

DESCRIPTION

SEALING DEVICE FOR STOKER TYPE INCINERATOR, AND STOKER TYPE
INCINERATOR

5

TECHNICAL FIELD

[0001]

The present invention relates to a sealing device for a stoker type incinerator and a stoker type incinerator.

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Priority is claimed on Japanese Patent Application No. 2017-253145, filed December 28, 2017, the contents of which are incorporated herein by reference.

BACKGROUND ART

15

[0002]

A stoker type incinerator capable of efficiently incinerating a large amount of objects to be incinerated without selection is known as an incinerator for incinerating objects to be incinerated such as waste. The stoker type incinerator is equipped with a plurality of treatment stages including a drying stage for drying the objects, a combustion stage for
20 combusting the objects, and a post-combustion stage for further combusting the objects.

In the stoker type incinerator equipped with the drying stage, the combustion stage, and the post-combustion stage, a metal seal (front fire
25 grate) is installed just under a drop wall present between each stage, and even when a movable fire grate moves, inflow of combustion air other than from the fire grate is prevented (see, for example, Patent Literature 1).

CITATION LIST

PATENT DOCUMENTS

[0003]

Patent Document 1: Japanese Unexamined Patent Application, First
Publication No. H04-186010

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SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0004]

In a conventional stoker type incinerator, a metal seal can rotate
10 about a pin following movement of a movable fire grate and can move up
and down. However, this rotational movement is likely to adversely affect
the sealing performance. Further, when foreign matter becomes caught
between the metal seal and the movable fire grate, since the foreign matter
cannot be eliminated at an early stage, and air may flow into the furnace
15 from clogged gaps, there is a possibility of occurrence of abnormal
combustion.

[0005]

An object of the present invention is to provide a sealing device for a
stoker type incinerator and a stoker type incinerator which movement of a
20 front fire grate is able to be reduced to a minimum and deterioration of
sealing properties is able to be inhibited.

SOLUTION TO PROBLEM

[0006]

25 The sealing device of the present invention is a sealing device in a
stoker type incinerator, for sealing a gap between a drop wall of the stoker
type incinerator and a movable fire grate, the stoker type incinerator being
provided with a plurality of fixed fire grates and a plurality of the movable
fire grates, and in which objects is subjected to incineration while conveying

the objects, the sealing device comprising: a front fire grate disposed of which a distal end abuts on the movable fire grate; a support portion having a top surface support plate fixed to the drop wall and configured to support a top surface of the front fire grate, and a bottom surface support plate
 5 disposed below the top surface support plate and configured to support a bottom surface of the front fire grate; and a spring configured to urge the front fire grate in a direction opposite to a direction in which the front fire grate is moved with the movable fire grate.

[0007]

10 According to such a configuration, a force of pulling the front fire grate in a direction opposite to the moving direction of the movable fire grate due to the spring acts on the front fire grate dragged by the movable fire grate and slightly moved. Therefore, even when waste biting occurs between the movable fire grate and the front fire grate, a force of returning
 15 the front fire grate sandwiching the waste acts. Further, since the moving direction of the front fire grate is restricted by the support portion, the movement of the front fire grate can be suppressed to the minimum and the deterioration of the sealing performance can be suppressed.

[0008]

20 The sealing device may further include a shaft-like member fixed to the front fire grate or the support portion and extending in a particular direction corresponding to a conveying direction of the objects to be incinerated; and a shaft support portion configured to support the shaft-like member to be freely slidable in the one direction.

25 [0009]

According to such a configuration, the moving direction of the front fire grate can be restricted by the shaft-like member and the shaft support portion, and the contact state between the front fire grate and the movable fire grate can be improved.

[0010]

The sealing device may further have a moving direction restricting portion configured to restrict a movement of the front fire grate to advance and retreat in the one direction, wherein the moving direction restricting
5 portion includes a penetration hole formed in the front fire grate and long in the particular direction in which the shaft-like member is extending, and a guide member inserted through the penetration hole and fixed to the support portion.

[0011]

10 According to such a configuration, the moving direction of the front fire grate can be restricted by the moving direction restricting portion, and the contact state between the front fire grate and the movable fire grate can be improved.

[0012]

15 The stoker type incinerator of the present invention includes a drying stage, a combustion stage and a post-combustion stage, each of the stages including a plurality of fixed fire grates and a plurality of the movable fire grates, in which objects to be incinerated are subjected to drying, combusting and pre-combusting while sequentially conveying the objects to
20 be incinerated through the drying, combustion and pre-combustion stages, wherein the drying stage is disposed to be inclined so that a downstream side in a conveying direction is directed downward, the combustion stage is connected to the drying stage and is disposed to be inclined so that the downstream side in the conveying direction is directed upward, the
25 post-combustion stage is connected to the combustion stage and is disposed to be inclined such that the downstream side in the conveying direction is directed upward, and in a state in which a front fire grate is urged in a direction of extruding the front fire grate toward the downstream side in the conveying direction, the above mentioned sealing device is disposed on a

drop wall between the drying stage and the combustion stage.

[0013]

In the stoker type incinerator, in a state in which the front fire grate is biased in a direction of extruding the front fire grate toward an upstream side in the conveying direction, the stoker type incinerator sealing device is disposed on the drop wall between the feeder and the combustion stage.

ADVANTAGEOUS EFFECTS OF INVENTION

[0014]

According to the present invention, it is possible to suppress the movement of the front fire grate to minimum, thereby suppressing deterioration of the sealing property, i.e., improving the sealing property.

BRIEF DESCRIPTION OF DRAWINGS

[0015]

Fig. 1 is a view showing a schematic configuration of a stoker type incinerator in which a stoker type incinerator sealing device of the present invention is disposed.

