United States Patent [19]

Straitz, III

[11] **3,824,073**

[45] **July 16, 1974**

[54] **FLARE STACK GAS BURNER**

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[73] Assignee: **Combustion Unlimited Incorporated,** Elkins Park, Pa.

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[21] Appl. No.: **387,785**

[52] **U.S. Cl.** **431/284,** 431/202

[51] **Int. Cl.** **F23q 9/00**

[58] **Field of Search** 431/202, 278, 284, 285

[56] **References Cited**

UNITED STATES PATENTS

2,222,822	11/1940	Nordensson	431/285
3,358,736	12/1967	Reed et al.	431/285
3,697,231	10/1972	Reed	431/202

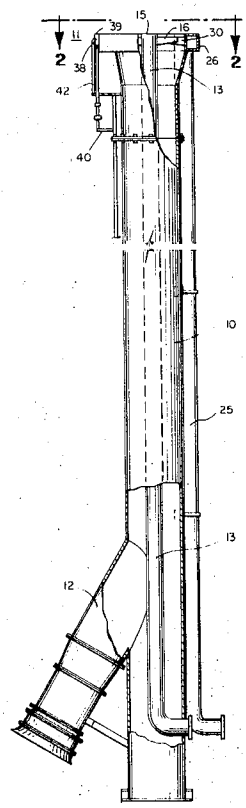
Primary Examiner—Carroll B. Dority, Jr.

Attorney, Agent, or Firm—Zachary T. Wobensmith, 2nd; Zachary T. Wobensmith, III

[57] **ABSTRACT**

A flare stack gas burner for waste combustible gases at both low and high pressure from oil refineries and the like is disclosed with separate delivery systems for the combustion gases, which includes a stack with a top mounted burner tip, the stack carrying a centrally disposed high pressure gas supply pipe closed at the top and with a plurality of outwardly extending vanes with gas delivery slots, the tops of the vanes being angularly disposed in a plane with respect to radial lines through the center of the stack for a swirling action of the burning gas. A low pressure gas supply pipe is mounted to and extends upwardly along the outside of the stack to a ring manifold mounted to the burner tip with a plurality of inwardly extending vanes, with gas delivery slots, the vanes being interposed between the outwardly extending vanes and angularly disposed in the same direction. Air at variable controlled low pressure is delivered into the stack at the bottom and moves upwardly between the vanes for smokeless burning. Optional fluidic seals can be provided in both the low and high pressure gas supply lines to prevent flashback. Ignitors and pilots are provided exteriorly of said stack.

