May 29, 1973 P. H. STIBBE 3,736,103

INCINERATOR COMBUSTION APPARATUS

Filed Sept. 20, 1971 3 Sheets-Sheet 1

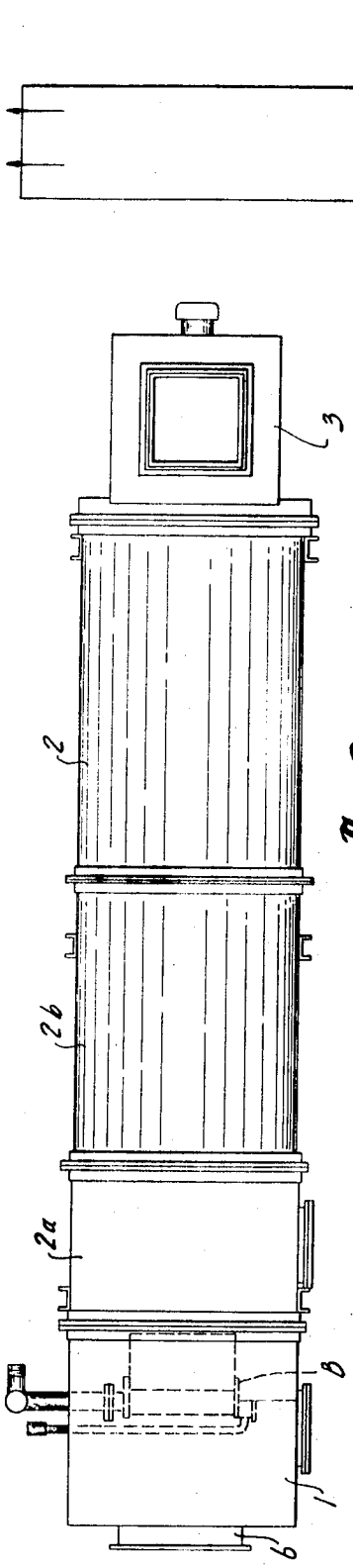


Fig. 2

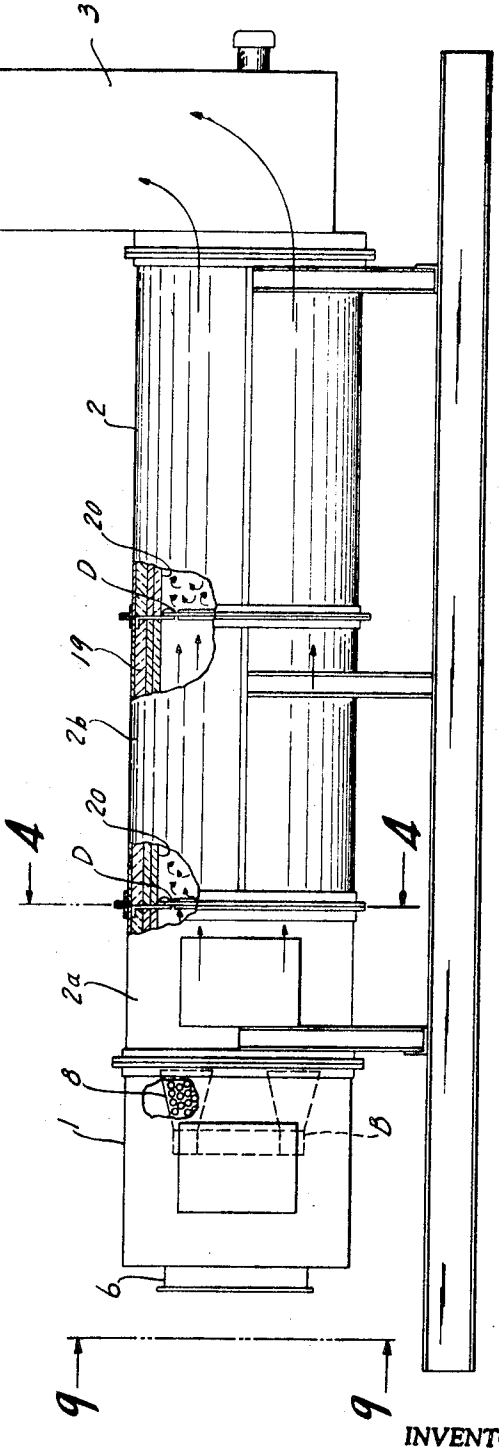


Fig. 1

INVENTOR.

