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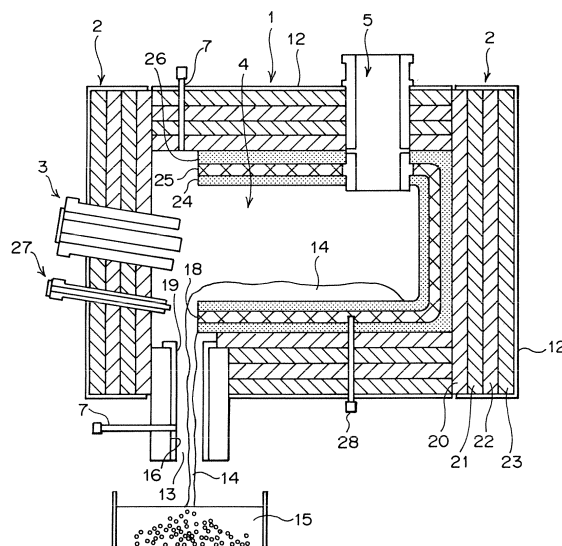
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(54) **Ash Melting Device**

(57) An ash melting device employing the means of using a crucible (4) with a three-layer (24,25,26) structure, using an auxiliary burner (27) for prevention of the lowering of temperature in the vicinity of the discharge outlet (13) employing furnace walls with a four-layer (20-23) structure to improve the heat insulating property and thereby improve the durability, providing lids (2) at both the left and right sides to enable the crucible to be taken out readily, etc. This ash melting device is intended to significantly improve durability even after a long period of use at a high temperature of 1600 to 1700°C or more, to resolve the problem of prevention of use of the melting furnace due to clogging of the vicinity of the discharge outlet by the cooling and solidification of the ash melt, to reduce fuel cost by the improvements in thermal efficiency through improvement of the heat insulating property of the furnace walls, and to enable the crucible to be exchanged readily in a short time.

FIG.2



EP 1 288 569 A2

Description

[0001] This invention concerns an ash melting device and particularly concerns an extremely efficient device, which can be made compact in size, for rendering harmless the incineration ash that is generated by incineration of industrial or domestic waste, etc., and melts the incineration ash prior to making the ash particulate, lump-like, or fibrous in form for the purpose of enabling reuse.

[0002] In recent years, the disposal of dioxins, heavy metals, hypodermic needles, etc., which are contained in incineration ash waste after incineration of waste discharged from households, factories, hospitals, etc., into the environment and the resulting environmental pollution have become a major social problem and means for treating such wastes are being demanded.

[0003] As a means for treating the above-mentioned incineration ash waste, melting and solidification methods for reducing the volume of waste and rendering the waste harmless have been disclosed for example, in Japanese patent application publication No. 2000-324734, which discloses an ash melting device of the type shown in Fig. 1. That publication discloses an ash melting device in the form of a furnace, wherein a main furnace body 1, having a discharge outlet 13 and an ash loading inlet 5, is equipped with a lid 2, is provided near the centre thereof with a burner part 3 that uses propane gas, butane gas, or other petroleum gas or city gas and oxygen gas as fuel, and having an exchangeable, single-layer crucible 4 provided at the innermost layer of the main furnace body 1, the open part of the crucible 4 being directed towards the side having the lid 2.

[0004] To give a more detailed description of this patent with reference to Fig. 1, the walls of main furnace body 1 comprise, in order starting from the innermost side, a crucible 4, fluidized sand 11, a first heat resistant layer 8, a second heat resistant layer 9, a third heat resistant layer 10, and an iron shell 12. An ash loading inlet 5 is provided at one location near the centre of the side surface of the main furnace body 1; a crucible ejection rod 6 is provided at the right side; a discharge outlet 13, for discharging the melt 14 and exhausting gas, is provided at the lower left side; a temperature sensor 7 is provided at the upper left side; and the melt dropping position 18 of crucible 4 is arranged so that melt 14 will not come into contact with the wall surface 16 of the discharge outlet 13.

[0005] The crucible 4 is in the form of a heat-resistant, graphite silicon carbide crucible, with a carbon content of 30 to 55% and an SiC content of 30 to 50%, such as that sold by Nippon Crucible Co., Ltd. Such a crucible is manufactured by forming to a predetermined size and then baking. For the first heat resistant layer 8 and the second heat resistant layer 9, a castable refractory, crucible, or fire brick, etc., may be used and a material of higher heat resistance is used for the first heat resistant

layer 8. For the third heat resistant layer 10, board or castable refractory, etc., is used.