7 Claims, 4 Drawing Figures



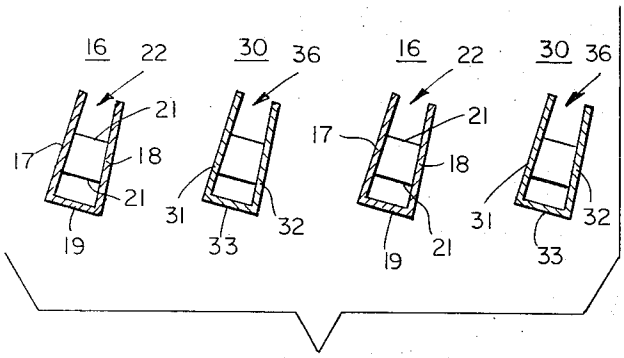

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Fig. 4

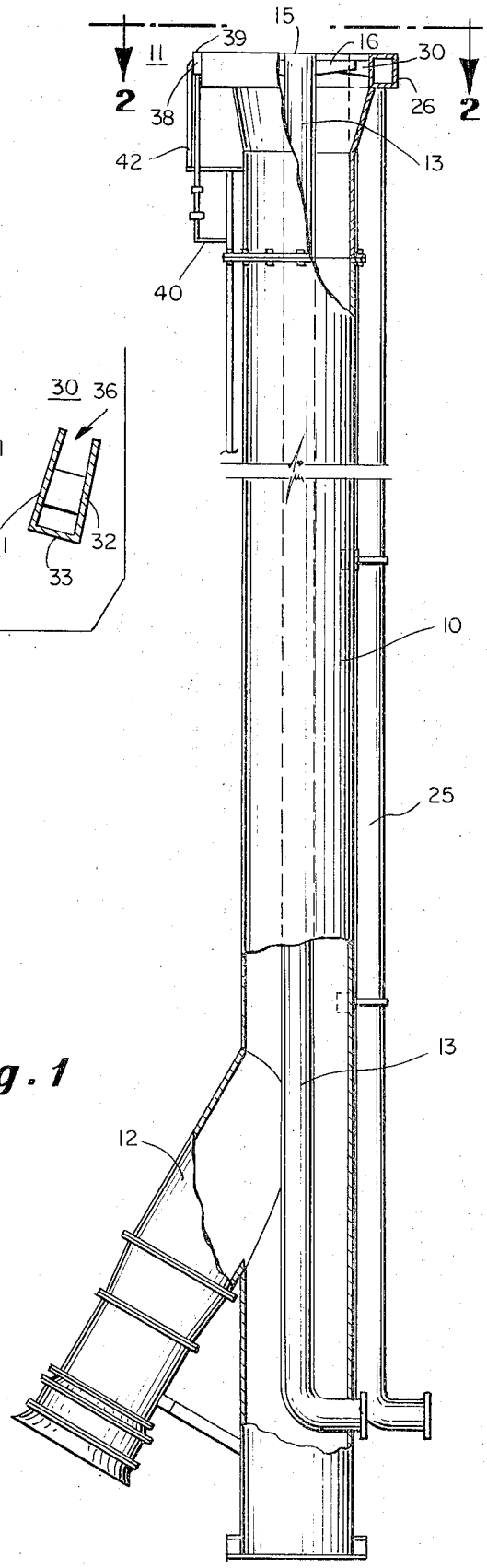

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Fig. 1

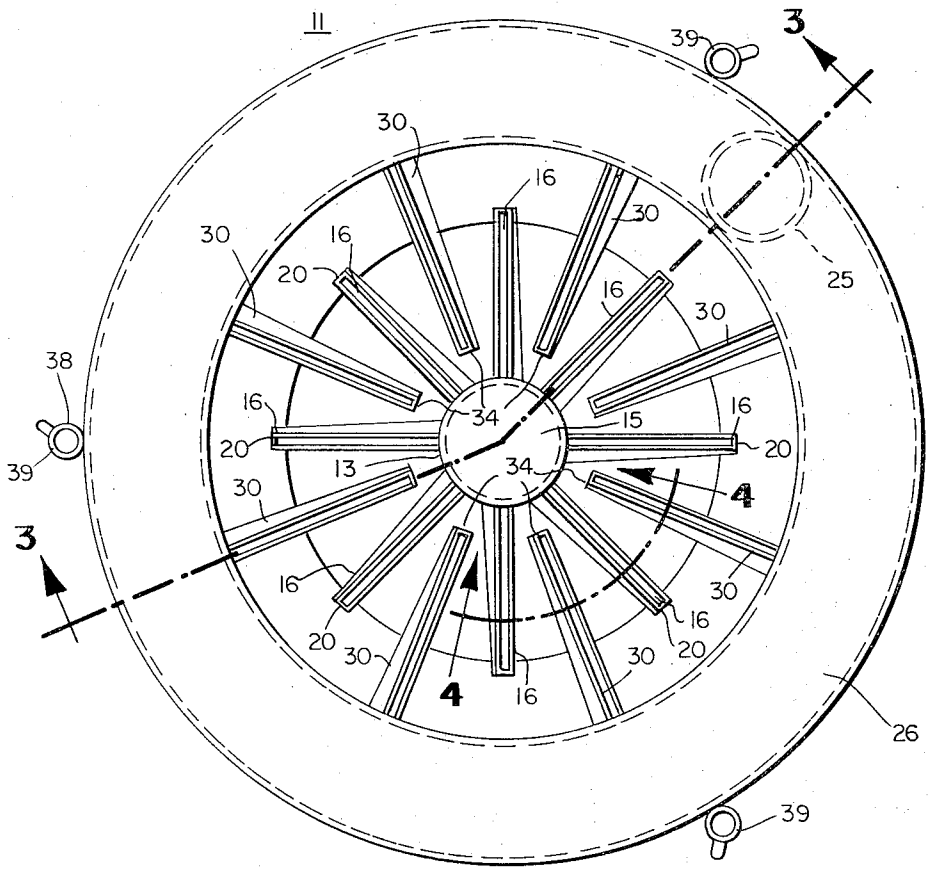

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Fig. 2

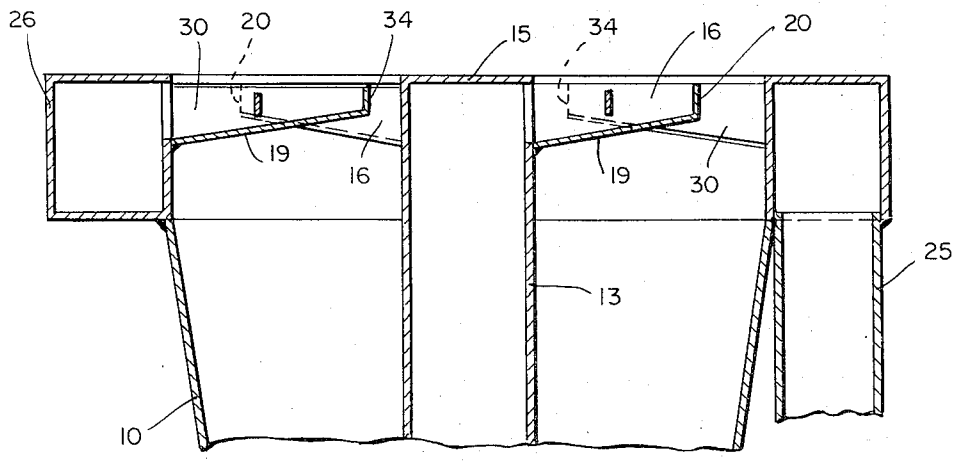

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Fig. 3

FLARE STACK GAS BURNER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to flare stack gas burners for both low and high pressure combustible waste gas from refineries and like, for smokeless burning without steam, with the gas delivered for burning from different interengaged burners.

2. Description of the Prior Art

In industrial operations and particularly in the operation of oil refineries it becomes necessary from time to time to burn various surplus quantities of combustible gaseous materials. The characteristics of these materials both as to composition and pressure vary considerably and there is no practical way now known of utilizing these gases.

The composition of the gases might vary from a light stream such as methane and ethane to a heavy stream of unsaturates such as ethylene and propylene. Ecological considerations require that the gases be destroyed without atmospheric pollution and the most satisfactory disposal method is burning of the gases. The gases must be burned without discharge of unburned carbon particles or smoke into the atmosphere both for the lowest pressure and the highest pressure of the waste gases at all the various gas compositions.

Flare stack burners have heretofore been proposed for high and low pressure gas but some of these have had serious limitations, particularly because of the difficulty of designing a unitary structure that will operate smokelessly at both low and high pressure and with varying gas compositions.

