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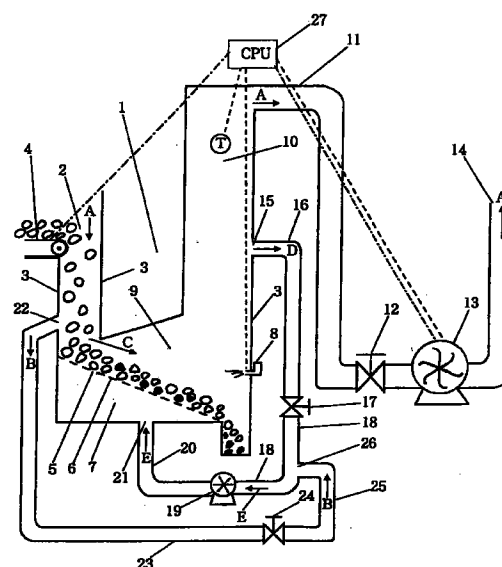
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(54) COMBUSTION SYSTEM AND COMBUSTION FURNACE

(57) A combustion system automatically controls the combustion air intake rate at a predetermined value by an induced fan through an air inlet of a combustion apparatus in accordance with the furnace temperature. The combustion system includes a combustion gas circulating system independent of the system for feeding high-temperature air for vaporizing the moisture and gasifying the volatile components in the materials to be burned or for initially burning the materials through the bottom of the furnace. A combustion furnace for use in this system is also disclosed.

Fig 1



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Description

FIELD OF THE INVENTION

The present invention relates to a control system for an incinerating furnace and an incinerating furnace using the same.

PRIOR ART

Conventionally, following three conditions are considered to be essential for complete combustion of the materials to be incinerated.

1. The temperature of the combustion chamber
2. A retention time of the combustion gas inside the furnace
3. Oxygen concentration in the furnace.

To accomplish the complete combustion, that is no residue carbon in the exhaust gas, and toxic substances such as dioxin, PCB or the like are completely decomposed during the incineration, it is desirable to operate the furnace under the condition such that the temperature of the combustion chamber is kept more than 1,200 °C, the retention time of the combustion gas is more than 2 seconds, and the oxygen concentration in the combustion chamber is more than 3%.

But if the temperature in the furnace reaches, for example, more than 1,400 °C, there may occur some drawbacks to the furnace; an amount of the thermal NO_x in the flue gas sharply increases, or the furnace wall is damaged by the high temperature.

The longer the retention time of the combustion gas, the more complete combustion is accomplished, however the capacity of the furnace may be reduced. For example, if a volume load is 100,000 Kcal/m³hr, and in case the 3% of an oxygen concentration and 1,200 °C of the exhaust gas, the retention time becomes approximately 4 seconds which is considered to be within a reasonable condition.

If the volume load is more than 200,000 Kcal/m³hr by increasing the charging rate of the materials to be incinerated, the retention time of the exhaust gas becomes too short to accomplish the complete combustion, consequently the residue carbon in the exhaust gas increases or the dioxin is not completely decomposed by combustion heat, furthermore, it is threatening that they remain in the exhaust gas and are emitted into the air.

A proper control system is desired in order to maintain the above mentioned three conditions within the preferable range, however, in the field of the fluidized bed furnace, it is still difficult to control the furnace automatically and the furnace control is dependent on the well experienced operator. (Chemical Engineering Thesis; Vol. 21, No. 2, P265).

In most stoker furnaces, as shown in Fig. 3, an amount of air for combustion equals to the amount of

primary air which is heated to high temperature by the high temperature exhaust gas through the heat exchanger and is forced into the furnace from the furnace bottom. That is, the amount of pressurized gas is dependent on the amount of intake air for combustion by an inducing fan, thereby the amount of pressurized gas and the temperature of the pressurized gas are influenced by the amount of intake air for combustion introduced by the inducing fan, consequently a full automatic combustion control is difficult in view of complexity of the system.

Japanese Patent Publication No. Kokoku Hei 3-79612, teaches a control system in which a blower inducing the exhaust gas in the incinerating furnace or the like is driven by an inverter, in which a motor and an inverter are not over-loaded although the automatic operation is carried out from the beginning of the operation, regardless of the temperature of the gas, therefore the objective is different from that of the present invention.

Further, the invention, disclosed in Japanese Patent Application Publication No. Hei 5-83811, is a method for controlling a furnace in which in case an automatic return of an inverter control circuit after a sudden power failure, a forced draft fan is restarted after detecting a restart of the inducing draft fan thereby preventing the combustion chamber being at positive pressure. The objective of the disclosed invention is different from that of the present invention.

It is an object of the present invention to provide an incineration control system and an incinerating furnace for using the system capable of stable operation by automatically controlling the operation of the incinerating apparatus, which is different from the conventional operation which has been controlled manually by an operator or semi-automatically with conventional control system.

