

PATENT DECLARATION FORM (CONVENTION)
COMMONWEALTH OF AUSTRALIA
Patents Act 1952
DECLARATION IN SUPPORT OF A CONVENTION APPLICATION
FOR A PATENT

In support of the Convention application made for a patent for an invention entitled: Incineration systems for the destruction of hazardous wastes

I/we Patrick A. Phillips (full name of declarant)
of 6860 NW 44th Court, Lauderhill, Florida 33319 (full address)

do solemnly and sincerely declare as follows:-

1. I/we am authorised by VESTA TECHNOLOGY LTD the applicant for the patent to make this declaration on its behalf.

2. The basic Application as defined by section 141 of the Act was made in the following country on the following date namely:-
in the United States of America on 14 July, 1987 by Patrick A Phillips

3. Patrick A Phillips
of 6860 N.W. 44th Ct., Lauderhill, Florida 33319
is the actual inventor of the invention and the facts upon which the applicant is entitled to make the application are as follows:

The Applicant is the Assignee of the said invention from the actual inventor.

4. The basic application referred to in paragraph 2 of this Declaration was the first application made in a Convention country in respect of the invention the subject of the application.

Declared at Ft. Lauderdale, Florida this 28th day of March, 1990.

To:
The Commissioner of Patents

Patrick A. Phillips
Signature of Declarant(s)

ARTHUR S. CAVE & CO.
PATENT AND TRADE MARK ATTORNEYS
SYDNEY
3014U/AJG

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INCINERATION SYSTEM FOR THE DESTRUCTION OF HAZARDOUS WASTES

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(56) Prior Art Documents
US 4718357
US 4547351

(57) Claim

1. A process for treating hazardous waste by incineration comprising the steps of:

- (a) incinerating hazardous waste in a first and in a second combustion chamber to produce a heavy solid residue, fine solids and vaporous by-products of combustion;
- (b) cooling the vaporous by-products of combustion;
- (c) cleaning the vaporous by-products so cooled by passing the cooled vaporous by-products through an atomized water spray and then deflecting the vaporous by-products down a Venturi tube into a water bath through which the vaporous by-products

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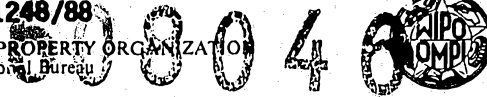
are passed and released for entry into a secondary scrubber chamber; and

- (d) releasing the vaporous by-products so cleaned into the atmosphere.

31. An apparatus for treating hazardous waste materials comprising (a) a first combustion chamber; (b) a second combustion chamber in communication with said first combustion chamber; (c) a compartment containing a system of cold water circulating coils, said compartment being in communication with said second combustion chamber; (d) a primary scrubber chamber in communication with said compartment, said primary scrubber chamber; and (e) a second scrubber in communication with said primary scrubber, said primary scrubber chamber containing a water bath at the bottom of said chamber, an inlet for receiving off-gases from said compartment positioned at the top of said chamber, a water spray positioned substantially about said inlet, deflecting means positioned so as to deflect the off-gases entering through said inlet into a Venturi tube, said Venturi tube whose upstream portion is connected with said deflecting means and whose downstream portion is immersed in said water bath, and an outlet for the off-gases so cleaned positioned substantially above said water bath, said outlet in communication with said second scrubber.

