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[21]	Appl. No.	24,577
[22]	Filed	Apr. 1, 1970
[45]	Patented	Oct. 5, 1971
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[56]

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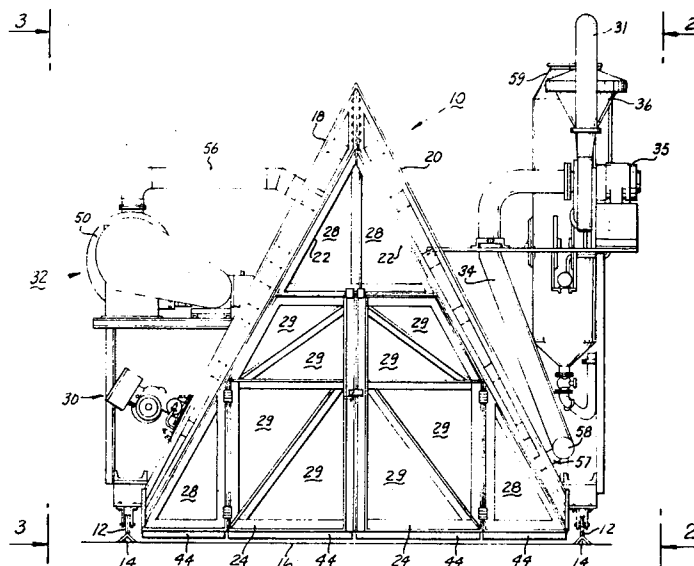
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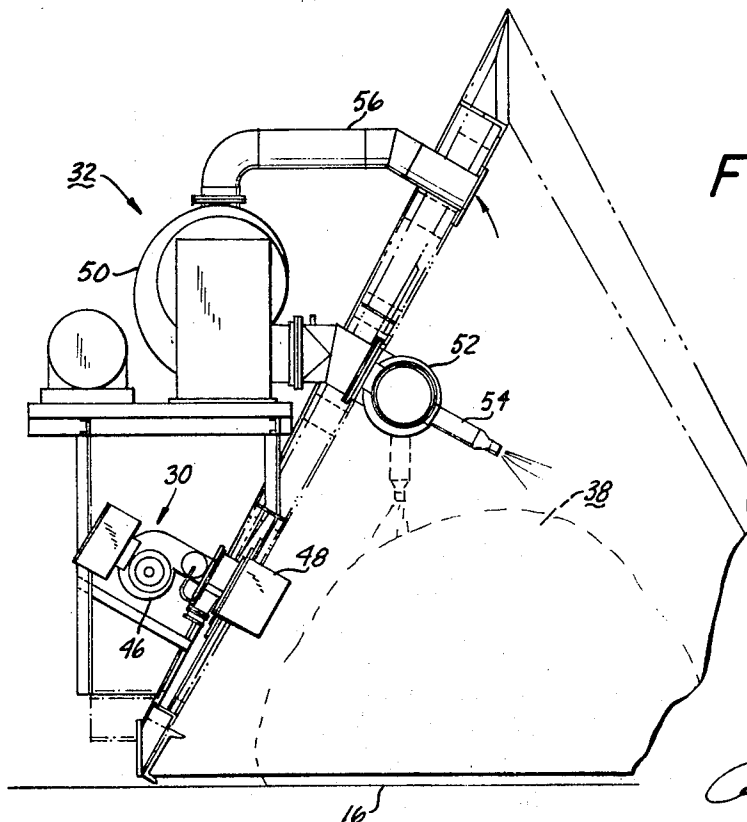
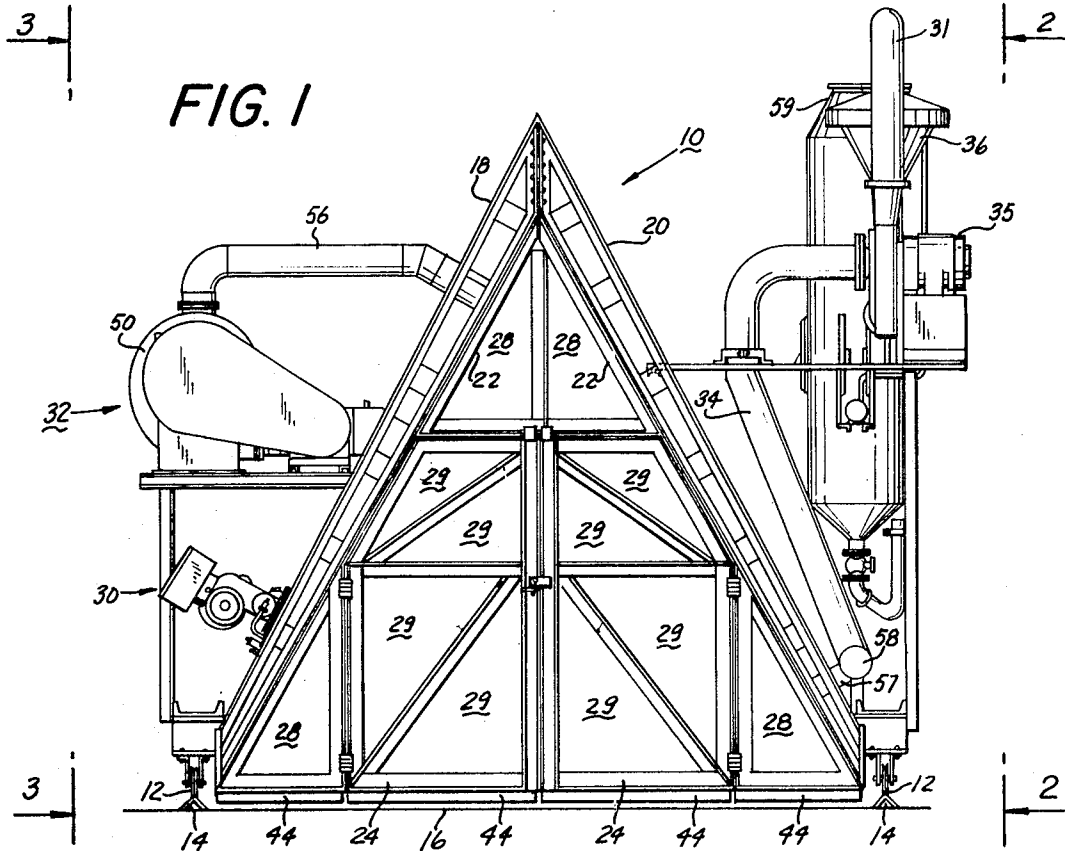
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[54] INCINERATOR AND METHOD OF BURNING COMBUSTIBLES
18 Claims, 9 Drawing Figs.