Fig. 2 is a view for explaining a stoker inclination angle of the stocker furnace of Fig. 1.

Fig. 3 is a side sectional view of a sealing device provided on a first drop wall of the stoker type incinerator of Fig. 1.

Fig. 4 is a cross-sectional view taken along line IV-IV of Fig. 3 and is a cross-sectional view of the sealing device of the present invention.

Fig. 5 is a side sectional view of the sealing device provided on a second drop wall of the stoker type incinerator of Fig. 1.

Fig. 6 is a side sectional view of a sealing device according to a modified example of the present invention.

Fig. 7 is a view for explaining a modified example of the stoker type

incinerator in which the stoker type incinerator sealing device of the present invention is disposed.

Fig. 8 is a graph explaining that an appropriate range of the stoker inclination angle of the drying stage is an angle between -15° and -25° .

5 Fig. 9 is a graph explaining that an appropriate range of stoker inclination angle of a combustion stage is an angle between $+5^{\circ}$ and $+15^{\circ}$.

Fig. 10 is a graph for explaining the reason why the appropriate range of the stoker inclination angle of the combustion stage is between $+8^{\circ}$ and $+12^{\circ}$ and the optimum value is $+10^{\circ}$ in view of both of the drying stage
10 and the combustion stage.

DESCRIPTION OF EMBODIMENTS

[0016]

(Embodiment)

15 Hereinafter, a stoker type incinerator in which a sealing device for a stoker type incinerator of the present invention will be described in detail with reference to the drawings.

The stoker type incinerator of the present embodiment is a stoker type incinerator for combustion of objects to be incinerated such as waste, and includes a hopper 2 for temporarily storing the objects T to be
20 incinerated, an incineration furnace 3 for combusting the objects T, a feeder 4 for feeding the objects T to the incineration furnace 3, a stoker 5 (including fire grates 15 and 16 of a drying stage 11, a combustion stage 12, and a post-combustion stage 13) provided on a bottom side of the
25 incineration furnace 3, a wind box 6 provided below the stoker 5, and a sealing device 30 (a sealing device for a stoker type incinerator) provided on drop walls 27 (a first drop wall), 28 (a second drop wall), and 29 (a third drop wall) of the stoker 5, as illustrated in Fig. 1.

[0017]

The feeder 4 pushes the objects T continuously fed onto a feed table 7 into the incineration furnace 3 via the hopper 2. The feeder 4 is reciprocated on the feed table 7 with a predetermined stroke by a feeder driving device 8.

5 Each of the wind boxes 6 supplies primary air from a blower (not illustrated) to each part of the stoker 5.

The incineration furnace 3 is provided above the stoker 5 and has a combustion chamber 9 including a primary combustion chamber and a secondary combustion chamber. A blower 10 for feeding secondary air to the combustion chamber 9 is connected to the incineration furnace 3.

[0018]

The stoker 5 is a combustion device in which the fire grates 15 and 16 are arranged in a stepwise manner. The objects T are combusted on the stoker 5.

15 Hereinafter, a direction in which the objects T are conveyed is referred to as a conveying direction D. The objects T are conveyed on the stoker 5 in the conveying direction D. In Figs. 1, 2 and 3, a left side is an upstream side D1 in the conveying direction, and a right side is a downstream side D2 in the conveying direction. Further, a surface on which
20 the fire grates 15 and 16 are attached is referred to as an installation surface, and an angle formed by a horizontal surface and the installation surface centered on the upstream ends (11b, 12b and 13b) of the drying stage 11, the combustion stage 12 and the post-combustion stage 13 is referred to as a stoker inclination angle (an installation angle). When the
25 downstream side D2 of the installation surface in the conveying direction is directed upward from the horizontal plane, the stoker inclination angle is set as a positive value, and when the downstream side D2 of the installation surface in the conveying direction is directed downward from the horizontal plane, the stoker inclination angle is set as a negative value.

[0019]

The stoker 5 has, in order from the upstream side D1 in the conveying direction of the objects T, a drying stage 11 for drying the objects T, a combustion stage 12 for combusting the objects T, and a post-combustion stage 13 for completely combusting unburnt components (post-combustion). In the stoker 5, drying, combustion, and post-combustion are performed, while sequentially conveying the objects T in the drying stage 11, the combustion stage 12, and the post-combustion stage 13.

Each of the stages 11, 12 and 13 has a plurality of fixed fire grates 15 and a plurality of movable fire grates 16.

The fixed fire grates 15 and the movable fire grates 16 are alternately arranged in the conveying direction D. The movable fire grates 16 are reciprocated in the conveying direction D. The objects T on the stoker 5 are conveyed and stirred by the reciprocating motion of the movable fire grates 16. That is, lower layer portions of the objects T are moved and replaced with upper layer portions.

[0020]

The drying stage 11 receives the objects T that are pushed out by the feeder 4 and falls into the incineration furnace 3, evaporates the moisture in the objects to be incinerated and partially thermally decomposes the objects T. The combustion stage 12 ignites the objects T dried in the drying stage 11 using the primary air fed from the wind box 6 below and combusts the volatile matter and the fixed carbon content. The post-combustion stage 13 combusts unburnt content such as the fixed carbon content having passed through without being sufficiently burned in the combustion stage 12 until the unburnt content is completely ashed.

An ash outlet 17 is provided at the exit of the post-combustion stage 13. The ash is discharged from the incineration furnace 3 through the ash

outlet 17.

[0021]

Each of the drying stage 11, the combustion stage 12, and the post-combustion stage 13 has a drive mechanism 18 for driving the movable
5 fire grates 16. That is, the drying stage 11, the combustion stage 12, and the post-combustion stage 13 each have a separate drive mechanism 18 for driving the plurality of movable fire grates 16.

