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SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO



No. 07-047091- -00003-0000

Fecha: 2008-07-17 14:38:51 Dep. 2020 NUECREACION
Tra. 11 PATENTEIYII Eve: 378 FASENACIONALI
Act. 538 PETICION Folios: 4

RADICACION 07.047.091
TRAMITE 011
EVENTO 379
ACTUACION 430
Con Anexos

**Ref: Expediente No 07.047.091 Solicitud de Registro de Patente de Invención
“DISPOSITIVO Y METODO PARA CONTROL DE TEMPERATURA DE
SOBRECALENTAMIENTO DE CALDERA” a nombre de la sociedad JUPITER
OXYGEN CORPORATION**

EL suscrito vecino de Bogotá D. C., abogado titulado, identificado como aparece al pie de mi firma, actuando como apoderado en este asunto, de acuerdo con lo establecido en el artículo 44 de la Decisión 486, para poder continuar con el trámite de la solicitud en referencia luego de la publicación en la Gazeta No 587, me permito adjuntar los comprobantes de pago Nos 08-56,712 del 16 de julio de 2008, 08-54,743 del 9 de julio de 2008 y 08-56,713 del 16 de julio de 2008, correspondiente a los derechos de la solicitud de examen de patentabilidad de la invención en referencia por la suma de \$ 420.000.oo.

Agradezco se agregue este escrito al expediente de la referencia, para que se continúe con su tramitación normal.

De la señora Jefe

Fernando Pérez Caballero
C.C. 17.173.340
T.P. 18.531

Bogotá, D.C. 17 de Julio 2008

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SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

NIT : 900176089-2

RECIBO OFICIAL DE CAJA : 08 - 55,712
FECHA : JULIO 16 DE 2008

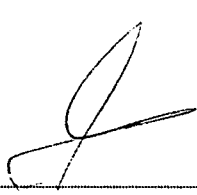
***** CONSIGNACION *****

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	No. PAGO	FECHA PGO	Vr. PAGO
JOSE J. PEREZ	CONSIGNACION	BANCO DE BOGOTA	062754387	81173783	16/07/2008	806,000.00

***** CONCEPTO *****

CANT.	RENTISTICO	CONCEPTO	TOTAL CONCEPTO
1	50005-01-06	REGISTRO DE CESION, CAMBIO NOM	13 NOMBRES Y ENSENAS COMERCIALES, MAR
			TOTAL : \$ 253,000.00

SON: DOSCIENTOS CINCUENTA Y TRES MIL PESOS

RESPONSABLE : 

RECIBO DE CAJA APLICADO AL EXPEDIENTE No. _____

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO



No. 07-047091- -00003-0000

Fecha: 2008-07-17 14:38:51 Dep. 2020 NUECREACIONE
Tra. 11 PATENTEIYII Eve: 378 FASENACIONALI
Act. 538 PETICION Folios: 4

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

NIT : 900176089-2

CERTIFICACION DE EXCEDENTE : 08 - 54,743
FECHA : JULIO 9 DE 2008

***** CONSIGNACION *****

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CONSUELO ZARAMA	CONSIGNACION	BANCO DE BOGOTA	062754387	918116	09/07/2008	923,000.00

***** CONCEPTO *****

ANT. RENTISTICO	CONCEPTO	TOTAL CONCEPTO
1 50005-01-09 OTROS SERVICIOS DE PROPIEDAD I	99 OTROS SERVICIOS ADMINISTRATIVOS	120,000.00
	TOTAL :	\$ 120,000.00

MON: CIENTO VEINTE MIL PESOS

RESPONSABLE : _____

RECIBO DE CAJA APLICADO AL EXPEDIENTE No. _____

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SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO



No. 07-047091- -00003-0000

Fecha: 2008-07-17 14:38:51 Dep. 2020 NUECREACION
Tra. 11 PATENTEIYII Eve: 378 FASENACIONALI
Act. 538 PETICION Folios: 4

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

NIT : 800176089-2

CERTIFICACION DE EXCEDENTE : 08 - 56,713
FECHA : JULIO 16 DE 2008

***** CONSIGNACION *****

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	No. PAGO	FECHA PGO	Vr. PAGO
JOSE J. PEREZ	CONSIGNACION	BANCO DE BOGOTA	062754387	81173783	16/07/2008	806,000.00

***** CONCEPTO *****

CANT.	RENTISTICO	CONCEPTO	TOTAL CONCEPTO
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			47,000.00
		TOTAL :	\$ 47,000.00

SON: CUARENTA Y SIETE MIL PESOS

RESPONSABLE : _____

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NO



US005078064A

United States Patent [19]

Breen et al.