PCT

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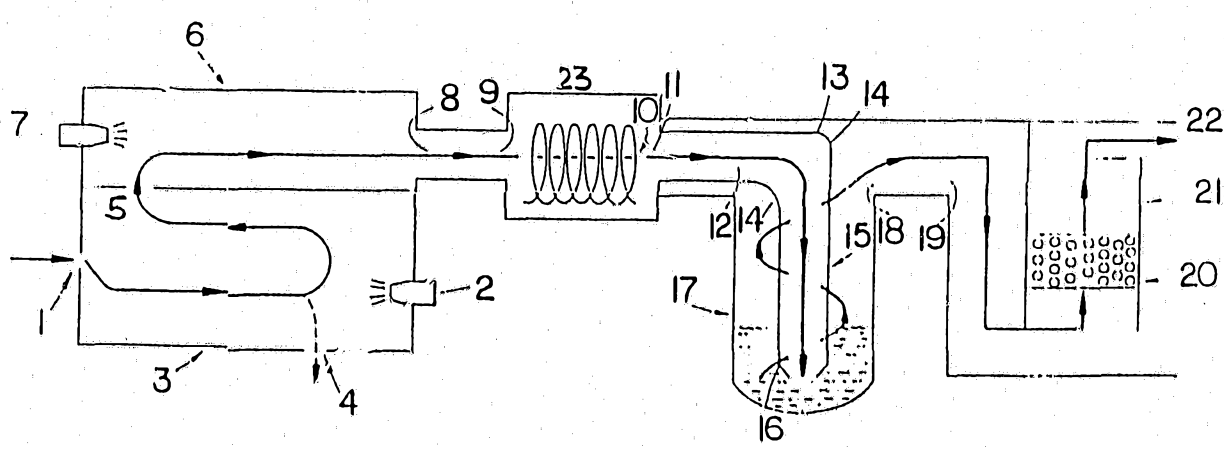
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(54) Title: INCINERATION SYSTEM FOR THE DESTRUCTION OF HAZARDOUS WASTES



(57) Abstract

A process and apparatus for the controlled incineration of hazardous wastes comprising a two stage combustion of the waste into gases. The gases are thereafter cooled and cleaned by passing through primary (17) and secondary (20) scrubbers for cleaning. The invention also concerns an apparatus for the incineration of hazardous waste. The system cleans the gases produced by the incineration process so that hazardous materials are completely incinerated and converted into environmentally safe products at the site of their production.

INCINERATION SYSTEM FOR THE DESTRUCTION OF HAZARDOUS WASTES

The present invention relates generally to the treatment of potentially hazardous waste materials, and more particularly to an improved process and apparatus for incinerating such materials.

Background of Invention

Prior to the present awareness of the hazardous nature of numerous waste materials, these materials were typically either dumped or were allowed to enter the ecosystem in other ways. Examples of such practices were the widespread dumping of wastes containing chlorinated hydrocarbons onto land or the release of toxic heavy metals, such as those produced in metal plating or metal finishing industries, into sewerage systems and hence to the sludges produced from sewage treatment or land farming. Such materials can and have entered the human food chain either through leaching by rain of the hazardous material into the underground water table or from food grown on land that has been contaminated by these substances.

Numerous attempts have been made to address such environmental problems. In the past, heavily contaminated soil or sludge was often transported to a site remote from population centers or from sources of drinking water. The

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contaminated soil or sludge was then deposited into "safe" landfills after fixation.

An attractive technical approach to the problem of disposing of hazardous waste material is offered by incineration which facilitates the conversion of chlorinated hydrocarbons into less hazardous by-products such as carbon dioxide and hydrogen chloride, or heavy metals into environmentally safe oxides. For this method to be successful, however, two requirements must be met. First, the incineration must be complete since partial oxidation of chlorinated hydrocarbons may result in the production of compounds that are more harmful than the original material. These harmful compounds may be either in the form of exhaust gases or residual ashes, or both. Second, all harmful combustion products must be removed completely from the gas stream produced by the incineration and thereafter rendered harmless.

Thus far, incineration processes have not met these two essential requirements. One problem is presented by the complexity and sensitivity of the control system required for effecting a complete combustion. Another obstacle has been the size and cost of incinerators capable of eliminating industrial quantities of waste. The size and cost of adequate scrubbing systems for cleaning the resulting gases

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are similarly daunting. Moreover, the cost efficiency of existing incineration systems is significantly reduced by the need for mechanical stirring or vibration within the scrubbing systems. Another formidable limitation is the opposition by the public toward both the location of such an incinerator in their vicinity and the transportation of hazardous wastes thereto.