DISCLOSURE OF THE INVENTION

The present invention is a combustion control system which is characterized by a circulating system of supplying a high temperature air for vaporizing or gasfying moisture and volatile component in the materials to be incinerated or for primary combustion of the materials to be incinerated supplied from furnace bottom a hearth bed, and the circulating system is independent from an air intake system for combustion driven by an inducing draft fan.

An air intake rate for combustion by the inducing draft fan is automatically controlled in relation with a temperature of the furnace thereby a release of a combustion energy of the materials to be incinerated or a combustion load of the furnace is kept constant value.

And an incinerating furnace which comprises an open type inlet or a closed type inlet for materials to be incinerated, an air inlet for inhaling air, a side wall extended from the air inlet, a combustion chamber having a lower side wall portion, a bottom of the furnace,

and an auxiliary burner; a high-temperature zone provided in the upper area of the combustion chamber; an exhaust gas flow control damper and/or frequency controlled inducing draft fan provided in an exhaust pipe provided in the upper portion of the high temperature zone to continue to a flue; an outlet for a part of a high-temperature combustion exhaust gas provided in the upper portion of the combustion chamber; a conduit passage for a high temperature combustion circulating gas connected to the outlet; a high temperature combustion gas circulating fan connected to the conduit passage; a high temperature pressure gas sending inlet provided in the furnace bottom link to the conduit passage; an intake for a part of the air for combustion connected through a conduit passage, a flow control valve for a part of the air for combustion, and a conduit passage leading to the conduit passage for the combustion high-temperature circulating gas; and a central processing unit controlling the subject to be incinerated inlet, the combustion chamber, the high-temperature zone, the exhaust gas flow control damper and/or frequency control inducing draft fan, the outlet for a part of a high-temperature combustion exhaust gas, the conduit passage for a high-temperature combustion circulating gas, the high-temperature combustion gas circulating fan, the high-temperature pressure gas sending inlet, and the intake for a part of the air for combustion in order to measure the temperature of the high-temperature zone, automatically control the air intake rate and automatically control the rate of charging the subject to be incinerated.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic sectional view of an incinerating furnace according to the present invention; Fig. 2 is a schematic sectional view of another incinerating furnace according to the present invention; and Fig. 3 is a schematic sectional view of a conventional incinerating furnace.

BEST MODE OF THE INVENTION

The present invention is a control system and an incinerating furnace for using the system, in which, in order to control the temperature of the furnace at a predetermined value, an air intake rate for combustion is automatically controlled, and at the same time, a charging rate of an subject to be incinerated (solid or fluid or both solid and fluid) into the furnace is also automatically controlled so that the air intake rate for combustion is kept at a predetermined specified rate.

The following is an means for accomplishing the furnace control.

Means for keeping the temperature in the furnace at a specified value by automatically controlling the rate of inhaling air for combustion by an inducing draft fan are;

(1) A revolution rate of the impeller of the inducing draft fan is automatically controlled by controlling the frequency of electric power supplied to an electric motor. Or, the air inhaling rate by the inducing draft fan is controlled by controlling the opening rate of the damper.

(2) Simultaneously a charging rate of the materials to be incinerated (solid or fluid or both solid and fluid) is controlled to maintain the value of the detected frequency of the supplied electric power, and/or the opening rate of the damper described above (1).

The present invention will be explained in more detail with reference to the attached drawings.

Fig. 1 is a side schematic sectional view of a furnace of a preferred embodiment of the present invention, Fig. 2 is a side schematic sectional view of another furnace of a preferred embodiment of the present invention. Fig. 3 is a schematic sectional view of a conventional incinerating furnace.

In Fig. 1, the incinerating furnace, which is provided with an open-type inlet 2 for materials to be incinerated, a side wall 3 extending from the inlet 2, and a conveyor 4 for transporting the materials to be incinerated, a combustion chamber 9 comprising a bottom 7 which includes the lower portion of the side wall 3, a hearth bed 6 having an inlet 5 for a part of a high-temperature gas E, an auxiliary burner 8 and so on, in which an materials to be incinerated is charged from the inlet 2 is incinerated by an air A charged from the inlet 2.

In the upper portion of the combustion chamber 9, a high-temperature zone 10 is provided, and further, in the upper portion of the high-temperature zone 10 an exhaust pipe 11 is provided. An exhaust gas A flows into the exhaust pipe 11 and flows into an exhaust gas flow control damper 12, a frequency controlled inducing draft fan 13 and then a flue 14. In the upper portion of the combustion chamber 9, a combustion gas outlet 15 for a part of the high-temperature combustion exhaust gas D is provided, whereby the part of the high-temperature combustion exhaust gas D is continuously flown from the combustion gas outlet 15 through a conduit passage 16, a flow control valve 17 for the high temperature gas, a conduit passage 18, a high-temperature circulating fan 19 and a conduit passage 20 to an inlet 21, and it is blown as a part of the high-temperature gas E from the inlet 21 through the flowing inlet 5 for the part of the high-temperature gas E, provided in the furnace bottom 7 to the combustion chamber 9.

