

DESCRIPTION

STOKER TYPE INCINERATOR FOR COMBUSTING OBJECT TO BE
INCINERATED

5

TECHNICAL FIELD

[0001]

The present invention relates to a stoker type incinerator for
combusting object to be incinerated such as waste.

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Priority is claimed on Japanese Patent Application No. 2017-201342,
filed October 17, 2017, the content of which is incorporated herein by
reference.

BACKGROUND ART

15

[0002]

A stoker type incinerator capable of efficiently incinerating a large
amount of object 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
combusting the objects, and a post-combustion stage for further combusting
the objects.

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[0003]

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In order to reliably incinerate the objects, an inclination angle of the
stoker has been studied. As described in Patent Document 1, for example,
the inclination angle of the stoker may be inclined so that a downstream side
in a conveying direction of an installation surface of all the stages of the
drying stage, the combustion stage, and the post-combustion stage is
directed downward. In the following description, for example, when the

downstream side in the conveying direction of the installation surface of the drying stage is directed downward, the drying stage is simply referred to as being directed downward (the same also applies to the combustion stage and the post-combustion stage).

5 Further, as described in Patent Document 2, there is a configuration in which the drying stage is inclined downward, and the combustion stage and the post-combustion stage are disposed horizontally, as described in Patent Document 3, there is a configuration in which the drying stage and the combustion stage are inclined downward and the downstream side in the
10 conveying direction of the installation surface of the post-combustion stage is inclined upward, and as described in Patent Document 4, there is a configuration in which all the stages are inclined upward. For example, when the downstream side end in the conveying direction of the installation surface of the combustion stage is directed upward, the combustion stage is
15 simply referred to as being directed upward (the same also applies to the case of the drying stage and the post-combustion stage).

CITATION LIST

PATENT DOCUMENTS

- 20 [0004]
Patent Document 1: Japanese Unexamined Patent Application, First Publication No. H06-265125
Patent Document 2: Japanese Unexamined Utility Model Publication No. H06-84140
25 Patent Document 3: Japanese Examined Patent Publication No. S57-12053
Patent Document 4: Japanese Unexamined Patent Application, First Publication No. S50-65062

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0005]

Incidentally, objects to be incinerated with various properties (materials, forms, moisture content) may be charged to a stoker type incinerator, but objects to be incinerated formed of a slippery material or having a shape to be easy to roll itself such as a spherical shape, or objects to be incinerated with a high moisture content (including large amount of water) may be difficult to incinerate in the same stoker type incinerator as that used for other objects to be incinerated.

10 [0006]

That is, in the stoker type incinerators described in Patent Documents 1, 2, and 3, since the drying stage is inclined downward and the combustion stage is inclined downward or disposed horizontally, objects to be incinerated in a form that readily roll may be transported to the post-combustion stage earlier than other materials, such that there may be a problem that the object to be incinerated is discharged while still burning without having been incinerated sufficiently.

[0007]

Further, in the stoker type incinerator described in Patent Document 4, since all of the drying stage, the combustion stage, and the post-combustion stage are inclined upward, objects to be incinerated in which slippery materials are included or having a shape to be easy to roll itself or objects to be incinerated with a high moisture content are gathered at the bottom of a step (a drop wall) disposed between the feeder and the drying stage, and since the object to be incinerated is hard to be conveyed to the combustion stage, in some cases, there is a problem that it is necessary to limit an charging amount or temporarily stop the charging.

[0008]

An object of the present invention is to provide a stoker type

incinerator for combusting objects to be incinerated such as waste capable of continuously charging the objects regardless of the properties thereof and eliminating combustion residuals of the objects.

5 SOLUTION TO PROBLEM

[0009]

According to a first aspect of the present invention, there is provided a stoker type incinerator for combusting objects to be incinerated such as waste which feeds the incinerated object from a feeder and performs each of
10 drying, combustion, and post-combustion, while sequentially conveying the objects, in a drying stage, a combustion stage, and a post-combustion stage, which include a plurality of fixed fire grates and a plurality of movable fire grates, wherein the drying stage is disposed to be inclined so that a downstream side in a conveying direction is directed downward, the
15 combustion stage is connected to the drying stage and disposed to be inclined so that the downstream side end thereof in the conveying direction is directed upward, and the post-combustion stage is connected to the combustion stage and disposed to be inclined so that the downstream side end thereof in the conveying direction is directed upward.

20 [0010]

According to such a configuration, since the drying stage is inclined downward in the conveying direction, it is possible to convey the objects to be incinerated with any properties to the combustion stage without delay. Further, since the combustion stage and the post-combustion stage are
25 inclined upward, the objects do not easily slide down or roll down after the combustion stage and is sufficiently burned and conveyed.