In addition at some locations there is inadequate or no steam available for smoke suppression or other considerations, such as climatic conditions, might preclude the use of steam to assist in smoke suppression.

Among the burners heretofore proposed are those shown in the U.S. Patents to Verner et al., No. 2,761,496; Webster, et al. No. 2,891,607; Shellentrager, No. 2,506,972; Rodman, No. 2,537,091; Zink et al., No. 2,779,399; Campbell et al., No. 2,802,521; Zink et al. No. 3,143,424; Turpin, No. 3,547,567; and in the Canadian Patent to Williams, No. 691,894, and in the British Patent to British Petroleum Co., et al. No. 795,664.

None of these burners or others previously available provide for smokeless burning of both low and high pressure combustible waste gases by use of separate interengaged gas delivery systems with forced air combustion.

SUMMARY OF THE INVENTION

In accordance with the invention a flare stack gas burner is provided for burning of combustible waste gas at low and high pressures from two separate gas delivery systems by structure which includes a high pressure delivery pipe within the stack closed at the top by a closure plate on a burner tip portion and communicating with outwardly extending attached vanes angularly disposed in a horizontal plane from radial lines through the center of the stack, the vanes having slots at their top margins for swirling the high pressure flare gas. A low pressure gas supply pipe is provided exteriorly mounted on the stack and connected to a manifold on the burner tip portion with inwardly extending angularly disposed vanes, with slots at the top margins of the vanes for swirling low pressure gas delivery. A low pressure air blower is provided at the bottom of the stack for introduction of air as a combustion inducing media and which air flows out past the vanes, for smokeless combustion of the high and low pressure waste gases. Ignitors and pilots are also shown.