[0022]

The drive mechanism 18 is attached to a beam 19 provided on the
10 stoker 5. The drive mechanism 18 has a hydraulic cylinder 20 attached to the beam 19, an arm 21 operated by the hydraulic cylinder 20, and a beam 22 connected to a distal end of the arm 21. The beam 22 and the movable fire grates 16 are connected to each other via a bracket 23.

[0023]

15 According to the drive mechanism 18, the arm 21 is operated by expansion and contraction of the rod of the hydraulic cylinder 20. With the movement of the arm 21, the beam 22 configured to move along each of the installation surfaces 11a, 12a and 13a of the stoker 5 moves, and the movable fire grates 16 connected to the beam 22 are driven.

20 [0024]

Although the hydraulic cylinder 20 may be used as the drive mechanism 18, there is no limitation thereto, and for example, a hydraulic motor, an electrical cylinder, a conductive linear motor, or the like can be adopted. Further, the form of the drive mechanism 18 is not limited to that
25 of the above-described embodiment, and any form may be adopted as long as the movable fire grates 16 can be made to reciprocate. For example, instead of disposing the arm 21, the beam 22 and the hydraulic cylinder 20 may be connected directly to each other and driven.

[0025]

The stoker type incinerator 1 of the present embodiment can set the driving speed of the movable fire grates 16 in the drying stage 11, the combustion stage 12, and the post-combustion stage 13 to the same speed or to different speeds in at least one of the drying stage 11, the combustion stage 12, and the post-combustion stage 13 with respect to the other.

For example, when the objects T required to be sufficiently burned in the combustion stage 12 are charged, by decreasing the speed of driving the movable fire grates 16 of the combustion stage 12, and by decreasing the conveying speed of the objects T on the combustion stage 12, the objects T can be sufficiently burned.

[0026]

As illustrated in Fig. 2, the fixed fire grates 15 and the movable fire grates 16 are disposed such that the downstream side D2 in the conveying direction is directed upward with respect to the installation surfaces 11a, 12a and 13a of the drying stage 11, the combustion stage 12, and the post-combustion stage 13. Further, the fire grates 15 and 16 are disposed such that the distal ends of the fire grates 15 and 16 are directed to the downstream side D2 in the conveying direction. Therefore, the movable fire grates 16 are operated to send the objects T on the fixed fire grates 15 to the downstream side D2 in the conveying direction.

[0027]

Some of the movable fire grates 16 of the drying stage 11 may be protrusive fire grates 16P, each of which having a protrusion (others are normal fire grates as will be described later). As illustrated in Fig. 2, each of the movable fire grates 16 in a particular area R1, which corresponds to 50% to 80% of a whole area of the drying stage 11 from the downstream side D2 thereof to the upstream side in the conveying direction D, is the protrusive fire grate 16P. Since the drying stage is provided with the protrusive fire grates 16P, it is possible to improve the stirring power of the

drying stage.

Here, each of the fixed fire grates 15 is a fire grate with no protrusion on the top surface of its distal end, and this shape is called a normal fire grate.

5 [0028]

In the present embodiment, the movable fire grates 16 are defined as the protrusive fire grates 16P, but it is not limited thereto, and both of the movable fire grates 16 and the fixed fire grates 15 may be the protrusive fire grates.

10 Further, the area in which the protrusive fire grates 16P are provided is not limited to the above-mentioned area, and for example, the protrusive fire grates 16P may be used for all of the fire grates of the drying stage 11.

Furthermore, depending on the properties or types of the objects T, all the fire grates (fixed fire grate and movable fire grate) in the drying stage
15 may be the normal fire grates.

[0029]

As similar to the drying stage 11, some of the movable fire grates 16 of the combustion stage 12 are the protrusive fire grates 16P. Specifically, each of the movable fire grates 16 in a particular area R2, which is
20 corresponds to 50% to 80% of a whole area of the combustion stage 12 from the downstream side D2 thereof to the upstream side in the conveying direction, is the protrusive fire grate 16P. The other movable fire grates 16 of the combustion stage 12 are the normal fire grates. As with the drying stage 11, both of the movable fire grates 16 and the fixed fire grates 15 may
25 be protrusive grates, depending on the properties and types of the objects T, and all the fire grates (fixed fire grates and movable fire grates) may be used as the normal fire grates.

In the fire grates of the post-combustion stage 13, both of the movable fire grates 16 and the fixed fire grates 15 are illustrated as the

normal fire grates in Fig. 2, but as with the drying stage 11 and the combustion stage 12, the protrusive fire grates may be adopted.

[0030]

Next, the stoker inclination angle (installation angle) of the drying stage 11, the combustion stage 12, and the post-combustion stage 13 will be described.

As illustrated in Fig. 2, the drying stage 11 of the stoker 5 of the present embodiment is arranged downward. That is, an installation surface 11a of the drying stage 11 is inclined so that the downstream side in the conveying direction is lower. Specifically, a stoker inclination angle θ_1 of the drying stage 11, which is the angle between the horizontal plane centered on the end portion 11b on the upstream side of the drying stage 11 and the conveying direction side of the installation surface 11a, is -15° (minus 15 degrees) to -25° (minus 25 degrees).

[0031]

The combustion stage 12 of the stoker 5 of the present embodiment is arranged upward. That is, the installation surface 12a of the combustion stage 12 is inclined so that the downstream side in the conveying direction is higher. More specifically, a stoker inclination angle θ_2 of the combustion stage 12, which is an angle between the horizontal plane centered on the upstream end portion 12b of the combustion stage 12 and the conveying direction side of the installation surface 12a, is $+5^\circ$ (plus 5 degrees) to $+15^\circ$ (plus 15 degrees).