[0006] As with the main furnace body 1, the lid 2 comprises, starting from the inner side, a first heat resistant layer 8, a second heat resistant layer 9, a third heat resistant layer 10, and an iron shell 12. The lid 2 has the burner 3 provided centrally, is able to be opened and closed readily by means of a hinge at one side, and is arranged to be fixed, seamlessly and yet in a manner enabling opening and closing, by means of screws, etc., to the main furnace body 1 as shown in Fig. 1.

[0007] With the above-mentioned invention, the burner 3 that is used is preferably of a type that uses propane gas, butane gas, or other petroleum gas as fuel and with which complete combustion is performed with a relatively small amount of oxygen or air that is nearly equivalent to the amount of fuel. With such an arrangement, the waste gas that is generated by the combustion of gas is relatively clean and since the gas is blown in at a relatively low pressure from burner 3 and there is thus little scattering of ash, the amount of ash contained in the exhaust gas can be kept small. Also, with this arrangement, the ash is loaded near the point at which the flame from the burner 3 is highest in temperature towards the centre of the crucible 4.

[0008] To operate the melting furnace of the above-mentioned patent specification as shown in Fig. 1, the condition shown in Fig. 1 is set up and, for example, a mixed gas of propane gas and a nearly equivalent amount of oxygen are blown in from and at the same time ignited at the burner 3. Then after confirming, by means of the temperature sensor 7, that the internal temperature of the furnace has reached the control state of approximately 1600°C, incineration ash is loaded from the ash loading inlet. The ash melts rapidly since the scattering of ash is low due to the slow blow-in rate of the flame and the ease of attaining a high temperature. The melt 14 then becomes a paste-like liquid and flows down into water 15 from discharge outlet 13 and is thereby made particulate. Alternatively, the melt may be brought into air instead of being placed in water and thereby gradually cooled and made lump-like in form or drawn out in a fibrous form. The melt can then be put to effective use as an aggregate material or reinforcing material for concrete.

[0009] With the furnace of the above-mentioned patent, when the crucible 4 becomes worn after long-term use and must be exchanged, the melting furnace is cooled, and thereafter, with lid 2 being opened to an angle of nearly 180°, the furnace is rotated about the protruding part 17 at the side surface of main furnace body 1 so that the lid 2 hangs downwards. The crucible ejection rod 6 is then driven hydraulically or by manual screw operation to push the crucible 4, and in combination with the action of the fluidized sand 11, crucible 4 is able to be taken out readily and exchanged extremely easily.

[0010] Furthermore, the ash melting device of the above-mentioned patent can be rotated and fixed about

a protruding part 17 of the main furnace body 1 at the centre. The inclination of the main furnace body 1 can thus be adjusted freely to enable adjustment of the rate of outflow of melt 14. A cylindrical attachment of prevention material 19 of the same composition as the crucible is preferably provided on the wall surface 16 of discharge outlet 13 to prevent the clogging of the outlet due to attachment and solidification of the melt onto the wall surface 16.

[0011] With the method of the abovementioned patent, though it is indicated that a heat-resistant type of graphite silicon carbide crucible, etc., with a carbon content of 30 to 55% and an SiC content of 30 to 50% and which for example is sold by Nippon Crucible Co., Ltd., etc., may be used in a single layer, when continuous use at a high temperature of approximately 1600° to 1700°C or more, which is necessary for the melting of ash, is made over a long period of time, the wear on the crucible 4 will be extremely severe and the crucible will withstand use over only a few weeks or a few months. The operation of the melting furnace must thus be stopped for repairs from time to time, or operation may be continued without noticing that the bottom of the melting furnace has fallen out so that in extreme cases, the heat-resistant layers at the inner side of the furnace also become destroyed, thus preventing further use. Use of the melting furnace may also be prevented by the clogging of discharge outlet 13 by the cooling and solidification of the ash melt due to a lowering of the temperature in the vicinity of the discharge outlet 13. Also, fuel costs are high due to poor thermal efficiency resulting from the inadequate heat insulating property of the furnace walls, and although the method of pushing the crucible out from one side by means of crucible ejection rod 6 is employed for the exchange of the crucible, it may not be possible to push the crucible out easily in some cases and time for cooling is required for exchange of the crucible.

[0012] In view of the above problems aims of the invention are to improve the durability significantly over the prior art even when use is made over long hours at a high temperature of 1600° to 1700°C or more, to resolve the problem of preventing use of the melting furnace by the clogging of discharge outlet 13 by the cooling and solidification of the ash melt due to a lowering of the temperature in the vicinity of discharge outlet 13, to improve the heat insulation property of the furnace walls to thereby improve the thermal efficiency and lower fuel costs, and to make the exchange of the crucible easier and thereby improve working efficiency.

