United States Patent [19]

Straitz, III

[11] **3,797,991**

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[54] **FLARE BURNER**

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

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[52] **U.S. Cl.** ..... **431/202,** 23/277 C

[51] **Int. Cl.** **F23b 5/00**

[58] **Field of Search** ..... 431/202, 5; 23/277 C

[56] **References Cited**

UNITED STATES PATENTS

3,547,567 7/1973 Turpin 431/202

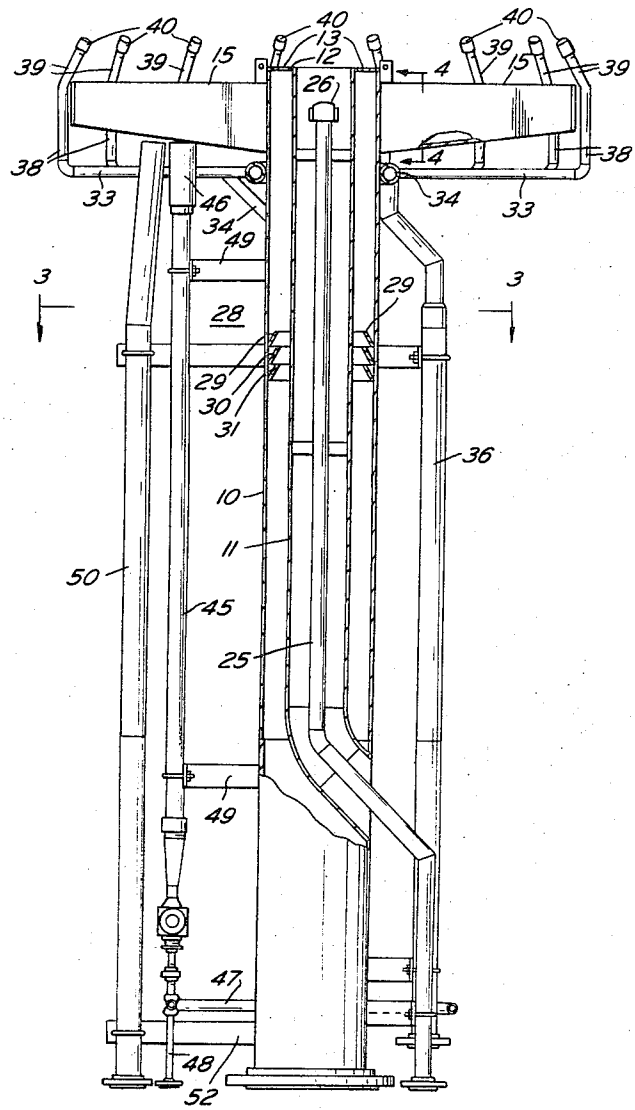
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[57] **ABSTRACT**

A flare burner for waste combustible gases from oil refineries and the like is disclosed which includes a stack for the gases with central air duct and steam pipe, the stack having 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. The stack has a closure plate with flame retention openings. An interior back flow preventing diode can be employed and also an optional steam ring with steam delivery pipes along the vanes and with angularly disposed tips to enhance the swirling action of the burning gas. Ignitors and pilots are shown.