[0032]

The post-combustion stage 13 of the stoker 5 of the present embodiment is arranged upward. That is, the installation surface 13a of the post-combustion stage 13 is inclined so that the downstream side in the conveying direction is higher. More specifically, a stoker inclination angle θ_3 of the post-combustion stage 13, which is an angle between the horizontal

plane centered on the upstream end portion 13b of the post-combustion stage 13 and the conveying direction side of the installation surface 13a, is +5° (plus 5 degrees) to +15° (plus 15 degrees).

[0033]

5 A first drop wall 27 (step) is formed between the feed table 7 and the drying stage 11. The stoker 5 has a first sealing device 30A that seals between the first drop wall 27 and the movable fire grate 16. The first sealing device 30A is a device for preventing inflow of combustion air from other than the fire grate when the movable fire grate 16 of the drying stage
10 11 moves.

[0034]

As illustrated in Fig. 3, the first sealing device 30A includes a front fire grate 31 arranged so that its distal end (the downstream side D2 in the conveying direction) comes into contact with the movable fire grate 16, a
15 support portion 32 for slidably supporting the front fire grate 31, a spring 35 (a compression coil spring) for urging the front fire grate 31 in a direction opposite to the direction in which the front fire grate 31 moves in accordance with the movement of the movable fire grate 16, and a moving direction restricting portion 44 for restricting the moving direction of the front fire
20 grate 31.

In the first sealing device 30A, the angle of the front fire grate 31 with respect to the horizontal plane corresponds to the angle of the installation surface 11a of the drying stage 11. That is, the front fire grate 31 of the first sealing device 30A is arranged so that the downstream side
25 D2 in the conveying direction is directed downward.

The moving direction of the front fire grate 31 is a direction in the conveying direction D, but strictly it is a direction along the installation surface 11a of the drying stage 11 which is inclined so that the downstream side D2 in the conveying direction is directed downward.

[0035]

The support portion 32 includes an top surface support plate 33 which is fixed to the first drop wall 27 to support the top surface 31a of the front fire grate 31, and a bottom surface support plate 34 which is fixed to
5 the top surface support plate 33 to support the lower surface 31b of the front fire grate 31.

[0036]

The front fire grate 31 has a front fire grate main body 37 having a rectangular plate shape and provided with a protrusion 31c at its distal end,
10 and a shaft-like member 38 connected to the rear end of a front fire grate main body 37. A male screw groove is formed in at least one of the shaft-like member 38.

As illustrated in Figs. 3 and 4, the front fire grate main body 37 is a rectangular plate-like member. The protrusion 31c is formed to come into
15 contact with the back surface 16a of the movable fire grate 16. The protrusion 31c extends in the width direction (a direction orthogonal to the paper surface of Fig. 1) of the incineration furnace 3. The protrusion 31c comes into contact with the movable fire grate 16 in the width direction, thereby preventing inflow of combustion air from other than the fire grate.

20 [0037]

The top surface support plate 33 is a plate-like member that supports the top surface 31a of the front fire grate 31. The top surface support plate 33 and the front fire grate 31 are arranged so that the lower surface 33a of the top surface support plate 33 and the top surface 31a of
25 the front fire grate 31 are in surface contact with each other.

The top surface support plate 33 is disposed so as to be inclined so that the downstream side D2 in the conveying direction becomes lower. A first shaft support portion 40 which slidably supports the shaft-like member 38 of the front fire grate 31 along the moving direction M of the front fire

grate 31 is provided at the end portion of the top surface support plate 33 on the upstream side D1 in the conveying direction. The first shaft support portion 40 of the present embodiment is a bearing provided on the first shaft support plate 39 formed by bending the top surface support plate 33.

5 [0038]

The bottom surface support plate 34 is a plate-like member that supports the lower surface 31b of the front fire grate 31. The bottom surface support plate 34 and the front fire grate 31 are disposed so that the top surface 34a of the bottom surface support plate 34 and the lower surface 10 31b of the front fire grate 31 are in surface contact. The bottom surface support plate 34 is disposed so that the main surface of the top surface support plate 33 and the main surface of the bottom surface support plate 34 are parallel to each other.

[0039]

15 The bottom surface support plate 34 is fixed to the top surface support plate 33 via a second shaft support plate 41 formed by bending the end portion of the bottom surface support plate 34 on the upstream side D1 in the conveying direction. The second shaft support plate 41 is provided with a second shaft support portion 42 which cooperates with the first shaft 20 support portion 40 to support the shaft-like member 38 of the front fire grate 31. The second shaft support portion 42 is a bearing provided on the second shaft support plate 41.

[0040]

25 The first shaft support portion 40 and the second shaft support portion 42 are arranged such that the shaft-like member 38 of the front fire grate 31 follows the direction parallel to the main surface of the top surface support plate 33 and the bottom surface support plate 34 in the direction M which is one direction corresponding to the conveying direction D. In other words, the shaft-like member 38 extends along the direction M by being

supported by the first shaft support portion 40 and the second shaft support portion 42.

The movement of the front fire grate 31 in the direction orthogonal to the direction M is restricted by the top surface support plate 33 and the bottom surface support plate 34, but the axial movement of the shaft-like member 38 is not restricted.

[0041]

The moving direction restricting portion 44 has two penetration holes 45 which are long along the direction M formed in the front fire grate 31, and two guide members 46 inserted through the penetration hole 45 and fixed to the support portion 32. As illustrated in Fig. 4, the penetration hole 45 is an elongated hole formed to extend along the moving direction of the front fire grate 31. The guide member 46 is a rod-like member provided to connect between the top surface support plate 33 and the bottom surface support plate 34. The guide member 46 can be formed, for example, by bolts.