[52] **U.S. Cl.**..... **110/8 C,**
110/18 C
[51] **Int. Cl.**..... **F23g 5/12**
[50] **Field of Search**..... 110/7, 8 R,
8 C, 18 R; 126/140

ABSTRACT: A method of burning and an incinerator using a semiclosed system including an enclosure having a thin covering of thermal conductive, substantially nonporous and abrasion resistant glass-ceramic material so that part of the heat generated within the incinerator may be transferred through the covering to the atmosphere and part of the heat is reused within the system to heat makeup air being added to the system to support the burning with the enclosure.





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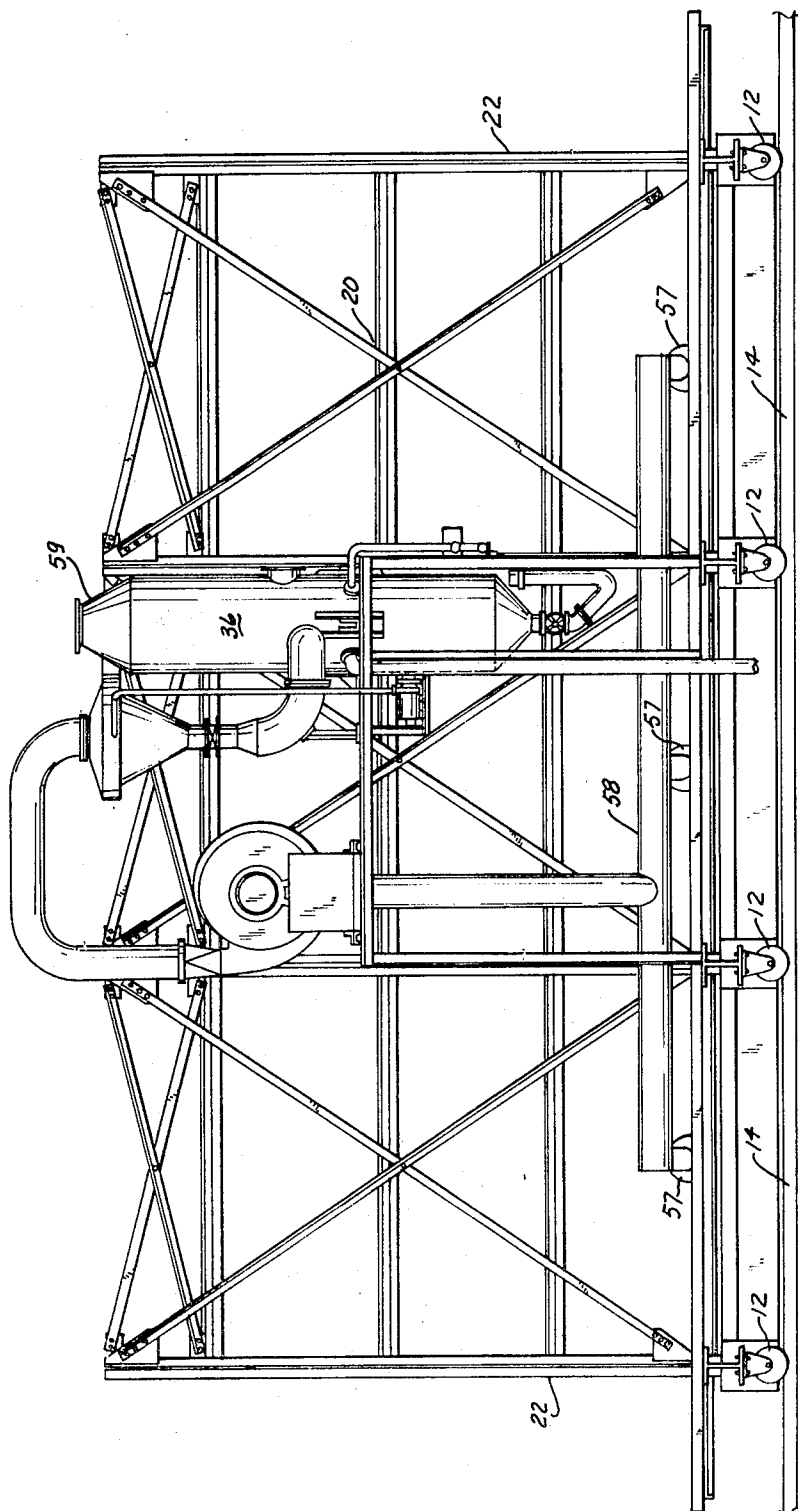


FIG. 2

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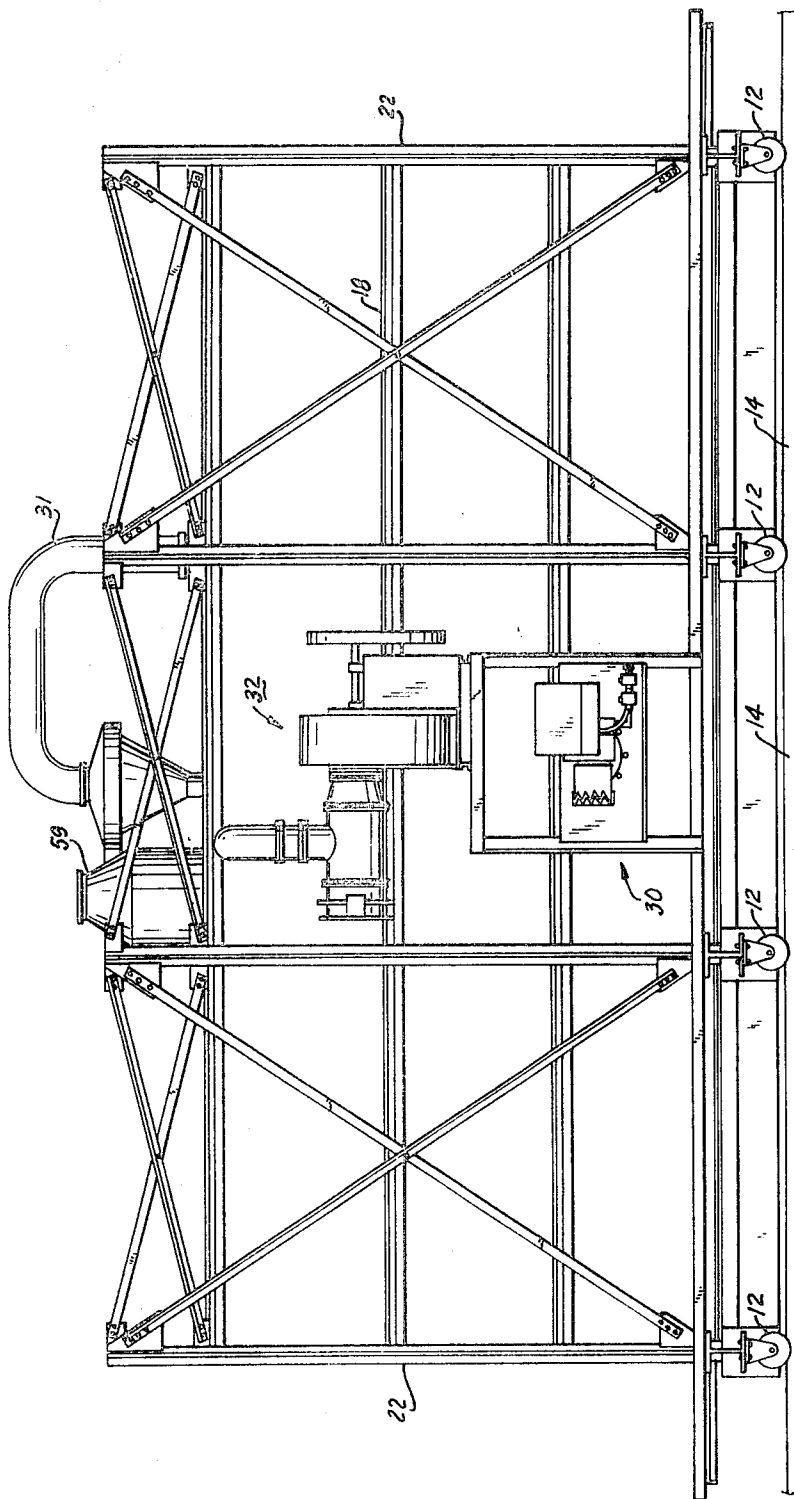