On the side wall 3 extended from the inlet 2, an air inlet 22 for air B for combustion is provided, which is connected through a conduit passage 23, air for a combustion flow controlling valve 24 and a conduit passage 25 to the conduit passage 18 at a leading inlet 26.

Incidentally, the flow control valve 17 for the high-temperature gas can be omitted if unnecessary.

The air A for combustion enters into the incinerating furnace from the open-type material inlet 2 introduced

by the inducing draft fan 13, in which the part of the air for combustion indicated as C directly enters into the combustion chamber 9 with the materials to be incinerated and is used for incineration.

The remainder of the air for combustion, indicated as B, is mixed with the part of the high temperature combustion exhaust gas D at a predetermined rate controlled by each flow control valve, and is forced into the combustion chamber 9 as the predetermined high temperature pressurized gas E.

That is, in view of gas flow system, the air for combustion is introduced from the open-type inlet 2, passing through the combustion chamber 9 and the combustion exhaust gas is emitted to the open air from the flue 14 which is an air supply system. And the other gas flow system is a high temperature gas circulating system in which the high-temperature gas circulates passing through the conduit passages 16, 18 and 20, the furnace bottom 7 and the combustion chamber 9.

A CPU (Central Processing Unit) 27 controls the amount of air for combustion flowing from the inlet 2 with the frequency controlled inducing draft fan 13 or the exhaust gas flow control damper 12 by detecting a T temperature inside the furnace of the high-temperature zone 10. Further, the CPU 27 controls the conveying rate of the materials to be incinerated conveyor 4 by detecting the frequency of electric power supplied to the inducing draft fan 13 or the opening degree of the flow control damper 12 in order that the amount of flowing air for combustion is to be the specified value.

Fig. 2 as well as Fig. 1 is an explanatory view of a system for circulating the high-temperature gas as another embodiment according to the present invention.

An incinerating furnace 28 has a closed-type materials to be incinerated guide inlet 29, a pusher apparatus 30 for the materials to be incinerated guide inlet 29, a side wall 31 extended from the pusher apparatus 30, a combustion chamber 36 including a furnace bottom 34 including a hearth bed 33 having an inlet 32 for a part of the high-temperature gas and an auxiliary burner 35, in which the materials to be incinerated is charged from the guide inlet 29 and is incinerated in the combustion chamber 36 with the air for combustion introduced from an inlet 53 through an inlet 50, an intake control valve 51, and a conduit passage 52.

The part of the air A at room temperature is sent to the inlet 53 as a combustible air through the conduit passage 52 into the combustion chamber 36 directly, and the remainder air B is sent through an outlet 54 disposed in the conduit passage 52, a conduit passage 55 extended from the outlet 54, a flow control valve 56 and a conduit passage 57 to an inlet 58 connected to the conduit passage 45, and further sent as the high-temperature pressurized gas E, being adjusted to be a specified temperature by mixing in the conduit passage 45 with a part of the high-temperature combustion exhaust gas D, into the combustion chamber 36.

Separately, an outlet 42 for a part of the high-temperature combustion gas is provided in the upper por-

tion of the combustion chamber 36, thereby a part of the high-temperature combustion exhaust gas D is flown from the outlet 42 through a conduit passage 43 continued from the outlet 42, a flow control valve 44 for the part of the high-temperature combustion gas D, a conduit passage 45, a high-temperature circulating fan 46, and a conduit passage 47 in order, and further the part of the high-temperature combustion exhaust gas D and the air B for combustion are controlled to be at specified temperature by being mixed; and sent as a high-temperature circulating pressurized gas E into the combustion chamber 36 for incineration of the materials to be incinerated.

Incidentally, the flow control valve 44 for the part of the high-temperature combustion gas D can be omitted if unnecessary.

In the upper portion of the combustion chamber 36, a high-temperature zone 37 is provided, and further, in the upper portion of the high-temperature zone 37, an exhaust pipe 38 is provided. The combustion exhaust gas A flown into the exhaust pipe 38 is, briefly, emitted through an exhaust gas flow control damper 39, a frequency controlled inducing draft fan 40 and a flue 41 to the open air.

Here, the air introduced from the inlet 50 for combustion is used for incineration of materials to be incinerated in the combustion chamber 36 and the high-temperature zone 37 and is emitted from the flue 41, and the high temperature exhaust gas circulates through the conduit passages 43, 45 and 47, the furnace bottom 34 and the combustion chamber 36.

A CPU 49 detects a temperature inside the high-temperature zone T and controls the amount of air intake rate for combustion with the aid of the frequency controlled inducing draft fan 40 or the flow control damper 39 to control the amount of air flown from the intake control valve 51 connected to the inlet 53 for the combustion air.