PAUL H. STIBBE

BY James E. Nibbe

ATTORNEY

May 29, 1973 P. H. STIBBE 3,736,103

INCINERATOR COMBUSTION APPARATUS

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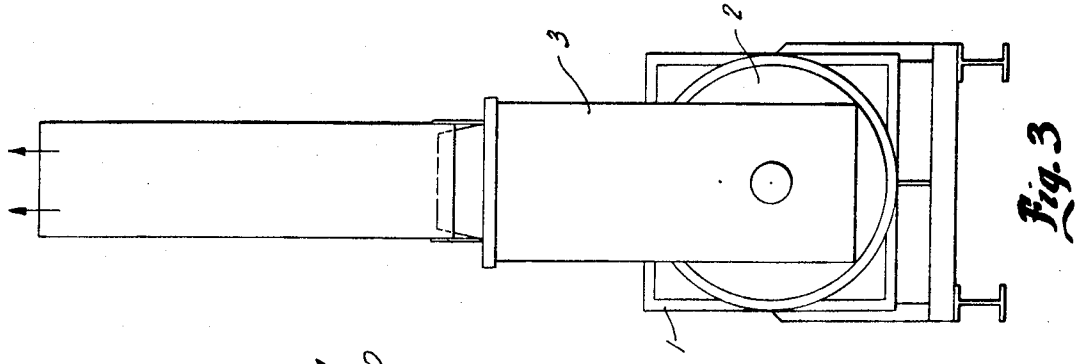