It is the principal object of the invention to provide a flare stack gas burner which is highly effective for smokeless combustion of combustible waste gases at low and high pressure by reason of enhanced air mixing and turbulence generation.

It is a further oject of the invention to provide a flare stack gas burner of the character aforesaid in which the low pressure combustible waste gas and air at the vanes burns smokelessly.

It is a further object of the invention to provide a flare stack gas burner in which the high pressure combustible waste gas at the vanes burns smokelessly.

It is a further object of the invention to provide a flare stack gas burner of the character aforesaid in which the component parts are simple, sturdy, trouble free, and require a minimum of maintenance.

Other objects and advantageous features of the invention will be apparent from the description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The nature and characteristic features of the invention will be more readily understood from the following description taken in connection with the accompanying drawing forming part hereof, in which:

FIG. 1 is a view partly in elevation and partly in vertical section of a flare stack in accordance with the invention;

FIG. 2 is a horizontal sectional view taken approximately on the line 2—2 of FIG. 1;

FIG. 3 is a vertical sectional view taken approximately on the line 3—3 of FIG. 2, and

FIG. 4 is an enlarged vertical sectional view taken on the line 4—4 of FIG. 2.

It should, of course, be understood that the description and drawings herein are illustrative merely and that various modifications and changes can be made in the structure disclosed without departing from the spirit of the invention.

Like numerals refer to like parts throughout the several views.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now more particularly to the drawings, a vertical stack pipe **10** is shown, circular in horizontal cross section, with a burner tip **11** removably mounted at the top, and at the bottom of which is mounted an air inlet pipe **12** with an axial fan (not shown) and a damper (not shown) to provide low pressure air into the interior of the stack pipe **10** for combustion of the waste gas. The pipe **10** and burner tip **11** are preferably fabricated of steel and coated to reduce rust.

The stack pipe **10** has, in spaced relation thereto, a centrally disposed interior high pressure gas supply pipe **13** with its lower terminus communicating with the supply of high pressure waste gas to be burned. The pipe **13** is closed at the top by an annular closure plate **15.**

The pipe 13 has extending outwardly therefrom a plurality of fixed vanes 16. The vanes 16 are shown as made of converging side wall plates 17 and 18, closed at the bottom by a bottom wall 19 and at the outer end by an end wall 20 and with intermediate stiffeners 21 parallel to the end wall 20. The plates 17 and 18 are separated at the top to provide a gas delivery slot 22 and at their inner ends the vanes 16 have their interiors in communication with the pipe 13.

The vanes 16 and their gas delivery slots 22 are each at an angle, in a horizontal plane, to a radial line through the center of the pipe 13 to impart a swirling motion to the high pressure gas delivered through the slots 22.

In larger flare stacks, in order to prevent downflow in the pipe 13 in the interior of the stack pipe 10, whether by external wind conditions or contraction by cooling of hot gas in the system, and also to reduce fluid oscillations, a fluidic seal such as is shown in my prior U.S. Pat. No. 3,730,673 may be employed mounted in the supply line to prevent flashback.

A low pressure gas supply pipe 25 is provided exteriorly mounted to the stack pipe 10 and extending upwardly to a horizontal manifold 26 removably mounted to the top of the burner tip 11.

The manifold 26, which is shown as being square in cross section has a plurality of fixed vanes 30 extending inwardly therefrom. The vanes 30 are similar to the vanes 16 and are made of converging side wall plates 31 and 32, closed at the bottom by a bottom wall 33, and at their inner end by an end wall 34. Intermediate stiffeners 35 may be provided fastened to the side walls 31 and 32 and parallel to the end wall 34. The plates 31 and 32 are separated at the top to provide a gas delivery slot 36 and at their inner ends the vanes 30 have their interiors in communication with the interior of the manifold 26. The vanes 30 and their gas delivery slots 36 are each at an angle in a horizontal plane to a radial line through the centerline of the pipe 13 to impart a swirling motion to the low pressure gas delivered through the slots 36 for combustion. A fluidic seal such as is shown in my prior U.S. Pat. No. 3,730,673 may be employed in the supply pipe 25 and spaced outwardly from the pipe 13 to prevent flashback.