Also the CPU 49 controls the amount of the materials to be incinerated introduced into the combustion chamber which is conveyed from the guide inlet 29 by controlling the frequency of the electric power supplied to the inducing draft fan 40 or the opening degree of the flow control damper 39 at a predetermined value.

But, in this method, as the guide inlet for the materials to be incinerated is concealed, the air intake control valve 51 should be operated depending on the pressure inside the furnace P whether to allow the air to flow from the inlet 50 to the combustion chamber 36 by detecting the pressure inside the furnace. And further, the rate of reaction of the temperature inside the furnace is slightly slower compared with the method illustrated in Fig. 1, because of a time-lag between the charge of the materials to be incinerated into the furnace and a start of combustion.

Fig. 3 is an explanatory view of a conventional incinerating furnace 59. The incinerating furnace 59 has a guide inlet 61 for the materials to be incinerated, having a pusher inlet 60, a side wall 62 extended from the

pusher inlet 60, a combustion chamber 67 including an auxiliary burner 66, a furnace bottom 65, including a hearth bed 64 having a high-temperature gas inlet 63, and so on, in which the materials to be incinerated in the airtight state sent from the guide inlet 61 is incinerated in the combustion chamber 67.

A high-temperature zone 68 is provided in the upper portion of the combustion chamber.

Separately, an air intake 69 for combustion opened to the outside atmosphere is provided. Air (A), introduced into the furnace from the intake 69 through a furnace pressure control valve 70 and air forcing draft fan 71, is heat exchanger at a heat exchanger 72, is passed through a conduit line 73 and a high-temperature forced draft air inlet 74 and is sent from the high-temperature gas inlet 63 of the furnace bottom 65 into the combustion chamber 67.

An exhaust pipe 75 is connected to the upper portion of the high temperature zone 68 of the furnace. The combustion exhaust gas from the exhaust pipe 75 is emitted to the open air through a flow control damper 76, an inducing draft fan 77 and a flue 78.

A CPU (Central Processing Unit) 79 detects a temperature inside the furnace T of the high temperature zone 68, and controls an air intake rate from the intake 69 by controlling the frequency of the inducing draft fan 77 or controlling the opening degree of the flow control damper 76. Also, the CPU 79 automatically controls the amount of the materials to be incinerated which the pusher inlet 60 conveys into the furnace so that the amount of intake air for combustion which passes through the inducing draft fan 77 is to be at a predetermined value.

The control system of the present invention illustrated in Fig. 1, the high-temperature exhaust gas produced by incinerating the materials to be incinerated is circulated independently from the intake air for combustion introduced into the furnace from the outside atmosphere, thereby the moisture and the volatile component of the materials to be incinerated are vaporized or gasified and the primary combustion is executed. After that, a secondary combustion of the materials to be incinerated is carried out with the air introduced from the inlet 2.

As a result, the temperature of the furnace is directly controlled by the amount of air introduced by the inducing draft fan, and furthermore, it turned out that the rate of conveying the materials to be incinerated by the conveyor can be controlled with a high response rate to maintain the temperature at predetermined value, whereby the combustion temperature can be completely and automatically controlled within a deviation of ± 50 °C by the CPU 27.

Similarly, the control system illustrated in Fig. 2, the high-temperature exhaust gas produced by incinerating the materials to be incinerated is circulated independently from the intake air for combustion introduced from the outside atmosphere, thereby the moisture and the volatile component of the materials to be incinerated are

vaporized or gasified and the primary combustion is executed. After that, a secondary combustion of the materials to be incinerated is carried out. As a result, the temperature of the furnace is directly controlled by the amount of air introduced by the inducing draft fan 40, and furthermore, it turned out that the rate of conveying the materials to be incinerated by the pusher 30 can be controlled to maintain the temperature at predetermined value, whereby the combustion temperature can be controlled within a deviation of ± 100 °C by the CPU 49. The response, however, is slower compared with the control system used in the embodiment 1 illustrated in Fig. 1.

However, in the control system illustrated in Fig. 3, the air for combustion of the materials to be incinerated is forced into the furnace by draft fan 71 and the forced air is heated through the heat exchanger 72, then the moisture and the volatile component of the materials to be incinerated are vaporized, and further, the primary combustion and the secondary combustion of the materials to be incinerated are executed simultaneously by controlling the inducing draft fan 77. Therefore, control factors of the system are related each other with complexity, in some cases the control system has some drawback that not only the delay of the response of the system but a rather big temperature deviation (± 100 °C) and the full automatic control can not be accomplished.