Fig. 3

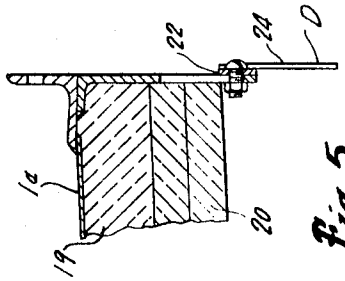


Fig. 5

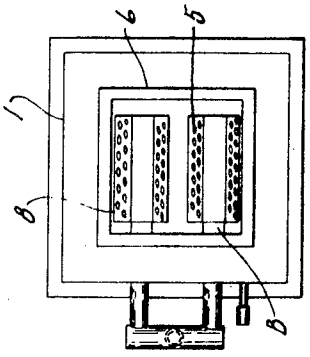


Fig. 9

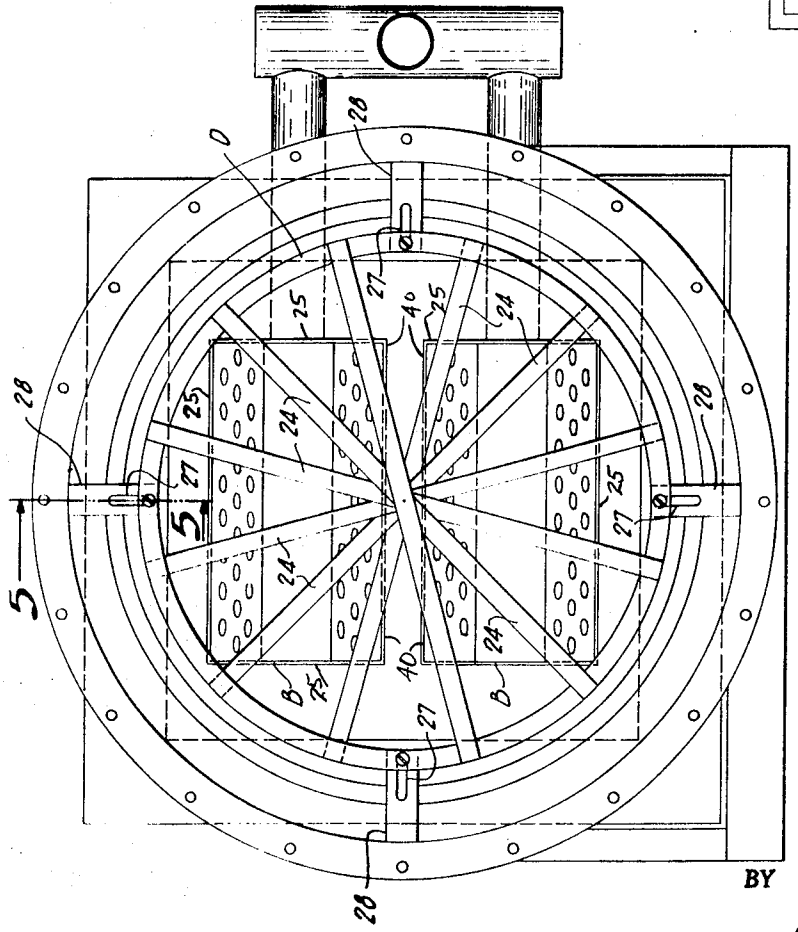


Fig. 4

INVENTOR.
PAUL H. STIBBE
BY
James E. Nilles
ATTORNEY

May 29, 1973 P. H. STIBBE 3,736,103

INCINERATOR COMBUSTION APPARATUS

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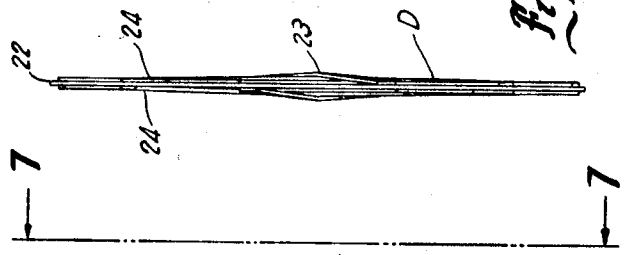


Fig. 7

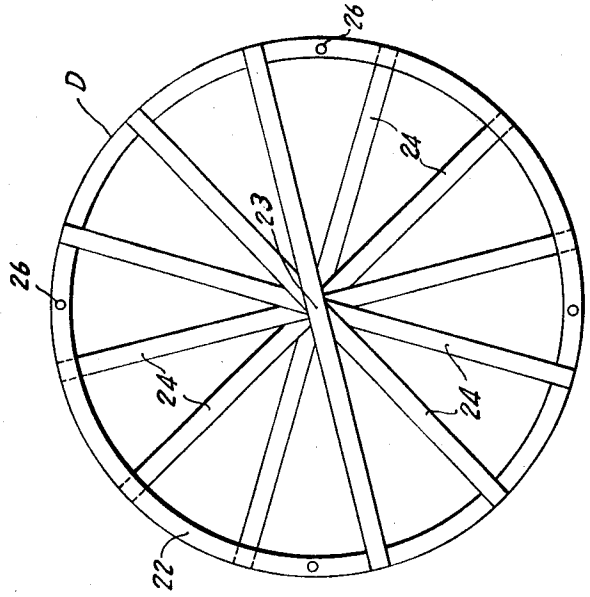


Fig. 6

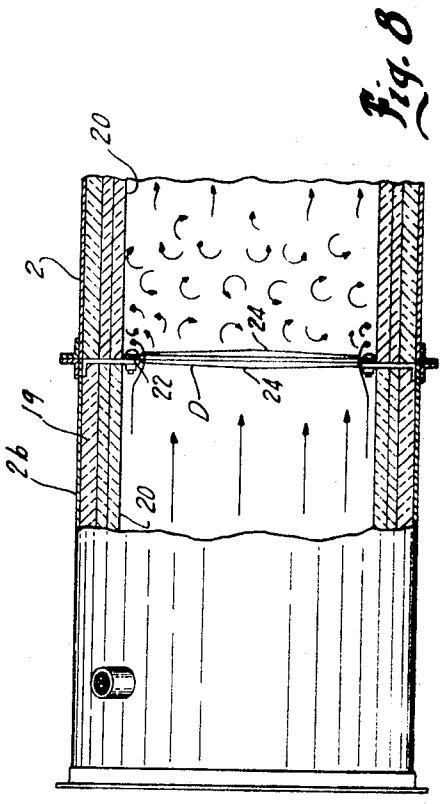


Fig. 8

INVENTOR.

