the stored water in the cooling bath 2 is higher than the predetermined water level, the water flow and the incinerated ash flowing with the water flow can be turned aside, and therefore, this arrangement can be an arrangement that prevents the electrodes from reducing their product life.

Thus, this arrangement can be employed when the water level of the stored water tends to become higher than the predetermined water level and when the amount of the incinerated ash flowing above the second inclined surface 8b is large.

[0039]

FIG. 9(3) is a diagram illustrating an example in which only one rod-like sensor is inserted into the protector 18. In a case that the water level gauge 10 includes a single rod-like sensor 10f, the water level gauge 10 is a device that can measure a plurality of different water levels by using only the rod-like sensor 10f, such as a detection method using electrostatic capacitance or a detection method using reflection of pulse waves. In this case, unlike the arrangements illustrated in FIGS. 9(1) and 9(2), the separator 19 is not necessary to be disposed, and therefore, the separator 19 is not illustrated in FIG. 9(3).

In this case, the rod-like sensor 10f is desirably disposed at a position where the water sprayed from the nozzle 11a hits the rod-like sensor 10f most effectively, that is, at the centers of the circles of the first annular section 18a and the second annular section 18b on the XY plane.

[0040]

In the above description of the ash discharger 1 and the protector 18, 18', the same XYZ coordinate system is used in FIGS. 1 to 9. However, there may be various positional relationships between the protector 18, 18' and the nozzle 11a disposed in the backward arrangement in the ash discharger 1.

With reference to FIGS. 10(1), 10(2), and 10(3), three different positional relationships between the protector 18, 18' and the nozzle 11a will be briefly described as examples.

Because the positional relationship in a case that the protector 18' is used, is the same as the positional relationship in a case that the protector 18 is used, and therefore, the protector 18 will be used for the description here.

In addition, because FIG. 10 illustrates the configuration toward the +X-axis direction from the introduction port 6 of the ash discharger 1 of FIG. 1 in a simplified manner on the XY plane, the configuration from the introduction port 6 toward the discharge port 7 of FIG. 1 is not illustrated at all.

Further, in FIG. 10, the same XYZ coordinate system as in FIG. 1 is used, but it does not necessarily coincide with the XYZ coordinate system in FIGS. 2 to 9 when the different positional relationship between the protector 18 and the nozzle 11a is explained, as described above.

[0041]

First, FIGS. 10(1), 10(2), and 10(3) will be sequentially described.

FIG. 10(1) illustrates the positional relationship between the protector 18, the water level gauge 10, and the nozzle 11a illustrated in FIGS. 1 to 4, on the XY plane (i.e., a horizontal plane) in an emphasized manner for easy

understanding. The positional relationship is illustrated in an emphasized manner, and therefore, the positional relationship does not strictly coincide with the positional relationship in FIG. 1.

However, similarly to the positional relationship between the protector 18, the water level gauge 10, and the nozzle 11a in FIGS. 1 to 4 described above, the nozzle 11a is disposed in the +X-axis direction with respect to the protector 18, and the second virtual line 22 is parallel to the X-axis.

Because the water flow generated by the reciprocating movement of the scraper 4 is in the X-axis direction, it is desirable to employ this positional relationship, as long as there is no particular restriction on the arrangement of other devices, piping, and the like arranged in the vicinity of the ash discharger 1.

[0042]

On the other hand, even when the arrangement of FIG. 10(1) is desired to be employed, there may be a case where the arrangement of FIG. 10(1) cannot be employed due to the arrangement of other devices, piping, and the like.

In that case, as illustrated in FIG. 10(2), the second virtual line 22 in the arrangement of FIG. 10(1) may be arranged to be inclined from the X-axis.

Alternatively, as illustrated in FIG. 10(3), the nozzle 11a may be arranged in the -X-axis direction with respect to the protector 18. In FIG. 10(3), the second virtual line 22 is inclined from the X-axis, but the second virtual line 22 may be parallel to the X-axis.

