

[54] FLARE STACK GAS BURNER

[75] Inventor: John F. Straitz, III, Jenkinton, Pa.

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

[22] Filed: Aug. 13, 1973

[21] Appl. No.: 387,710

[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
R27,507	10/1972	Turpin	431/202

Primary Examiner—Carroll B. Dority, Jr.

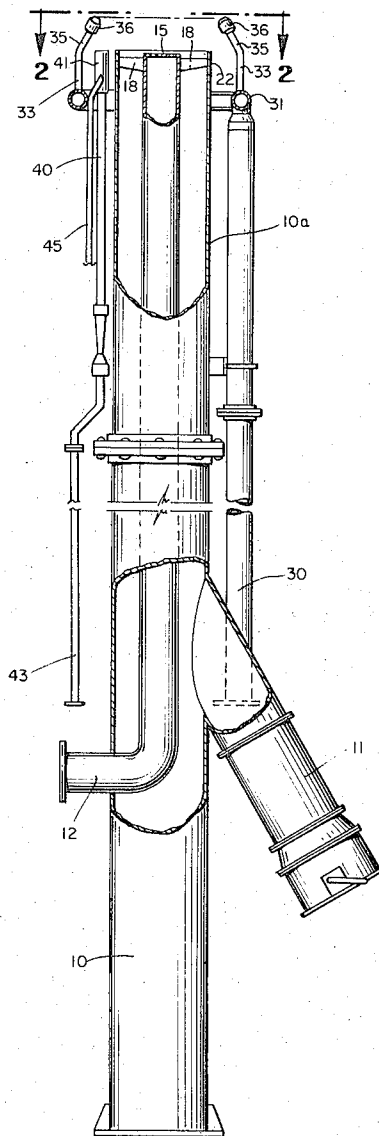
Attorney, Agent, or Firm—Zachary T. Wobensmith,
2nd; Zachary T. Wobensmith, III

[57]

ABSTRACT

A flare stack gas burner for waste combustible gases at both low and high pressure and under all flow conditions including low pressure gas without any high pressure gas stream from oil refineries and the like is disclosed with separate delivery systems for the combustion gases which includes a stack with a central low pressure gas delivery tube which has at its top outwardly extending vanes with gas delivery slots, the vanes being disposed for imparting a swirling action to the burning gas. The delivery pipe is closed at the top by a closure plate with flame retention openings. Air at variable low pressure is delivered into the stack at the bottom and flows upwardly between the vanes for smokeless burning. A pipe is provided for high pressure gas mounted exteriorly of the stack for delivery to a manifold ring and thence to delivery pipes with angularly disposed tips for enhancement of the burning of the gases. An optional fluidic seal can be provided in the low pressure gas supply. Ignitors and pilots are provided exteriorly of said stack.

7 Claims, 4 Drawing Figures



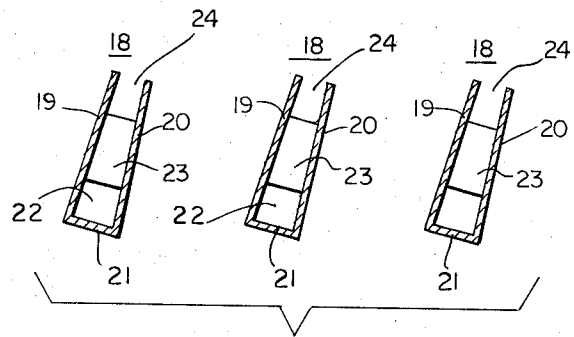
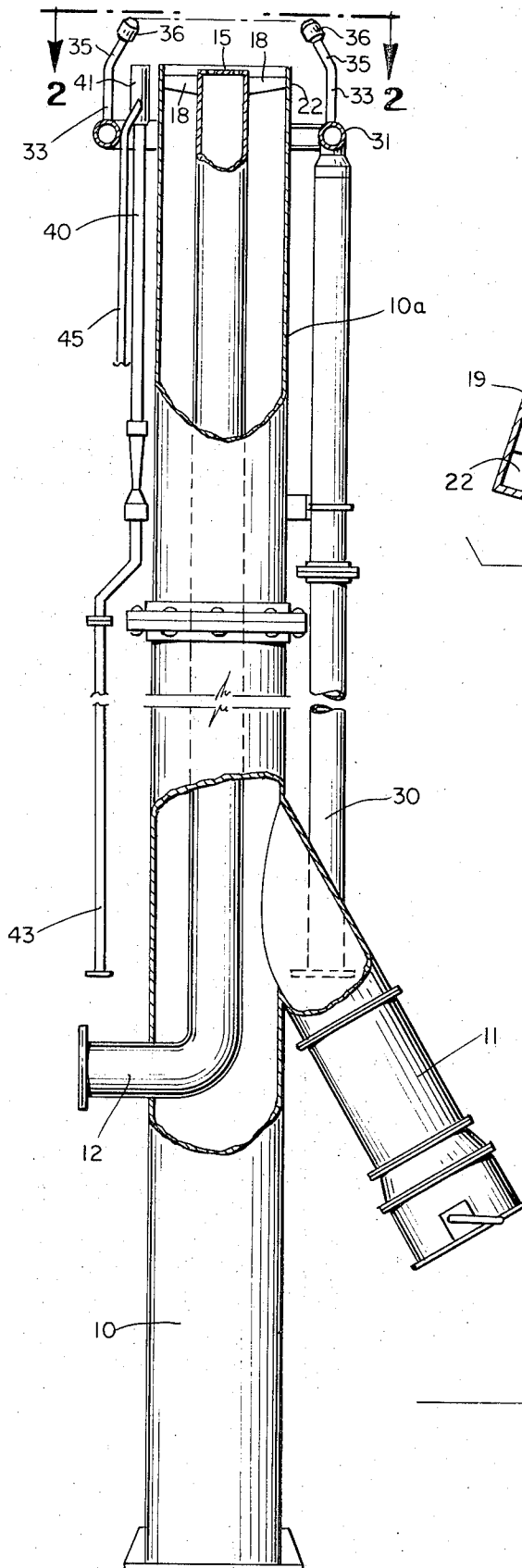


