United States Patent [19]

Straitz, III

[11] **3,822,984**

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[54] **FLARE GAS BURNER**

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[52] **U.S. Cl.** **431/283,** 431/202, 431/284

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

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

[56] **References Cited**

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1,808,120	6/1931	Runkwitz	431/284
3,358,736	12/1967	Reed et al.	431/285
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R27,507	10/1972	Turpin	431/202

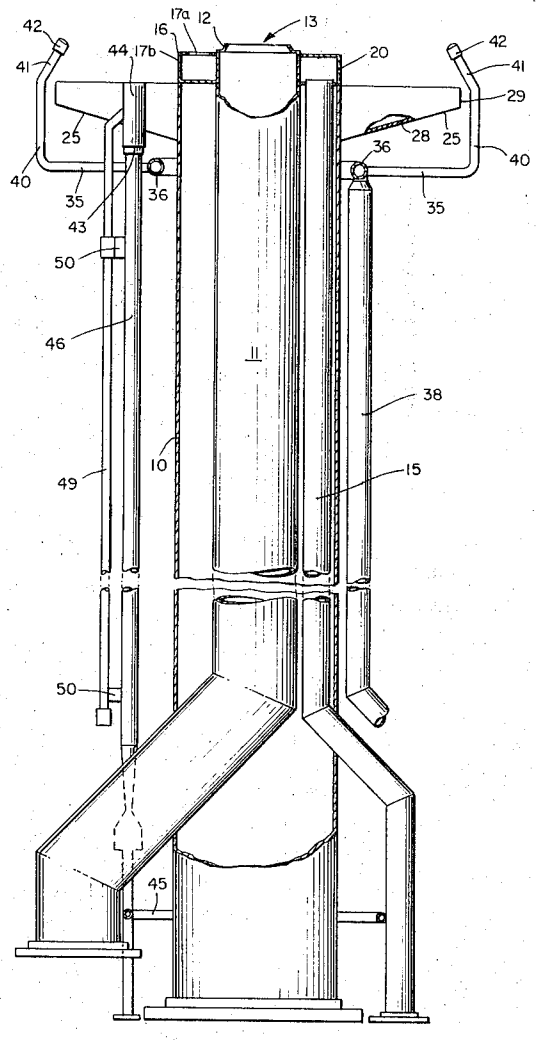
Primary Examiner—Carroll B. Dority, Jr.

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

[57] **ABSTRACT**

A flare gas burner for waste combustible gases from oil refineries and the like is disclosed which includes an outer stack pipe for high pressure gases having at the top thereof a plurality of outwardly extending tilted 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 pipe for a swirling action of the burning gas. An optional supply of high pressure assist gas can be provided for low flow rates of high pressure gas. A supply pipe is provided within the stack pipe for delivery of low pressure gas to an annular ring at the top of the stack which ring has elongated slots in the top and side for delivery of low pressure gas for burning. A relief or emergency dump gas supply pipe is also carried within the stack pipe for delivery of gas to the top of the stack pipe for burning. A steam ring is provided carried at the top of the stack with steam delivery pipes along the high pressure vanes and with angularly disposed tips delivering steam to enhance the swirling action of the burning gas and to suppress smoke. Ignitors and pilots are shown for initiating combustion of the gases.