[0013] In order to achieve the above objects, this invention provides an ash melting device, which is characterized in that in a furnace, with which a cover equipped with a burner is provided on a main furnace body having a discharge outlet and an ash loading inlet, an exchangeable crucible of a multilayer structure *j~ provided at the innermost layer of the abovementioned main furnace body and, for the melting of the ash, the

open part of the abovementioned crucible is directed towards the side of the lid with the burner and the melt is discharged from the discharge outlet by the action of gravity.

[0014] One example of an ash melting device according to the invention will now be described with reference to the accompanying drawings, in which:-

Fig.1 is a sectional side view of an embodiment of a prior-art method; and,

Fig.2 is a sectional side view of an embodiment of a device according to the present invention.

[0015] With reference to Fig.2, The principal parts include a main furnace body 1, lids 2, a burner part 3, a crucible 4, an ash loading inlet 5, and temperature sensors 7, etc.

[0016] As shown in Fig. 2, with the abovementioned embodiment, a crucible 4 with a three-layer structure, which is significantly lower in wear than the prior art, is used, an auxiliary burner 27 is used to prevent the lowering of the temperature of the vicinity of discharge outlet 13, furnace walls with a four-layer structure are employed to improve the heat insulating property and increase durability, and lids are provided at both the left and right sides (as shown) to enable the crucible to be taken out more readily and improve working efficiency by shortening the cooling time in the process of exchanging the crucible.

[0017] The arrangement of the specific embodiment of this invention will now be described in line with Fig. 2.

[0018] Though main furnace body 1 preferably has a cylindrical shape, it may have the shape of a quadratic prism or other polygonal prism. The walls are formed, starting from the innermost side, of five layers including a first heat resistant layer 20, which uses a castable refractory, etc., a first heat insulating layer 21, made of asbestos, etc., a second heat resistant layer 22, made of castable refractory, etc., a second heat insulating layer 23, made of asbestos, etc., and an iron shell 12. An ash loading inlet 5 is provided on the upper surface of the main furnace body 1, and intermediary backup sand 25 is provided between a first crucible 24 and a second crucible 26, a melt leakage sensor 28 is provided for detection of cracks and other anomalies of first crucible 24. Lids 2 are provided at two locations at the right side and the left side, a discharge outlet 13 for discharge of melt 14 and exhaustion of gas is provided at the lower left, temperature sensors 7 are provided at the upper left and at discharge outlet 13, and the dropping position 18 of crucible 4 is set so that melt 14 will not come in contact with the wall surface 16 of discharge outlet 13.

[0019] The crucible 4 has at least a three-layer structure and for example is comprised, starting from the inner side, of a first crucible 24, backup sand 25, and second crucible 26. As the first crucible 24, an ultrahigh temperature durable type crucible, for example, of an aluminum titanate, alumina, zirconia, or magnesia type

crucible, which can withstand high temperatures of approximately 1700 to 2400 C, is used. As backup sand 25, a heat resistant type, such as a magnesia cement type, is used and as the second crucible 26, for example, the conventional graphite silicon carbide crucible, made by Nippon Crucible Co., Ltd. and having a carbon content of 30 to 55% and SiC content of approximately 30 to 50%, is used. By employing at least this three-layer arrangement, use can be made of the conventional graphite silicon carbide crucible's advantage that cracks due to heat shock will not occur due to the extremely favourable heat conductivity. Also, extremely favourable high-temperatures and long-term durability can be obtained through the use of the ultrahigh—temperature durable type first crucible 24 as the part that comes into contact with the molten ash at the innermost layer and use of the heat insulating backup sand 25, which is high in heat resistance and durability, at the outer side of first crucible 24, and the fact that the number of times the crucible has to be exchanged, which had to be performed frequently with the prior art, can be reduced significantly. Needless to say, even better effects can be obtained by arranging crucible 4 from more than three layers.

[0020] Lids 2 are disposed at two locations at the left and the right, and as with main furnace body 1, each lid is composed of five layers: a first heat resistant layer 20, which uses a castable refractory, etc., a first heat insulating layer 21, made of asbestos, etc., a second heat resistant layer 22, made of castable refractory, etc., a second heat insulating layer 23, made of asbestos, etc., and an iron shell 12. Through the lid 2 at the left side, the burner 3 is provided in a manner whereby it is directed towards the open part of crucible 4 and slightly downwards and an auxiliary burner 27 is provided to face the vicinity of the discharge outlet 13 at the lower side. The left and right lids 2 are arranged with hinges at the sides to enable opening and closing to be performed readily and are arranged to be fixed in a well-sealed manner to the main furnace body 1 by means of screws, etc., as shown in Fig. 2.