That is, while incinerating objects in which slippery materials are included or having a shape to be easy to roll itself, since it is conveyed to the combustion stage at an early stage due to rolling over on the drying stage or

the like, there is a likelihood that it may not be sufficiently dried in the drying stage. However, since the combustion stage and the post-combustion stage are inclined upward, the objects to be incinerated rolling down the drying stage do not roll further down the combustion stage and the post-combustion stage, and the objects to be incinerated is sufficiently dried and incinerated in the combustion stage as necessary. Since the objects to be incinerated having high water content is conveyed to the combustion stage while being dried without staying in the drying stage, the objects to be incinerated is also incinerated sufficiently in the combustion stage.

As a result, regardless of the properties of the object to be incinerated, it is possible to continuously charge object to be incinerated, and it is possible to eliminate residual burning of the object to be incinerated.

[0011]

In the stoker type incinerator, an end portion of the post-combustion stage on the downstream side in the conveying direction may be disposed in a vertical direction substantially at the same position as the end portion of the combustion stage on the downstream side in the conveying direction, or at a position higher than the end portion of the combustion stage.

[0012]

According to such a configuration, even in the case in which the objects to be incinerated roll down the drying stage, it is possible to prevent the objects to be incinerated from being discharged from the post-combustion stage without being sufficiently burned.

[0013]

In the stoker type incinerator, each of the fixed fire grates and the movable fire grates may be disposed to be inclined so that the downstream side end thereof in the conveying direction is directed upward with respect to

installation surfaces of the drying stage, the combustion stage, and the post-combustion stage.

[0014]

With such a configuration, the movable fire grates can be operated to stir and feed the objects to be incinerated on the fixed fire grates to the downstream side in the conveying direction while stirring.

[0015]

In the stoker type incinerator, each of the drying stage, the combustion stage, and the post-combustion stage may have a driving mechanism configured to drive the plurality of included movable fire grates, and driving speeds in the drying stage, the combustion stage, and the post-combustion stage are set to same speed or different speed in at least one of the drying stage, the combustion stage, and the post-combustion stage with respect to the other.

[0016]

According to such a configuration, it is possible to change the conveying speeds of each stage depending on the properties of objects to be incinerated.

[0017]

In the stoker type incinerator, the combustion stage and the post-combustion stage may be continuously connected to each other without steps.

[0018]

With such a configuration, it is easier to continuously incinerate the object to be incinerated.

[0019]

In the stoker type incinerator, at least one of the movable fire grates of the drying stage may be a protrusive fire grate in which a protrusion is formed on the distal end of the protrusive fire grate.

[0020]

With such a configuration, it is possible to improve the stirring effect of the objects to be incinerated when the movable fire grates are reciprocated.

5 [0021]

In the stoker type incinerator, at least one of the movable fire grates of the combustion stage may be a protrusive fire grate in which a protrusion is formed on the distal end of the protrusive fire grate.

[0022]

10 In the stoker type incinerator, a stoker inclination angle of the drying stage may be arranged at an angle between -15° and -25° , and the stoker inclination angle of the combustion stage and the post-combustion stage may be arranged at an angle between $+5^{\circ}$ and $+15^{\circ}$.

15 Preferably, the stoker inclination angle of the drying stage may be -20° , and the stoker inclination angle of the combustion stage and the post-combustion stage may be arranged at $+10^{\circ}$.

According to such a configuration, since the required stoker length can be shortened, it is possible to provide a small-sized and economical stoker type incinerator.

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ADVANTAGEOUS EFFECTS OF INVENTION

[0023]

25 According to the present invention, it is possible to continuously charge the objects to be incinerated, regardless of the properties of the objects to be incinerated, and it is possible to eliminate the combustion residuals of the objects.

BRIEF DESCRIPTION OF DRAWINGS

[0024]

Fig. 1 is a view showing a schematic configuration of a stoker type incinerator according to a first embodiment of the present invention.

Fig. 2 is a view for explaining a stoker inclination angle of a stoker type incinerator according to the first embodiment of the present invention.

5 Fig. 3 is a side view illustrating a shape of fire grates of the stoker type incinerator according to the first embodiment of the present invention.

Fig. 4 is a graph explaining that an appropriate range of the stoker inclination angle of a drying stage is an angle between -15° and -25° .

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

Fig. 6 is a graph explaining the reason why the appropriate range of the stoker inclination angle of the combustion stage is between $+8^{\circ}$ and $+12^{\circ}$ and an optimum value is $+10^{\circ}$ in view of both of the drying stage and the combustion stage.