The disposition of the vanes 16 and 30 is such that they are staggered alternately one between the other around the perimeter of the tip 11.

A plurality of gas pilots 38 are provided with their heads 39 disposed outside the manifold 26. The pilots 38 can be of the venturi air inspirating type and connected to a gas manifold ring (not shown) to which combustible gas is supplied through a pipe 40. The gas pilots 38 can be supported by brackets 41 secured to the pipe 10.

In order to ignite the gas pilots 38, an igniter pipe 42 is provided through which a gas flame is directed when desired. The igniter pipe 42 can be supported by a bracket (not shown) secured to the pipe 10.

In use the pilots 38 are continuously burning, ignition being effected by flame delivered through the igniter pipe 42.

Waste gas at low pressure to be burned is delivered through pipe 25 where it passes upwardly and then outwardly into the vanes 30 for delivery through the slots 36 in a plurality of sheet flame patterns as determined by the positioning of the slots 36 and with a whirling movement. Air is delivered to the inner margins of the flames from the slots 36 through the pipe 10 into the burner tip 11, as desired, by the blower (not shown) which provides the quantity of air needed for smokeless operation, as called for by a flow sensor (not shown) which is connected into the low pressure gas supply pipe 25.

If waste gas at high pressure is to be burned it is supplied through pipe 13 to vanes 16 and thence through the slots 22 for combustion.

The inclination of vanes 16 and the inclination of the slots 22 produces a whirling action which permits complete smokeless combustion of the waste gas.

If desired, the air blower (not shown) may be used to provide additional combustion air for high pressure gas with a high amount of unsaturates.

The gases at low pressure and at high pressure may be burned at the same time or independently as desired and without any back pressure effect which would impede the flow of the low pressure gas.

It should be noted that the flame does not reach the vanes due to the turbulence but occurs several feet above the burner tip 11 which results in cooler operation and enhanced tip life.

It will thus be apparent that structure has been provided with which the objects of the invention are achieved.

I claim:

1. A flare stack gas burner for combustible waste gas having an outer stack with a burner tip portion at its upper end comprising

a combustible high pressure waste gas supply pipe extending upwardly within said stack,

a plurality of outwardly extending hollow vanes at the upper end of the burner tip portion of said supply pipe with spaces therebetween and having upwardly facing gas delivery openings connected to said gas supply pipe for discharge of said high pressure waste gas for combustion,

a combustible low pressure waste gas supply pipe extending upwardly with respect to said stack,

a hollow manifold mounted to said burner tip portion to which said low pressure gas supply pipe is connected,

a plurality of inwardly extending hollow vanes contiguous to said first mentioned hollow vanes attached to said manifold with spaces therebetween and having upwardly facing gas delivery openings communicating with said manifold for discharge of said low pressure waste gas for combustion,

means associated with said stack pipe for supplying air therethrough for delivery of air through the spaces between said vanes for combustion of waste gas delivered through said supply pipes,

said vanes being disposed to impart a swirling action to the gas delivered therefrom and to the air delivered therebetween.

2. A flare stack gas burner as defined in claim 1 in which

said low pressure vanes are tilted.

3. A flare stack gas burner as defined in claim 1 in which

said high pressure vanes are tilted.

4. A flare stack gas burner as defined in claim 1 in which

said high pressure vanes have their slots disposed at an angle to a radius through the vertical longitudinal axis of said high pressure supply pipe.

5. A flare stack gas burner as defined in claim **4** in which

said low pressure vanes have their slots disposed at an angle to a radius through the vertical longitudinal axis of the high pressure supply pipe.

6. A flare stack gas burner as defined in claim **1** in which

said low pressure vanes and said high pressure vanes are alternately disposed around the radius of said tip.

7. A flare stack gas burner as defined in claim **1** in which

said manifold is square shape in cross section.

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