EMBODIMENT 1

The furnace illustrated in Fig. 1 having the hearth bed area of 0.4 m^2 is used. The inducing fan having a capacity of 300 mm Aq. and $3,000 \text{ Nm}^3/\text{hr}$ at a rated input power of 50 Hz is used. An air intake rate is controlled by an inverter control system, the control value is 25 Hz. Waste of $2,000 \text{ Kcal/kg}$ of an average low level calorific value is introduced into the furnace by the conveyor and the furnace temperature is controlled at 1200 °C. The incineration is executed steadily with a waste charging rate of approximately 220 kg/hr . The air intake rate for combustion is measured of about $1,000 \text{ Nm}^3/\text{hr}$.

Then, materials to be incinerated is changed to the waste having $6,000 \text{ Kcal/kg}$ of an average low level calorific value. Ten minutes later of this change, though the temperature inside the furnace rises to $1,250$ °C at maximum, the control system works to raise the frequency of the electric power supply to 35 Hz and another ten minutes later, thereby the temperature inside the furnace falls down to $1,200$ °C again and is kept the same.

The maximum air intake rate for combustion is approximately $1,300 \text{ Nm}^3/\text{hr}$. After that, the frequency of the inverter gradually falls to 25 Hz in 20 minutes and become steady. During the steady state combustion, an automatic charging rate of the materials to be incinerated is approximately 70 kg/hr .

On the other hand, the high-temperature circulating gas blown up from the furnace bottom is independently controlled and operated continuously at a temperature of 350 °C and approximately $1,200 \text{ Nm}^3/\text{hr}$ of circulating

velocity. The control system is designed to automatically start ignition of the auxiliary burner if the temperature in the furnace falls below 1,150 °C, to supplement the shortage of the total calorific value in the furnace, however, during the operation, no use of the auxiliary burner is observed.

Embodiment 2

The operation is conducted under the same condition of the embodiment 1 described above, the combustion was carried out using the furnace illustrated in Fig. 2.

When the materials to be incinerated is changed to waste of 6,000 Kcal/kg of an average low level calorific value, the temperature inside the furnace rises to 1,300 °C at maximum, the frequency of the inverter reaches 45 Hz at maximum and the air intake rate reaches at 1,500 Nm³/hr. Consequently, the pushing rate of the materials to be incinerated falls down to 40 kg/hr at minimum. Then the temperature inside the furnace falls rapidly below 1,150 °C 30 minutes later, and the auxiliary burner starts burning temporarily, but turns back to the predetermined temperature of 1,200 °C in 40 minutes. The frequency of the inverter shows 25 Hz. During the operation, the pressure control valve 51 is operated by the CPU 49. Similar to the embodiment 1, the temperature of the high-temperature circulating gas blown up from the furnace bottom is 350 °C and the velocity of the circulating gas is 1,200 Nm³/hr at all times.

COMPARATIVE EXAMPLE 1

Using the furnace illustrated in Fig. 3, the operation condition is likewise the embodiment 1. When the materials to be incinerated is changed to waste having 6,000 Kcal/kg of an average low level calorific value, whereupon, 30 minutes later, the frequency of the inverter reached to 50 Hz, the temperature in the furnace reaches to 1,400 °C at maximum, and the air intake rate rises up to approximately 1,600 Nm³/hr. The pushing rate of materials to be incinerated by the pusher 60 is constantly reduced with the operation of the CPU 79, to 30kg/hr at minimum. Consequently the temperature in the furnace falls to 1,150 °C which was below the predetermined acceptable level, so that the auxiliary burner 66 automatically starts burning temporarily. The temperature in the furnace still falls down 1,100 °C, but after a while it is reversed to rise. increased. After that, at a deviation of ± 150 °C, it fluctuates for a while and becomes stable one and a half hours later.

After being in the stable state, a pushing rate of materials to be incinerated is approximately 70 kg/hr, the temperature in the furnace is 1,200 °C, and the amount of air intake (air intake rate) for combustion is approximately 1,000 Nm³/hr.

The temperature of the high-temperature pressurized gas forced from the inlet 63 falls down to 180 °C at minimum, and the intake rate of the high-temperature pres-

surized gas fluctuates greatly between a maximum of 1,600 Nm³/hr and a minimum of 600 Nm³/hr. During incinerating of the furnace 28, the CPU 79 controls the furnace pressure control valve 70. Incidentally, the pressure inside the furnace of both embodiment 2 and comparative example 1 are controlled to be minus 10 mm Aq.

INDUSTRIAL APPLICABILITY OF THE INVENTION.

The inventors of the present invention invented the process and the equipment in which the high temperature gas for combustion blown up from the furnace bottom is circulated independently from the air for combustion thereby the full automatic control system of the continuous incineration furnace is accomplished. Further, the temperature inside the furnace is uniquely determined by controlling the air intake rate for combustion introduced by the inducing draft fan.