[0042]

The spring 35 is disposed between a nut 47 screwed into the male screw groove of the shaft-like member 38 and the first shaft support plate 39. A shaft-like member 38 is inserted into the inside of the spring 35. One end of the spring 35 is fixed to the nut 47, and the other end of the spring 35 is fixed to the first shaft support plate 39. That is, the elastic force of the spring 35 acts on the nut 47 and the first shaft support plate 39.

[0043]

The spring 35 of the sealing device 30A of the first drop wall 27 is balanced in a state of urging the front fire grate 31 in a direction of being drawn to the upstream side D1 in the conveying direction. From this state, when the front fire grate 31 moves to the downstream side D2 in the conveying direction with the movement of the movable fire grate 16 toward

the downstream side D2 in the conveying direction, the spring 35 is extended. When the spring 35 extends from the balanced state, the front fire grate 31 is urged to the upstream side D1 in the conveying direction (the direction opposite to the direction in which the front fire grate 31 moves with the movement of the movable fire grate 16).

[0044]

When the front fire grate 31 moves to the upstream side D1 in the conveying direction with the movement of the movable fire grate 16 toward the upstream side D1 in the conveying direction, the spring 35 contracts.

As the spring 35 contracts from the balanced state, the front fire grate 31 is urged toward the downstream side D2 in the conveying direction (the direction opposite to the direction in which the front fire grate 31 moves with the movement of the movable fire grate 16).

[0045]

A second drop wall 28 is formed between the drying stage 11 and the combustion stage 12. The end portion 11c of the drying stage 11 on the downstream side in the conveying direction is formed to be higher in the vertical direction than the end portion 12b of the combustion stage 12 on the upstream side in the conveying direction.

A second sealing device 30B is provided on the second drop wall 28. As illustrated in Fig. 5, the angle of the second front sealing device 30B with respect to the horizontal plane of the front fire grate 31 corresponds to the angle of the installation surface 12a of the combustion stage 12. That is, the front fire grate 31 of the second sealing device 30B is arranged so that the downstream side D2 in the conveying direction is directed upward.

[0046]

The spring 35 of the second sealing device 30B is balanced in a state of being urged in the direction of extruding the front fire grate 31 toward the downstream side D2 in the conveying direction. From this state, when the

front fire grate 31 moves to the downstream side D2 in the conveying direction with the movement of the movable fire grate 16 to the downstream side D2 in the conveying direction, the spring 35 extends. When the spring 35 extends from the balanced state, the front fire grate 31 is urged to the upstream side D1 in the conveying direction (the direction opposite to the direction in which the front fire grate 31 moves in accordance with the movement of the movable fire grate 16).

[0047]

When the front fire grate 31 moves to the upstream side D1 in the conveying direction with the movement of the movable fire grate 16 toward the upstream side D1 in the conveying direction, the spring 35 contracts. As the spring 35 contracts from the balanced state, the front fire grate 31 is urged toward the downstream side D2 in the conveying direction (the direction opposite to the direction in which the front fire grate 31 moves with the movement of the movable fire grate 16).

[0048]

Likewise, a third drop wall 29 is formed between the combustion stage 12 and the post-combustion stage 13. An end portion 12c of the combustion stage 12 on the downstream side in the conveying direction is formed to be higher in the vertical direction than an end portion 13b of the post-combustion stage 13 on the upstream side in the conveying direction.

A third sealing device 30C is provided on the third drop wall 29. The configuration of the third sealing device 30C is the same as that of the second sealing device 30B.

[0049]

The spring 35 in the sealing device 30 can be adjusted by changing the position of the nut 47. The sealing device 30 of the present embodiment can extend the spring 35 by bringing the nut 47 close to the front fire grate main body 37.

[0050]

The end portion 12c of the combustion stage 12 on the downstream side in the conveying direction and the end portion 13c of the post-combustion stage 13 on the downstream side in the conveying direction are substantially at the same position in the vertical direction or the end portion 13c of the post-combustion stage 13 is disposed above the end portion 12c of the combustion stage 12. The stoker type incinerator 1 of the present embodiment is an example in which the end portion 12c of the combustion stage 12 on the downstream side in the conveying direction and the end portion 13c of the post-combustion stage 13 on the downstream side in the conveying direction are located at the same position in the vertical direction.

[0051]

Next, the reason why the stoker inclination angle of the drying stage 11 is set to an angle between -15° (minus 15 degrees) and -25° (minus 25 degrees) will be described.

The function of the drying stage 11 is to efficiently remove the moisture in the objects T by drying using the radiant heat from the flame above the objects T and the sensible heat of the primary air from the lower part of the fire grates.

Here, the radiation heat from the flame has a higher contribution to the drying than the sensible heat of the primary air, and the drying of the upper layer portion of the objects T easily proceed.

For this reason, the drying speed is improved by moving the lower layer portion of the objects T upward by a stirring operation of the fire grates and replacing the lower layer portion with the upper layer portion.

However, even when the stirring operation is carried out, since essentially there has to be no incineration in the drying stage 11, it is necessary to secure a length enough for moisture evaporation to sufficiently

proceed. As the length increases, the size of the device increases, and the costs also increase. Thus, it is required to make the stoker length as short as possible.

[0052]

5 If an absolute value of the stoker inclination angle is larger than an angle of repose of the objects T, since the objects T collapse under its own weight and layers of the objects T are not formed, the stoker 5 does not work properly. On the other hand, if the absolute value of the stoker inclination angle is smaller than the angle of repose of the objects T, the
10 stoker 5 does work properly, but the movement of the objects T due to gravity (movement due to its own weight) decreases. Further, when the installation surface is directed upward, that is, when the stoker inclination angle is inclined at a positive value (plus value), gravity acts in a direction of pushing back the objects T from the conveying direction.