[11] Patent Number: 5,078,064

[45] Date of Patent: Jan. 7, 1992

[54] APPARATUS AND METHOD OF LOWERING NOX EMISSIONS USING DIFFUSION PROCESSES

[75] Inventors: Bernard P. Breen; Steven E. Winberg, both of Pittsburgh, Pa.; James E. Gabrielson, Plymouth, Minn.; James C. McMichael, Monroeville, Pa.

[73] Assignee: Consolidated Natural Gas Service Company, Inc., Pittsburgh, Pa.

[21] Appl. No.: 623,782

[22] Filed: Dec. 7, 1990

[51] Int. Cl.⁵ F23B 5/00; F23C 9/00; F23G 7/06

[52] U.S. Cl. 110/212; 110/345; 422/182; 422/183

[58] Field of Search 110/212, 213, 214, 345, 110/344, 342; 422/182, 183

[56] References Cited

U.S. PATENT DOCUMENTS

4,368,677 1/1983 Kline 110/212
4,597,342 7/1986 Green 110/347

4,779,545 10/1988 Breen et al. 110/212
4,790,743 12/1988 Leikert et al. 431/8
4,974,530 12/1990 Lyon 110/212 X

OTHER PUBLICATIONS

European Patent Application No. 0 280 568 to Masai.

Primary Examiner—Edward G. Favors

Attorney, Agent, or Firm—Buchanan Ingersoll

[57] ABSTRACT

An apparatus and method for reducing nitrogen oxide emissions from furnace flue gas is provided in which natural gas or other fluid fuel which has little or no fixed nitrogen is introduced into the upper portion of the furnace. The fuel diffuses by laminar or turbulent diffusion into oxygen-rich flue gas where it reacts with oxygen and nitric oxide to form CO₂, H₂O and N₂, thus reducing the nitrogen oxide emissions from the furnace. In this manner, the amount of nitrogen oxide in the flue gas is reduced. The apparatus and method can be easily applied to new furnaces or retrofitted on existing furnaces.

40 Claims, 3 Drawing Sheets

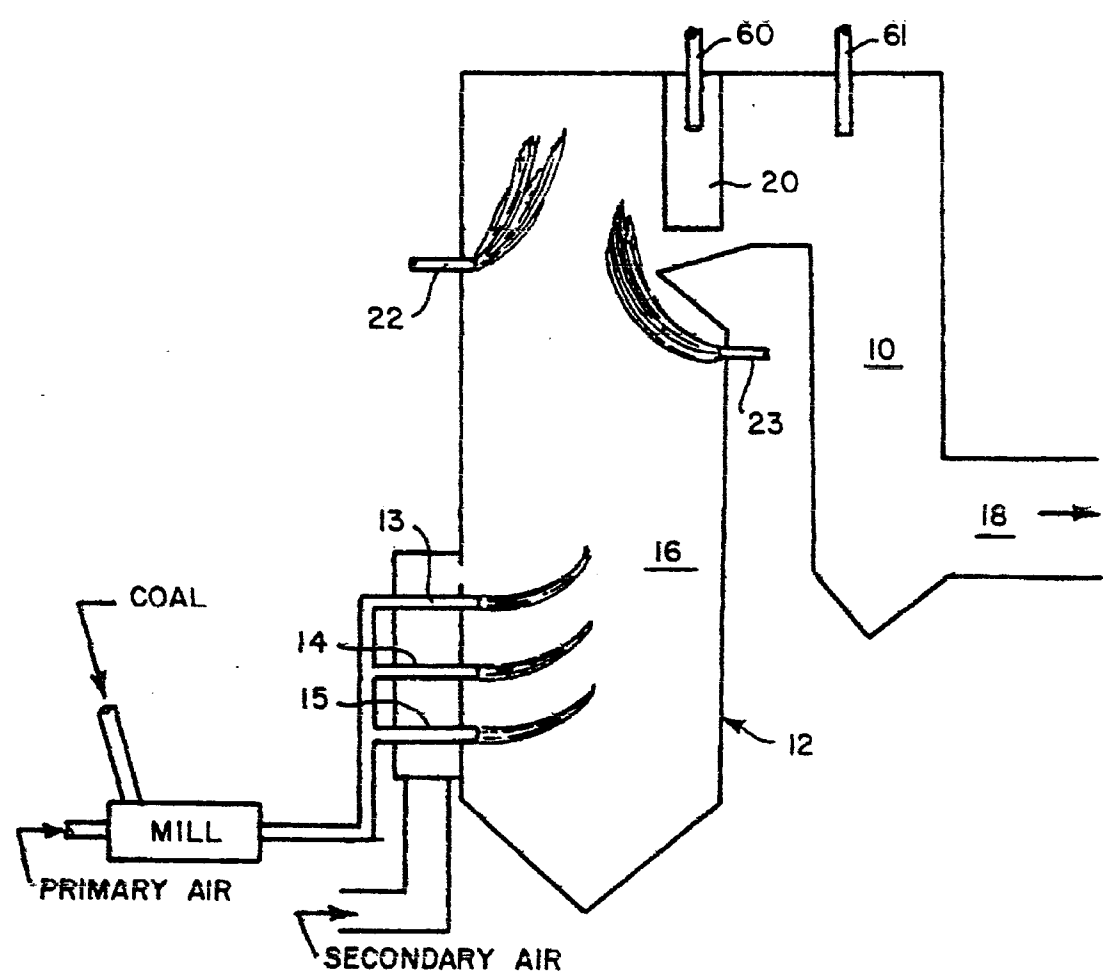


Fig. 1.