BY PAUL H. STIBBE

James E. Nilles

ATTORNEY

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3,736,103

INCINERATOR COMBUSTION APPARATUS

Paul H. Stibbe, De Pere, Wis., assignor to TEC Systems, Inc., De Pere, Wis.

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Int. Cl. F23g 7/06
U.S. Cl. 23—277 C 4 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for incinerating gaseous waste material, for example, the combustible portions of the effluents from various industrial equipment such as wire enameling ovens, metal coating ovens, paint ovens, web dryers or the like. The apparatus includes a diffusor for the combustible chamber and which acts to create turbulence and flow disturbance to the gaseous material as it proceeds through the combustion chamber, thereby promoting effluent mixing for complete combustion.

BACKGROUND OF THE INVENTION

Industrial fume incinerating apparatus has been used with some success in incinerating the combustible portions of the effluents which are discharged from the various dryers, or other industrial equipment. Some of these prior devices utilized direct gas fired incinerating for attempting to combust the waste products. The three primary variables that control the thermal oxidizing process when incinerating combustible gaseous waste are the degree of turbulence of the gaseous material, the temperature at which the incinerating takes place, and the time during which the gas is subjected to the incinerating process.

Various devices have heretofore been proposed to increase the amount of turbulence of the gaseous material in the combustion chamber and thereby attempt to maintain the incineration temperatures as low as possible, restrict the time required for such incineration to a minimum, and thus increase the overall efficiency of the entire unit. These various prior art turbulence creating devices have not proved to be entirely satisfactory however, for example due to their inability to break up the boundary layer of air adjacent the interior surface of the combustion chamber. It has also been difficult to create the necessary degree of high turbulence in other cross sectional areas of the flow path of the gaseous material. Furthermore, due to burner configuration, it has also been difficult to create a uniform distribution, that is good symmetry of flow, across the cross sectional area of the chamber.

Prior art direct gas fired burners of the type contemplated for use with the present invention are shown and described in the U.S. Pat. Nos. Re. 25,626, issued July 28, 1964 to Yeo et al. and entitled "Air-Heating Gas Burner"; 3,178,161, issued Apr. 13, 1965 to Yeo et al. and entitled "Air Heating Gas Burner"; and 3,297,259 issued Jan. 10, 1967 to Maxon, Jr., et al., and entitled "Air Heating Gas Burner."

SUMMARY OF THE INVENTION

The present invention provides incinerator combustion apparatus for waste effluents and which apparatus includes a combustion chamber into which the waste gas is introduced, more particularly introduced through gas fired burners or the like. More specifically, the present invention provides such a combustion chamber in which a gas diffusor is located and which serves to break up the boundary layer of air that lies closely adjacent the interior wall of the chamber and thereby creates a region of high turbulence which promotes good mixture of effluents for combustion.

A more specific aspect of the present invention relates to such a diffusor which is used in a chamber of generally circular cross section, and which diffusor creates a circumferential wake flow region of high turbulence. The diffusor furthermore includes radially spaced strips which function to provide a multiplicity of wake flow regions of high turbulence that create excellent mixing and efficient incineration of hydrocarbons, carbon monoxide, and odor producing compounds. These strips also function to form a center target area that acts as an efficient flow distributor and re-establishes symmetrical flow with the desired high degree of turbulence after the gaseous material leaves the burners. In this manner, the radially spaced strips assure that the gas mixes efficiently with the burner heated air for complete combustion of the effluents.