15 When the conveying amount of the objects T due to the stoker 5 is less than the charged amount of the objects T, the ability of the stoker 5 is reached to the conveyance limit and the stoker 5 cannot incinerate the charged amount of the object T properly.

[0053]

20 The optimum stoker inclination angle differs depending on the amount of objects T to be charged and the moisture content of the objects T. Here, description will be provided on the assumption that a case in which the amount of the objects T to be charged is high and the moisture content is high (the amount of moisture is large) is a case in which the load of the
25 charged objects is large. On the contrary, a case in which the amount of objects T to be charged is small and the moisture content is low is a case in which the load of the charged objects is small.

[0054]

Fig. 8 illustrates a graph in which a horizontal axis represents a

stoker inclination angle of the drying stage 11, a vertical axis represents a required stoker length of the drying stage 11, and in order of a case (1) in which the load of the charged objects is the largest to a case (4) in which the load of the charged objects is the smallest, a relationship between the stoker inclination angle of the drying stage 11 and the required stoker length of the drying stage 11 is plotted.

Here, the required stoker length is the distance at which 95% of the moisture of the charged objects T is dried. "Angle of repose" on the horizontal axis represents the angle of repose of the objects T.

10 [0055]

As illustrated in the graph of Fig. 8, a stoker inclination angle of -30° is a limit for forming the layer of the objects T. With respect to the stoker inclination angle of the layer formation limit, the required stoker length decreases as the stoker inclination angle is reduced. However, when the stoker inclination angle turns to a positive value, the required stoker length gradually becomes longer. This is because when the stoker inclination angle becomes a positive value, the installation surface is directed upward and the conveying speed becomes slower, and as a result, the layer of the objects T becomes thick and it is difficult for drying of the objects T at the lower layer to proceed.

It should be noted that, in the four cases of the case (1) in which the load of the objects T to be charged is the largest to the case (4) in which the load of the objects T to be charged is the smallest, no matter what the properties or quantity of the objects T is, the stoker inclination angle of the optimum drying stage 11 at which the objects T can be suitably processed and the stoker length can be set to be shortest has an appropriate range of an angle between -15° (minus 15 degrees) and -25° (minus 25 degrees). Further, the optimum value is -20° (minus 20 degrees).

[0056]

Next, in the case in which the stoker inclination angle of the drying stage 11 is set to be within the appropriate range as described above, the reason why it is appropriate to make the stoker inclination angle of the combustion stage 12 between $+5^{\circ}$ (plus 5 degrees) and $+15^{\circ}$ (plus 15 degrees) will be explained.

The function of the combustion stage 12 is to maintain the temperature of the layer of the objects T by radiant heat from flames and self-combustion heat, to promote the generation of combustible gas by thermal decomposition of the volatile matter, and to promote combustion of the fixed carbon that is left after the thermal decomposition.

[0057]

Here, since the time required for combustion of the fixed carbon is longer than the time required for volatilization of the volatile combustible gas, the required stoker length of the combustion stage 12 is determined according to the time required for combustion of the fixed carbon.

[0058]

Fig. 9 illustrates a graph in which, in a case in which the stoker inclination angle of the drying stage 11 is set in the appropriate range as described above, a horizontal axis represents the stoker inclination angle of the combustion stage, the vertical axis represents the required stoker length of the combustion stage, and in order from the case (1) in which load of the charged objects is the largest to the case (4) in which load of the charged objects is the smallest, a relationship between the stoker inclination angle of the combustion stage and the required stoker length of the combustion stage is plotted. Here, the required stoker length of the combustion stage is the distance at which 95% of the combustible content volatilizes or burns.

[0059]

As illustrated in Fig. 9, the stoker inclination angle -30° is the limit of forming the layer of the objects T. For the stoker inclination angle of the

layer formation limit, the required stoker length decreases as the angle becomes loose. Considering the conveyance limit, the appropriate range of the stoker inclination angle can be set to a range surrounded by the single dotted-dashed line illustrated in Fig. 9.

5 [0060]

Even when the load of the charged objects is large in the drying stage 11, since the drying stage 11 has the stoker inclination angle within the appropriate range, the water content reduction and the volume reduction of the waste are accelerated. Therefore, for example, even if the load
 10 corresponds to (1) in the drying stage 11, since the load changes to those corresponding to (3) and (4) in the combustion stage 12, the larger stoker inclination angle can be adopted in the combustion stage 12. That is, since the combustion stage can be directed upward, it is possible to secure the retention time required for combustion of the fixed carbon, and further the
 15 stoker length can be shortened.

[0061]

Fig. 10 is a graph in which a horizontal axis represents the stoker inclination angle of the combustion stage 12, a vertical axis represents the stoker length required for both of the drying stage 11 and the combustion
 20 stage 12, and in order from the case (1) in which the load of the objects T to be charged is the largest to the case (4) in which the load of the objects T to be charged is the smallest, a relationship between the stoker inclination angle of the combustion stage 12 and the stoker length required for both of the drying stage 11 and the combustion stage 12 is plotted. Here, the
 25 stoker inclination angle of the drying stage 11 is set to an optimum value of -20° (minus 20 degrees).

[0062]

As illustrated in Fig. 10, when considering the conveyance limit, the appropriate range of the stoker inclination angle of the combustion stage 12

is an angle between $+8^{\circ}$ (plus 8 degrees) and $+12^{\circ}$ (plus 12 degrees).
Further, in the case in which the stoker inclination angle of the drying stage 11 is the optimum value of -20° (minus 20 degrees), the optimum value of the stoker inclination angle of the combustion stage 12 is $+10^{\circ}$ (plus 10
5 degrees).