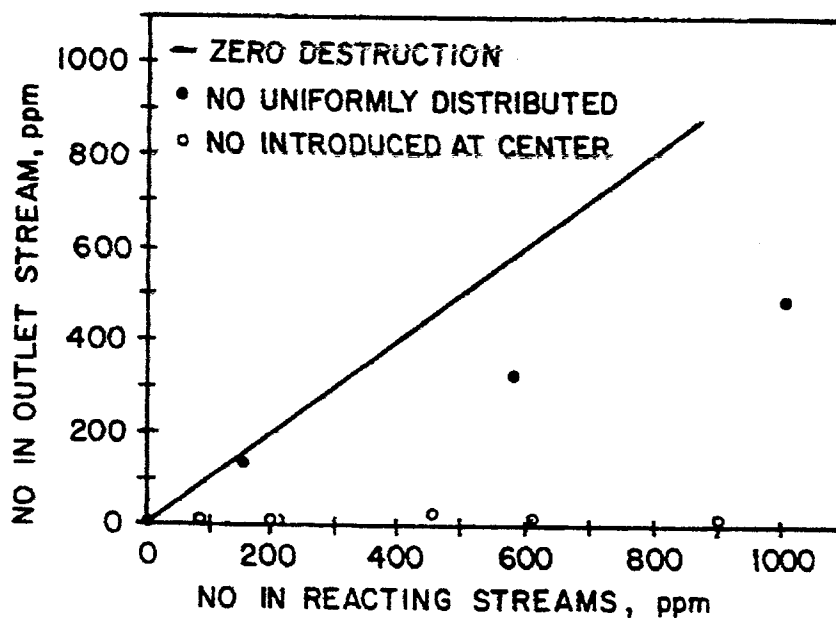


Fig. 2.