15 Fig. 7 is a view for explaining a stoker inclination angle of a stoker type incinerator according to a second embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0025]

20 (First Embodiment)

Hereinafter, 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, as illustrated in Fig. 1, includes a hopper 2 for temporarily storing the
25 objects T to be 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

incineration furnace 3, and a wind box 6 provided below the stoker 5.

[0026]

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
5 reciprocated on the feed table 7 with a predetermined stroke by a feeder driving device 8.

The wind box 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
10 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.

[0027]

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

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 right side is a
20 downstream side D1 in the conveying direction. Further, a surface on which the fire grates 15 and 16 are attached is referred to as an installation surface, and an angle on the conveying direction D formed by a horizontal surface and the installation surface centered on the upstream ends (11b, 12b and 13b) of the drying stage, the combustion stage or the
25 post-combustion stage is referred to as a stoker inclination angle (an installation angle). When the downstream side end 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 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.

[0028]

The stoker 5 has, in order from the upstream side 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.

20 [0029]

The drying stage 11 receives the objects T that are pushed out by the feeder 4 and fall 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 the combustion stage 12 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.

5 [0030]

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 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.

[0031]

The drive mechanism 18 is attached to a beam 19 provided on the 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.

[0032]

According to the drive mechanism 18 of this embodiment, 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.

[0033]

25 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 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.

[0034]

5 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

10 For example, when the objects T required to be sufficiently burned in the combustion stage 12 are charged, by decreasing the driving speed of 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.

15 [0035]

 As illustrated in Figs. 2 and 3, the fixed fire grates 15 and the movable fire grates 16 are disposed such that the downstream side end thereof in the conveying direction is directed upward with respect to the installation surfaces 11a, 12a and 13a of the drying stage 11, the
20 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 D1 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 D1 in the conveying
25 direction.

[0036]

 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 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.

As illustrated in Fig. 3, the protrusive fire grate 16P has a plate-like fire grate body 25 and a triangular protrusion 26 formed on the distal end of the fire grate body 25. The protrusion 26 protrudes upward from the top surface of the fire grate body 25. The shape of the protrusion 26 is not limited thereto, and it may be, for example, trapezoidal or round.

Here, each of the fixed fire grates 15 of FIG. 3 is a fire grate with no protrusion on the top surface of its distal end, and this shape is called a normal fire grate.

[0037]

In the present embodiment, some of 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.

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 may be the normal fire grates.

[0038]

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

corresponds to 50% to 80% of a whole area of the combustion stage 12 from the downstream side 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, both of the movable fire grates 16 and the fixed fire grates 15 may 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.

[0039]

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).

[0040]

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).

5 [0041]

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 becomes higher. More specifically, a stoker inclination
10 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 $+5^{\circ}$ (plus 5 degrees) to $+15^{\circ}$ (plus 15 degrees).

[0042]

15 A step (a drop wall) 27 is formed between the drying stage 11 and the combustion stage 12. An 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.

20 Similarly, a step (drop wall) 28 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.

25 [0043]

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 in the vertical direction. 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.

[0044]

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 dry and remove the moisture in the objects T by 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 incinerator increases, and the cost also increases. Thus, it is required to make the stoker length as short as possible.

[0045]

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 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), the gravity acts in a direction of pushing back the objects T from the conveying direction.

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 stoker 5 is reached to the conveyance limit and the stoker 5 cannot incinerate the charged amount of the object T properly.

[0046]

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, the 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 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.

[0047]

Fig. 4 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.

5 [0048]

As illustrated in the graph of Fig. 4, a stoker inclination angle of -30° is the 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
 10 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
 15 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
 20 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).

[0049]

25 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 the flame and self-combustion heat, and 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.

[0050]

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.

[0051]

Fig. 5 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.

[0052]

As illustrated in Fig. 5, 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 the range surrounded by the single dotted-dashed line illustrated in Fig. 5.

[0053]

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
 5 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 fixed carbon, and further the
 10 stoker length can be shortened.

[0054]

Fig. 6 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
 15 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
 20 stoker inclination angle of the drying stage 11 is set to an optimum value of -20° (minus 20 degrees).

[0055]

As illustrated in Fig. 6, when considering the conveyance limit, the appropriate range of the stoker inclination angle of the combustion stage 12
 25 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 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 possible to provide a small-sized and economical stoker as compared with the conventional one.

[0056]

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 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 to the downstream side of the combustion stage 12 and is sufficiently burned and conveyed.

[0057]

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 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 combustion residuals of the objects T.

[0058]

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 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.

10 [0059]

(Second Embodiment)

Hereinafter, a stoker type incinerator according to a second embodiment of the present invention will be described in detail with reference to the drawings. In this embodiment, differences from the above-described first 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 combustion stage 12 and the post-combustion stage 13 of the stoker 5 of this embodiment. That is, the combustion stage 12 and the post-combustion stage 13 of this embodiment 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 upstream side in the conveying direction are formed to have the same height.