FIG. 3

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FIG. 4

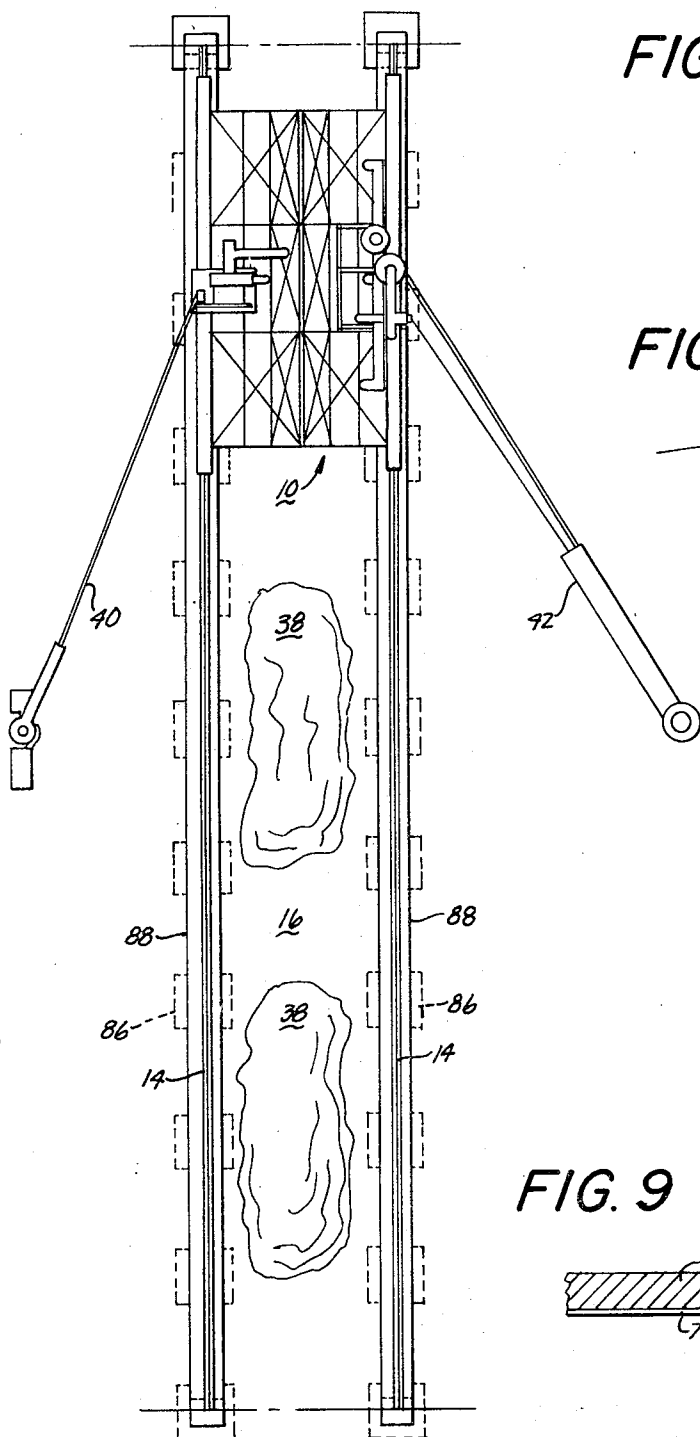


FIG. 5

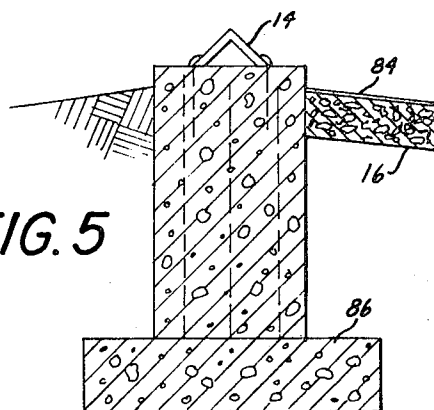


FIG. 6

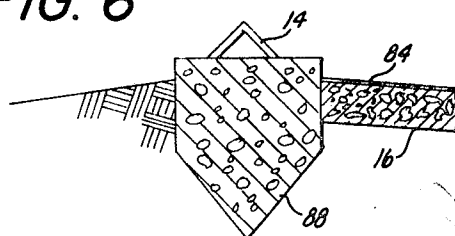


FIG. 8

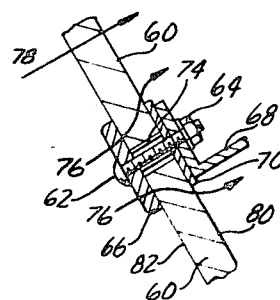
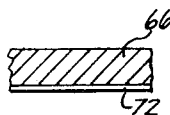


FIG. 9



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INCINERATOR AND METHOD OF BURNING COMBUSTIBLES

BACKGROUND OF THE INVENTION

This invention relates to an apparatus and method for incinerating combustible materials by means of a semiclosed system.

Pollution of the atmosphere from open burning of dumps and even from the high stacks of the well known insulating refractory-lined incinerators has caused substantial problems with the environment.

With open dump fires there is really no attempt made to control the escape of pollutants, both gaseous and particulate, to the atmosphere. With the standard high stack incinerator, some attempt has been made by means of electrostatic precipitators, air scrubbers and other such devices, and as far as is known with limited success.

The standard incinerator with its high stack and insulated fire box is not only extremely expensive to construct, but it is not particularly well suited for the selected incineration successively of various waste materials from industrial operations. As an example, scrap insulated copper wire has a recovery value if the insulation can be removed without unduly melting or destroying the copper. Obviously, such an operation must be conducted at a low heat and under good control conditions. On the other hand an old automobile which is to be incinerated to remove all combustible materials so that only the metal will remain, must be burnt off at a higher heat in order to reach the hidden combustibles scattered about the various intricacies of the automobile, as well as quickly for economic reasons. The standard incinerator would not be able to handle quickly successive loads which may range from the copper wire to old automobiles to organic waste, the latter which may require incineration to the smallest amount of ash residue.