United States Patent

[11] 3,556,412

[72]	Inventor	Joseph A. Vietorisz Pittsburgh, Pa. 738,014 June 18, 1968 Jan. 19, 1971 Koppers Company, Inc. a corporation of Delaware	[56]	References Cited			
[22] Fileo [45] Pate	Appl. No.			UNITED STATES PATENTS			
	Filed Patented Assignee		943,927	,	12/1909 Gehring et al	239/489X	
			2,878,065 3,111,979	3/1959 Watkins 11/1963 Peoples 11/1964 Kraus	239/405X 239/406X 239/591X		
			3,156,091				
			3,308,870	-,	3/1967 Rex	431/183X	
				FOREIGN PATENTS			
			231,731	4/1925	Great Britain	239/404	

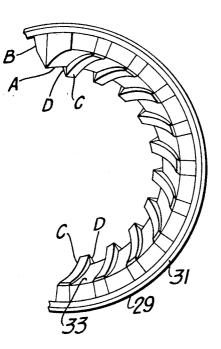
[54] BURNER NOZZLE FOR HOT BLAST STOVE 8 Claims, 5 Drawing Figs.

o claims, o brawing rigs.

 ABSTRACT: A burner nozzle includes a cylindrical shell having an inner lining of insulating material and a plurality of refractory units inside of the lining. The refractory units are complementary and form a plurality of channels that direct a gaseous fluid, flowing through the nozzle in a spirally converg-

ing manner into a mixing relation with another gaseous fluid

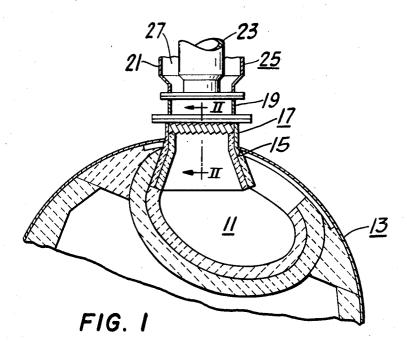
flowing through the nozzle in an axial manner.

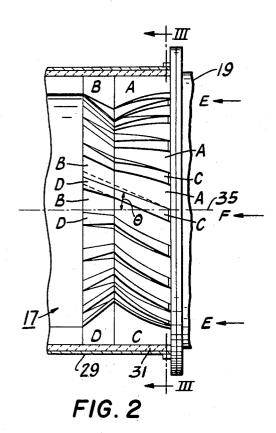


PATENTED JAN 1 9 1971

3,556,412

SHEET 1 OF 2





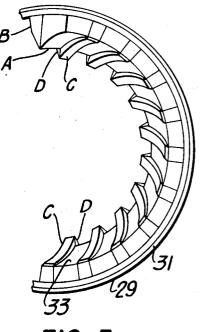


FIG. 3

BY

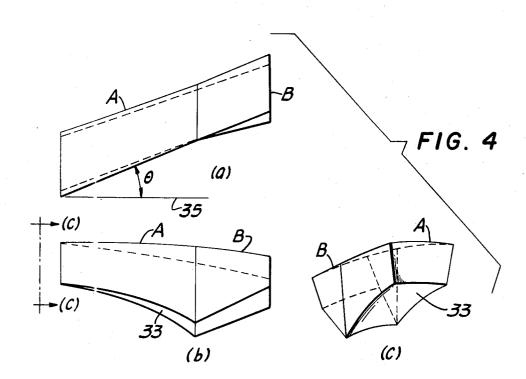
INVENTOR. JOSEPH A, VIETORISZ

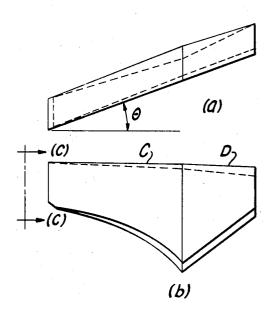
Sherman Moaren his Allorney bar

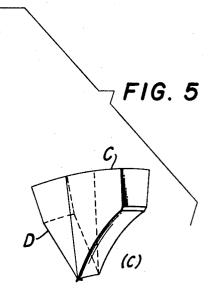
PATENTED JAN 1 9 1971

3,556,412

SHEET 2 OF 2







INVENTO**R.** Joseph A. vietorisz

BY Sherman arler his Hilorney

BURNER NOZZLE FOR HOT BLAST STOVE

BACKGROUND OF THE INVENTION

Conventional hot blast stoves, for example, are heated by burning a mixture of cumbustible gas and air in a combustion chamber forming a portion of the stove, and the hot gases pass through flues in the checkerbrick work and heat it.

The combustible gas and the air are separately conveyed to a burner at the entrance of the combustion chamber where the combustible gas and air are mixed and then burned in the combustion chamber of the stove.