Fig. 4

Fig. 1

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 waste gas from refineries and the like for smokeless burning without steam.

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 quantities of combustible gaseous materials. The characteristics of these materials both as to composition and pressure varies considerably. Ecological considerations require that the gases be burned and that the combustion be carried out without discharge of unburned carbon particles in the form of smoke into the atmosphere both for the lowest pressure and the highest pressure of the waste gases and over the whole range.

Various flare stack gas burners have heretofore been proposed for high and low pressure gas but these have had serious limitations, particularly because of the difficulty of designing a structure that will operate smokelessly with both low and high pressure combustible gases and over a wide range of flows.

In addition, at some locations, an inadequate supply of steam would be available for smoke suppression as used in many flare stack burners, and other considerations such as climate might also preclude the use of steam for 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; Shellen-trager, 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; and in Canadian Patent to Williams, No. 691,894, and in British Patent to British Petroleum Co., et al. No. 795,664.

None of these burners or others previously available provide for smokeless burning of low and high pressure waste gases by use of separate gas delivery systems.

SUMMARY OF THE INVENTION

In accordance with the invention a flare stack gas burner is provided for burning of gases from two low and high pressure separate gas delivery systems and over a wide range of flow by structure which includes a low pressure delivery pipe within the stack closed at the top by a closure plate, with flame retention openings, and communicating with 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 low pressure flare gas delivery, a low pressure air blower is provided at the bottom of the stack for introduction of air as a combustion supporting media and which air flows past the vanes.

A high pressure gas line delivers waste combustible gas at high pressure to a ring outside the stack and thence through inclined pipes to upwardly and angularly inclined burner nozzles for smokeless combustion. Ignitors and pilots are also shown.

It is the principal object of the invention to provide a flare stack gas burner which is more effective for the combustion of waste combustible gases at low and high pressure by reason of separate delivery of the high and low pressure gas for combustion.

It is a further object of the invention to provide a flare stack gas burner of the character aforesaid in which the combustible low pressure 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 combustible waste gas at high pressure is delivered at the top of the stack for smokeless combustion.

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, require a minimum of maintenance, and which is more effective in its burning of the waste gas than the flare burners heretofore available.

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 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 top plan view of the flare stack of FIG. 1;

FIG. 3 is a horizontal 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 and at the bottom of which is mounted an air inlet pipe 11 with an axial fan (not shown) and a damper (not shown) to provide variable low pressure air into the interior of the stack pipe 10 for combustion of the waste gas. The stack pipe 10 has a burner tip portion 10a which may be detachably connected for replacement and of a height of the order of eight feet. The pipe 10 is preferably fabricated of steel and coated to reduce rust and may be of the order of fifty feet in height, and of a diameter of the order of two feet.

The stack pipe 10 has, in spaced relation thereto, a centrally disposed interior low pressure delivery pipe 12 with its lower terminus communicating with the supply of low pressure waste gas to be burned. The pipe 12 is closed at the top by an annular closure plate 15 which can be provided with a plurality of openings 16 therethrough for improved flame retention as hereinafter pointed out and in a specific embodiment may have a diameter of the order of ten inches.

