United States Patent

Sugano

[15] **3,643,633**

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[54] INCINERATOR

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Apr. 15, 1970 Japan.....45/31716

[52] **U.S. Cl.**.....**122/2,** 110/8 A, 110/10

[51] **Int. Cl.**.....**F23g 5/00**

[58] **Field of Search**.....110/7, 8, 8 A, 10; 122/2

[56] **References Cited**

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Primary Examiner—Kenneth W. Sprague
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[57] **ABSTRACT**

An incinerator comprising a first combustion chamber provided with a hearth. A second combustion chamber is superposed above the first combustion chamber and a flame extinguishing chamber is positioned above the second combustion chamber. The hearth has slanted portions for forming a well offset from alignment with the second combustion chamber and the second combustion chamber is provided with a gate through which material to be incinerated may be fed so as to be preheated as it falls into the first combustion chamber and is directed into the well.

4 Claims, 7 Drawing Figures

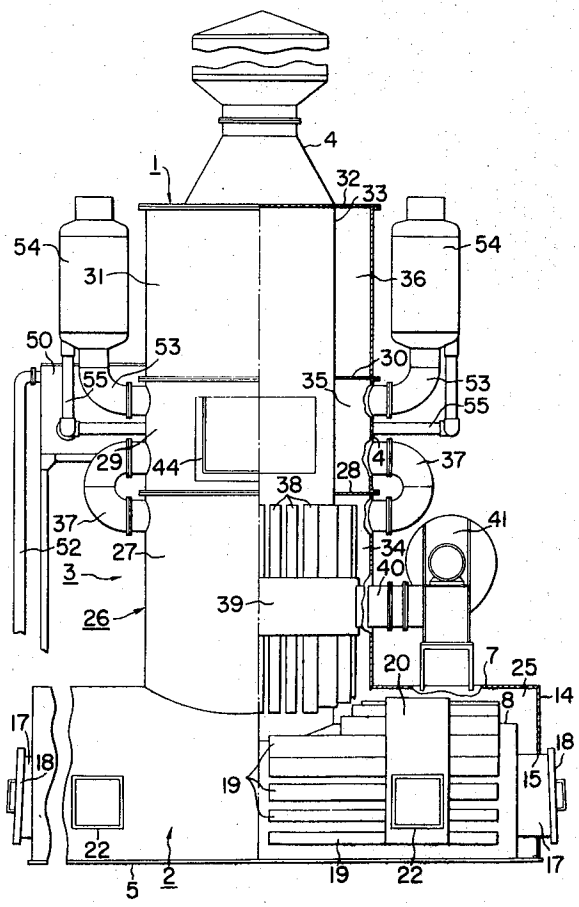

FIG. 1

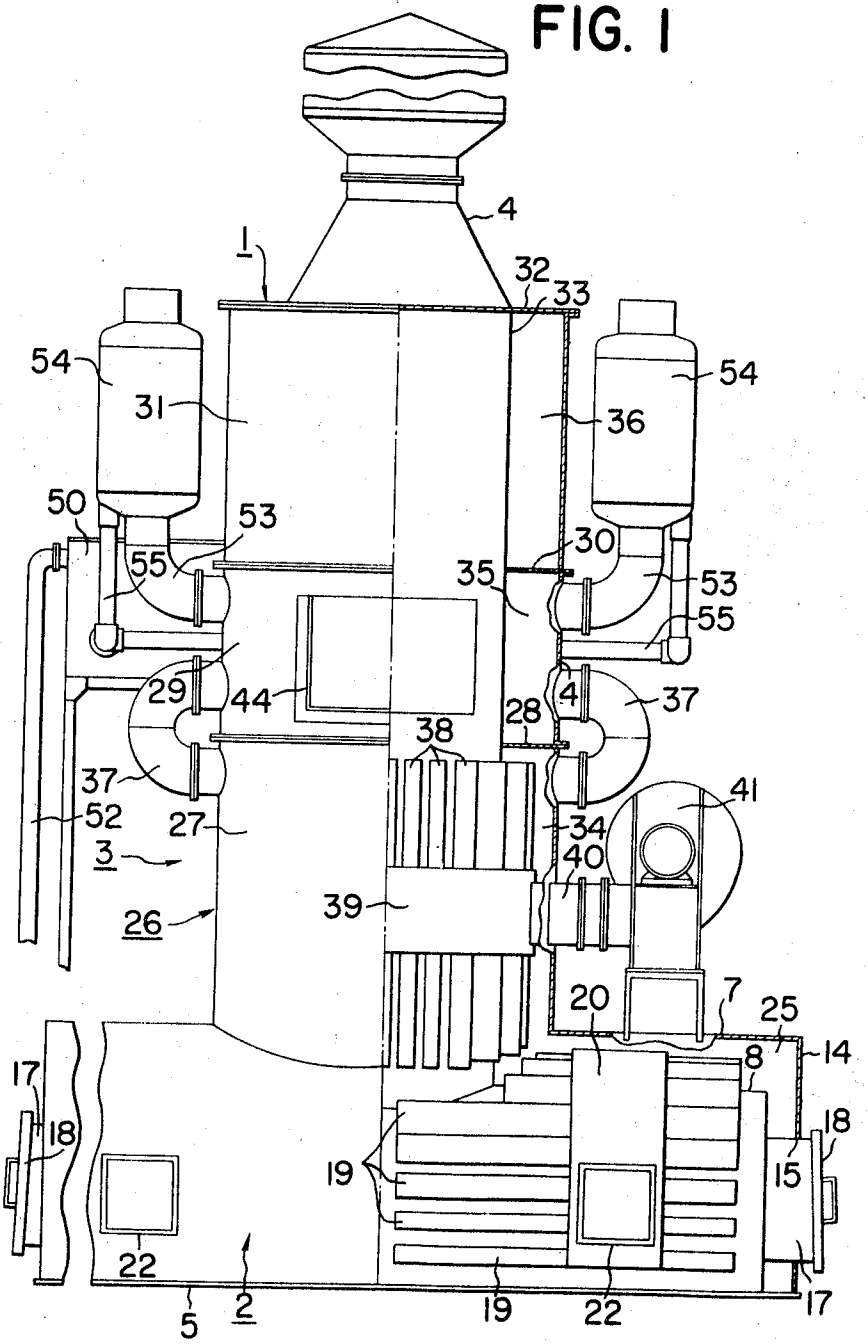

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FIG. 2

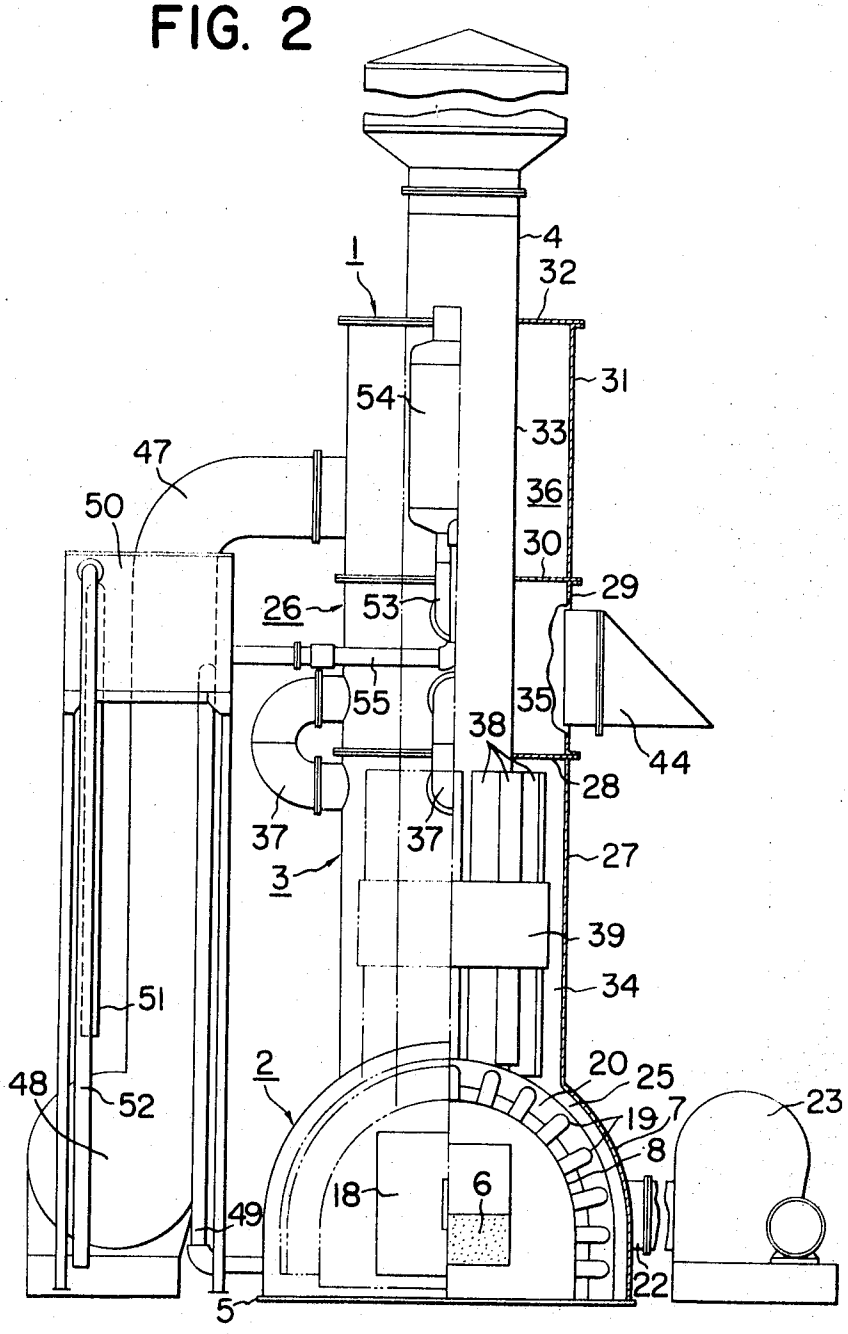

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FIG. 3