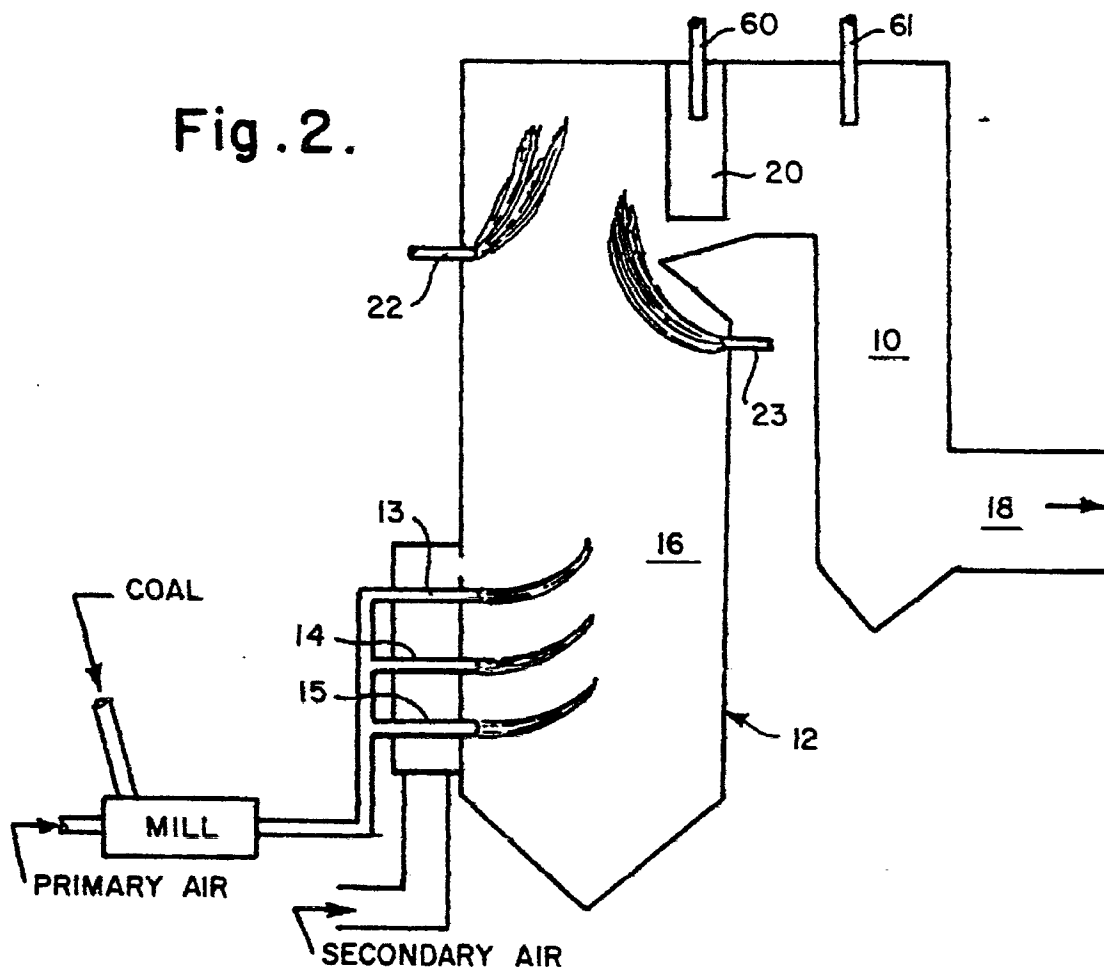


TABLE 1

NO Reduction when NO is Mixed with Oxygen Rich Gas		
Test	Initial NO, as ppm of total gas	Final NO as ppm of total gas
1	0	20
2	130	130
3	580	310
4	1000	480

In Test 1, no nitrogen oxide was introduced with the oxidizer and 20 ppm was produced during the reaction; this result was not surprising. In Test 2, no change in the nitrogen oxide occurred; and this result, starting from a modest amount of NO, was not surprising. In Test 3 where 580 ppm of NO was reduced to 310 ppm, and in Test 4 where 1000 ppm of NO was reduced to 480 ppm, the results were positive and better than expected.

A second set of experiments was conducted in which the NO was introduced as concentrated NO at the center line of the impinging jets. The NO readings were 20 to 40 ppm independently of the amount of NO introduced. Surprisingly, this set of experiments shows that when the NO is actually brought to the reacting interface between air-rich and fuel-rich streams it can be expected to approach very close to the equilibrium value. Table 2 shows the results which are plotted in FIG. 1 as circles.

TABLE 2

Test	Initial NO, as ppm of total gas	Final NO as ppm of total gas
5	80	20
6	190	25
7	210	20
8	450	40
9	620	20
10	910	30

From these results it can be seen that when fuel is introduced into flue gas at a place in the furnace where the resulting combustion temperature is low, the NO in the flue gas will be reduced; very large reductions can be achieved. The necessary apparatus may be introduced at any suitable point in the air intake circuit. Through such apparatus we introduce into the secondary air stream natural gas or other gases or volatile fuels having little or no fixed nitrogen. The resulting fuel/air mixture does not have enough fuel to burn at ambient temperatures. However, as it mixes with flames in the furnace or hot gases from the primary flames, the fuel so introduced will burn. Much of it burns at temperatures well below the peak flame temperature.

Because of the simplicity of this system, it is well-suited for retrofitting existing coal furnaces. Because the process relies only on natural mixing, there is no need for an air addition stage. Because natural gas burns more rapidly at a lower temperature than coal, the fuel can be introduced at a higher elevation and lower temperature. This lower temperature acts to reduce the equilibrium level of nitrogen oxide in the flue gas and, hence, increases the nitrogen oxide reduction possible. Finally, duct work is not necessary for injection air nor for completion air. As a consequence, the cost of reducing the nitrogen oxide emissions in the flue gas is greatly reduced. Other objects and advantages of the invention will become apparent as a description of the preferred embodiments proceeds.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a graph of NO destruction in fuel-lean laminar diffusion flames.

FIG. 2 is a schematic of a furnace arrangement suitable for the practice of our invention.

FIG. 3 is a side view partially in section of a fuel injection pipe which can be used in the furnace of FIG. 2.

FIG. 4 is a side view partially in section of a fuel injector with an annular opening which can be used in the furnace of FIG. 2.

FIG. 5 is a side view partially in section of an orifice which can be used in the furnace of FIG. 2.

FIG. 6 is a side view partially in section of a converging-diverging nozzle which can be used in the furnace of FIG. 2.

FIG. 7 is a side view of a metallic fuel diffuser which can be used in the furnace of FIG. 2.

FIG. 8 is a side view partially in section of a ceramic fuel diffuser which can be used in the furnace of FIG. 2.

FIG. 9 is a side view partially in section of a fiberglass or ceramic sock which can be used in the furnace of FIG. 2.