As a result, incineration plants have generally been very large, costly, and, by necessity, stationary. Consequently, large quantities of hazardous waste materials have had to be carted from the waste-producing location over long distances on public roads with an obvious concomitant risk to the environment. In addition, the resistance by neighborhoods to the siting of such incinerating plants in their localities has grown to such a level as to inhibit the construction and use of this possibly beneficial technology.

Summary of the Invention

In one broad form the invention provides a process for treating hazardous waste by incineration comprising the steps of:

- (a) incinerating hazardous waste in a first and in a second combustion chamber to produce a heavy solid residue, fine solids and vaporous by-products of combustion;
- (b) cooling the vaporous by-products of combustion;



- (c) cleaning the vaporous by-products so cooled by passing the cooled vaporous by-products through an atomized water spray and then deflecting the vaporous by-products down a Venturi tube into a water bath through which the vaporous by-products are passed and released for entry into a secondary scrubber chamber; and
- (d) releasing the vaporous by-products so cleaned into the atmosphere.

In another form the invention provides a process for treating hazardous waste by incineration comprising:

- (a) incinerating the hazardous waste in a first combustion chamber to produce a heavy solid residue, fine solids and vaporous by-products of combustion;
- (b) discarding the heavy solid residue so produced from said first combustion chamber and introducing the fine solids and vaporous by-products into a second combustion chamber;
- (c) fully incinerating the fine solids and vaporous by-products in said second combustion chamber to produce off-gases;
- (d) removing the off-gases from said second combustion chamber and passing the gases over a system of cold water circulating coils so as to lower the temperature of the off-gases to at least about 1000°F;



- (e) introducing the cooled gases into a primary scrubber by passing the cooled gases through an atomized water spray;
- (f) deflecting the gases down a Venturi tube into a water bath;
- (g) passing the gases through the water bath so that they are released into said primary scrubber chamber;
- (h) introducing the released gases from said primary scrubber into a secondary scrubber;
- (i) passing the gases through said secondary scrubber so as to remove any aerosol bubbles and remove any residual materials; and
- (j) exhausting the cleaned gases.

The invention also provides an apparatus for treating hazardous waste materials comprising (a) a first combustion chamber; (b) a second combustion chamber in communication with said first combustion chamber; (c) a compartment containing a system of sold water circulating coils, said compartment being in communication with said second combustion chamber; (d) a primary scrubber in communication with said compartment, said primary scrubber comprising a Venturi tube; and (e) a second scrubber in communicatino with said primary scrubber.

Brief Description of the Drawings

To the accomplishment of the aforementioned and to such further objects as may hereinafter appear, the present invention relates to a waste material incinerator system substantially as defined in the appended claims and as



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described in the followed specification as considered with the accompanying drawing in which:

Fig. 1 is a schematic of the inventive incineration system.

Detailed Description of the Invention

In practicing the present invention, as illustrated in Fig. 1, solid or liquid forms of contaminated waste material are fed into an open end (1) of a first combustion or rotary furnace chamber (3), which is held in a horizontal, slightly inclined position. On the end of rotary furnace chamber (3) opposite open end (1), a flame or burner (2) is arranged so as to give a counter-current incineration of the feed material within combustion chamber (3). The counter-current incineration permits the lighter combustion products to pass to the upper portions of combustion chamber (3) whereas the heavier combustion products remain at the bottom of chamber (3). In this way, less waste materials travel through the system.

The heavier solid residue from this combustion event is removed at an opening (4) in rotary furnace chamber (3) whereas partially combusted fine solids and vaporous materials are carried in a gas stream in a tangential direction into a second combustion chamber (6). These

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particulate solids and vaporous materials pass from first combustion chamber (3) into second combustion chamber (6) through open end (5). Another flame or burner (7) arranged at the opposite end of second chamber (6) provides a co-current horizontal mode of combustion leading to a full incineration of the particulate and gaseous matter. The tangential approach into second combustion chamber (6) imparts a spinning motion to the gas stream carrying the combusted fine solids and vaporous materials. Thus, there is an increase in residence time within second chamber (6) without the depositing of particulate waste material in chamber (6).