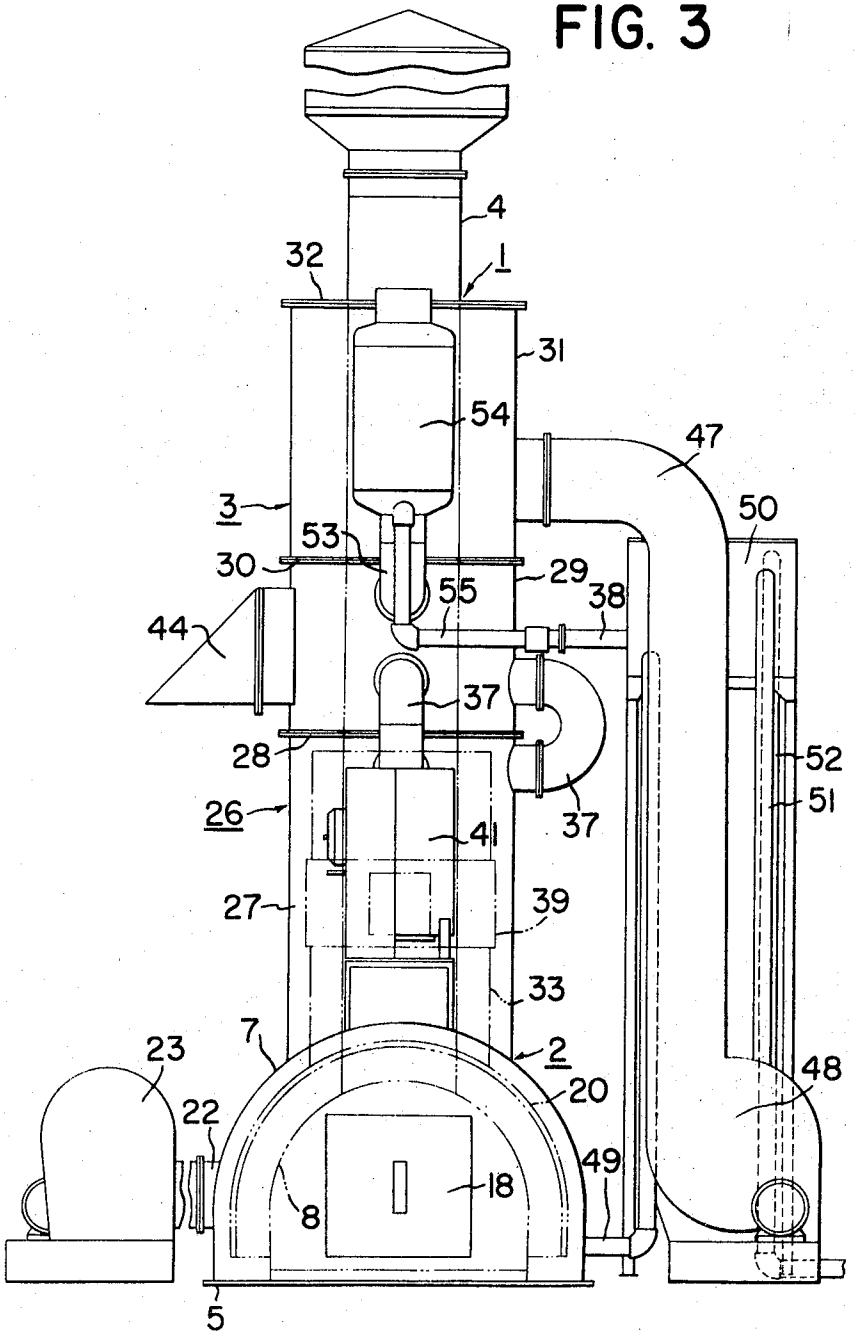

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FIG. 4

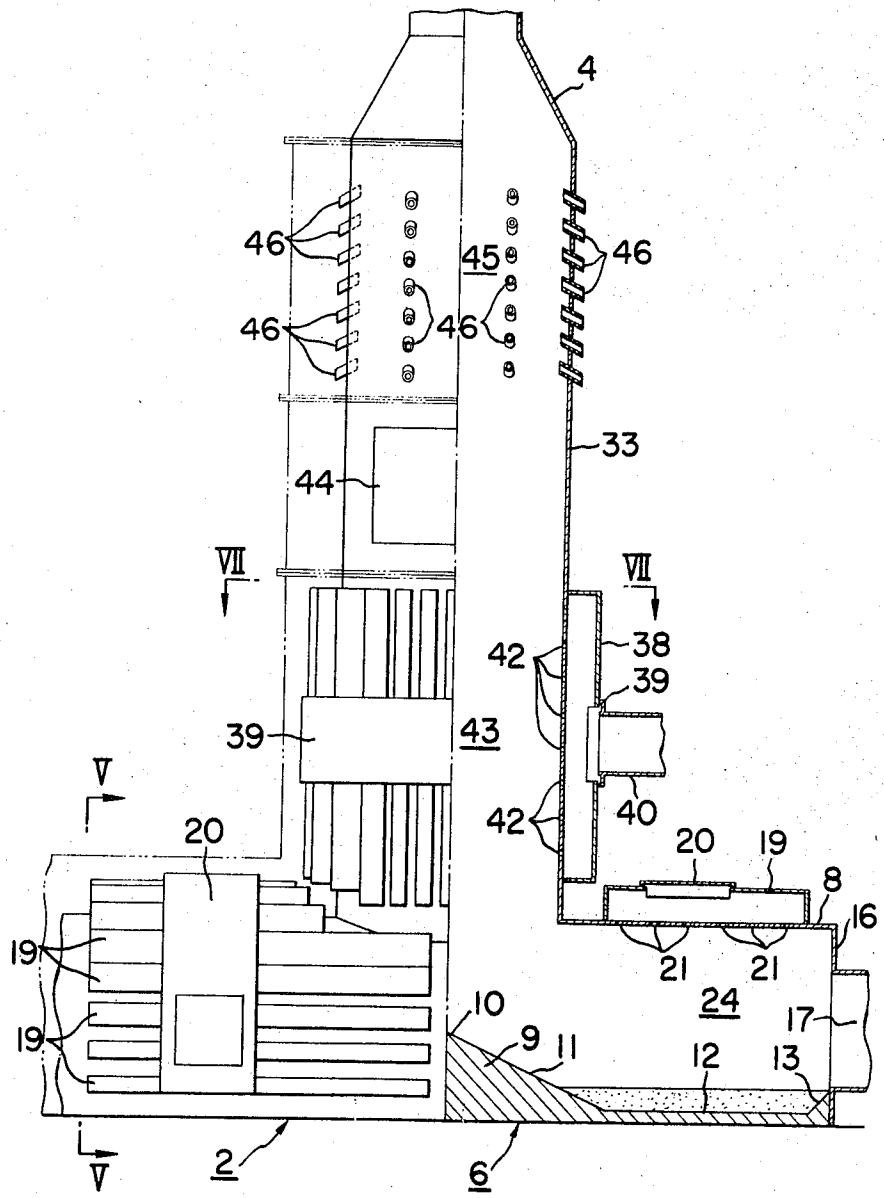

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FIG. 5

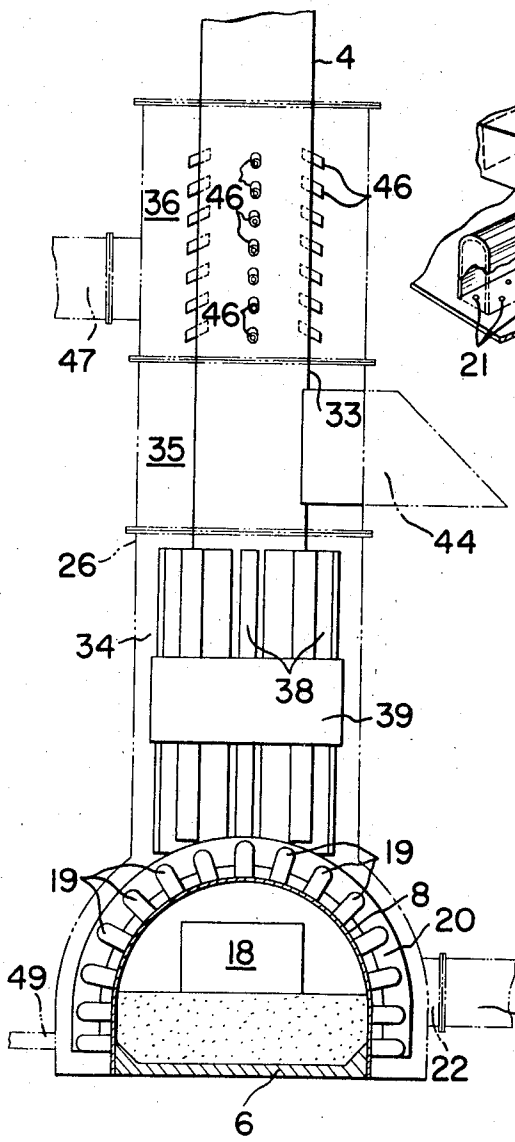

FIG. 6

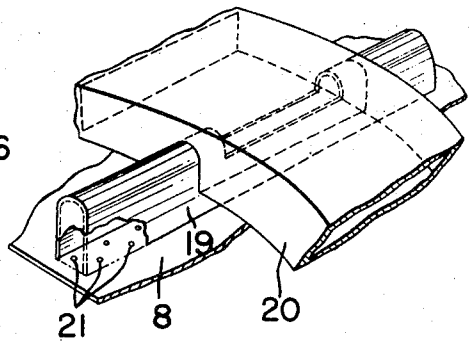

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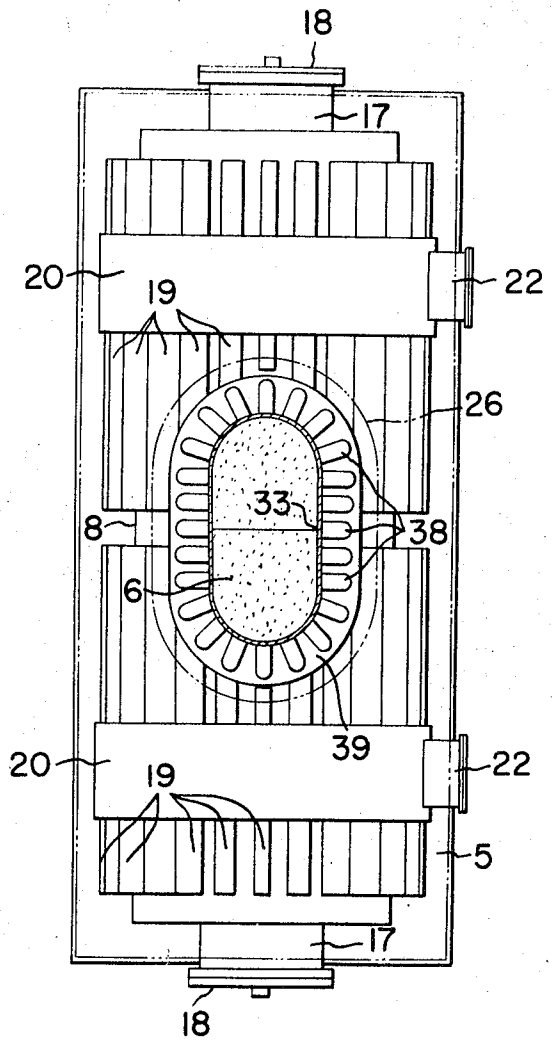
FIG. 7



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INCINERATOR

This invention relates to a novel incinerator, and more specifically, to a new and better incinerator designed especially for the complete combustion of waste materials containing a high percentage of synthetic resins and other nonflammable substances.

Huge quantities of waste materials are produced every day by large cities that are growing at an accelerating rate into the megalopolitan dimensions. The difficulties involved in their disposal, generally by incineration, have come to pose one of the most serious problems in every thickly populated city of the world. One such difficulty comes from an ever increasing percentage of nonflammable synthetic resins present in the waste materials produced by our modern communities. When burnt incompletely, as they usually are, the synthetic resins emit gases that are damaging to our health, so that the