FIG. 10 is a schematic of a portion of the furnace of FIG. 2 illustrating the apparent diffusion mechanics in our method.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Our improved apparatus for reducing nitrogen oxide emissions in furnace flue gas can be readily retrofitted to an existing furnace. Our method and apparatus can be used for a wide variety of furnaces. The furnace could be a boiler, a process heater, an incinerator or the type of furnace which directly or indirectly supplies hot gases to heat materials in a process. The furnace 12 shown in FIG. 2 is designed to consume coal milled and mixed with primary air or any other fuel. The fuel enters the furnace 12 by way of fuel entries 13, 14 and 15, which are located in the bottom portion of the furnace 12. It burns in primary combustion zone 16 which typically has a temperature above 3000° F. Flue 18 provides an exit for the flue gas which is created in primary combustion zone 16 during the combustion of the fuel. The flue gas has a temperature in the range of 2100° F. to 2400° F. when it exits the furnace near heat exchangers 20. Heat exchangers 20 in the upper convective zone of the furnace cause a rapid temperature drop of the flue gas. During the combustion of the fuel, some of the fixed nitrogen reacts with oxygen to form nitrogen oxide, and NO_x is formed from atmospheric nitrogen and oxygen.

We provide fuel addition apparatus 22 and 23 which are positioned above combustion zone 16 to introduce natural gas or other fuel having little or no fixed nitrogen content which flows from these diffusers into the surrounding combustion products in the upper portions of the furnace 12 above the primary combustion zone 16. Other fluid fuels which usually contain little fixed nitrogen include those of the general forms C_xH_y or C_xH_yO_z.

Our fuel injection devices 22 and 23 may each be a pipe 30 passing through a wall of the furnace 11 as shown in FIG. 3, which can be of any convenient cross sectional shape. We may also use a pipe 31 having an annular opening 32 as shown in FIG. 4, pipes or ducts 33 having a plate 34 with orifices 35 at its discharge, as



US006314896B1

(12) **United States Patent**
Marin et al.

(10) **Patent No.:** **US 6,314,896 B1**
(45) **Date of Patent:** **Nov. 13, 2001**

(54) **METHOD FOR OPERATING A BOILER USING OXYGEN-ENRICHED OXIDANTS**

(75) **Inventors:** **Ovidiu Marin, Lisle; Oliver Charon, Chicago, both of IL (US)**
(73) **Assignees:** **L’Air Liquide, Societe Anonyme pour l’Etude et l’Exploitation des Procèdes Georges Claude, Paris (FR); American Air Liquide, Countryside, IL (US)**

(*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) **Appl. No.:** **09/437,526**
(22) **Filed:** **Nov. 10, 1999**

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/329,555, filed on Jun. 10, 1999.
(51) **Int. Cl.⁷** **F23C 9/00**
(52) **U.S. Cl.** **110/345; 110/204; 110/214; 110/254; 110/345**
(58) **Field of Search** **110/204, 205, 110/210, 234, 238, 214, 254, 395; 122/199, 15, 176**

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,426,734	*	2/1969	Rickard et al.	122/478
4,286,548	*	9/1981	Brash	122/1 R
4,495,874	*	1/1985	Greskovitch et al.	110/347
4,515,095	*	5/1985	Greskovich	110/347
4,547,351	*	10/1985	Im et al.	423/242
4,656,972	*	4/1987	Shimoda	122/4 D
4,762,074	*	8/1988	Sorensen	110/346
5,002,484	*	3/1991	Lofton et al.	432/222

5,040,470	*	8/1991	Lofton et al.	110/234
5,291,841	*	3/1994	Dykema	110/347
5,309,850	*	5/1994	Downs et al.	110/235
5,402,739	*	4/1995	Abboud et al.	110/346
5,752,452	*	5/1998	Leger	110/346
5,771,823	*	6/1998	Vierstra et al.	110/347
5,918,555	*	7/1999	Winegar	110/345
5,960,722	*	10/1999	Kiss	110/229
5,992,337	*	11/1999	Phillipe et al.	110/348

FOREIGN PATENT DOCUMENTS

1301852A * 4/1987 (SU).

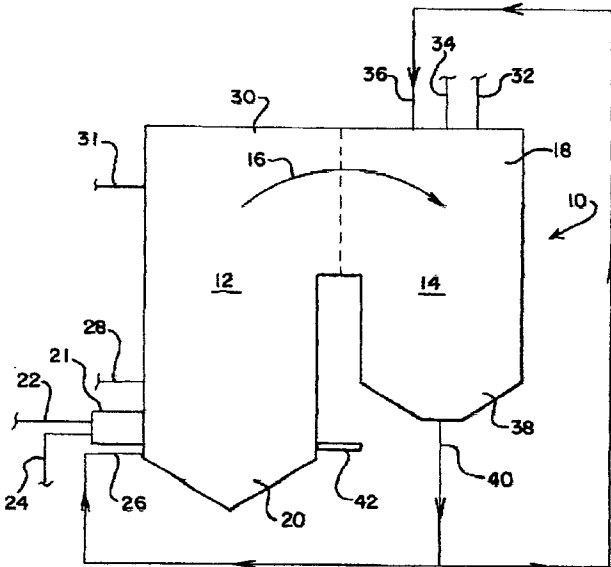
* cited by examiner

Primary Examiner—Henry Bennett
Assistant Examiner—K. B. Rinehart
(74) *Attorney, Agent, or Firm*—Jasper W. Dockrey; Brinks Hofer Gilson & Lione