10 Claims, 4 Drawing Figures



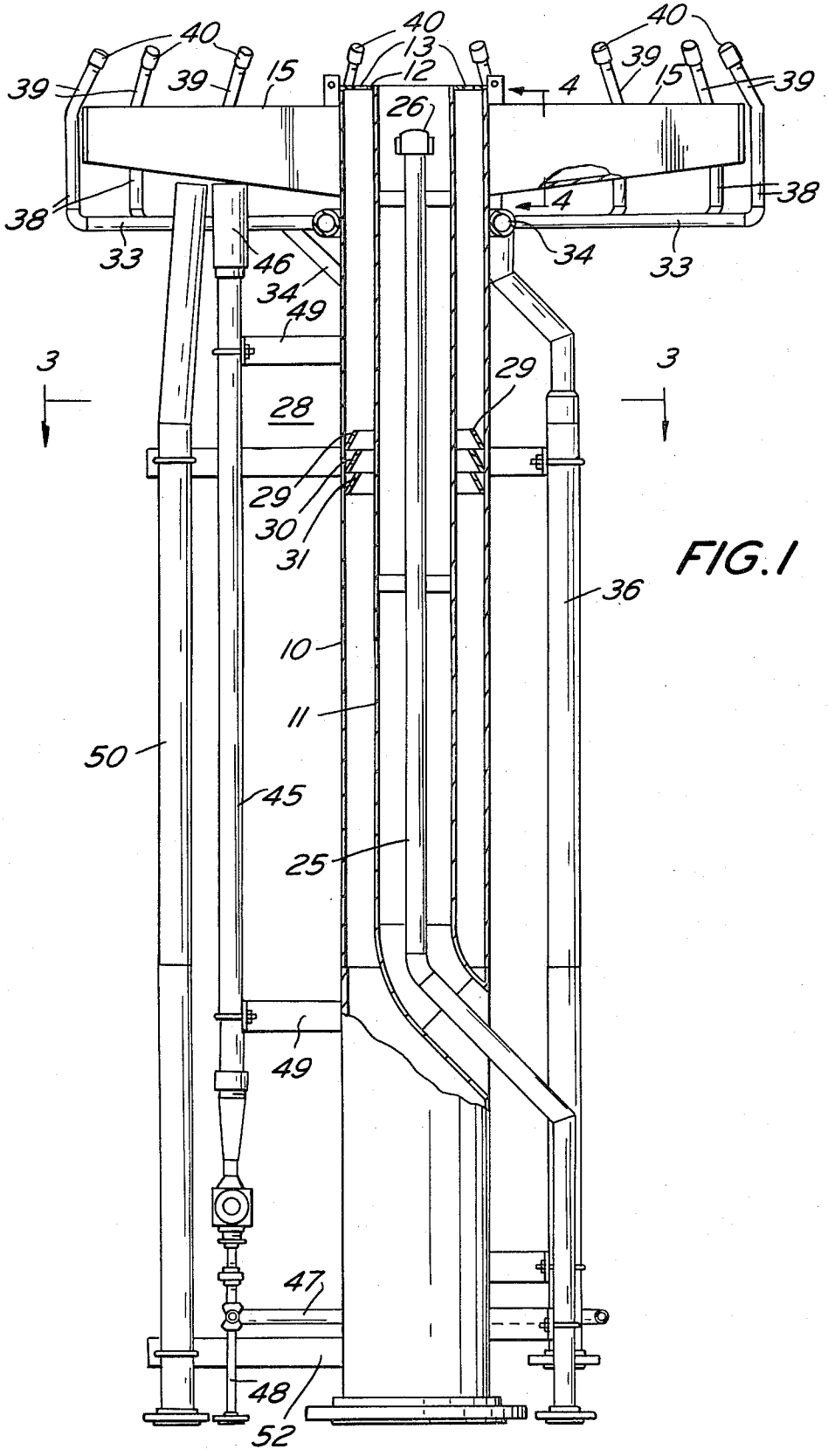

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FIG. 1

FIG. 2

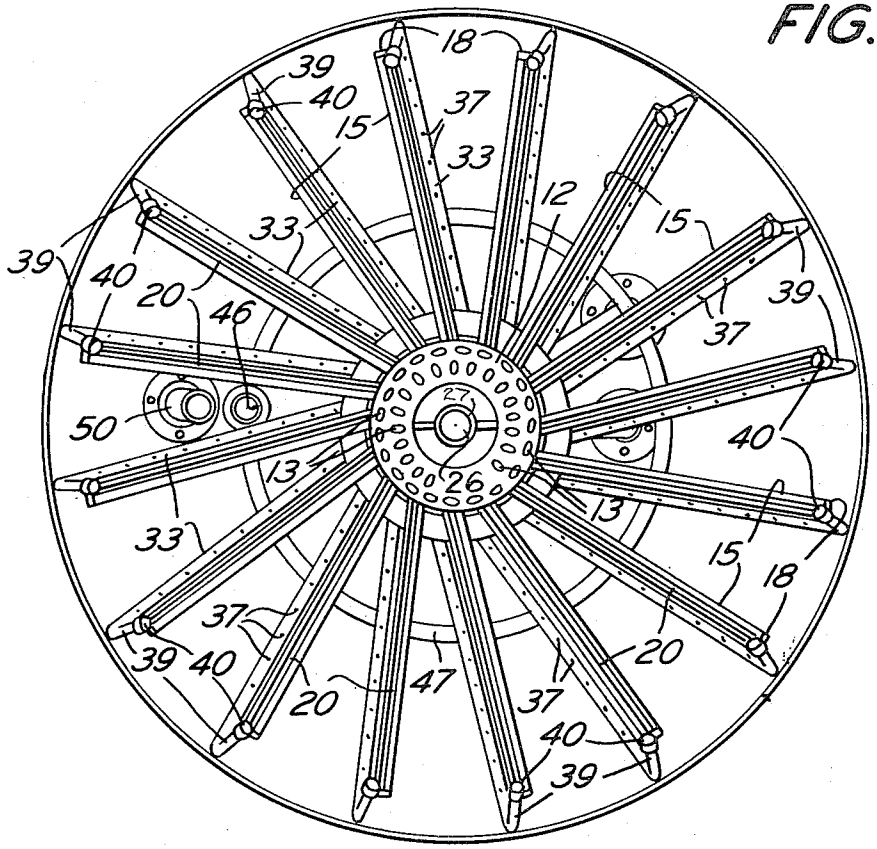
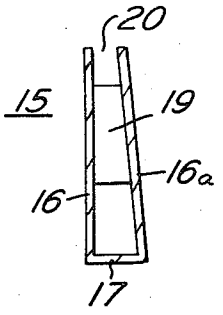