incineration of such substances within urban areas is altogether undesirable. Yet, to transport them over long distances for disposal at less populous locations is not quite a satisfactory alternative in view of the time and labor that has to be expended.

It is, of course, possible to reduce to some extent the poisonous gases and smoke produced by the incineration of waste materials by providing a filter in a smoke passage of an incinerator, but such filters are both costly and inefficient. Complete oxidation will best enable the elimination of such smoke and poisonous gases produced by the incineration of waste materials and, in particular, synthetic resins. Combustion of any substance is accelerated by intensifying the oxidation of the substance and, hence, is greatly dependent upon temperature and the amount of oxygen supplied. Therefore, the complete combustion of a substance results when it is heated up to sufficiently high temperature under sufficient supply of oxygen.

A blower has been the usual means employed heretofore to supply a greater amount of oxygen into the incinerator. But these conventional incinerators have had a serious drawback in that the temperature of their combustion chambers is lowered by each newly introduced batch of rubbish, with the result that the materials which have been burnt therein are then oxidized to a lesser degree.

This drawback is a crucial bar to the complete combustion of synthetic resins, which consists of a twofold process of liquefaction and gasification. As the synthetic resins liquefied by heat and being heated further for their final gasification process in a combustion chamber merge with a newly introduced batch of solid synthetic resins, the desired gasification of the former is retarded not only by the cold temperature possessed by the latter, but also by heat loss caused by the succeeding fusion thereof. Thus, the conventional incinerators have been incapable of complete combustion of the substances, especially when these are introduced in a consecutive manner.

Another drawback attendant to the conventional incinerators is that the walls of their combustion chambers have been easily overheated due to air fed into them in order to accelerate the oxidation of waste materials being burnt therein.

Furthermore, the conventional incinerators have had their dumping gates more or less close to the combustion chambers, so that their operators have been tormented by a great deal of high-temperature smoke and poisonous gases outflowing each time the gates are opened.

The present invention overcomes all the above deficiencies attendant to its predecessors, making possible the complete combustion of nonflammable synthetic resins, among other substances, and maintaining a high rate of combustion efficiency even when waste materials are introduced consecutively into the incinerating sections.

It is accordingly a primary object of this invention to provide an incinerator wherein waste materials containing a high percentage of synthetic resins and other nonflammable substances are completely oxidized so that the production of smoke or poisonous gases is minimized.

Another object of the invention is to provide an incinerator wherein a second combustion chamber is provided above a first combustion chamber into which waste materials are first introduced via the high-temperature first combustion chamber, where they are preheated, so that the temperature of the second combustion chamber is not lowered to any appreciable degree even when the waste materials are supplied consecutively.

Yet another object of the present invention resides in the provision of an incinerator whose incinerating sections are provided with a double-wall structure including inner and outer walls between which are formed cooling water and air jackets thereby to prevent them from overheating.

Yet a further object of the invention is to provide an incinerator whose dumping gate is designed to let out no poisonous gases resulting from incomplete combustion of waste materials.