The pipe 12 has extending outwardly therefrom a plurality of fixed tilted vanes 18. The vanes 18 (see FIG. 4) are shown as made with converging side wall plates 19 and 20, closed at the bottom by a bottom wall

21 and at the outer end by an end wall 22 and with intermediate stiffeners 23 parallel to the end wall 22. The plates 19 and 20 are separated at the top to provide a gas delivery slot 24 inclined with respect to the horizontal, and at their inner ends the vanes 18 have their interiors in communication with the pipe 12.

The vanes 18 and their gas delivery slots 24 are each at an angle, in a horizontal plane, to a radial line through the center of the pipe 12, which with the tilting imparts a swirling motion to the gas delivered through the slots 24 and with respect to the openings 16 in the closure plate 15.

In larger flare stacks, in order to prevent downflow 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 diode (not shown) such as that shown in my U.S. Pat. No. 3,730,673, dated May 1, 1973 for Vent Seal, can be employed in the burner tip portion 10a or lower in the stack 10.

A high pressure gas supply pipe 30 is provided exteriorly mounted on the stack pipe 10 and extending upwardly to a horizontal ring manifold 31. The ring 31 has gas delivery pipes 32 connected thereto.

Each of the pipes 32 has a vertically upwardly extending portion 33 and an angularly disposed terminal end 35 with a tip 36.

The tip 36, if desired can be similar to that shown in the Bitterlich U.S. Pat. No. 3,463,602, dated Aug. 26, 1969.

The tip 36 and terminal end 35 are inclined and turned or angularly disposed to direct the high pressure gas so as to enhance the swirling action of the burning gases from the high pressure supply.

A plurality of gas pilots 40 are provided with their heads 41 or upper termini between the pipes 32. The pilots 40 can be of the venturi air inspiring type and connected to a gas manifold ring (not shown) to which combustible gas is supplied through a pipe 43. The gas pilots 40 can be supported by brackets 44 secured to the pipe 10.

In order to ignite the gas pilots 40, an igniter pipe 45 is provided through which a gas flame is directed when desired. The igniter pipe 45 can be supported by a bracket (not shown) secured to the pipe 10.

In use, the pilots 40 are continuously burning, ignition being effected by flame delivered through the igniter pipe 45.

Waste gas at low pressure to be burned is delivered through pipe 12 where it passes upwardly and then outwardly into the vanes 18 for delivery through the slots 24 in a plurality of sheet flame patterns offset from horizontal radii through the vertical axis and inclined by the tilting of vanes 18, as determined by the positioning of the slots 24. Air is delivered between the vanes 18 and along the margins of the flames from the slots 24 through the pipe 10, aided as desired by the blower 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 12.

The flame retention openings 16 permit small streams of gas to be discharged to burn above the closure plate 15 and prevent adverse effect of wind on the flame sheets from the slots 24.

If waste gas at high pressure is also or alternatively to be burned it is supplied through pipe 30 to the ring

manifold 31 thence through pipes 32 to tips 36. The inclination of pipes 32 and the inclination of the tips 36 together with the disposition of the spaces between the vanes 18 combine to produce a swirling action which permits complete smokeless combustion of the waste gas.

At high flow rates of only high pressure gas, the swirling action produced by the tips 36 is sufficient to produce smokeless operation without using the air blower.

With high flows of low pressure gas at the same time as high flows of the high pressure gas, air supply from the blower is desirable.

With low flow of low pressure gas and a large flow of high pressure gas, the swirling action brought about by the tips 36 produces smokeless action of both streams.

Both low pressure waste gas and high pressure waste gas can be burned simultaneously, and over a very wide range of flow conditions.

I claim:

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

a combustible low pressure waste gas delivery pipe extending upwardly within said stack pipe,

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

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 pipe,

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

a combustible high pressure waste gas supply pipe exteriorly mounted with respect to said stack pipe, and

a plurality of burner tips connected to said supply pipe and disposed beyond said burner tip portion of said stack pipe and directing said high pressure gas into the path of air from between said vanes, said burner tips being angularly inclined to swirl the gases passing there-through.

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

said high pressure waste gas supply pipe has a plurality of gas delivery pipes connected thereto on which said burner tips are carried.

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

said high pressure gas delivery pipes are inclined upwardly and angularly.

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

said gas delivery pipes are connected to a ring manifold to which said supply pipe is connected.

5. A flare stack burner as defined in claim 1 in which

said low pressure waste gas delivery pipe has an end closure provided with flame retention ports.

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

said vanes are tilted.

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

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

* * * * *