Reference Signs List

[0043]

- 1 Ash discharger
- 2 Cooling bath
- 3 Conveyor
- 4 Scraper
- 4a Upper plate
- 4b Push-out plate
- 4c Side plate
- 4d Leading end
- 4e Rear 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
- 8c Lowermost surface
- 9 Wall surface
- 10 Water level gauge
- 10 10a to 10d Rod-like sensor (detection electrode, common electrode)
- 10e Base portion
- 10f Rod-like sensor
- 11 Water injection pipe
- 11a Nozzle
- 15 12a Ceiling plate for drive device
- 13 Control device
- 14 Drainage pipe
- 15 Solenoid valve
- 16 Space
- 20 17 Gas pipe
- 17a One end of gas pipe
- 17b Another end of gas pipe
- 17c Gas injection port
- 17d Compressor
- 25 17e Gas solenoid valve
- 18, 18' Protector
- 18a First annular section
- 18b Second annular section
- 18c Coupling rod
- 30 19 Separator
- 20A First region
- 20B Second region
- 21 First virtual line
- 22 Second virtual line
- 35 23 Third virtual line
- 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 shaped like a tube 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 a bottom plate to push the incinerated ash toward the discharge port in the
- 10 cooling bath, and
- a drive device to drive the scraper, disposed 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 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
- 30 backward position, and including a nozzle spraying water at a leading end thereof,
- a water level gauge in the backward arrangement, including a sensor which is shaped like a rod or a plurality of sensors each of which is shaped like a rod, and
- 35 a protector which is shaped like a fence, in which the sensor or each of the sensors is inserted to restrict a movement of a lower part of the sensor or

the sensors not to be bending, and including no shielding object in a main passage of the water sprayed toward the sensor or the sensors,

wherein the water injection pipe and the water level gauge are penetrating a ceiling plate for the drive device, which is above the second

5 inclined surface and above the drive device,

wherein the protector is fixed to the ceiling plate, and

wherein water is sprayed from the nozzle to be injected into the cooling bath, and the sensor or each of the sensors is washed by at least a part of the water sprayed, when the stored water falls below the predetermined water level.

10

[Claim 2]

The ash discharger according to claim 1,

wherein the protector includes

a first annular section fixed to the ceiling plate,

15 a second annular section disposed below the first annular section to restrict the movement, and

a plurality of coupling rods, including at least three coupling rods, coupled to the first annular section and the second annular sections sequentially from a head coupling rod to an end coupling rod among the coupling rods in a counterclockwise direction, and

20

wherein, when viewed in a horizontal plane, the nozzle is disposed on a second virtual line, perpendicular to a first virtual line connecting the head coupling rod and the end coupling rod which are adjacent to each other among the coupling rods, and passing through a center of the first annular section or a center of the second annular section.

25

[Claim 3]

The ash discharger according to claim 2,

wherein the water level gauge includes

30 a plurality of electrodes as the sensor which are shaped like a rod, and

a separator to prevent the plurality of electrodes from contacting with each other.

[Claim 4]

35 The ash discharger according to claim 3,

wherein the plurality of electrodes includes

a common electrode, and

a detection electrode to detect a water level by being electrically connected to the common electrode via the stored water, and

wherein, when viewed in the horizontal plane, a third virtual line connecting the common electrode and the detection electrode is set to be
5 inclined at 90° with respect to the second virtual line or at smaller than 90° with respect to the second virtual line.

[Claim 5]

The ash discharger according to claim 4,
10 wherein the nozzle is disposed either in the backward direction from the water level gauge or in the forward direction from the water level gauge.

[Claim 6]

The ash discharger according to any one of claims 1 to 5, further
15 comprising
a gas pipe disposed extending from one end to another end at a position which is located above the second inclined surface and which is not in contact with the scraper performing the reciprocating movement and the arm,
wherein the one end of the gas pipe is arranged below the predetermined
20 water level,
wherein the gas pipe includes a gas injection port injecting gas introduced from the other end of the gas pipe, between the second inclined surface and the scraper, and
wherein return ash, which is about to deposit on the second inclined
25 surface, is stirred by water flow of the stored water caused by the gas injected from the gas injection port and is stirred by bubbles due to the gas.