The pressures and temperatures utilized in first combustion chamber (3) and second combustion chamber (6) are not critical. Generally, the temperature will be within the range of about 1400-1600°F and the pressure will be within the range of about 1-2 lbs. A temperature of about 1500°F and a pressure of about 1 lb. atmosphere are generally preferred.

Generally, the oxygen source in first combustion chamber (3) and second combustion chamber (6) will be air.

The off-gases emanating from second chamber (6) exit open end (8) of second combustion chamber (6) and enter a compartment (23) containing a system of cold water-

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circulating coils (10) through open end (9). The off-gases are first passed horizontally over cold water-circulating coils (10). The temperature of the gases is thereby lowered to about 1000°F resulting in a reduction of the volume of the gases before introduction into a primary scrubber (17). At the entrance (12) of primary scrubber (17), the cooled gases are subjected to a spray of atomized water (13) to further cool the gases and to remove any remaining heavy particulate matter. The gases are then directed by deflectors (14) down a Venturi tube (15) into a water bath (16) located at the lower end of primary scrubber compartment (17). The deflectors (14) are positioned at the end of Venturi tube (14).

Due to the initial severe angle of deflection of at least 135° from the horizontal, the gases assume a tortuous path through Venturi tube (15), and repeatedly hit the scrubbing surface. The gases then enter water bath (16) in a direction and velocity so as to produce a brisk stirring action or turbulence. Advantageously, this action is produced entirely by the change of direction of the air flow and does not require any moving mechanical parts. The pH of the resulting solution can be easily controlled by introducing suitable acids or bases into water bath (16).

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Generally, the pH of the resulting solution is within the range 6.5 - 8.5.

In the continuation of treatment, the gases or vapors released from water bath (16) pass from primary scrubber (17) to secondary scrubber (20). In one embodiment of the invention, secondary scrubber (20) may be a column packed with solids in which the solids in the column bed are coated with a film of continuously running water introduced through an aperture (21). The packing material consists of plastic irregular-shaped pieces which cannot nest or compact. This stage is to remove any aerosol bubbles produced by the turbulence in the preceding scrubbing stage. It also serves to remove any residual materials not cleaned by the previous treatment. Finally, the cleaned gases are exhausted through a chimney (22) into the atmosphere without danger or contamination.

Control of the combustion process which is essential to "clean" burning is achieved in the present invention by a reliable process in which gas temperatures are measured and controlled automatically via a microcomputer-directed feedback system that operates the air intake control valves at the location of first combustion chamber (3). Thus both incineration chambers (3) and (6) can be run at pre-determined and continually maintained temperatures. More

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specifically, the microcomputer feedback system is a continuous monitoring system comprising a sampling probe, a heat gas transport line, sampling pumps, an oxygen O₂ and carbon monoxide CO analyzer, a manually calibrated analyzer system and a data recorder. Once the combustion conditions such as temperature and pressure ranges are established, the microcomputer feedback system will monitor the operation of the incineration system under the desired treatment conditions. If operation conditions deviate from the predetermined ranges, a fail safe will be initiated.

A further aspect of the invention is the facility to remove particulate and gaseous incineration products by introducing chemicals to inactivate or bind the water soluble hazardous materials in primary scrubber system (17). Specifically, the inventive system permits the use of very reactive compounds in primary scrubber stage (17) followed by water or less reactive materials in secondary scrubber (10). Examples of these facilities are: sodium hydroxide solution present in both scrubbers to remove the hydrogen chloride produced by combustion of chlorinated hydrocarbons; and hydrazide or sodium borohydride in the first scrubber stage to chemically reduce to metal those metal oxides which are the incineration by-products from heavy metal contaminated sludges.