(57) **ABSTRACT**

A method for operating a boiler using oxygen-enriched oxidants includes introducing oxygen-enriched air, or oxygen and air, in which the oxygen concentration ranges from about 21% to about 100% by volume. Fuel and oxygen-enriched air are introduced into the combustion space within the steam-generating boiler. The fuel and oxygen-enriched air is combusted to generate thermal energy. At least a portion of the flue gases are collected and at least a portion are recirculated through the boiler. In the steam-generating boiler, the oxygen-enriched oxidant is introduced at one or more locations within the radiation zone and the convection zone of the boiler. Additionally, flue gas is collected and recirculated into one or more locations within the radiation zone and/or the convection zone of the boiler. The amount of oxygen enrichment and the total gas flow through the boiler is controlled so as to maintain the heat transfer patterns within the boiler at the originally-design specification for operation by air combustion.

6 Claims, 4 Drawing Sheets



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such as carbonaceous waste materials and the like. The method of the present invention also allows adjustment in the turn down ratio over a wide range. Importantly, the method of the present invention enables the use of oxygen-enhanced combustion within a boiler originally designed for air combustion. Accordingly, the gas flow patterns and heat transfer characteristics within the boiler are not substantially altered from the originally-designed heat transfer patterns developed from unenriched air combustion.

In one aspect of the invention, oxygen-enriched air containing about 21 to about 100 percent by volume oxygen is introduced into one or more locations within a steam-generating boiler. In the process of the invention, oxygen-enriched air can be introduced into the radiation zone and/or into the convection zone using one of several techniques such as oxygen premixing, oxygen lancing and oxygen burners. Additionally, the method of the invention also includes the introduction of recirculated flue gasses. The flue gas recirculation rate is adjusted to maintain temperature profile and the flow of flue gases within the originally-designed parameters for the subject boiler.

In another aspect of the invention, the amount of oxygen introduced at the various injection points in the boiler is predetermined depending upon the particular operational aspect of the boiler that is to be optimized. The specific amount of oxygen introduced at each predetermined location within the boiler is adjusted such that oxygen-enriched combustion is carried out within the boiler at a total volume metric oxygen concentration of between about 21% to about 100%.

In yet another aspect, a method of operating a steam-generating boiler is disclosed that includes a radiation zone and a convection zone includes introducing a fuel into the combustion space within the boiler. Either oxygen-enriched air or oxygen in combination with air is also introduced into the combustion space. The total oxygen concentration ranges from about 21% to about 100% by volume. The oxygen-enriched air is combusted with the fuel to generate thermal energy within the combustion space of the boiler. Flue gases are collected and recirculated through the boiler with the oxygen-enriched air.

BRIEF DESCRIPTION OF SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a schematic diagram of a high-capacity steam-generating boiler having a plurality of oxygen introduction sites arranged in accordance with the invention;

FIG. 2 is a cross-sectional schematic diagram of an oxygen sparger for premixing oxygen in accordance with the invention;

FIG. 3 is a cross-sectional schematic diagram of an oxygen lance useful for injecting oxygen in accordance with the invention;

FIG. 4 is a cross-sectional schematic diagram of an oxygen burner useful for introducing oxygen into the convection zone of a steam-generating boiler in accordance with the invention;

FIG. 5 is a plot of fuel savings versus oxygen concentration obtained by operating a steam-generating boiler in accordance with the invention;

FIG. 6 is a plot of recirculation ratio versus oxygen concentration for the operation of a steam-generating boiler in accordance with the inventions and

FIG. 7 is a plot of recirculation ratio versus oxygen concentration for the operation of a steam-generating boiler at oxygen concentrations up to 100% in accordance with the invention.

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DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Shown in FIG. 1 is a cross-sectional schematic diagram of a high-capacity steam-generating boiler 10. Boiler 10 includes a radiation zone 12 and a convection zone 14. Those skilled in the art will appreciate that steam-generating boilers include a multitude of components such as water-tubes, steam-tubes, superheaters, boiler drums and the like. In general, the flow of water is upward through radiation zone 12 converting to steam in the upper regions of radiation zone 12. The superheated steam and hot water are transferred to convection zone 14 and exit through an outlet (not shown) at the upper portion of radiation zone 12. The flow of flue gases within boiler 10 is generally represented by arrow 16. In accordance with the invention, combustion of fuel introduced into boiler 10 can take place throughout radiation zone 12 and the upper region 18 of convection zone 14.