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an apparatus and method for inexpensively incinerating materials of various kinds. It is a further object to provide such an apparatus and method which is easily adapted to handle, at a minimum of expense, successive varieties of different materials.

It is still a further object of the present invention to provide an apparatus and method which utilizes a semiclosed incineration system to reduce the amount of gaseous and particulate pollutants which may be permitted to escape to the atmosphere.

Another object is to provide an apparatus which may be readily moved from one location to another at a minimum of expense in order to reduce the cost of transporting waste materials to a central site having a fixed incinerator.

These and other objects are obtained by means of using a semiclosed system including an enclosure having a thin covering of thermal conductive, substantially nonporous and abrasion resistant glass-ceramic material. In addition, part of the heat generated within the incinerator may be transferred through the covering to the atmosphere and, further, part of the heat reused within the system to heat makeup air being added to support the burning of the combustibles within the enclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of the apparatus in accordance with the present invention;

FIG. 2 is a side view of the apparatus in accordance with the present invention taken from the direction of lines 2—2 of FIG. 1;

FIG. 3 is a side view of the apparatus in accordance with the present invention taken from the direction of lines 3—3 of FIG. 1;

FIG. 4 is a partially schematic top plan view of the apparatus in accordance with the present invention showing its location to a material supporting surface and platform;

FIG. 5 is a detailed sectional view through one of the supporting footings for the support rail for the mobile incinerator;