7 Claims, 5 Drawing Figures



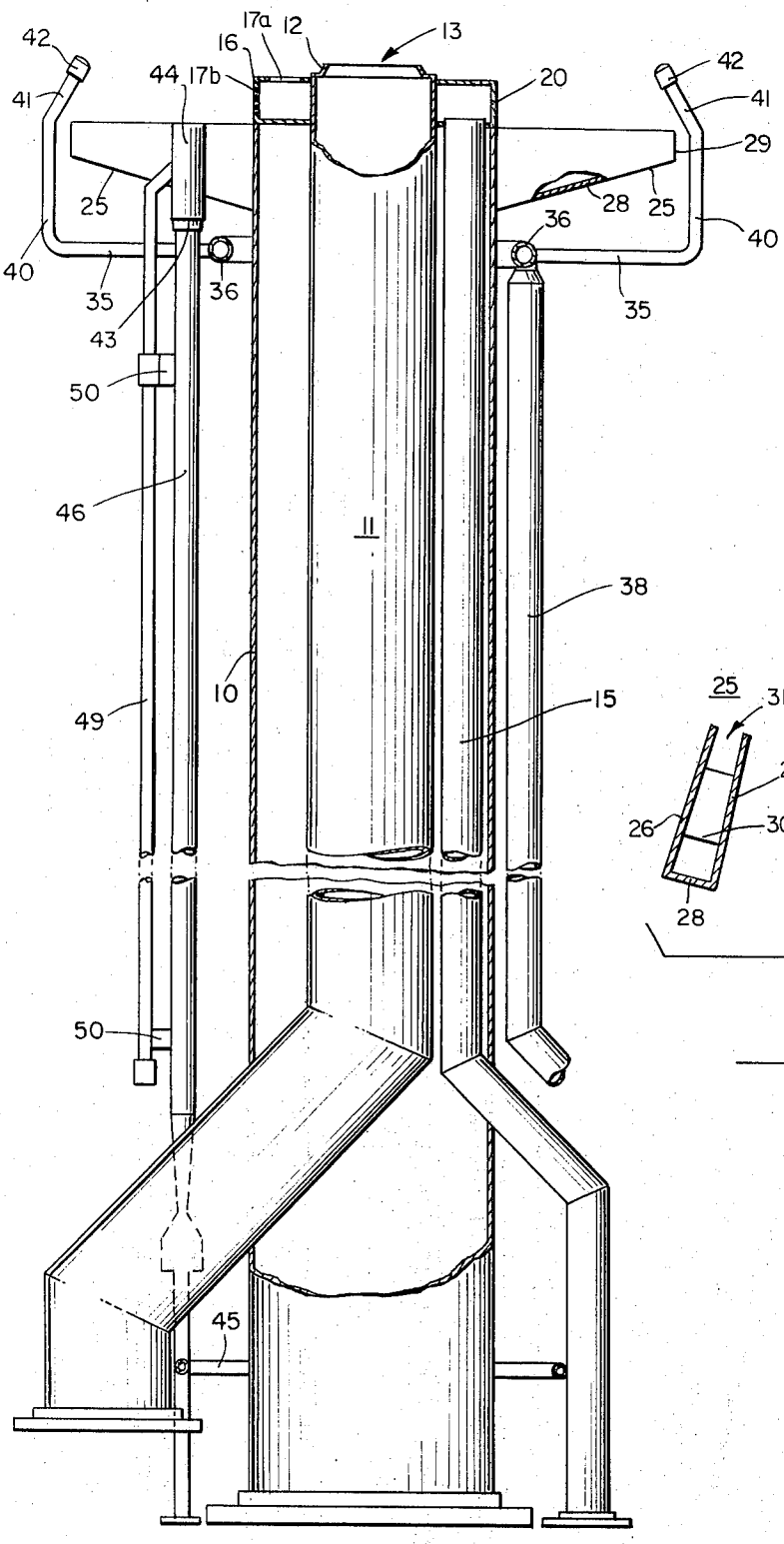

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Fig. 1

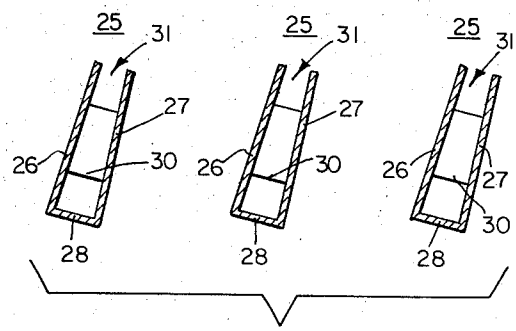
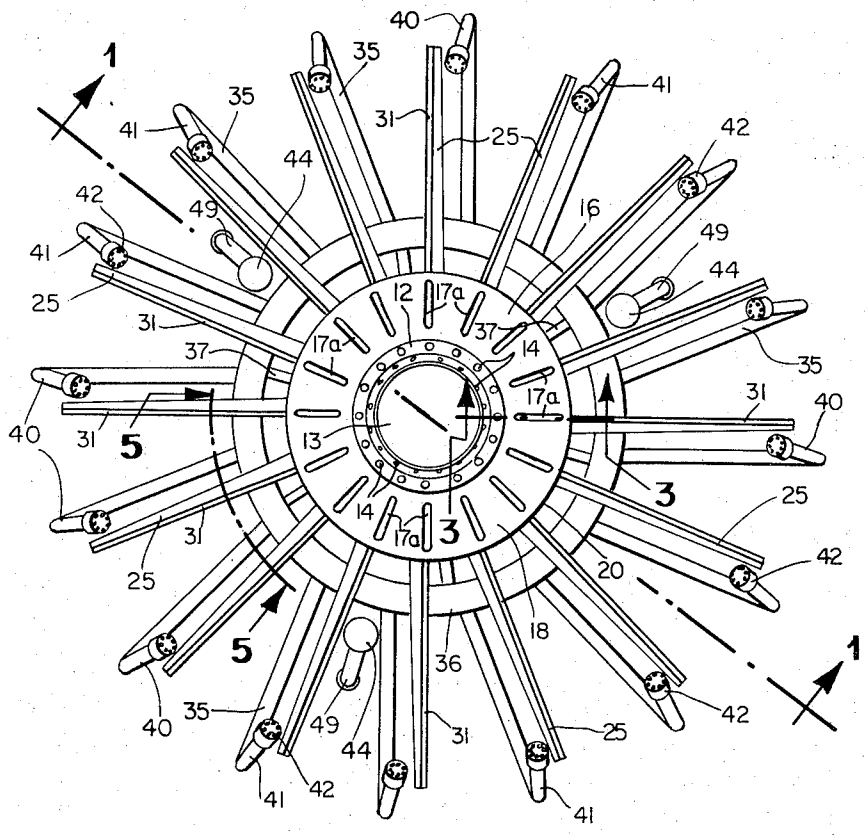

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Fig. 5

Fig. 2



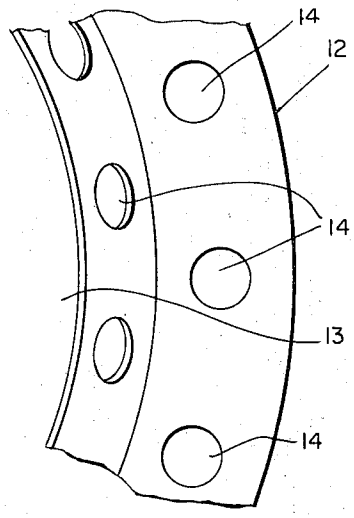
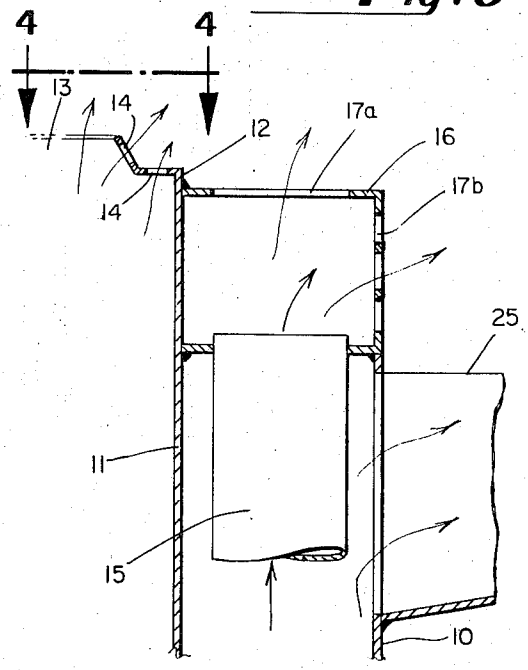


Fig. 4

Fig. 3



FLARE GAS BURNER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to flare gas burners for waste gas from refineries and the like of the type wherein emergency dump high and low pressure gas can be burned independently and at the same time in smokeless condition.

2. Description of the Prior Art

In industrial operations and particularly in the operation of petroleum processing refineries it becomes necessary from time to time to burn various surplus quantities of combustible gaseous materials at low pressure, high pressure or at the entire possible design gas output of the refinery due to emergency conditions. The characteristics of these gaseous materials as well as ecological considerations require that they be burned and that the combustion be carried out without discharge of unburned carbon particles (smoke) into the atmosphere.

Various combination flare gas burners have heretofore been proposed, but some of them have had serious limitations, particularly becuase of inadequate turbulence and intermixing of combustible gases, air, and steam necessary for smoke elimination.

