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Katz

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[54] **TWO-STAGE INCINERATOR**

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[52] **U.S. Cl.** ..... **110/8 F**; 110/28 J

[51] **Int. Cl.** **F23g 5/12**

[58] **Field of Search** ..... 110/8 R, 8 C, 8 A, 28 J; 122/4 D; 48/209

[56] **References Cited**

UNITED STATES PATENTS

3,119,378	1/1964	Marshall	122/4
3,306,236	2/1967	Campbell	110/8
3,589,313	6/1971	Smith et al	110/8
3,680,500	8/1972	Pryor	110/8
3,702,595	11/1972	Muirhead et al.	110/28
3,759,036	9/1973	White	48/209

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Attorney, Agent, or Firm—Neuman, Williams, Anderson & Olson

[57] **ABSTRACT**

Incineration of waste products such as hydrocarbon oils or similar products which are difficult to combust is accomplished in a two-stage incinerator including a first stage vaporization zone with burner and forced air supply and a catalyst material. Communication is provided between the first stage vaporization zone and a second stage combustion zone with burner and forced air supply.

2 Claims, 2 Drawing Figures

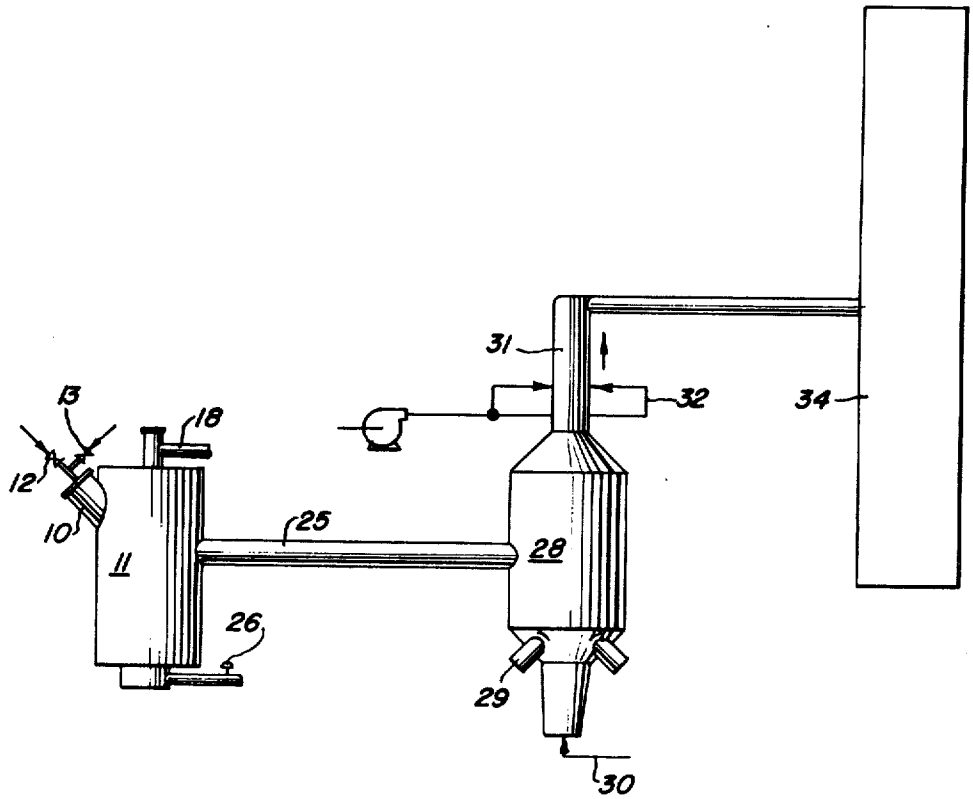


FIG. 1

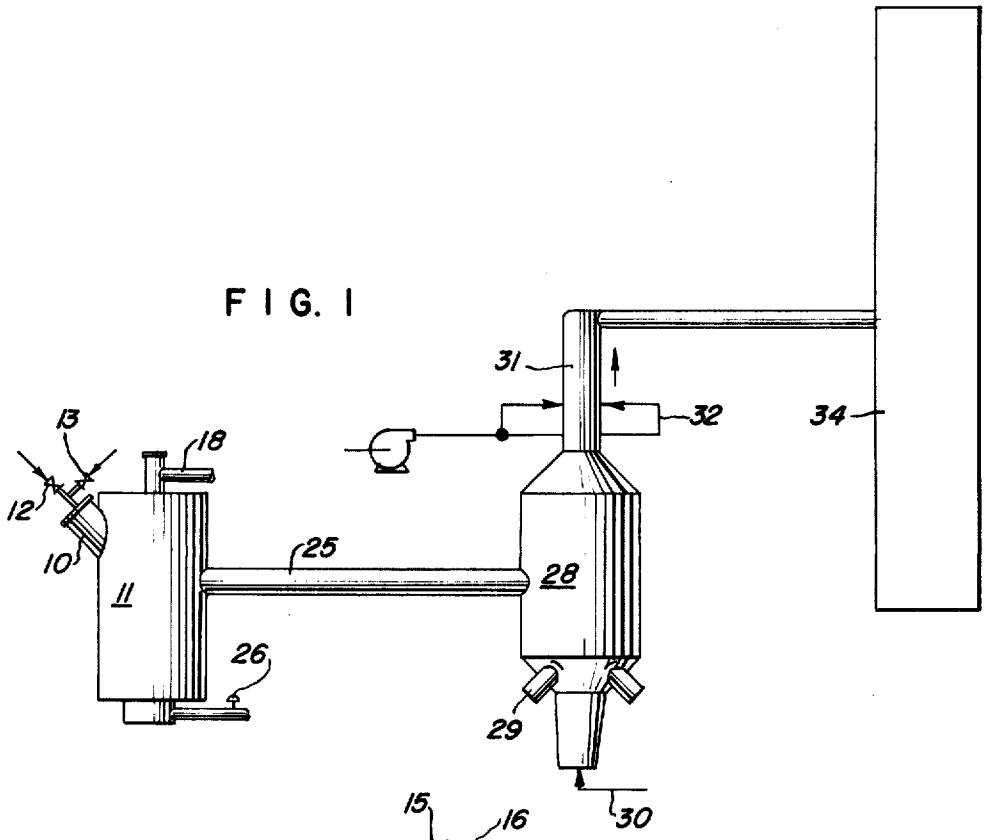
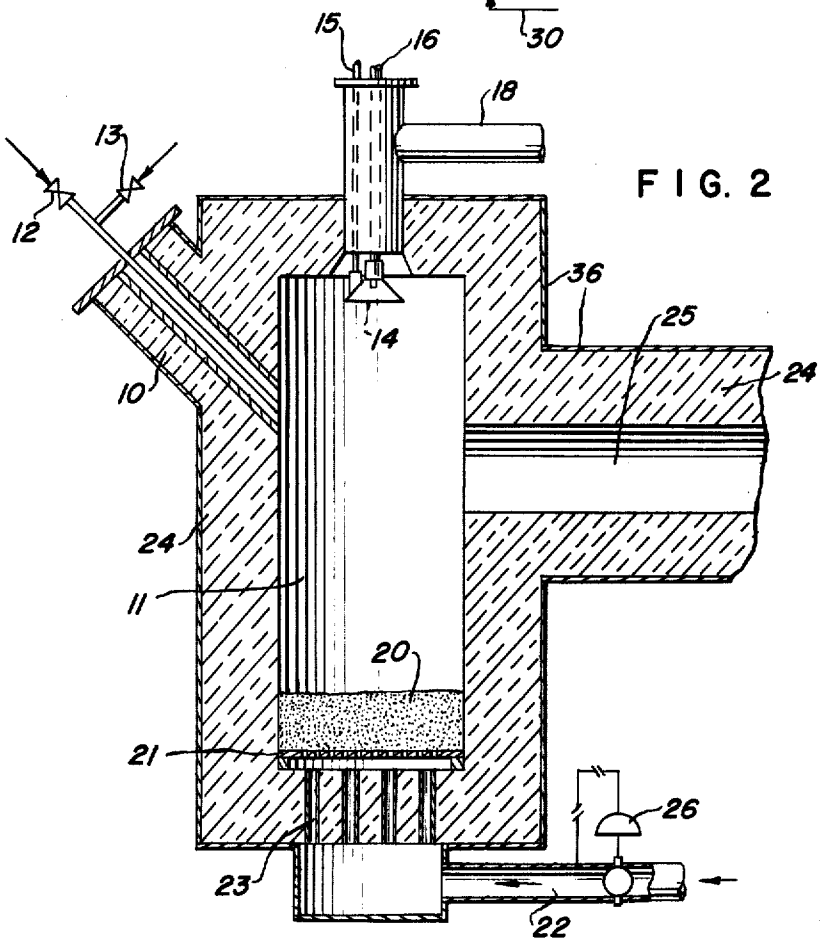

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FIG. 2


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TWO-STAGE INCINERATOR

This invention relates to improvements in the incineration of waste materials. More particularly, the invention relates to an improved method for combustion of waste materials and to an improved smokeless incinerator.