Since the required stoker lengths of the drying stage 11 and the combustion stage 12 can be made as short as possible by setting the respective stoker inclination angles to appropriate ranges, particularly optimum values, even if the post-combustion stage 13 is included, it is
10 possible to provide a small-sized and economical stoker as compared with the conventional one.

[0063]

According to this embodiment, since the drying stage 11 is inclined downward, it is possible to convey any kind of the objects T up to the
15 combustion stage 12 without delay. Further, since the combustion stage 12 and the post-combustion stage 13 are inclined upward, the objects T do not easily slide down or roll down on the downstream side of the combustion stage 12 and is sufficiently burned and conveyed.

[0064]

20 That is, while incinerating the objects T in which slippery materials are included or having a shape to be easy to roll itself, since the objects are transported to the combustion stage 12 earlier due to rolling on the drying stage 11 or the like, there is a likelihood that it will not be able to be dried thoroughly in the drying stage 11. However, since the combustion stage 12
25 and the post-combustion stage 13 are inclined upward, the objects T rolling down the drying stage 11 does not roll further down the combustion stage 12 and the post-combustion stage 13, and the objects T can be sufficiently dried and incinerated in the combustion stage 12 as necessary. Since the objects T having high water content are conveyed to the combustion stage

12 while being dried without staying in the drying stage 11, the objects T are also incinerated sufficiently in the combustion stage 12.

As a result, regardless of the properties of the objects T, it is possible to continuously charge the objects T, and it is possible to eliminate the
5 combustion residuals of the objects T.

[0065]

Further, the end portion 13c of the post-combustion stage 13 on the downstream side in the conveying direction is located substantially at the same position in the vertical direction as the end portion 12c of the
10 combustion stage 12 on the downstream side in the conveying direction, or above the end portion 12c of the combustion stage 12. Accordingly, even in the case in which the objects T roll down or the like in the drying stage 11, it is possible to prevent the objects T from being discharged from the post-combustion stage 13 without being sufficiently burned.

15 [0066]

According to the above embodiment, a force of pulling the front fire gate in a direction opposite to the moving direction of the movable fire grate 16 due to the spring 35 acts on the front fire grate 31 dragged by the movable fire grate 16 and slightly moved. Therefore, even when waste
20 biting occurs between the movable fire grate 16 and the front fire grate 31, a force of returning the front fire grate 31 sandwiching the waste acts.

Further, since the moving direction of the front fire grate 31 is restricted by the support portion 32, the movement of the front fire grate 31 can be suppressed to the minimum and the deterioration of the sealing
25 performance can be suppressed.

[0067]

Further, since the moving direction of the front fire grate 31 is limited only in the direction in which the front fire grate 31 is in contact with the movable fire grate by the shaft-like member 38 and the shaft support

portions 40 and 42, the contact state between the front fire grate 31 and the movable fire grate 16 can be improved.

Further, the contact state between the front fire grate 31 and the movable fire grate 16 can be further improved by the moving direction
5 restricting portion 44 including the penetration hole 45 and the guide member 46.

[0068]

Further, the sealing device 30 of the present invention is disposed in a stoker type incinerator in which the drying stage 11 is directed downward
10 at the aforementioned angle and the combustion stage 12 and the post-combustion stage 13 face upward at the aforementioned angle, by appropriately setting the urging direction as an "extruding direction" and a "drawing direction" as described above. Thus, it is possible to improve the sealing property of the stoker type incinerator.

15 [0069]

The structure of the shaft-like member 38 of the sealing device 30 and the structure of the shaft support portion are not limited to the above-described structure. For example, as illustrated in Fig. 6, the shaft-like member 38B may be fixed to the support portion 32B (the top
20 surface support plate 33B) and the cylindrical shaft support portion 40B may be fixed to the front fire grate main body 37. The spring 35 connects the nut 47 and the shaft support portion 40B. The shaft support portion 40B can slide on the inner peripheral surface of the penetration hole 41a formed in the second shaft support plate 41 of the bottom surface support plate 34.

25 That is, any configuration may be adopted as long as the front fire grate 31 can be urged in a direction opposite to the direction in which the front fire grate 31 moves with the movement of the movable fire grate 16.

In addition, although the sealing device 30 is not limited to the present embodiment, and can be effectively applied to a stoker type

incinerator in which a plate-shaped moving grate is present immediately under a falling wall and reciprocates, the present embodiment in which the direction of inclination of each stage of the stoker is different is preferable because the equipment costs can be reduced due this being able to be
5 adopted the same mechanisms.

[0070]

(Modified example)

Hereinafter, a modified example of the stoker type incinerator in which the sealing device for a stoker type incinerator of the present
10 invention is disposed will be described in detail with reference to the drawings. In this modified example, differences from the above-described embodiment will be mainly described, and description of similar portions will be omitted.

As illustrated in Fig. 7, there is no step (drop wall) between the
15 combustion stage 12 and the post-combustion stage 13 of the stoker 5. That is, the combustion stage 12 and the post-combustion stage 13 are continuously connected to each other. In other words, the end portion 12c of the combustion stage 12 on the downstream side in the conveying direction and the end portion 13b of the post-combustion stage 13 on the
20 upstream side in the conveying direction are formed to have the same height.

The second sealing device 30B is provided only on the second drop wall 28 between the drying stage 11 and the combustion stage 12.

[0071]

25 According to the present modified example, even if the objects T rolling down the drying stage 11 have a strong momentum and passes through the combustion stage 12 with its momentum, it stops at least in the post-combustion stage 13 and is not be discharged from the post-combustion stage 13. Further, since the post-combustion stage 13 and

the combustion stage 12 are continuously connected to each other without steps, even if the objects T which are not sufficiently burned roll to the post-combustion stage 13, the objects T return to the combustion stage 12 due to its own weight, and combustion can be performed. In other words, it is possible to reduce the discharge of incompletely burned objects T.