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The present invention provides a further advantage in that the inventive incineration system can be transported to any desired location. The incineration system of the present invention is comprised of first combustion chamber (3), second combustion (6) in communication with first combustion chamber (3), compartment (23) containing a system of cold water circulating coils (10), wherein compartment (23) is in communication with second combustion chamber (6), primary scrubber (17) in communication with compartment (23), and secondary scrubber (20) in communication with primary scrubber (17). The chambers and parts comprising the incineration system can either be transported as a unit or be assembled at the site of hazardous waste. In this way, hazardous materials can be treated and disposed of at the site of their production, thus eliminating the need for costly and dangerous transportation of such materials.

It will be appreciated that the waste incinerator system of the present invention as described hereinabove meets the objects set forth in that it is mobile and allows for the treatment of hazardous waste at the site of production. It will also be appreciated that modifications can be made in the embodiment of the invention described without departing from the spirit and scope of the invention.

The claims defining the invention are as follows:

1. A process for treating hazardous waste by incineration comprising the steps of:

- (a) incinerating hazardous waste in a first and in a second combustion chamber to produce a heavy solid residue, fine solids and vaporous by-products of combustion;
- (b) cooling the vaporous by-products of combustion;
- (c) cleaning the vaporous by-products so cooled by passing the cooled vaporous by-products through an atomized water spray and then deflecting the vaporous by-products down a Venturi tube into a water bath through which the vaporous by-products are passed and released for entry into a secondary scrubber chamber; and
- (d) releasing the vaporous by-products so cleaned into the atmosphere.

2. The method of claim 1, further comprising the step of incinerating the hazardous waste through said first combustion chamber in a counter-current direction to the hazardous waste entering said first combustion chamber.

3. The method of claim 1, further comprising the step of incinerating at least part of the combustion products of said first chamber through said second combusting chamber in a co-current direction with the combustion products entering said second combustion chamber.



4. The process of claim 1, further comprising the step of discarding the heavy solid residue so produced from said first combustion chamber and introducing the fine solids and vaporous by-product into said second combustion chamber.

5. The method of claim 4, further comprising the step of fully incinerating the fine solids and vaporous by-products in said second combustion chamber to produce off-gases.

6. The method of claim 5, further comprising the step of removing the off-gases from said second combustion chamber and passing the off-gases so removed over a system of cold water circulating coils so as to lower the temperature of the off-gases to at least about 1000°F to produce cooled gases.



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7. The method of claim 1, further comprising the step of introducing a chemical agent into said water bath to control the pH of said water bath.

8. The method of claim 7, the pH of said water bath being within the range 6.5 - 8.5.

9. The method of claim 7, the chemical agent being selected from the group consisting of sodium hydroxide, hydrazine and sodium borohydride.

10. The method of claim 1, said secondary scrubber chamber being packed with plastic irregular shaped pieces which are coated with a film of flowing water.

11. The method of claim 1, further comprising the step of controlling the incineration in said first and second combustion chambers by a temperature probe and a computer feed back system.

12. A process for treating hazardous waste by incineration comprising;

- (a) incinerating the hazardous waste in a first combustion chamber to produce a heavy solid

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residue, fine solids and vaporous by-products of combustion;

- (b) discarding the heavy solid residue so produced from said first combustion chamber and introducing the fine solids and vaporous by-products into a second combustion chamber;
- (c) fully incinerating the fine solids and vaporous by-products in said second combustion chamber to produce off-gases;
- (d) removing the off-gases from said second combustion chamber and passing the gases over a system of cold water circulating coils so as to lower the temperature of the off-gases to at least about 1000°F;
- (e) introducing the cooled gases into a primary scrubber by passing the cooled gases through an atomized water spray;
- (f) deflecting the gases down a Venturi tube into a water bath;
- (g) passing the gases through the water bath so that they are released into said primary scrubber chamber;
- (h) introducing the released gases from said primary scrubber into a secondary scrubber;

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- (i) passing the gases through said secondary scrubber so as to remove any aerosol bubbles and remove any residual materials; and
- (j) exhausting the cleaned gases.

13. The method of claim 12, further comprising the step of moving the hazardous waste through said first combustion chamber in a counter-current direction to the hazardous waste entering said first combustion chamber.