Other objects and advantages will appear hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of apparatus embodying the present invention, certain parts being shown in section or broken away for the sake of clarity;

FIG. 2 is a plan view of the apparatus shown in FIG. 1;

FIG. 3 is an end elevational view of the device shown in FIG. 1;

FIG. 4 is a sectional view taken generally along the line 4—4 in FIG. 1, but on an enlarged scale;

FIG. 5 is an enlarged, fragmentary sectional view taken along the line 5—5 in FIG. 4;

FIG. 6 is a transverse view of a diffusor used with the present invention;

FIG. 7 is a view taken generally along the line 6—6 in FIG. 5;

FIG. 8 is an enlarged, longitudinal view, partially in section, of a portion of the combustion chamber shown in FIG. 1;

FIG. 9 is an end view of the inlet end of the apparatus, the view being taken along line 9—9 in FIG. 1.

DESCRIPTION OF A PREFERRED EMBODIMENT

The incinerator combustion apparatus provided by the present invention includes a burner section 1, an elongated combustion chamber 2, and a discharge section 3 through which the gaseous material flows in that order, as indicated by the arrows in FIG. 1.

More specifically, the burner section is rectangular in cross section and includes an inlet conduit 6 at its end which receives the exhaust air from a web dryer or the like (not shown). The present invention finds utility with incinerating effluents from various industrial equipment such as wire enameling ovens, coating ovens, dryers, or various other types of industrial equipment which discharge polluted air or other gaseous material. In any event, the exhaust material enters the burner section 1 and passes through perforated plates 5 and is then heated by the flames which issue from the perforated burner surfaces 8 of the burners B.

The burners, the perforated plates, and the adjustable profile plates 10 are all conventional and are shown and described in said U.S. Pats. Re. 25,626; 3,178,161; and

3,297,259. It is believed sufficient to say that the burners heat the incoming exhaust gas to the desired temperature. The amount of heat supplied is of course, variable, but for maximum efficiency, it is desired to utilize the smallest amount of heat possible, consistent with complete combustion of the effluents.

As the heated mixture discharges from the burner section it passes through combustion chamber 2*a* which is square-to-round in cross section and then passes through the round cross section combustion chamber 2*b*. Chamber 2 is of such a volume that the mixture is located in the incinerating combustion chamber for a predetermined length of time sufficient to incinerate the waste material. After the material has been burned, the clean air is discharged from the stack section 3.

By way of example, in connection with the temperatures involved, the exhaust air from a dryer (not shown) as it enters the inlet of the burner section may be in the neighborhood of 300 to 500 degrees, and the temperature of the clean air as it is discharged from the discharge section may be in the neighborhood of 1100 to 1300 degrees.

A gas diffusor is located within the combustion chamber and for the purposes of illustration, two of these diffusors D have been shown as axially spaced in the chamber.

The combustion chamber section 2 is lined with insulating material 19 and defines an effective interior circular wall 20 of the combustion chamber.

As shown in FIGS. 6 and 8, the diffusors include an outer member in the form of a ring 22 which closely fits the interior wall 20 of the combustion chamber. The radial width of the ring can be on the order of one inch, which dimension has proved to be effective in operation.

The diffusor also includes a plurality of strips which extend into the cross sectional area of the chamber, such as the radially extending strips 24 which have a flat surface (FIGS. 6 and 7) and which strips overlap one another at the center 23 of the diffusor. These strips may be on the order of one inch in width and, in general, the percentage of open area through the diffusor and through which gaseous material passes is, for example in the nature of 60 percent of the total cross sectional area defined by the inner surface 20 of the combustion chamber. This percentage of course may vary but the amount desired has proven to be particularly effective.

The diffusor increases the turbulence of the gaseous material which in turn results in the ability to use lower firing temperatures and a shorter time during which the material is in the combustion chamber. The circumferential ring 22 acts to skim the air from the wall as it passes through the combustion chamber, that is to say, it provides a flow disturbance (see FIG. 8) to all the combustion chamber boundary layer air and in particular to the regions closely adjacent the interior chamber wall. This area adjacent the interior chamber wall is frequently referred to as a laminar sublayer and the circular ring or skimmer creates a circular wake flow region of high turbulence which creates effluent flow mixture for complete combustion. Thus the diffusor ring 22 promotes turbulence and assures immediate mixing of the perimeter profiled effluent air.

The previously mentioned burners are so constructed that some of the air enters the combustion chamber through the profile slots 25 (FIG. 4). The majority of the total profile slot area is located adjacent the interior wall of the combustion chamber, that is around the perimeter of the combustion chamber.