U.S. Pat. No. 3,680,500 relates to a two-stage incinerator. The first stage is a vaporization or volatilization stage achieved by directing a flame from a first burner together with forced air in a generally downward manner to the first stage and onto the upper area or surfaces of the materials to be combusted. Volatile matter is volatilized, some combustion occurs in this chamber and all gaseous products are conducted to a contiguous second stage in which further oxidation and combustion occur through the use of a second burner and a further supply of forced air. While the incinerator described in U.S. Pat. No. 3,680,500 effectively achieves incineration of various waste materials, it has now been found that even more effective incineration of materials, particularly difficultly combustible liquid waste materials, can be accomplished. Oil/water emulsions, heavy hydrocarbon oils and similar materials are hard to incinerate due to high water and carbon contents which require long residence time at high temperatures to achieve complete combustion. The improved incinerator and the incineration method of the present invention effectively accomplish substantially complete combustion of such difficulty combustible waste materials.

The improved incinerator and process of this invention will be discussed in further detail in conjunction with the drawings wherein:

FIG. 1 shows in elevation form the components of the improved incinerator.

FIG. 2 is a sectional view showing diagrammatically the construction of the first stage vaporization zone of the improved incinerator.

Thus, referring to the drawings, a waste material which is difficult to combust is introduced through chute **10** into first vaporization zone **11.** In the case of liquid waste materials, such as oil/water emulsions or hydrocarbon oils, such materials can be introduced by means of injection nozzle **12.** Similarly, atomizing air or steam can be introduced through injection nozzle **13.** In the vaporization zone **11,** the waste materials are subjected to a high rate input of fuel from burner **14.** Fuel is directed to a pilot light on burner **14** through line **15** with the main supply of fuel to the burner being fed through line **16.** The fuel, which can be any conventional fuel such as gas, fuel oil or the like, is mixed with air or other oxygen-containing gas which is introduced through conduit **18.** The combustion gas introduced through conduit **18** is generally, though not necessarily, over and above that necessary for simple combustion of the fuel supply to the burner **14.** The forced air supplied through **18** may provide at least partial combustion in the first stage vaporization zone **11,** but primarily the purpose of the first stage vaporization zone **11** is to provide a zone of high rate heat input so as to vaporize readily vaporizable components in the waste material to be consumed. The burner **14** is illustratively posed with a generally vertically-directed combustion thrust downwardly toward and onto the waste material which is introduced through chute **10** at a point below

the burner. A plurality of burners **14** can be employed in the upper portion of vaporization zone **11.**

The heavy components in the waste material which are not readily vaporized in zone **11** fall downwardly through vaporization zone **11** and eventually admix with a pelleted catalyst material **20** which is supported on perforated plate or screen **21.** A gas such as air is introduced through conduit **22,** controlled by pressure control valve **26,** passed upwardly through air tubes **23** and through perforated plate **21** to at least partially fluidize the catalyst particles **20.** The heavy waste material which accumulates in the catalyst bed **20** is partially burned with the underfire air, and also, in the case of heavier hydrocarbons, it is cracked into lighter, more vaporizable components. The catalyst **20** can be any suitable catalyst known to be useful for cracking hydrocarbons. Representative catalysts are activated clay, synthetic gels, such as silica-alumina, silica-zirconia, alumina-boria, silica-magnesia, and particularly the natural and synthetic zeolite materials, more particularly the synthetic materials commonly termed molecular sieves, all well known in the cracking art. The catalyst may be in the form of pellets, wafers, cylinders and the like. Particle size of the catalyst is not critical and can range from about 1/32 inch diameter to ⅜ inch diameter, or larger, preferably 1/16 inch to ¼ inch diameter if pellets are used. Corresponding sizes of other catalyst particle shapes may be used. All gaseous products, including products of combustion of the fuel, excess air, vaporized waste and any products of partial combustion in the first vaporization zone **11** form a gaseous stream which is conducted by confined conduit **25** to the second stage **28** combustion zone wherein primary oxidative combustion takes place.