Among the burners heretofore proposed are those shown in the U.S. patents to Verner et al., U.S. Pat. No. 2,761,496; Webster, et al., U.S. Pat. No. 2,891,607; Shelentrager, U.S. Pat. No. 2,506,972; Rodman, U.S. Pat. No. 2,537,091; Zink et al., U.S. Pat. No. 2,779,399; Campbell et al., U.S. Pat. No. 2,802,521; Zink et al., U.S. Pat. No. 3,143,424; Turpin, U.S. Pat. No. Re. 27,507 and in the Canadian Patent to Williams, No. 691,894; and in the British patent to British Petroleum Co., et al., No. 795,664.

Turpin in U.S. Pat. No. Re. 27,507, shows a flare stack combustion tip at the top of the stack, with a plurality of radial arms with movable plates to control the flow and with an outside air venturi shroud to mix the air with the flare gas. The use of movable parts at the relatively inaccessible top of a flare stack is unacceptable from a reliability standpoint since ice deposits as well as likelihood of fouling or corrosion tend to interfere with the demand for availability of operation at any time. The air venturi is also unacceptable from a maintenance standpoint as the wind can cause recirculation down through the venturi causing its destruction by burning within a very short time.

None of the previous structures provide separate provisions for delivery of three different sources of combustible waste gas, i.e. low pressure, high pressure or emergency dump to a single structure where the gases can be burned independently or simultaneously in a smokeless condition.

SUMMARY OF THE INVENTION

In accordance with the invention a flare gas burner is provided which has a stack pipe with high pressure gas introduced thereinto at the bottom, with fixed vanes extending from the top of the stack pipe angularly disposed in a horizontal plane from radial lines through the center of the pipe, the vanes having slots at their top margins for flare gas delivery, the stack carrying a pipe for supplying low pressure waste gas to an annular ring at the top of the pipe with elongated slots for burning of the gas. A centrally disposed relief or emergency gas supply pipe is also carried within the stack pipe for delivery of relief waste gas to the top of the stack for burning.

A steam ring can also be provided, exteriorly mounted to the top of the stack pipe, dependent upon the inherent tendency of the waste gas to develop smoke, with outwardly and upwardly extending pipes along the vanes, with steam delivery to upwardly and angularly disposed tips positioned to enhance the swirling action of the burning gases. An optional supply of high pressure assist gas can be provided to assist the high pressure gas in inducing sufficient air for smokeless burning at low flow rates. Ignitors and pilots are also shown.

It is the principal object of the invention to provide a flare gas burner which is highly effective for the combustion of waste combustible gas at different pressures by reason of the increased turbulence imposed on the combustible gas, air and steam at the top of the stack pipe.

It is a further object of the invention to provide a flare gas burner with three separate gas supply systems for delivery of gas to one location for burning at different supply pressures.

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

It is a further object of the invention to provide a flare gas burner with effective steam delivery for smoke elimination.

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 the flare gas burner in accordance with the invention;

FIG. **2** is a top plan view of the flare gas burner of FIG. **1**;

FIG. **3** is an enlarged fragmentary vertical sectional view taken approximately on the line **3—3** of FIG. **2**;

FIG. **4** is an enlarged fragmentary horizontal sectional view taken approximately on the line **4—4** of FIG. **3**, and

FIG. **5** is an enlarged vertical sectional view taken approximately on the line **5—5** 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 the bottom of which is mounted onto the top of a flare stack (not shown) to which high pressure gas for combustion is delivered from time to time.

The pipe **10** has carried therein a centrally disposed interior relief or emergency dump gas delivery pipe **11** connected to the supply of relief or emergency dump gas. the pipe **11** is closed at the top by an annular closure plate **12** which is provided with a central opening **13** and elongated openings **14** for delivery of the relief gas for burning as hereinafter pointed out.

The pipe **10** has carried therein and shown to one side of the pipe **11** an upwardly extending low pressure gas supply pipe **15** which has its lower terminal connected to a supply of low pressure waste combustible gas. The pipe **15** is connected to an annular ring **16** secured to the top of the pipe **10** with the pipe **11** secured to the center thereof in fluid tight relation which closes off the pipe **10** at the top. The ring **16** is provided with elongated slots **17a** disposed along its top portion **18** and holes **17b** around its outside perimeter **20** for delivery of low pressure gas for burning.