It will be noted that one of the diffusors D is located closely adjacent the end of the combustion chamber adjacent the burner.

The diffusors have a series of holes 26 which are aligned with slots 27 in the clips 28 that are fixed to and extend inwardly from the combustion chamber,

The radially spaced strips 24 of the diffusors act to provide a series of wake flow regions of high turbulence throughout the cross sectional area of the combustion chamber creating excellent mixing and efficient incineration of combustible products such as hydrocarbons, carbon monoxide and other odor producing compounds. Furthermore, the strips provide a center target area with radial spokes and the construction becomes an efficient flow distributor. In other words, most burner configurations do not provide good symmetry of flow within a combustion chamber and the present diffusor construction re-establishes symmetrical flow with a desired high turbulence. Burner configurations also having profiling slots 40 (FIG. 4) in the center areas of the assemblies and the center target area of the present diffusor assures that this air will also mix efficiently with the burner heat air for complete combustion of the effluent.

RESUME

The present invention provides a combustion chamber of an incinerator which has diffusors which act to break up the boundary layer of the air in the combustion chamber and also act to create a high degree of turbulence throughout the entire cross sectional area of the chamber and provide a uniform distribution or flow path of air through the chamber. The result is the ability to hold the temperature of the units to a minimum, maintain the resident time required in the combustion chamber to a minimum, and results in complete combustion of the effluent material.

I claim:

1. Incinerating combustion apparatus for exhaust gas to be treated and comprising, a burner section, a combustion chamber in communication with said burner section, and a discharge section in communication with said combustion chamber, said burner section having an inlet for receiving exhaust gas to be treated, heat supplying means in said burner section for heating said exhaust gas and forcing said gas into said combustion chamber through which said heated exhaust gas passes for incineration in said chamber, and diffusor means located in said combustion chamber and including an outer member located closely adjacent the interior wall of said chamber and for breaking up the flow of boundary layer air along said interior wall of the chamber, said diffusor also having a plurality of centrally inwardly extending the flat strips in the same general transverse plane as said outer member and extending into the cross sectional area of the chamber and crossing one another in the center of said chamber to form a central target area that acts as an efficient flow distributor, whereby said diffusor means provides a multiplicity of high turbulence flow regions in the chamber.

2. The apparatus as set forth in claim 1 further characterized in that the percentage of open area through the diffusor is in the nature of 60 percent of the total cross sectional area defined by the chamber.

3. Incinerating combustion apparatus for polluted gas to be treated and comprising an inlet section for receiving said gas, heat supplying means in said section for heating said exhaust gas, a combustion chamber through which said heated exhaust gas passes for incineration therein, said chamber being generally circular in cross section, and diffusor means located in said combustion chamber and including a ring located closely adjacent the interior wall of said chamber and for breaking up the flow of boundary layer air along said interior wall of the chamber, said diffusor also having a plurality of flat strips extending radially across the cross sectional area of the chamber to thereby provide a multiplicity of high turbulence flow regions in the chamber, said strips being generally in the same transverse plane as said ring and crossing one another in the cross sectional center of said combustion

chamber and thereby forming a center target in said chamber for distributing the flow in said chamber.

4. The apparatus as set forth in claim 3 further characterized in that the percentage of open area through the diffusor is in the nature of 60 percent of the total cross sectional area defined by the chamber.

References Cited

UNITED STATES PATENTS

1,022,436	4/1912	Mireau.	
3,120,430	2/1964	Voelker.	
3,350,878	11/1967	Lambert	23—277 C
1,015,720	1/1912	Washburn	23—277 R X
3,607,120	9/1971	Nesbitt	110—8 A X
3,608,278	9/1971	Greenspan	110—18 A X
2,817,690	12/1957	Lobo	23—277 R X
3,006,738	10/1961	Wagner	23—277 R X
3,145,076	8/1964	Reichert et al.	23—277 R X

MORRIS O. WOLK, Primary Examiner

D. G. MILLMAN, Assistant Examiner

U.S. Cl. X.R.

110—97 R; 431—354