Not only the temperature inside the furnace is controlled between the predetermined temperature range but also the retention time of the exhaust gas is automatically controlled between the predetermined range by the simultaneous control of combustion calorific value of the materials to be incinerated and the air intake rate for combustion with the frequency controlled inducing fan.

Claims

1. A combustion control system comprising: a high temperature gas circulating system blown up from a furnace bottom for vaporizing a moisture or gasifying a volatile component of materials to be incinerated and for primary combustion of the materials to be incinerated, which is independent from an air intake system for combustion, the air for combustion being introduced into the furnace by an inducing draft fan, in which an air intake rate from the outside atmosphere through an inlet is controlled depending on the temperature inside the furnace and also the air intake rate is controlled at the predetermined value thereby controlling a combustion calorific value of the materials to be incinerated at constant value.
2. An incinerating furnace, comprising: an open-type or closed type inlet for materials to be incinerated; a side wall extended from the air intake inlet for material to be incinerated, a combustion chamber having an air intake inlet for combustion, a lower side wall portion, a furnace bottom, and an auxiliary burner; a high-temperature zone provided in the upper area of the combustion chamber; a damper for controlling an exhaust gas flow and/or a frequency control inducing draft fan provided in an exhaust pipe, connected to the high temperature zone a flue connected to the exhaust pipe; an outlet for extracting a part of a high-temperature combustion exhaust gas disposed in upper portion of the

combustion chamber; a conduit passage for circulating the high temperature combustion gas extending from the outlet ; a fan for circulating the high temperature combustion gas connected to the conduit passage; the conduit passage being connected to an inlet for introducing the high temperature pressure gas into the combustion chamber from the furnace bottom; an air inlet for combustion; a conduit pipe connected to the air inlet; a flow control valve for controlling a part of the air for combustion, and a conduit passage connected to the conduit passage for circulating the high-temperature combustion gas; and a central processing unit which controls a charging rate of the materials to be incinerated by detecting the temperature of the high temperature zone in upper portion of the combustion chamber and controlling the air intake rate for combustion.