14. The method of claim 12, further comprising the step of moving the hazardous waste through said second combustion chamber in a co-current direction with the hazardous waste entering said second combustion chamber.

15. The method of claim 12, further comprising the step of introducing a chemical agent into said water bath to control the pH of said water bath.

16. The method of claim 15, the pH of said water bath being within the range 6.5 - 8.5.

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17. The method of claim 15, the chemical agent being selected from the group consisting of sodium hydroxide, hydrazine and sodium borohydride.

18. The method of claim 12, said secondary scrubber chamber being packed with plastic irregular shaped pieces which are coated with a film of flowing water.

19. The method of claim 12, further comprising the step of controlling the incineration in said first and second combustion chambers by a temperature probe and a computer feed back system.

20. An apparatus for treating hazardous waste materials comprising (a) a first combustion chamber; (b) a second combustion chamber in communication with said first combustion chamber; (c) a compartment containing a system of cold water circulating coils, said compartment being in communication with said second combustion chamber; (d) a primary scrubber in communication with said compartment, said primary scrubber comprising a Venturi tube; and (e) a second scrubber in communication with said primary scrubber.

21. The apparatus of claim 20, said primary scrubber further comprising an atomized water spray positioned intermediate the compartment and said Venturi tube.

22. The apparatus of claim 21, said primary scrubber further comprising means for deflecting gases into said Venturi tube whose upstream end is connected with said deflecting means.

23. The apparatus of claim 22, said primary scrubber further comprising a water bath located at the downstream end of said primary scrubber.

24. The apparatus of claim 20, said first combustion chamber comprising a rotary furnace in which the hazardous waste materials are incinerated to produce a heavy solid residue, fine solids and vaporous by-products of combustion.

25. The apparatus of claim 24, said rotary furnace comprising a first open end through which the hazardous waste materials are introduced into said rotary furnace, a second open end through which the heavy solid residue so



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produced is discarded, a third open end through which the fine solids and vaporous by-products pass from said first combustion chamber into said second combustion chamber and a first burner opposite said first open end.

26. The apparatus of claim 25, said first burner being arranged within said rotary furnace so as to move the waste materials through said first combustion chamber in a counter-current direction to the hazardous waste materials entering said first combustion chamber.

27. The apparatus of claim 25, said second combustion chamber comprising said third open end through which the fine solid and vaporous materials pass from said first combustion chamber into said second combustion chamber to be fully incinerated to produce off gases, a fourth open end through which the off-gases so produced are removed from said second combustion chamber to be passed over said system of cold water circulating coils and a second burner.

28. The apparatus of claim 27, said second burner being arranged within said second combustion chamber so as to move the hazardous waste materials through said second combustion chamber in a co-current direction with the

hazardous waste materials entering said second combustion chamber.

29. The apparatus of claim 20, said secondary scrubber comprising a column packed with solids that are coated with a film of continuously running water.

30. The apparatus of claim 29, said solids consisting of irregular shaped pieces of plastic.

31. An apparatus for treating hazardous waste materials comprising (a) a first combustion chamber; (b) a second combustion chamber in communication with said first combustion chamber; (c) a compartment containing a system of cold water circulating coils, said compartment being in communication with said second combustion chamber; (d) a primary scrubber chamber in communication with said compartment, said primary scrubber chamber; and (e) a second scrubber in communication with said primary scrubber, said primary scrubber chamber containing a water bath at the bottom of said chamber, an inlet for receiving off-gases from said compartment positioned at the top of said chamber, a water spray positioned substantially about said inlet, deflecting means positioned so as to deflect the off-gases entering through said inlet into a Venturi tube, said Venturi tube whose upstream portion is connected with said deflecting means and whose downstream portion is immersed in said water bath, and an outlet for the off-gases so cleaned positioned substantially above said water bath, said outlet in communication with said second scrubber.



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32. An apparatus for treating hazardous waste, substantially as herein described with reference to the drawing.