FIG. 6 is a sectional view through the supporting joist for the support rail of FIG. 5;

FIG. 7 is a partially fragmentary sectional view showing the location of the burning and combustion air systems of the incinerator;

FIG. 8 is a sectional view showing a typical panel fastening means for holding the covering of the incinerator on the supporting frame; and

FIG. 9 is an enlarged sectional view showing the coating of the fastening means of FIG. 8.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings and to FIGS. 1 through 4 in particular, an incinerator 10 for carrying out the present invention is shown. The incinerator 10 is mounted on wheels 12 which are caused to ride on guide rails 14. The rails 14 in turn are positioned along a burning platform or slab 16.

In the illustrated embodiment the incinerator 10 is comprised of a side frame 18, a second side frame 20 and a pair of end frames 22. Hinged doors 24 are provided in the end frames 22. The side frames 18 and 20 are clad with a series of panels 26, the end frames with panels 28 and the hinged doors 24 with panels 29.

The panels 26, 28 and 29 are advantageously fastened on the interior of the frames and doors so that they form the enclosure for the incinerator 10, thus putting the supporting framework outside the incinerator enclosure. The panels are formed from a thin glass-ceramic material, less than 1-inch thick and preferably having a thickness of about 0.20–0.30 inches. Because it will be subjected to high heat within the incinerator, the material must have good thermal conductivity and at the same time a low coefficient of linear thermal expansion. Further, since it will be exposed to the atmosphere and changing climatic conditions while the interior is subjected to high heat, it must be resistant to thermal shock and material having a resistance to thermal shock of at least 1,000 to 32 F. is advantageously used. Of course, a material having a resistance to thermal shock of a greater temperature differential may be used if needed and desired.

The amount of linear expansion of the panel material has a direct relationship to the design of the side frames 18 and 20, and the end frames 22 including the hinged doors 24. If there is a substantial expansion of the panel material in going from ambient temperature to the operating temperatures of the incinerator expansion joints must be built into the frames to accommodate the panel expansion.

Preferably the coefficient of expansion would not be greater than 2×10^{-6} inches per inch per degree Fahrenheit in going from 77° to 570° F.

A glass-ceramic material which is found suitable for use as panels is made by Corning Glass Works, Corning, New York, and sold under the trademark "PYRAM."

Mounted on the side frame 18 and extending through the underlying panel 26, are a burner assembly 30 and a combustion gas handling assembly 32. Mounted on the opposite side frame 20 and extending through the panels 26 is an exhaust gas duct 34, which connects to an exhaust blower 35 and a scrubber assembly 36.

As shown in FIG. 4 in particular a series of piles 38 of combustible material are spread along the burning platform 16. Connected to the burner assembly 30 and the combustion assembly 32 are utility connections 40 for gas and electric power. Similar utility connections 42 for electric power and water are connected to the exhaust blower 35 and the scrubber assembly 36. In actual operation, after a burning pile 38 has been positioned on the platform 16, the hinged doors 24 are swung open and the incinerator 10 moved by any suitable apparatus so that it straddles the pile to be burnt. With the incinerator 10 in place, the doors 24 are closed reestablishing an enclosure overlying the platform 16 and the burning pile 38. The incinerator 10 is spaced slightly above the platform 16

to permit some air from the atmosphere to enter the interior of the incinerator. If desired, skirt portions 44 may be attached to the lower portion of the side frames 18 and 20 or the end frames 22 to limit the amount of entering air or, if desired, to permit the greatest amount to enter from a selected direction.

With the incinerator in place the burner assembly 30 is ignited and directed at the desired pile 38 as shown in FIG. 7. The burner assembly is comprised of a standard blower 46 with a nozzle 48. The burner supplies sufficient heat to cause the pile 38 to ignite. Combustion air is furnished to the ignited pile 38 by means of the combustion gas assembly 32. This assembly is comprised of blower 50 which feeds air to a manifold 52 which in turn is connected to a series of swivelable nozzles 54 which may be rotated to a selected position to direct the air necessary to support combustion to preselected regions surrounding the pile 38. It is to be understood that where the term "air" is used, that term encompasses the atmospheric oxygen or, in specialized cases, an additional supply of oxygen may be injected into the system if desired.