Still another object of the invention is to provide an incinerator wherein air is fed efficiently into a first combustion chamber and a second combustion chamber, thus accelerating the gasification of liquefied synthetic resins in the former and the complete oxidation of the gasified synthetic resins fed therefrom into the latter.

A still further object of the invention is to provide an incinerator wherein a flame-extinguishing chamber is provided above the second combustion chamber and air is fed into the flame-extinguishing chamber thereby to extinguish part of the combustion gases that may come flaming up from the second combustion chamber and to lower the temperature of the combustion gases before sending them up into a smokestack.

Still a further object of the present invention is to provide an incinerator wherein the second combustion chamber is provided upwardly from the center of the horizontally elongated first combustion chamber, while the interior of this first combustion chamber is substantially bisected by means of a projection in the middle of its floor corresponding to the axis of the combustion chamber. Thus, the gases of the synthetic resins combusted on both sides of the projection in the first combustion chamber are mixed efficiently with air supplied into it, and the mixture is fed smoothly up into the second combustion chamber.

Yet a further object of this invention is to provide an incinerator wherein air is fed upwardly into the flame-extinguishing chamber so that combustion gases are easily directed into the smokestack in an upward draft.

These, together with the various ancillary objects and features of the present invention, which will become apparent as the following description proceeds, are attained by this incinerator, a preferred embodiment of which is illustrated in the accompanying drawing, by way of example only, wherein:

FIG. 1 is a front elevational view of an incinerator constructed in accordance with the concepts of the present invention, with parts being broken away to show other parts in detail;

FIG. 2 is a left-hand side elevational view of the incinerator with parts thereof being broken away;

FIG. 3 is a right-hand side elevational view of the incinerator;

FIG. 4 is a vertical sectional view of the incinerator with its outer wall and the right hand half of the inner wall being shown broken away;

FIG. 5 is a vertical sectional view taken along the plane of lines V—V in FIG. 4;

FIG. 6 is an enlarged partial perspective detail view with parts being broken away illustrating a detail of the inner wall and one of the tubular members employed in the first combustion chamber of the incinerator; and,

FIG. 7 is a horizontal sectional detail view taken along the plane of line VII—VII in FIG. 4.

Referring now to the drawings, the reference numeral 1 generally designates an incinerator constructed in accordance with the present invention, incorporating a horizontally elongated first incinerating section 2, a second incinerating section

3 standing upwardly from the middle of the first incinerating section 2, and a smokestack section 4 on top of the second incinerating section 3. The first incinerating section 2 comprises a rectangular hearth plate 5, a hearth 6 superposed on the hearth plate 5, an arched cast-steel outer wall 7 mounted on the hearth plate 5, and a cast-steel inner wall 8 having approximately the same shape as the outer wall 7. The inner wall 8 is also mounted on the hearth plate 5 inside the outer wall 7 with a certain spacing therebetween. The hearth 6 includes a projection 9, FIG. 4, whose ridge 10 is located at the center of the longitudinal distance of the hearth 6 and is extended horizontally in the transverse directions thereof and which has surfaces 11 slanting downwardly from the edge 10 on both sides thereof, horizontal hearth portions 12 on both sides of the projection 9, and slanted hearth portions 13 at both ends of the longitudinal directions of the hearth 6. The arched outer wall 7 is provided with sidewalls 14 at both ends which are each formed with a quadrilateral opening 15. The arched inner wall 8 is also provided with sidewalls 16 at both ends which are provided with quadrilateral discharge portions 17 extending outwardly through the openings 15 of the sidewalls 14 and equipped with openable doors 18 at their outer ends. Two groups of channel-shaped tubular members 19 with closed ends are provided longitudinally on the outside surface of the arched inner wall 8 in semisymmetrical arrangement. The tubular members 19 constituting each of the two groups are disposed in parallel with each other and are intercommunicated by means of a wide, arched tubular member 20 coupled therewith at their cutaway middle portions, as illustrated in detail in FIG. 6. The inner wall 8 is provided with a plurality of bores 21 therethrough communicating the tubular members 19 with a first combustion chamber 24 formed by the inner wall 8, the hearth 9, and the sidewalls 16. The tubular member 20 is connected with an air channel pipe 22 which extends through an opening (not shown) formed in the outer wall 7 and is connected with a blower 23. Thus, the air fed by the blower 23 is directed into the first combustion chamber 24 via the air channel pipe 22, the tubular member 20, the tubular members 19 and the bores 21. A space 25 between the outer wall 7 and the inner wall 8 is filled with water to form a cooling water jacket.

The second incinerating section 3 has a semicylindrical outer wall 26 including an outer wall part 27 extending vertically upwardly from the middle of the outer wall 7 of the first incinerating section 2 and formed in one piece therewith. An outer wall part 29 is mounted on top of the outer wall part 27, with the interposition of a hollow partition member 28 therebetween, and an outer wall part 31 is further mounted on top of the outer wall part 29, also with the interposition of a hollow partition member 30 therebetween. Thus, the outer wall 26 consists of these outer wall parts 27, 29, and 31. The upper end of the outer wall part 31 is blocked by another hollow partition member 32.