25 [0060]

According to the embodiment, 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
 5 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.

[0061]

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

In the above embodiment, the distal ends of the fire grates 15 and 16 are disposed to face the downstream side D1 in the conveying direction. However, the present invention is not limited thereto. For example, the
 15 distal ends of the fire grates 15 and 16 of the drying stage 11 may be arranged to face the upstream side in the conveying direction.

REFERENCE SIGNS LIST

[0062]

- | | |
|----|---------------------------|
| 20 | 1 STOKER TYPE INCINERATOR |
| | 2 HOPPER |
| | 3 INCINERATION FURNACE |
| | 4 FEEDER |
| | 5 STOKER |
| 25 | 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
	12a INSTALLATION SURFACE OF COMBUSTION STAGE
5	13 POST-COMBUSTION STAGE
	13a INSTALLATION SURFACE OF POST-COMBUSTION STAGE
	15 FIXED FIRE GRATE
	16 MOVABLE FIRE GRATE
	16P PROTUSIVE FIRE GRATE
10	17 ASH OUTLET
	18 DRIVE MECHANISM
	19 BEAM
	20 HYDRAULIC CYLINDER
	21 ARM
15	22 BEAM
	23 BRACKET
	25 FIRE GRATE BODY
	26 PROTRUSION
	27, 28 STEP (DROP WALL)
20	D CONVEYING DIRECTION
	D1 DOWNSTREAM SIDE IN CONVEYING DIRECTION
	T OBJECT TO BE INCINERATED
	$\theta 1, \theta 2, \theta 3$ STOKER INCLINATION ANGLE

CLAIMS

1. A stoker type incinerator for combusting objects to be incinerated such as waste, comprising:

5 a drying stage, a combustion stage and a post-combustion stage, each of the stages having a plurality of fixed fire grates and a plurality of movable fire grates, and in which the objects to be incinerated supplied from a feeder is subjected to drying, combustion and post-combustion while sequentially conveying the objects to be incinerated through the drying
10 stage, the combustion stage and the post-combustion stage,

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 disposed to be inclined so that the downstream side end thereof in the conveying
15 direction is directed upward,

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

an end portion of the post-combustion stage on the downstream side
20 in the conveying direction is disposed in a vertical direction substantially at the same position as the end portion of the combustion stage on the downstream side in the conveying direction, or at a position higher than the end portion of the combustion stage.

25 2. The stoker type incinerator for combusting the objects to be incinerated such as waste according to claim 1, wherein each of the fixed fire grates and the movable fire grates is disposed to be inclined so that the downstream side end thereof in the conveying direction is directed upward with respect to installation surfaces of the drying stage, the combustion

stage, and the post-combustion stage.

3. The stoker type incinerator for combusting the objects to be incinerated such as waste according to claim 2, wherein the drying stage,
5 the combustion stage, and the post-combustion stage each has a drive mechanism configured to drive the plurality of included movable fire grates, and

driving speeds in the drying stage, the combustion stage, and the post-combustion stage are set to same speed or different speed in at least
10 one of the drying stage, the combustion stage, and the post-combustion stage with respect to the other.

4. The stoker type incinerator for combusting the objects to be incinerated such as waste according to claim 3, wherein the combustion
15 stage and the post-combustion stage are continuously connected to each other without steps.

5. The stoker type incinerator for combusting the objects to be incinerated such as waste according to claims 3 or 4, wherein at least one of
20 the plurality of movable fire grates of the drying stage is a protrusive fire grate in which a protrusion is formed on the distal end of the protrusive fire grate.

6. The stoker type incinerator for combusting the objects to be incinerated such as waste according to claim 5, wherein at least one of the
25 plurality of movable fire grates of the combustion stage is a protrusive fire grate in which a protrusion is formed on the distal end of the protrusive fire grate.

7. The stoker type incinerator for combusting the objects to be incinerated such as waste according to claim 6, wherein a stoker inclination angle of the drying stage is arranged at an angle between -15° and -25° ,
the stoker inclination angle of the combustion stage and the
5 post-combustion stage is arranged at an angle between $+8^{\circ}$ and $+12^{\circ}$, and
the stoker inclination angle of the post-combustion stage is the same
as the stoker inclination angle of the combustion stage.

8. The stoker type incinerator for combusting the objects to be
10 incinerated such as waste according to claim 7, wherein the stoker
inclination angle of the drying stage is -20° , and
the stoker inclination angle of the combustion stage and the
post-combustion stage is $+10^{\circ}$.