Since in the illustrated embodiment the side frames 18 and 20 are arranged in a tapered relationship converging at the top of the incinerator 10, unused but heated air will rise to the top. There it is pulled into a return air duct 56 and directed into the blower 50 where it is combined with ambient makeup air to heat the makeup air and be recycled through the manifold 52 and the exhaust nozzle 54. Depending upon the material which is being incinerated, the burner assembly 30 may or may not continue to be used after there has been initial ignition of the pile 38. Where the material is sufficiently combustible to support burning the air furnished by the blower 50 may be all that is required. Positioned opposite the burner 48 are a series of outlets 57 connected to an exhaust manifold 58, which in turn is connected to the exhaust gas duct 34 and the exhaust blower 35.

Since the incinerator 10 is a semiclosed system, the gaseous and particulate pollutants normally associated with incineration and with open burning are trapped within the incinerator. The exhaust blower is continuously drawing off pollutants so generated and that polluted gas stream is directed to the scrubber 36 where it is washed and the exhaust gas exited through the stack 59. Advantageously, the capacity of the exhaust blower 35 may be slightly greater than the combustion gas blower 50. For example, the combustion gas blower 50 may have a capacity of 750 cubic feet per minute while the exhaust blower 35 has a capacity of 900 cubic feet per minute. Due to the differential of 150 cubic feet per minute a slightly negative pressure will be maintained within the enclosure of the incinerator 10 causing the generated gas with its pollutants to remain therein and permit the entry of additional makeup air in the lower regions of the incinerator where it is spaced from the burning platform 16.

Since the panels 26, 28 and 29 are in contact with the heat generated within the incinerator 10, and the panels have a low rate of thermal expansion, the structural members of the incinerator 10 will not be adversely effected to any substantial degree by the generated heat. Also, the panels have a fairly good coefficient of thermal conductivity compared to other materials. The coefficient of glass-ceramic material sold by Corning Glass Works under the trademark "PYRAM" is about 13.6 while glazed tile has a coefficient of 2.7 and glazed cemented asbestos has a coefficient of 1.8. Due to the relatively good thermal conductivity of the panels the heat which is absorbed is quickly dissipated to the atmosphere outside the incinerator. This is also helped by the thinness of the panels. As a result there is a controlled heat dissipation so that the spaced frames will not become too heated.

As shown in FIG. 8, the panels of the illustrated incinerator consist of a series of sheets 60. In order to fasten the sheets to the frames any suitable fastening means may be used. One such fastening means may comprise a bolt 62 and a nut 64, which together with a plate 66 are attached to an angle support 68 which in turn may be part of one of the frames. To cushion the panels 60 and to insulate the angle support 68

from the heat conducted by the panels, an asbestos sheet 70 is placed between the angle and the panel 60. The asbestos sheet 70 not only serves as a cushion and an insulator, but if impregnated with sodium silicate, may also act as a water-proofing member to prevent leakage from the outside and into the incinerator.

The plate 66 is preferably protected by suitable means from the heat generated within the enclosure. One means of doing this is to use a ceramic coating resistant to a heat of at least about 1,000° F. and which may be applied by a flame spray device which is well known in the art of plasma flame coating; for example that manufactured by Metco Inc., Westbury, New York.

The fastening joint shown in FIG. 8 may also include a sleeve 74 which surrounds the bolt 62 and functions as a spacer to prevent any undue pressure being applied to the sheets 60.

Heat which is generated within the incinerator is dissipated primarily through the sheets 60 and a small amount through the fastening plates 66. The heat transmitted through the fastening plates 66 is designated by the arrows 76. This heat is transferred to the sheets 60, and because of the presence of the asbestos insulating material 70, it bypasses the angle support 66 and is transferred to the ambient atmosphere and not to the supporting frame.

Normal generated heat is designated by the arrow 78 and that is conducted directly outwardly through the sheets 60.

When in cold climates the sheets 60 may be subjected to substantial thermal shock. For example, the outer surface 80 of the sheet 60 may be exposed to a temperature of 32° F. while the inner surface 82 may be exposed to a generated internal heat of 1,000° F. As a result the thermal shock may be from 32° to 1,000° F. and the panels must be capable of absorbing such extremes of temperature simultaneously.

The surface of the burning platform 16 may be of any suitable material depending upon the needs of the operation. In some instances an earthened platform may be sufficient. Usually some sort of a hardened surface will be desired and a refractory material such as fire brick may be used, although in some cases an inexpensive surfacing may be used such as a concrete slab.

If the incinerator 10 is to be moved from position to position, it is well to furnish an adequate support. In such a case a series of footings 86 and connecting rail joists 88 may be used as shown in FIGS. 5 and 6.