[0021] With this invention, the burner 3 that is used is preferably of a type that uses propane gas, butane gas, or other petroleum gas as fuel and with which complete combustion is performed with a relatively small amount of oxygen gas or air that is nearly equivalent to the amount of fuel. With such an arrangement, the waste gas that is generated by the combustion of gas is relatively clean and since the gas is blown in at a relatively low pressure from burner 3 and there is thus little scattering of ash, the amount of ash contained in the exhaust gas can be made small. Also, with this arrangement, the ash is loaded near the point at which the flame from the burner 3 is highest in temperature, towards the centre of the crucible 4. Melting of the ash is thus started immediately after the ash is loaded, and since, due to the particular furnace arrangement described above, the thermal efficiency is extremely high, city gas, which con-

tains low-cost natural gas, or kerosene or other fossil fuels can be used.

[0022] To operate the melting furnace of the device of this invention shown in Fig. 2, the condition shown in Fig. 2 is set up and, for example, a mixed gas of propane gas and a nearly equivalent amount of oxygen gas is blown in from and at the same time ignited from burner 3. Then, when after confirming by means of the temperature sensor 7 that the internal temperature of the furnace has reached the control state of 1600° to 1650°C, incineration ash is loaded from the ash loading inlet 5. The ash melts rapidly since the scattering of ash is low due to the slow blow-in rate of the flame and the ease of attaining a high temperature. The melt 14 then becomes a liquid and flows down into water 15 from discharge outlet 13 and is thereby made particulate. Alternatively, the melt may be brought into air instead of being placed in water and thereby gradually cooled and made lump-dike in form or drawn out in a fibrous form. The melt can then be put to effective use as an aggregate material or reinforcing material for concrete or asphalt.

[0023] Due to having the above-described arrangement, the ash melting device of this invention provides the following effects.

(1) The crucible has a three-layer structure, formed, starting from the inner side, of a first crucible, backup sand, and a second crucible, an ultra-high temperature durable type crucible, which is durable even at a high temperature of approximately 1700° to 2400°C or more, being used as the first crucible, a heat resistant type backup sand, such as a magnesia cement type, being used as the backup sand, and a conventionally used graphite silicon carbide crucible being used as the second crucible, and by employment of this three-layer arrangement, use can be made of the conventional graphite silicon carbide crucible's advantage that cracks due to heat shock will not occur due to the extremely good heat conductivity. Also, extremely favourable high temperatures and long-term durability can be obtained through the use of the ultrahigh temperature durable type first crucible as the part that comes in contact with the molten ash at the innermost layer and use of the heat insulating backup sand, which is high in heat resistance and durability, in the middle, and the number of times of crucible exchanges, which had to be performed frequently with the prior art, can be reduced significantly.

(2) By use of auxiliary burner 27 in the vicinity of discharge outlet 13, the clogging of discharge outlet 13 by molten ash, which had been a major problem of the prior art, can be prevented without fail.

(3) Since lids 2 are provided at both the left and right sides, the work of exchanging a worn crucible can be performed more readily than with the prior art, and since the cooling of the furnace in the crucible

exchange process can thus be quickened, the crucible exchange work can be performed in a short time and the work of cleaning the inner side is facilitated.

5

insulating layer, a second heat resistant layer, a second heat insulating layer, and an iron shell.

Claims

1. An ash melting device having a furnace with a cover equipped with a burner provided on a main furnace body which includes a discharge outlet, an ash loading inlet, and an exchangeable crucible as the innermost layer of the main furnace body and for the melting of the ash, the open part of the crucible being directed towards the side of the lid provided with the burner and the melt being discharged from the discharge outlet by the action of gravity, **characterized in that**
the crucible is of a multilayer construction. 10 15 20
2. An ash melting device according to Claim 1, wherein the crucible has a three-layer structure including a first crucible, backup sand, and second crucible. 25
3. An ash melting device according to Claim 2, wherein an ultra-high-temperature durable type crucible, for example, an aluminum titanate, alumina, zirconia, or magnesia type crucible, which can withstand high temperatures of approximately 1700° to 2400°C or more, is used as the first crucible and a graphite silicon carbide crucible is used as the second crucible. 30 35
4. An ash melting device according to any of Claims 1 to 3, wherein the burner is directed diagonally downwards and the burner flame is blown towards the lower bottom of the crucible. 40
5. An ash melting device according to any of Claims 1 to 4, wherein an auxiliary burner is provided at the vicinity of the discharge outlet. 45
6. An ash melting device according to any of Claims 1 to 5, wherein lids are provided at two opposed end locations. 50
7. An ash melting device according to any of Claims 1 to 6, wherein the ash loading inlet is provided above the main furnace body. 55
8. An ash melting device according to any of Claims 1 to 7, wherein a melt leakage sensor is provided in the backup sand disposed between the first crucible and the second crucible.
9. An ash melting device according to any of Claims 1 to 8, wherein the lid and main furnace body include five layers: a first heat resistant layer, a first heat