The second incinerating section 3 also has a semicylindrical inner wall 33 standing vertically upwardly out of the outer wall 26 from the middle of the inner wall 8 of the first incinerating section 2. The part of the inner wall 33 projecting out of the partition member 32 on top of the outer wall 26 substantially forms the smokestack section 4. The space between the inner wall 33 and the outer wall 26 is partitioned into two water chambers 34 and 35 and an air chamber 36 by means of the partition members 28 and 30. The water chamber 34 is of one piece with the water chamber 25 of the first incineration section 2 and is communicated with the water chamber 35 by means of pipes 37.

Channel-shaped tubular members 28 with closed ends are juxtaposed in parallel with each other on the outside surface of that portion of the inner wall 33 which corresponds to the part 27 of the outer wall 26, and the tubular members 38 are, like the above-mentioned tubular members 19, intercommunicated by means of a wide, annular tubular member 39 coupled therewith at their cutaway middle portions. The tubular member 39 is connected with an air channel pipe 40 which extends out of the outer wall part 27 through an opening formed therein and which is connected to a blower 41. The inner wall 33 has a plurality of bores 42 therethrough communicating the channel-shaped tubular members 38 with a second combustion chamber 43. Hence, the air fed by the blower 41 is directed into the second combustion chamber 43 via the air channel pipe 40, the tubular member 39, the tubular members 38 and the bores 42. A gate 44, through which waste materials are introduced into the incinerator, is provided at the portion of the inner wall 33 corresponding to the part 29 of the outer wall 26, the gate 44 extending out of the outer wall 26 through an opening (not shown) formed therein.

The interior of the portion of the inner wall 33 corresponding to the part 31 of the outer wall 26 constitutes a flame-extinguishing chamber 45, and the surrounding wall thereof has a plurality of airblast pipes therethrough which are so arranged as to introduce blasts of air upwardly into the flame-extinguishing chamber 45 from the air chamber 36. The outer wall part 31 is connected with an air channel pipe 47 which leads to a blower 48. Hence, the air fed by the blower 48 is directed into the air chamber 36 through the air channel pipe 47, and thence to the fire-extinguishing chamber 45 through the airblast pipes 46.

Cooling water is supplied into the water chambers 25, 34 and 35 from an elevated tank 50 through a pipe 49 connected to a lower portion of the outer wall 7. The tank 50 is normally filled with water supplied from an adequate source (not shown) through a supply pipe 51, and the surplus thereof is discharged through a discharge pipe 52. The steam produced in the water chambers 25, 34, and 35 is led into a pair of steam condensers 54 through their respective pipes 53 connected to the outer wall part 29, and then returned into the tank 50 through pipes 55 which are joined together on their way back to the tank 50.

The operations and functions of the incinerator of the invention, constructed as described in the foregoing and illustrated in the attached drawings, are described hereinbelow.

Water supplied into the tank 50 through the supply pipe 51 flows down the pipe 49 into the water chamber 25. After filling the water chamber 25, the water goes up to the water chamber 34 and thence to the water chamber 35 through the pipes 37. The tank 50 is provided at a less elevated position than the steam condensers 54 so that the water contained in the tank 50 may not flow into the steam condensers 54 through the pipes 55, but at a sufficient height for the water to fill the water chambers 28, 34, and 35.

The incinerator 1 may be ignited in a variety of ways. One is to charge waste materials into the first combustion chamber 24 through the door 18 and to set fire to them by means of a burner and the like. (By the "waste materials" here are meant those of inflammable synthetic resins in order to clarify the advantages of the present invention.) As the waste materials begin burning, the blowers 23, 41, and 48 are set in motion thereby to make operative the air supply system of the incinerator 1. Although there may at first be low fire activity due to the coldness of the first combustion chamber 24, the fire intensifies as air if fed into the chamber from the blower 23 through the air channel pipe 22, the tubular member 20, the tubular members 19, and the bores 21. The synthetic resins first liquefied by the heat rests on the horizontal parts 12 of the hearth 6, and are gasified succeedingly as they are further combusted.

The air supplied into the first combustion chamber 24 from the blower 23 is designed primarily to accelerate the gasification of the liquefied synthetic resins, keeping the chamber 24 unsaturated with their steam and swiftly carrying the gases produced by the liquefied synthetic resins up into the second combustion chamber 43. Thus, most of the gases of the yet incompletely combusted synthetic resins in the first combustion chamber 24 is fed into the second combustion chamber 43, so that the temperature in the interior of the first combustion chamber 24 is elevated by the combustion heat of the synthetic resins only up to 700° to 800° C.