A burner valve is usually provided in the conduit leading to the burner nozzle, which valve is closed when the stove is heating cold blast air, and which valve is opened when the stove is on combustion.

Typically, the burner nozzle of hot blast stoves extends through a burner port into the combustion chamber and is, therefore, subjected to great changes in temperature-one moment the burner nozzle is in the path of hot blast air issuing 20 from the stove at a temperature above 2,000° F. according to latest blast furnace practice, while shortly thereafter the burner nozzle is passing a mixture of fuel gas and air at about ambient temperature. The resulting thermal cycling on the burner nozzle is so severe that in a short while the usual type 25 of stainless steel burner head collapses, the ceramic pipe head shatters, and the burner head is no longer functional.

Those skilled in the art should recognize that the type of burner heads found in the prior art are not entirely satisfactory, and that the burner nozzle of the present invention over- 30 comes most of the deficiencies found in the prior art burner heads.

SUMMARY OF THE INVENTION

The burner nozzle of the invention comprises a cylindrical shell that is lined with a layer of insulating material and with a plurality of complementary refractory shapes. A gaseous fluid, which may be fuel or air, passing through the nozzle, is caused to spiral convergently and to mix intimately with another different gaseous fluid, flowing axially through the burner nozzle in a zone just beyond the burner nozzle, sustaining thereby a smooth burning in the combustion chamber.

For a further understanding of the invention and for advantages and features thereof, reference may be made to the 45 following description taken in conjunction with the drawings which show, for the purpose of exemplification, a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is a plan view, partly in section, of a burner nozzle in accordance with the invention;

FIG. 2 is a sectional view along line II-II of FIG. 1;

FIG. 3 is a sectional view along line III-III of FIG. 2;

FIG. 4 is a schematic representation (three views being shown) of one group of complementary refractory shapes used to construct the burner nozzle of FIG. 2; and

FIG. 5 is a schematic representation (three views being 60 shown) of another group of complementary shapes, used with the shapes of FIG. 4, to construct the burner nozzle of FIG. 2.

DETAILED DESCRIPTION

FIG. 1 illustrates a horizontal sectional view through a com- 65 bustion chamber 11 of a conventional hot blast stove 13. The combustion chamber 11 is provided with a burner port 15 in which is mounted a burner nozzle 17, in accordance with the invention. The burner nozzle 17 is a type that may be connected to a burner shutoff valve 19, of the type described in 70 my copending application Ser. No. 738,003, filed Jun. 18, 1968 concurrently herewith. The burner shutoff valve 19 is connected to a conventional type of burner box 21; such burner box being provided with an inner conduit 23 for the passage of either air or a gaseous fuel, and an outer concentric 75 zles found in the prior art.

conduit 25 for the passage of either gaseous fuel or air through the annular space 27 between the inner 23 and the outer 25 conduits.

Referring to FIGS. 2 and 3, it will be noticed that the burner nozzle is comprised of a cylindrical metal shell 29 that is provided with an inner layer of insulating material 31, and a plurality of pairs of complementary refractory shapes A, B and C, Đ.

Each refractory shape A has a surface 33 that is a portion of a spherical surface. Such spherical surfaces 33 are separated by the refractory shapes C, which, as may be noticed from FIG. 3, act as guide vanes in relation to the spherical surfaces 33. From FIGS. 4 and 5 it will be noticed that each pair of refractory complementary shapes A, B and C, D. are disposed

at an angle θ with respect to the longitudinal axis 35 of the 15 burner nozzle 17. The angle θ is a suitable angle to give the required velocity and rotational characteristics to the gas flow. In a preferred embodiment of the invention the angle θ is about 20°. However, the angle θ may range from 5° o 45°.

Conventionally, in operating the stove 13, combustible gas flows in the annular space 27 between inner conduit 23 and concentric outer conduit 25; but, air may flow in the space 27, and gas in the inner conduit 23. The gas passes through the burner shutoff valve 19 and enters the burner nozzle 17, in the direction of the marked arrows E; that is from right to left, as viewed in FIG. 2.

Simultaneously, the air flows in the inner conduit 23 into and through the open burner shutoff valve 19 and axially in the direction of the marked arrow F (FIG. 2) into the burner nozzle 17.

The gases, however, enter the burner nozzle 17 along the periphery thereof and impinge upon the spherical surfaces 33 whereby the gases are induced to flow in a spirally converging manner due to the angular disposition and configuration of the

35 refractory shapes A, B and C, D. The gas flows generally between the guide vanes C, D. Thus, the gases flow with increased velocity through the burner nozzle 17, due to the form and position of the refractory shapes A, C. The refractory shapes C act as vanes, and are positioned at the angle θ with 40 respect to the longitudinal axis 35, and thereby, force a part of the gases to move tangentially to the direction of flow of the air.