FIG. 1

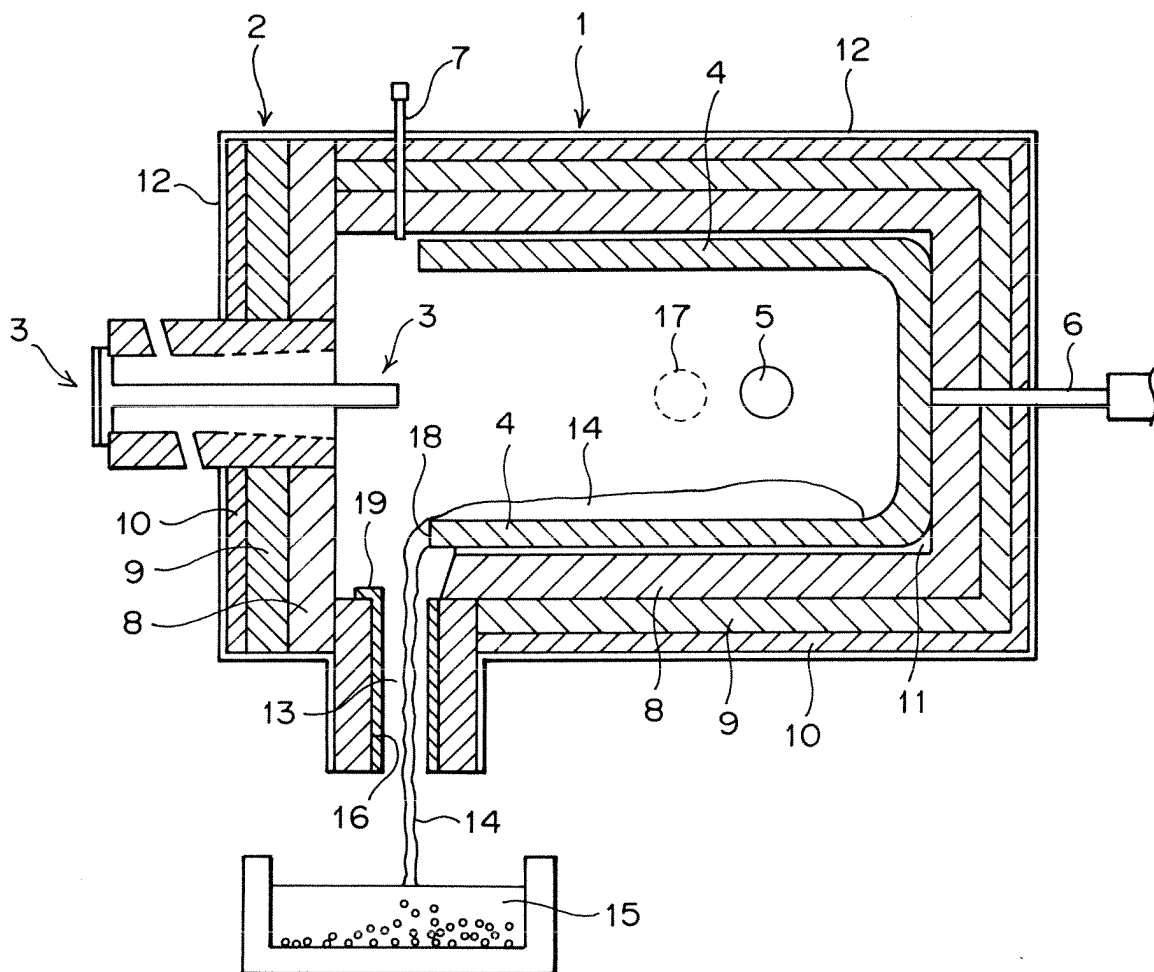


FIG. 2