In the second stage combustion zone **28,** fuel is admitted to burner means **29** together with additional and preferably preheated forced air or oxygen-containing gas introduced through line **30.** This forced air is considerably in excess of that necessary for combustion purposes. One or more burners **29** can be utilized, two such being shown in the drawing. All vaporized, oxidizable components received in the second stage combustion zone **28** are fully combusted therein, that is, oxidized as fully as possible, and exit from the combustion zone through conduit **31.** The second stage combustion zone **28** is preferably equipped near its outlet with quench air inlet means **32,** single or multiple, so that the temperature of the hot gases is sharply reduced by mixing with relatively large quantities of relatively cool ambient air. The temperature reduction can be controlled within a wide range, depending on relative temperatures and volumes of the hot gases and the quench air. The final exit gases are essentially smokeless and exit the system through stack **34.**

A highly refractory protective lining designated by numeral **24** is placed within each of the zones **11** and **28** and the closed conduit **25** between said zones, and to the extent necessary within exit line **31** and stack means **34.** The employment of quench air at the exit of the second stage combustion zone **28** radically cools the exiting gases to a degree more compatible for simpler disposal and reduces quite sharply the insulative requirements of the stack means **34.**

The temperature reached or maintained in the first vaporization zone **11** and the second combustion zone **28** will depend upon the materials to be combusted and can reach elevated temperatures of 1,500° to 2,400° F.

or more in the first stage vaporization zone and equivalently even higher in the second stage oxidative combustion zone. The respective temperatures in the first stage and the second stage can be regulated by the respective degree or extent of fuel or air introduced to each burner therein and for fluidizing purposes. More easily volatilized components or materials in the first stage vaporization zone containing the cracking catalyst can be volatilized at lower temperatures, with primary combustion then controlled to occur in the second stage oxidative combustion zone. More difficulty volatilizable materials, of course, may require even higher temperatures in the first stage vaporization zone.

It presently appears to be preferable to operate with a volume ratio of first zone to second zone of approximately 1:3. A volume ratio of about 1:2.5 may be considered as being a preferred minimum, 1:3 as being more preferred, and the ratio may extend upwardly to as much as 1:6 where additional volume in the second stage and stack are desired or when required by legal restrictions concerning stack sizes and heights.

The improved incinerator and method of this invention are particularly adapted for incineration of heavy hydrocarbon oils and oil/water emulsions which are ordinarily resistant to combustion. The presence of the cracking catalyst in the first vaporization zone causes cracking of the heavy components which accumulate therein to form more easily vaporizable materials. Because of this, less auxiliary fuel, shorter residence times and lower temperatures are required in vaporization zone **11**.

Any residue remaining on top of or intermingled with the catalyst can be periodically removed by providing access thereto. The cracking catalyst can be periodically regenerated by stopping the introduction of waste material into zone **11** and permitting upwardly flowing air to contact the catalyst.

The exterior casing of elements **10, 11, 25** and **28** is metal represented by numeral **36.**

The burners useful in the first and second stages of the incinerator of this invention can be any suitable high combustion rate burners. Where disposal of waste gases additionally is desired, that is, in addition to or in conjunction with the aforedescribed liquid wastes, specialized burners such as described in U.S. Pat. No. 2,753,925, Campbell et al., are useful in that while my incinerator incinerates liquid wastes, such burners incinerate the waste gases.

Those modifications and equivalents which fall within the spirit of the invention are to be considered a part thereof.

What is claimed is:

1. A two-stage contiguous incinerator comprising:

a. a first stage comprising a vaporization zone, at least one first burner, at least one forced air supply, inlet for waste materials, outlet for gaseous products,

b. a bed of catalyst within said vaporization zone,

c. a second stage comprising a combustion zone, at least one second burner, at least one second forced air supply, entrance for receiving gaseous products from said first stage, outlet for combusted gaseous products from said second stage,

d. connecting conduit for conducting vaporous products from said first stage to said second stage by confined means.

2. A method of incinerating waste products comprising the steps of:

a. vaporizing vaporizable components of said waste products in a first stage zone in the presence of a fluidized bed of cracking catalyst,

b. conducting said vaporized components from said step (a) by confined means to a second stage,

c. oxidatively combusting said vaporized components in said second stage in the presence of excess oxygen at an elevated temperature, and

d. exhausting the products of oxidative combustion from said step (c) to the atmosphere.

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