The pipe **10** at the top thereof below the ring **16** has extending outwardly therefrom a plurality of fixed inclined vanes **25.** The vanes **25** are shown as made of converging side wall plates **26** and **27** closed at the bottom by a bottom wall **28** and at the outer end by an end wall **29** and with intermediate stiffeners **30** parallel to the end wall **29.** The plates **26** and **27** are separated at the top to provide a gas delivery slot **31** and at their inner ends have their interiors in communication with the interior of the pipe **10.**

The inclined vanes **25** and their gas delivery slots **31** are each at an angle, in a horizontal plane, to a radial line through the center of the pipe **10** to impart a swirling motion to the gas delivered through the slots **31.**

The vanes **25** preferably have disposed therealong horizontal steam delivery pipes **35** connected to a horizontal steam supply ring **36.** the ring **36** can have supporting brackets **37** secured thereto and to the pipe **10** and is supplied with steam by a steam supply pipe **38.**

Each of the pipes **35** has a vertically upwardly extending portion **40** and an angularly disposed terminal end **41** with a tip **42.** The tip **42** can be similar to the tip shown in the U.S. Patent to Bitterlich, U.S. Pat. No. 3,463,602 and the terminal end **41** is inclined and turned or angularly disposed to direct steam to enhance the swirling action of the burning gases.

A plurality of gas pilots **43** are provided with their heads **44** or upper terminii between the vanes **25.** The pilots **43** can be of the venturi air inspirating type and connected to a gas manifold ring **45** to which combustible gas is supplied through a pipe **46.** The gas pilots **43** can be supported by brackets **47** secured to the pipe **10.**

In order to ignite the gas pilots **43,** an igniter pipe **49** is provided through which a gas flame is directed when desired. The igniter pipe **49** can be supported by brackets **50** secured to the pilot **43.**

In use the pilots **43** are continuously burning, ignition being effected by flame delivered through the igniter pipe **49.**

The waste gas to be burned at high pressure is delivered through the flare stack to the pipe **10** where it passes upwardly and then outwardly into the vanes **25** for delivery through the slots **31** in a plurality of sheet flame patterns as determined by the positioning of the slots **31.**

If low pressure waste gas is to be burned it is supplied through pipe **15** to the annular ring **16** where it passes out through the slots **17*a*** and holes **17*b*** and is ignited by the pilots **43.**

If high pressure gas is then introduced into the vanes **25** the burning low pressure gas assists in igniting it.

If relief or emergency dump gas is to be burned it flows upwardly in pipe **11** to plate **12** where it passes out through openings **13** where it is ignited by burning low pressure gas or by the pilots **43.**

If the flare is not burning smokelessly, steam can be introduced through the pipes **35** and out the tips **42** where it serves to enhance the swirling action of the gases and suppress smoke.

In addition if the high pressure gas flow is insufficient for complete combustion high pressure assist gas can be supplied to pipe **10.**

It is therefore apparent that the flare is capable of burning low pressure waste gas, high pressure waste gas or emergency dump waste gas either independently or simultaneously as dictated by the plant conditions and without smoke, for the low pressure and high pressure waste streams and with gaseous fluid such as steam or assist gas for smoke suppression.

I claim:

1. A flare gas burner for combustible waste gas comprising

an outer stack pipe connected to a supply of waste gas at high pressure,

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

said vanes having their slots disposed at an acute angle to a plane including a radius and the vertical longitudinal axis of said pipe,

a low pressure gas supply pipe associated with said stack pipe,

means connected to said low pressure pipe for delivery of said gas for burning at the upper end of said stack pipe and within the confine of the surrounding vanes,

an emergency dump waste gas supply pipe associated with said stack pipe,

means connected to said dump gas supply pipe for delivery of said gas for burning at the upper end of said stack pipe and within the confine of the low pressure gas delivered to the upper end of the stack, and

means associated with said stack pipe supplying gaseous fluid for smoke suppression.

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

said means for burning connected to said low pressure supply pipe includes an annular manifold having elongated slots on its top and along its perimeter.

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

said means for burning connected to said emergency dump gas supply pipe includes a plate with openings therein.

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

said smoke suppression means includes a steam ring with angularly upwardly extending pipes, and

said pipes are provided with angularly inclined tips.

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

said smoke suppression means includes members for supplying gas to the upper end of said stack pipe.

6. A flare gas burner as defined in claim **2** in which

said low pressure gas supply pipe is carried within said stack pipe, and

said manifold is secured to the top of said stack pipe.

7. A flare gas burner as defined in claim **2** in which said emergency dump gas supply pipe is secured to said manifold.

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