FIG. 4



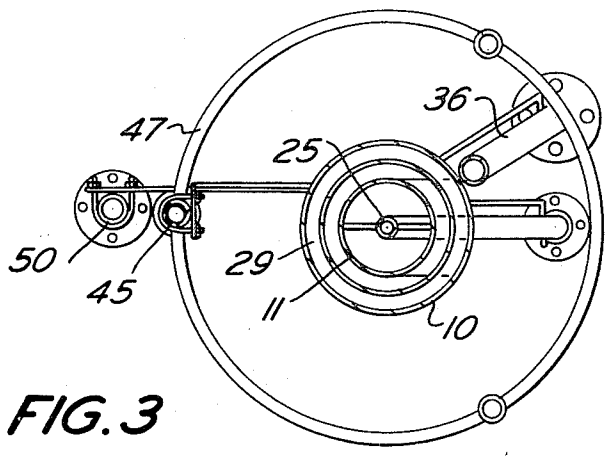


FIG. 3

FLARE BURNER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to flare burners for waste gas from refineries and the like.

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 large quantities of combustible gaseous materials. The characteristics of these materials as well as ecological considerations require that they be burned and that the combustion be carried out without discharge of unburned carbon particles in the form of smoke into the atmosphere.

Various flare stack burners have heretofore been proposed but these have had serious limitations, particularly because of inadequate turbulence and intermixing of combustible gases, air, and the steam necessary for smoke elimination.

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; 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. R. 27507, 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 a recirculation down through the venturi causing its destruction by burning within a very short time.

It has heretofore been proposed in gas fired burners to employ radial arms with gas jets to provide a radial flame pattern in furnaces, (see Reed U.S. Pat. No. 2,824,603), but these burners were not suitable for nor intended for use with flare stacks and do not provide turbulence as with the flare burner of the present invention.

SUMMARY OF THE INVENTION

In accordance with the invention a flare stack burner is provided with which more effective intermixture of combustible gas, air and steam is accomplished by structure at the top of the stack including fixed vanes extending from the stack angularly disposed in a horizontal plane from radial lines through the center of the stack, the vanes having slots at their top margins for flare gas delivery, the central part of the stack having an annular closure plate with flame retention openings, and a center opening for air delivery through a central air duct. If desired, steam or air as an inducing media can be delivered through a central pipe. The stack, dependent on its size and the atmospheric wind conditions can have an interior diode to prevent downflow of air within the stack but permit unretarded upward delivery of combustible stack gas.

A steam ring can also be provided, additionally or alternatively to the inducing fluid pipe, dependent upon the inherent tendency of the waste gas to develop smoke, with outwardly extending pipes along the vanes, with or without steam delivery ports, and with an upwardly and angularly disposed tip positioned to enhance a swirling action of the burning gas. Ignitors and pilots are also shown.

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

It is a further object of the invention to provide a flare burner of the character aforesaid in which the combustible waste gas, air and steam at the burner are given a swirling action.

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

It is a further object of the invention to provide a flare gas burner with improved delivery of the gas for combustion.

It is a further object of the invention to provide a flare gas burner having improved provisions for 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 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. 1; and

FIG. 4 is an enlarged vertical sectional view taken on the line 4—4 of FIG. 1.

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 burner pipe 10 is shown, circular in horizontal cross section and the bottom of which is mounted onto the top of a flare stack to which gas for combustion is delivered from time to time.

The pipe 10 has in spaced relation thereto a centrally disposed interior air delivery pipe 11 with its lower terminus 12 communicating with the atmosphere at the exterior of the pipe 10. The space between the pipes 10 and 11 is closed at the top by an annular closure plate

12 which can be provided with a plurality of openings 13 therethrough for flame retention as hereinafter pointed out.

The pipe 10 has extending outwardly therefrom a plurality of fixed vanes 15. The vanes 15 are shown as made of converging side wall plates 16 and 16a closed at the bottom by a bottom wall 17 and at the outer end by an end wall 18 and with intermediate stiffeners 19 parallel to the end wall 18. The plates 16 and 16a are separated at the top to provide a gas delivery slot 20 and at their inner ends have their interiors in communication with the space between the pipes 10 and 11.

The vanes 15 and their gas delivery slots 20 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 20 and with respect to the central opening in the pipe 11.