In accordance with the invention, oxygen-enriched air, or air and oxygen, or both, can be introduced at one or more locations in boiler 10. In one embodiment, one or more air burners 21 are attached and inserted into a lower portion 20 of radiation zone 12. Fuel is injected into air burner 21 through a fuel line 22. Preheated, oxygen-enriched air is introduced through oxidant line 24. Oxygen can be premixed with air either before or after the air preheater (not shown). Additionally, recirculated flue gas is introduced into lower portion 20 through flue gas recirculation line 26. Those skilled in the art will recognize that a variety of techniques are possible for introducing recirculated flue gas into boiler 10. For example, flue gas recirculation line 26 can be connected to fuel line 22 or to oxidant line 24. Alternatively, recirculated flue gas can be directly injected at one of several locations in radiation zone 12.

In addition to introducing oxygen-enriched air through air burner 21, oxygen can be injected by lancing into various stages of radiation zone 12. Oxygen-enriched air or oxygen can be lanced into lower portion 20 of radiation zone 12 through oxidant line 28. Additionally, the present invention contemplates the use of oxygen staging at one or more locations in radiation zone 12 beginning at lower portion 20 and extending to an upper portion 30 of radiation zone 12. For example, oxygen can be lanced into radiation zone 12 at upper portion 30 through an oxidant line 31. Although FIG. 1 depicts two oxygen introduction sites at stage levels above lower portion 20, it is to be understood that a plurality of such oxygen introduction stages can be employed at various locations between lower portion 20 and upper portion 30 of radiation zone 12.

The method of the present invention also contemplates the introduction of oxygen-enriched air or a combination of air and oxygen, or both, into boiler 10 within convection zone 14. For example, oxygen and fuel can be introduced in upper region 18 of convection zone 14 through a fuel line 32 and an oxidant line 34, respectively. The oxygen and fuel initiate combustion in upper region 18. Additionally, recirculated flue gas can be introduced in upper region 18 through flue gas recirculation line 36. The flue gases are collected at a lower region 38 of convection zone 14 and exit through a flue gas collection line 40.

In addition to providing an operating method in which oxygen-enriched air or oxygen and air can be introduced at various locations within boiler 10, the present invention also contemplates operation of boiler 10 using low-calorie fuel. Accordingly, boiler 10 can include an oxygen-enriched fuel burner 42 inserted into lower portion 20 of radiation zone 12