The spirally converging flow of gas combines with the straight axial flow of air (FIG. 2) in the left region or zone of the burner nozzle 17, as viewed in FIG. 2. The fuel gases impact and partially penetrate the air flow mass, and the spiral movement of the intimately mixed gases spread toward the inside wall of the burner nozzle 17.

Some increase in pressure can be regained by using refrac-50 tory shapes B and D, since, after passing through the spherical zone of shapes A, the gases can gradually expand, lose velocity and thereby increase in pressure. Shapes B and D also serve to protect the working shapes A, C from direct radiation of heat from the combustion chamber when the burner shutoff valve 55 19 is closed and the stove 13 is on blast.

Those skilled in the art will recognize that the refractory shapes A, B, C, and D may, if preferred, be provided with cooling passages through which a cooling fluid may circulate, or they may be cooled externally if desired. No insulating inner liner 31 is used in such design of course.

Further, the arrangement of the individual refractory shapes A, B, C and D, shown in FIGS. 2 and 3, may, if preferred, be replaced by a complete monolithic formed structure, or the combination of monolithic formed portions and individual refractory shapes. Also, the spherical surface of shape A may be replaced by any surface generated by revolving a plane curve about the axis of nozzle; the surface generated converging toward that axis in a way as to provide a tangential entrance and to accelerate the fluid flow smoothly.

A feature of the invention is that the air experiences a low pressure drop and a small energy loss as it passes through the burner nozzle of the present invention. Therefore, the burner nozzle of the invention is more economical than burner noz-

15

A feature of the invention is that there is improved mixing of combustible gases.

A feature of the invention is that the burner nozzle is more economical to construct since the refractory construction will last considerably longer than the burner heads found and used 5 in prior art devices.

A feature of the invention is that the burner nozzle imparts a spirally converging motion to the gases which, therefore, mix more effectively with the axial flow of air through the burner nozzle.

A feature of the invention is the gas and air mixture burn more smoothly and eliminate pulsations in the flame.

A feature of the invention is that the burner nozzle described herein can be successfully used for intimate mixing of gaseous substances, in general, as long as they are energized sufficiently to overcome the flow resistances at considerable velocities.

Although the invention has been described herein with a certain degree of particularity, it is understood that the 20 present disclosure has been made only as an example and that the scope of the invention is defined by what is hereinafter claimed.

I claim:

1. A burner nozzle for cooperation with a combustion 25 chamber comprising:

- a. a tubular conduit adapted to be in communication with said combustion chamber and having a longitudinal axis extending in the direction of fluid flow through said burner nozzle; and 30
- b. a lining mounted within said tubular conduit comprised of spaced apart first refractory members cooperating with second refractory members disposed between adjacent first members and forming spaced apart channels of fluid flow which are portions of a surface of revolution, said 35 channels being angularly biased toward said axis whereby combustible gases flowing in said channels spirally converge toward said axis.

2. The invention of claim 1 wherein said channels are disposed between radially oriented vane members that are ar- 40

ranged at a preselected angle with respect to the axis of the tubular conduit.

3. The invention of claim 1 wherein said surface of revolution is spherical.

4. The invention of claim 1 wherein said surface of revolution is so oriented that said fluid impinges tangentially on said surface and is directed smoothly and convergently toward said axis.

 The invention of claim 1 wherein said lining is monolithic
in structure and includes spaced apart vane portions between which are said fluid flow channels.

6. The invention of claim 1 wherein:

- a. a portion of said lining is monolithic; and
- b. another portion of said lining is comprised of individual
- refractory shapes.

7. A burner nozzle for cooperation with a combustion chamber comprising:

- a. a tubular conduit adapted to be in communication with said combustion chamber and including an axis extending in the direction of fluid flow through said burner nozzle;
- b. a lining within said tubular conduit comprised of:
 - i. a plurality of first shapes each of which has a surface that is a portion of a spherical surface, the center of curvature of said spherical surfaces being within said tubular conduit, and
- ii. a plurality of second shapes disposed between adjacent first shapes and disposed at a preselected angle with respect to the longitudinal axis of said tubular conduit, said second shapes forming the sides of fluid flow channels in the spherical surface of said lining; and
- c. means for protecting said first and second shapes from heat radiating from said combustion chamber when no combustion is taking place in said chamber.
- 8. The invention of claim 7 wherein:
- a. said first and second shapes are made of refractory material; and
- b. said means includes refractory shapes that are complementary to said respective first and second refractory shapes.

45

50

55

65

60

70

75