What is claimed:

1. An incinerator for burning material comprising:
 1. a supporting surface for material to be burnt and
 2. a structure adjacent to said surface and combining therewith to form an enclosure for the material to be burnt;
 3. said structure including a thin covering of thermal conductive and substantially nonporous glass-ceramic material;
 4. said glass-ceramic material having a resistance to thermal shock of at least about 1,000° F. to 32° F.; whereby said covering may be exposed to the heat generated by the burning material
2. An incinerator for burning material as defined in claim 1, and further including a burner for use in supplying sufficient heat to the material to be burnt to cause it to ignite.
3. An incinerator as defined in claim 2 and further including a blower system for supplying air to the region about the material to be burnt.
4. An incinerator as defined in claim 3, and further including exhaust means for removing gaseous pollutants generated by the burning of material within the enclosure.
5. An incinerator as defined in claim 4 wherein the structure has an upwardly tapered cross section.
6. An incinerator as defined in claim 4 wherein the structure has side and end walls and at least one end wall has a closeable opening therein to permit material to be burnt to be placed within the structure.

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7. An incinerator as defined in claim 4 wherein at least a portion of the structure adjacent to the supporting surface is spaced therefrom whereby makeup air may thereby enter the interior of the structure.

8. An incinerator as defined in claim 4 wherein the exhaust means for removing gaseous pollutants includes an air cleaner.

9. An incinerator as defined in claim 4 wherein the blower system for supplying air to the region about the material to be burnt includes at least one air nozzle movably mounted whereby the direction of the air from the nozzle may be controlled.

10. An incinerator for burning material comprising:

1. a supporting surface for material to be burnt and

2. a structure adjacent to and overlying said surface and combining therewith to form an enclosure for the material to be burnt;

3. said structure including side and end walls and a supporting frame;

4. a thin covering of thermal conductive, substantially nonporous and abrasion resistant glass-ceramic material mounted on the interior of said frame;

5. said glass-ceramic material having resistance to thermal shock of at least about 1,000° to 32° F. and a low coefficient of thermal expansion;

6. burner means cooperating with said structure and adapted to supply sufficient heat to the material to be burnt to cause it to ignite;

7. a blower system for supplying air to the region about the material to be burnt, said system including at least one air nozzle directed at the material to be burnt;

8. exhaust means for removing gaseous pollutants from the interior of the enclosure which result from the burning of the material therein and an air washer for treating the removed gas streams; and

9. a portion of the structure adjacent to the supporting surface spaced therefrom whereby makeup air from the atmosphere may enter the interior of the structure.

11. An incinerator as defined in claim 10 wherein the volume of gas removed from the enclosure by the exhaust means is greater than the volume of gas supplied by the blower system whereby the internal pressure within the enclosure is less than atmospheric pressure.

12. An incinerator as defined in claim 10 wherein the structure is mounted on wheels permitting said structure to be

moved relative to the supporting surface.

13. An incinerator as defined in claim 12 wherein the wheels are supported on rails adjacent to the supporting surface and said wheels and rails cooperate to define a pathway for the structure relative to the supporting surface.

14. An incinerator as defined in claim 10 and further comprising means for mounting the covering on the interior of the supporting frame, said means including heat resistant members extending through the covering and connected to the frame.

15. An incinerator as defined in claim 14 wherein the heat resistant members include metallic plates positioned on the interior side of the covering and fasteners extending through the covering and connected to the frame and a ceramic material resistant to heats of at least 1,000° F. coated on the portions of the plates exposed to the interior of the closure.

16. A method of incinerating combustible material comprising:

1. placing the material in an enclosure including a material supporting surface and thin enclosing walls of thermal conductive, substantially nonporous and abrasion-resistant glass-ceramic material;

2. exposing the material to a source of heat sufficient to cause said material to ignite;

3. supplying air to the ignited material in quantities sufficient to support continuous combustion;

4. removing a portion of the heat generated by the combustion through the glass-ceramic material;

5. recycling part of the generated heat and gases together with makeup air to constitute the principal air supply;

6. removing from the enclosure part of the generated gases and associated pollutants by gas exhaust means;

7. maintaining the interior of said enclosure at a pressure less than the surrounding atmospheric pressure.

17. A method of incinerating combustible material as defined in claim 16, and further including furnishing part of the air supply to the enclosure by means of the pressure differential between the interior of the enclosure and the surrounding atmosphere.

18. In a combustion chamber for burning material, a thin lining for said combustion chamber, said thin lining being thermal conductive, substantially nonporous and abrasion resistant glass-ceramic material, said glass-ceramic material having resistance to thermal shock of 1,000° F. to 32° F.

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