The gases of the incompletely combusted synthetic resins going up the second combustion chamber **43** are supplied with air fed by the blower **41** through the air channel pipe **40**, the tubular member **39**, the tubular members **38**, and the bores **42**. Thus supplied with a sufficient amount of oxygen, the gases are recombusted in the second combustion chamber **43**. The temperature of the interior of the combustion chamber **43** rises due to the heat of the recombustion of the gasified synthetic resins higher than any other section of the incinerator **1**, i.e., up to 1,200° to 1,300° C. This is due to the violent oxidation of the gasified synthetic resins by the air blasted out toward the center of the second combustion chamber **43** from all over its surrounding wall. The gasified synthetic resins are thus almost completely combusted as they leave the second combustion chamber **43**, and, still partially in flames, enter the flame-extinguishing chamber **45**. This flame-extinguishing chamber **45** is being supplied with air from the blower **48** through the air channel pipe **47**, the air chamber **36** and the airblast pipes **46**. The combustion gases which have come flaming up from the second combustion chamber **43** are completely oxidized, and also cooled by an excess amount of air supplied, in the flame-extinguishing chamber **45**; hence, desirably, the amount of air supplied thereto should be sufficiently more than that theoretically necessary for the complete oxidation of the combustion gases. Since the airblast pipes **46** are directed upwardly toward the interior of the flame-extinguishing chamber **45**, the gases oxidized completely by the air blasted therefrom are speedily carried upwards into the smokestack section **4**.

Now, as synthetic resins to be incinerated are charged into the incinerator from its gate **44**, they drop down onto the hearth **6** through the second combustion chamber **43** whose temperature is elevated to 1,200° to 1,300° C., as is already mentioned. Since the liquefaction of synthetic resins occurs at a temperature range of 170° to 180° C., the synthetic resins charged into the present incinerator are liquefied before they reach the first combustion chamber **24**. The synthetic resins thus liquefied and heated up to a temperature of approximately 200° C. drop on one or both of the horizontal hearth portions **12** on both sides of the projection **9**, where they merge with the liquid of the previously introduced synthetic resins. In this instance, since the newly introduced synthetic resins are already heated to a temperature of 200° C. or so, they do not lower the temperature of those already present on the hearth **6** to such an extent as to prevent their gasification. Accordingly, the highly efficient combustion of nonflammable synthetic resins made possible by the present incinerator is not hampered to any appreciable degree even when they are introduced succeedingly.

The projection **9** formed in the middle of the hearth **6** to provide the two horizontal hearth portions **12**, where liquefied synthetic resins are pooled prior to their gasification, substantially bisects the first combustion chamber **24**, with the resultant advantages described hereinbelow. Should the hearth **6** be flat altogether, the synthetic resins charged into the incinerator from its gate **44** could collect right below the inner wall **33**, restricting the course of their gases from the first combustion chamber **24** back into the second combustion chamber **43** and thus deteriorating the efficiency of combustion. The projection **9** not only eliminates this difficulty, but also greatly facilitates the mixing of the gasified synthetic resins with the air supplied into the first combustion chamber **24** from the blower **23**.

Although exposed to extremely high temperatures due to the combustion of synthetic resins, the inner walls **8** and **33** are prevented from overheating by means of the water chambers **25**, **34**, and **35**, so that the incinerator **1** is capable of well withstanding service over extended periods of time.

Quantities of hot water and steam obtained by the heat exchange of the cooling water can be used for appropriate purposes by leading them out, for instance, from the pipes **53** running between the water chamber **35** and the steam condensers **54**.

The doors **18** are to be opened for the discharge of the ashes of incinerated waste materials on the hearth **6**.

Although a specific embodiment of the invention has been shown and described in the foregoing, it will be obvious that many modifications, substitutions and changes thereof are possible. The invention, therefore, is not intended to be restricted by the exact showing of the drawings and description thereof but is considered to include reasonable and obvious equivalents coming within the spirit and scope of the invention disclosed herein.

I claim:

1. An incinerator comprising a first combustion chamber including a hearth and having an inner wall and outer wall with a spacing therebetween to provide a cooling water jacket, a second combustion chamber having a tubular inner wall above said first combustion chamber, partition members secured to said tubular inner wall, and a tubular outer wall standing upwardly from the middle of said outer wall of said first combustion chamber and at least partially surrounding said tubular inner wall and said partition members to provide a cooling water jacket, a flame-extinguishing chamber above said second combustion chamber by extensions of said tubular inner wall and said tubular outer wall defining a flame-extinguishing chamber above said second combustion chamber, said flame-extinguishing chamber having an annular air chamber between said extensions and also having a plurality of airblast pipes therethrough for blowing air upwardly into the interior thereof from said air chamber, and a gate portion for charging waste materials into said first combustion chamber via said second combustion chamber and extending horizontally from outside into the interior of said tubular inner wall.

2. An incinerator according to claim **1**, including groups of channel-shaped members having closed ends arranged in side-by-side relationship on the periphery of said inner wall of said first combustion chamber for blowing air into said first combustion chamber through a plurality of bores provided through said inner wall thereof, each of said groups of channel-shaped members being intercommunicated by means of a tubular member into which air is supplied.

3. An incinerator according to claim **2**, including another group of channel-shaped members having closed ends and arranged in side-by-side relationship on the periphery of said inner wall of said second combustion chamber for blowing air into said second combustion chamber through a plurality of bores formed in said tubular inner wall, said other group of channel-shaped members being intercommunicated by means of a tubular member into which air is supplied.

4. An incinerator according to claim **1**, wherein said hearth is provided with slanted portions to form a well offset from vertical alignment with said second combustion chamber.

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