FIG. 1

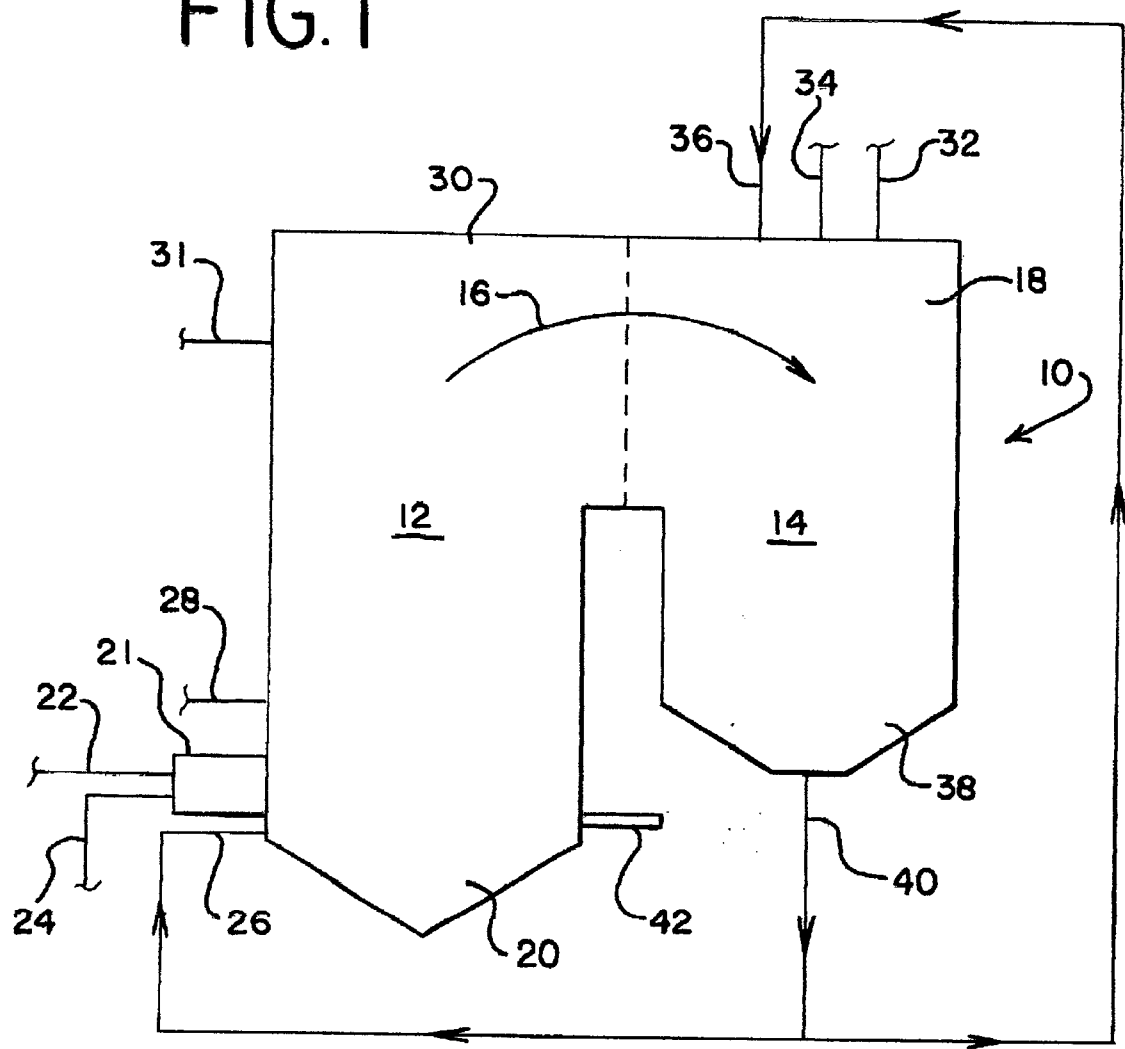


FIG. 2

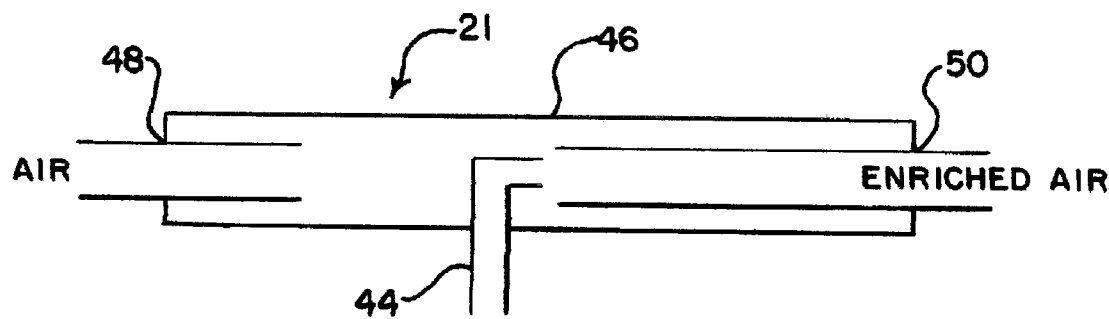


FIG. 3

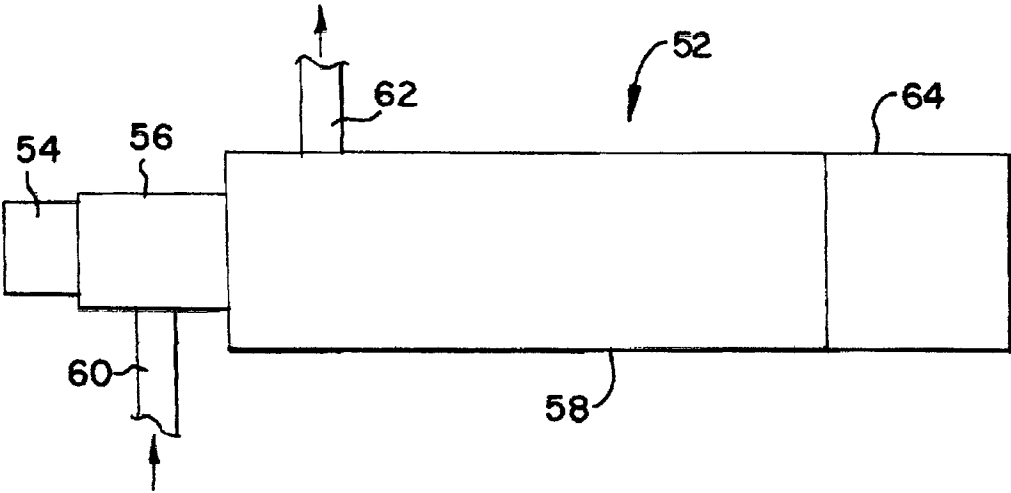


FIG. 4