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Fig 1

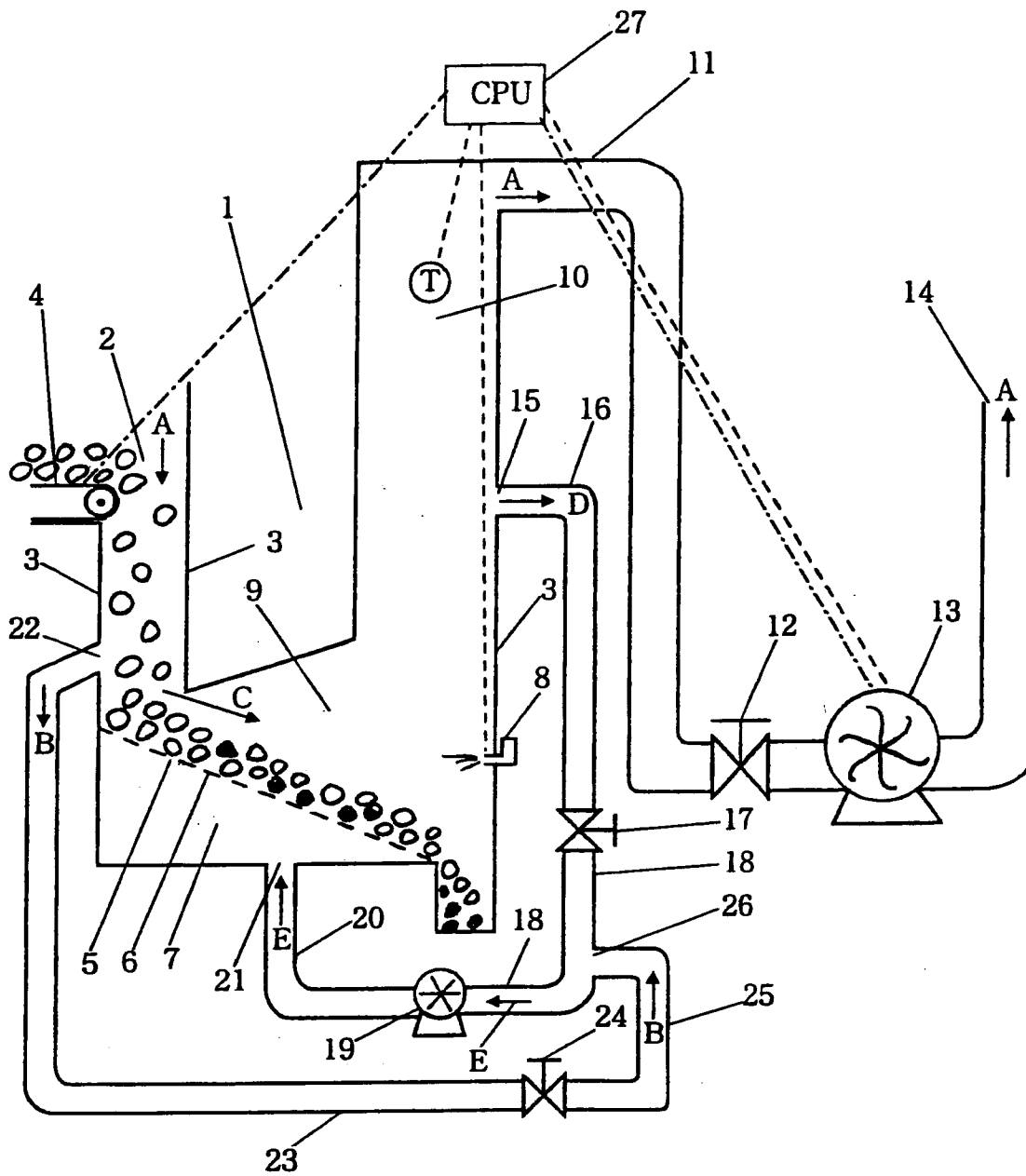


Fig 2

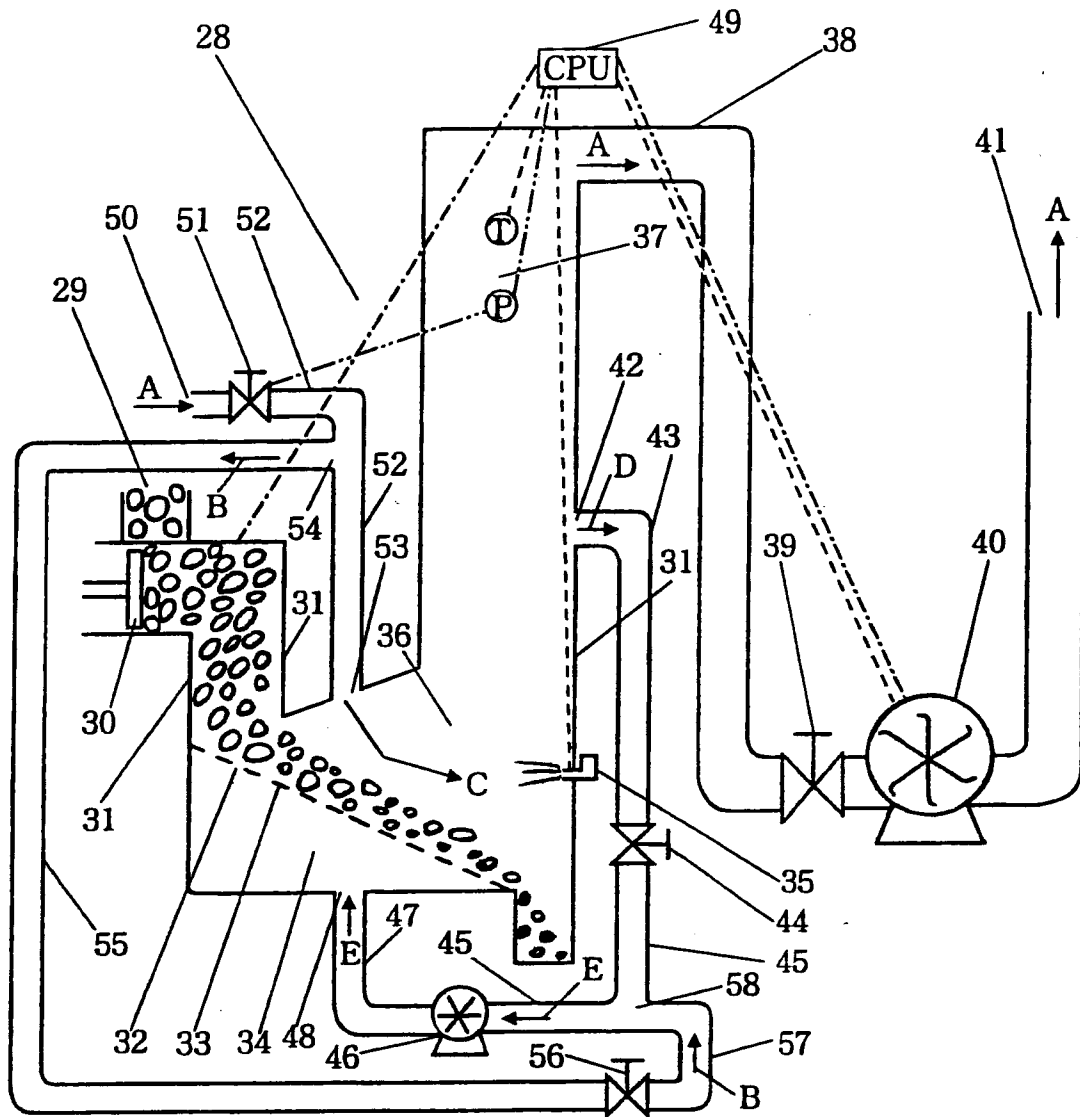
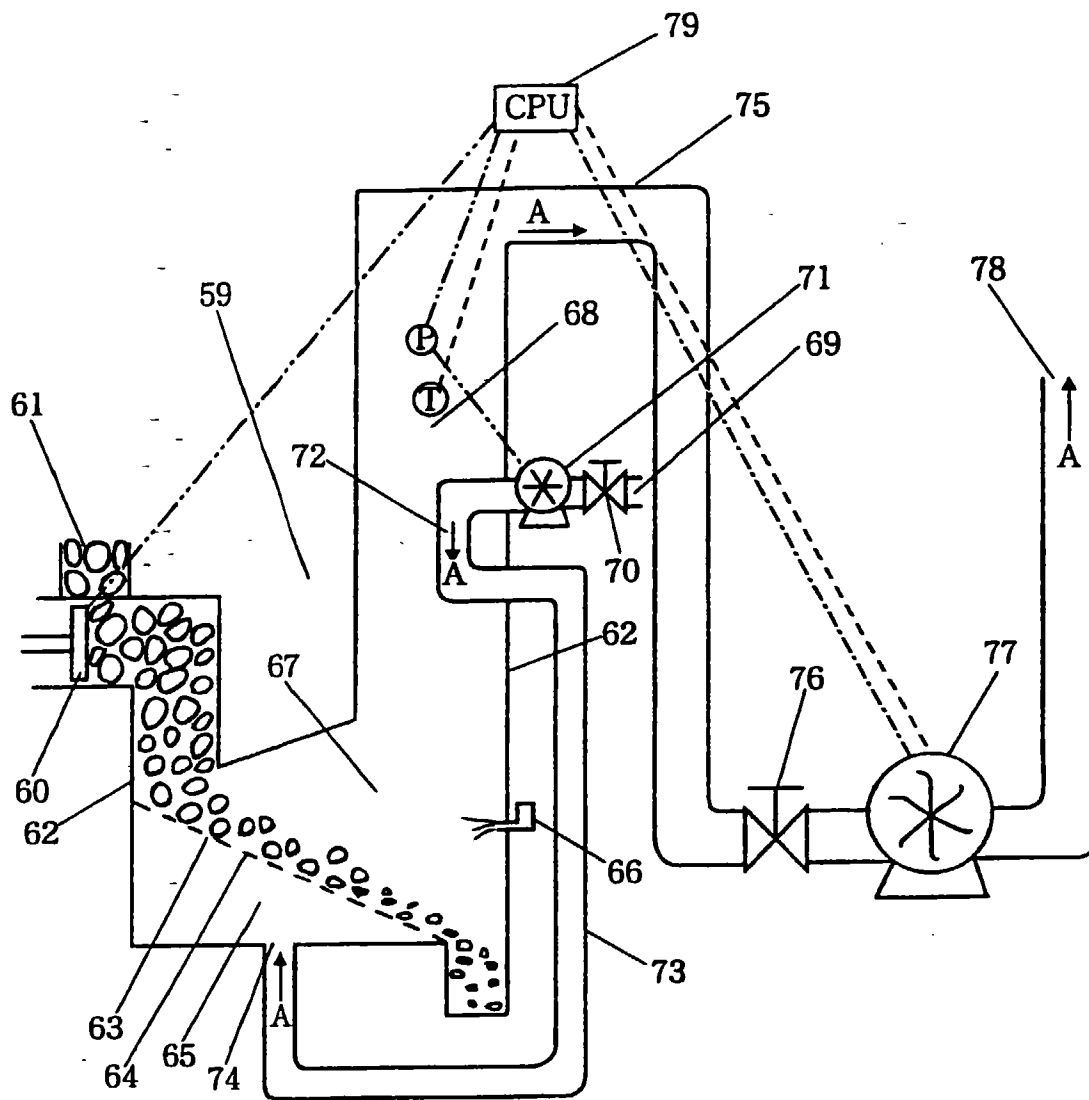


Fig 3



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP96/03437

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl⁶ F23G5/50, F23G5/04, F23L17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl⁶ F23G5/04, F23G5/50, F23L17/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1926 - 1997

Kokai Jitsuyo Shinan Koho 1971 - 1996

Toroku Jitsuyo Shinan Koho 1994 - 1997

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 02-101312, A (Mitsubishi Heavy Industries, Ltd.), April 13, 1990 (13. 04. 90) (Family: none)	1, 2
A	JP, 56-040017, A (Unitika Ltd.), April 16, 1981 (16. 04. 81) (Family: none)	1, 2

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

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"&" document member of the same patent family

Date of the actual completion of the international search

February 12, 1997 (12. 02. 97)

Date of mailing of the international search report

February 25, 1997 (25. 02. 97)

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