Also in this modified example, the sealing efficiency of the stoker type incinerator can also be improved by appropriately setting and arranging the sealing device 30 in the "extruding direction" and the "drawing direction" as described.

10 [0072]

Although the embodiments of the present invention have been described in detail with reference to the drawings, specific configurations are not limited to this embodiment, and design changes and the like within a scope not deviating from the gist of the present invention are included.

15 The configuration for energizing the front fire grate 31 is not limited to the above-described configuration, and for example, a tension coil spring or a Belleville spring may be adopted instead of a compression coil spring.

REFERENCE SIGNS LIST

20 [0073]

1 STOKER TYPE INCINERATOR

2 HOPPER

3 INCINERATOR

4 FEEDER

25 5 STOKER

6 WIND BOX

7 FEED TABLE

8 FEEDER DRIVING DEVICE

9 COMBUSTION CHAMBER

	10 BLOWER
	11 DRYING STAGE
	11a INSTALLATION SURFACE OF DRYING STAGE
	12 COMBUSTION STAGE
5	12a INSTALLATION SURFACE OF COMBUSTION STAGE
	13 POST-COMBUSTION STAGE
	13a INSTALLATION SURFACE OF POST-COMBUSTION STAGE
	15 FIXED FIRE GRATE
	16 MOVABLE FIRE GRATE
10	16P PROTRUSIVE FIRE GRATE
	17 ASH OUTLET
	18 DRIVE MECHANISM
	19 BEAM
	20 HYDRAULIC CYLINDER
15	21 ARM
	22 BEAM
	23 BRACKET
	27 FIRST DROP WALL
	28 SECOND DROP WALL
20	29 THIRD DROP WALL
	30 SEALING DEVICE
	30A FIRST SEALING DEVICE
	30B SECOND SEALING DEVICE
	30C THIRD SEALING DEVICE
25	31 FRONT FIRE GRATE
	31a TOP SURFACE
	31b BOTTOM SURFACE
	31c PROTRUSION (TIP)
	32 SUPPORT PORTION

	33 TOP SURFACE SUPPORT PLATE
	34 BOTTOM SURFACE SUPPORT PLATE
	35 SPRING
	37 FRONT FIRE GRATE MAIN BODY
5	38, 38B SHAFT-LIKE MEMBER
	39 FIRST SHAFT SUPPORT PLATE
	40 FIRST SHAFT SUPPORT PORTION
	41 SECOND SHAFT SUPPORT PLATE
	42 SECOND SHAFT SUPPORT PORTION
10	44 MOVING DIRECTION RESTRICTING PORTION
	45 PENETRATION HOLE
	46 GUIDE MEMBER
	47 NUT
	D CONVEYING DIRECTION
15	D1 UPSTREAM SIDE IN CONVEYING DIRECTION
	D2 DOWNSTREAM SIDE IN CONVEYING DIRECTION
	T OBJECT TO BE INCINERATED
	$\theta 1, \theta 2, \theta 3$ STOKER INCLINATION ANGLE

CLAIMS

1. A sealing device in a stoker type incinerator, for sealing a gap
between a drop wall of the stoker type incinerator and a movable fire grate,
5 the stoker type incinerator being provided with a plurality of fixed fire grates
and a plurality of the movable fire grates, and in which objects is subjected
to incineration while conveying the objects, the sealing device comprising:
a front fire grate disposed of which a distal end abuts on the movable
fire grate;
10 a support portion having a top surface support plate fixed to the drop
wall and configured to support a top surface of the front fire grate, and a
bottom surface support plate disposed below the top surface support plate
and configured to support a bottom surface of the front fire grate; and
a spring configured to urge the front fire grate in a direction opposite
15 to a direction in which the front fire grate is moved with the movable fire
grate.
2. The sealing device according to claim 1, further comprising:
a shaft-like member fixed to the front fire grate or the support
20 portion and extending in a particular direction corresponding to a conveying
direction of the objects to be incinerated; and
a shaft support portion configured to support the shaft-like member
to be freely slidable in the one direction.
- 25 3. The sealing device according to claim 2, further comprising:
a moving direction restricting portion configured to restrict a
movement of the front fire grate to advance and retreat in the one direction,
wherein the moving direction restricting portion includes a
penetration hole formed in the front fire grate and long in the particular

direction in which the shaft-like member is extending, and

a guide member inserted through the penetration hole and fixed to the support portion.

- 5 4. A stoker type incinerator comprising a drying stage, a combustion stage and a post-combustion stage, each of the stages including a plurality of fixed fire grates and a plurality of the movable fire grates, in which objects to be incinerated are subjected to drying, combusting and pre-combusting while sequentially conveying the objects to be incinerated through the drying, 10 combustion and pre-combustion stages,

wherein the drying stage is disposed to be inclined so that a downstream side in a conveying direction is directed downward,

- the combustion stage is connected to the drying stage and is disposed to be inclined so that the downstream side in the conveying 15 direction is directed upward,

the post-combustion stage is connected to the combustion stage and is disposed to be inclined such that the downstream side in the conveying direction is directed upward, and

- in a state in which a front fire grate is urged in a direction of 20 extruding the front fire grate toward the downstream side in the conveying direction, the sealing device according to any one of claims 1 to 3 is disposed on a drop wall between the drying stage and the combustion stage.

5. The stoker type incinerator according to claim 4, wherein in a state in 25 which the front fire grate is urged in a direction of extruding the front fire grate toward an upstream side in the conveying direction, a sealing device for the stoker type incinerator is disposed on the drop wall between the feeder and the combustion stage.