Within the inner pipe 11, and on the central vertical axis of the pipes 10 and 11, a pipe 25 is provided having a tip 26 with diverging openings 27. The tip 26 can, if desired, be similar to that shown in the Bitterlich U.S. Pat. No. 3,463,602 The pipe 25 is connected to a suitable source of inspirating fluid, preferably steam, to aid in the upward delivery of air in the pipe 11 and thereby eliminate any hard central core of gas which would not be penetrated by air from outside.

In place of steam delivered to and through the pipe 25, in some instances air under pressure may be employed for aiding in the delivery of air upwardly through and from the pipe 11.

In larger flare stacks, in order to prevent downflow in the interior of the 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 28, such as that shown in my U.S. application filed May 12, 1971 Ser. No. 142,700 , for vent seal, can be employed. The fluidic diode 28 preferably comprises a plurality of frusto-conical baffles 29, 30 and 31 of metal or other material not adversely effected by the elevated temperature of the flare gas, which may be of the order of 400° to 700° Fahrenheit. The baffles 29, 30 and 31 terminate at their peripheries at the pipe 10, and have aligned central openings which are preferably of increasing ascending areas.

The vanes 15 preferably have disposed therealong horizontal steam delivery pipes 33 connected to a horizontal steam supply ring 34. The ring 34 can have supporting brackets 35 secured thereto and to the pipe 10 and is supplied with steam by a steam supply pipe 36.

Each of the pipes 33 can have therealong a plurality of holes 37 to push air upwardly between the vanes 15 for burning the gas from the slots 20.

Each of the pipes 33 has a vertically upwardly extending portion 38 and an angularly disposed terminal end 39 with a tip 40. The tip 40 can be similar to the tip 26 and terminal end 39 is inclined and turned or angularly disposed to direct steam to enhance the swirling action of the burning gases.

A plurality of gas pilots 45 are provided with their heads 46 or upper terminii between vanes 15. The pilots 45 can be of the venturi air inspirating type and connected to a gas manifold ring 47 to which combustible gas is supplied through a pipe 48. The gas pilots 45 can be supported by brackets 49 secured to the pipe 10.

In order to ignite the gas pilots 45, an igniter pipe 50 is provided through which a gas flame is directed when desired. The igniter pipe 50 can be supported by a bracket 52 secured to the pipe 10.

In use the pilots 45 are continuously burning,ignition being effected by flame delivered through the igniter pipe 50.

The waste gas to be burned is delivered through the flare stack to the pipe 10 where it passes upwardly and then outwardly into the vanes 15 for delivery through the slots 20 in a plurality of sheet flame patterns as determined by the positioning of the slots 20. Air is delivered to the inner margins of the flames from the slots 20 through the pipe 11, aided as desired by inspirating fluid, discharged through the tip 26 from the pipe 25. If the content of waste gas is such that smoke formation tends to occur,the inspirating fluid through the pipe 25 is steam which tends to reduce smoke formation in and/or discharge with the flame.

The pipes 33, dependent on the content of the waste gas, deliver air or steam through the tips 40 to provide a swirling action and can deliver air or steam through the holes 37 to induce upward movement of air between the vanes to aid in the combustion and to promote turbulence of that air and the contiguous flames. If there is a tendency to smoke formation then steam is preferred for delivery through the pipe 33 through openings 37 and their tips 40.

The flame retention openings 13 permit small streams of gas to be discharged to burn above the closure plate 12 and prevent adverse effect of wind on the flame sheets from the slots 20.

I claim:

1. A flare stack burner for waste gas comprising

a waste gas delivery pipe,

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

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

means associated with said pipe for inducing air flow for combustion of waste gas delivered through said pipe.

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

said pipe has an air delivery pipe in spaced relation in the interior thereof.

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

said means for inducing air flow includes a pipe within said air delivery pipe delivering air flow inducing fluid under pressure upwardly in said air delivery pipe.

4. A flare stack burner as defined in claim 3 in which

said air flow inducing pipe is connected to a source of steam.

5. A flare stack burner as defined in claim 2 in which

said waste gas delivery pipe and said air delivery pipe have a closure provided with flame retention ports.

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

said waste gas delivery pipe has a fluidic diode therein permitting upward flow in said pipe and obstructing downward flow therein.

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

said vanes have air flow inducing pipes therealong, and

said pipes have openings for delivery of flow inducing pressure fluid to induce swirling of burning gas from said slots.

8. A flare stack as defined in claim 1 which

said means for inducing air flow comprise air flow inducing pipes along said vanes, and

said pipes along their lengths have upwardly facing openings for inducing upward air flow between said vanes for contact with gas from said slots.

9. A flare stack burner as defined in claim 8 in which

said air flow inducing pipes are connected to a source of steam.

10. A flare stack burner as defined in claim 3 in which

said means for inducing air flow further comprises

air flow inducing pipes extending along said vanes and having discharge openings for discharge of air flow inducing fluid into contact with gas from said slots.

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