33. A method for treating hazardous waste, substantially as herein described with reference to the drawing.

DATED this 8th day of August, 1990.

VESTA TECHNOLOGY LTD
By Its Patent Attorneys
ARTHUR S. CAVE & CO.



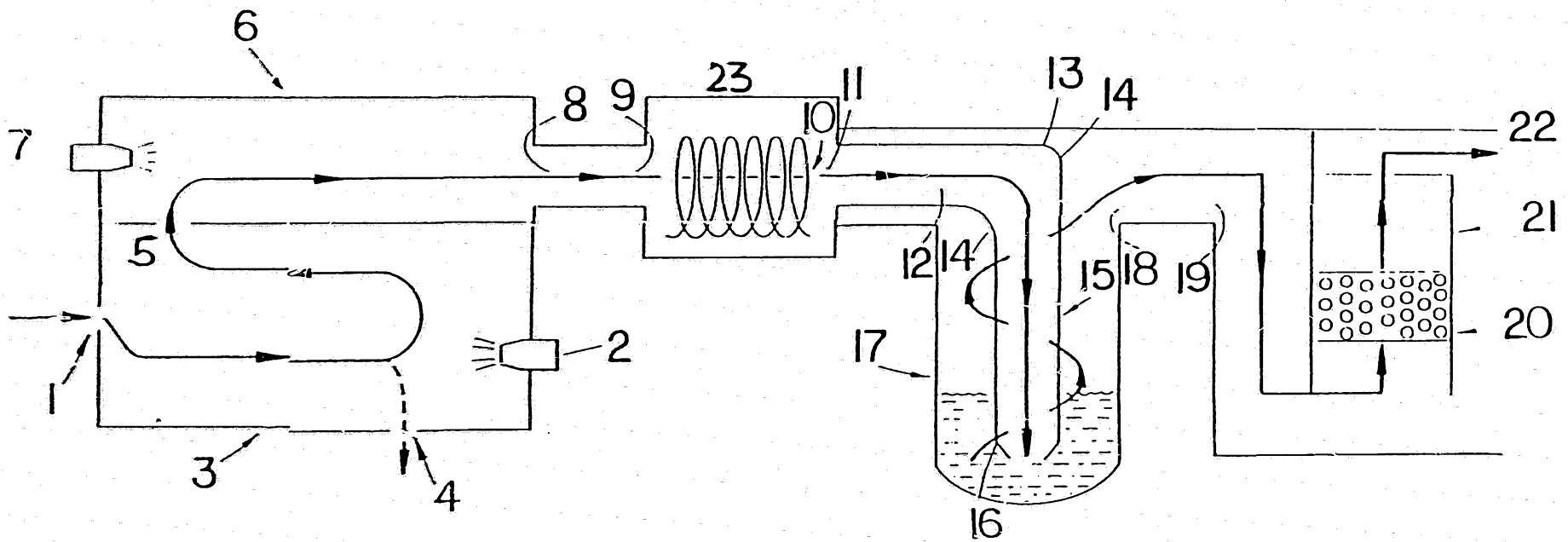


FIG. 1

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US88/02310

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC ⁴ F23D 14/00		
U.S. CL. 110/235		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
U.S. CL.	126/113	110/341, 345, 346
	110/210, 213, 215, 216, 235-237, 241, 243, 245, 246, 255, 259	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category [*]	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
Y	US, A 773,920 BOULGER 01 November 1904 (01.11.04)	1-9, 11-17, 19 20-29, 31
Y	US, A 4,547,351 IM ET AL. 15 October 1985 (15.10.85)	1-9, 11-17, 19 20-29, 31
Y, P	US, A 4,718,357 WANG ET AL 12 January 1988 (12.01.88)	1-9, 11-17, 19 20-29, 31
<p>[*] Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"Z" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search		Date of Mailing of this International Search Report
06 October 1988		05 DEC 1988
International Searching Authority		Signature of Authorized Officer
ISA/US		<i>Larry Jones</i> Larry Jones