Oct. 10, 1972 R. D. REED 3,697,231

BURNER ASSEMBLY FOR FLARE STACK

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FIG. 1.

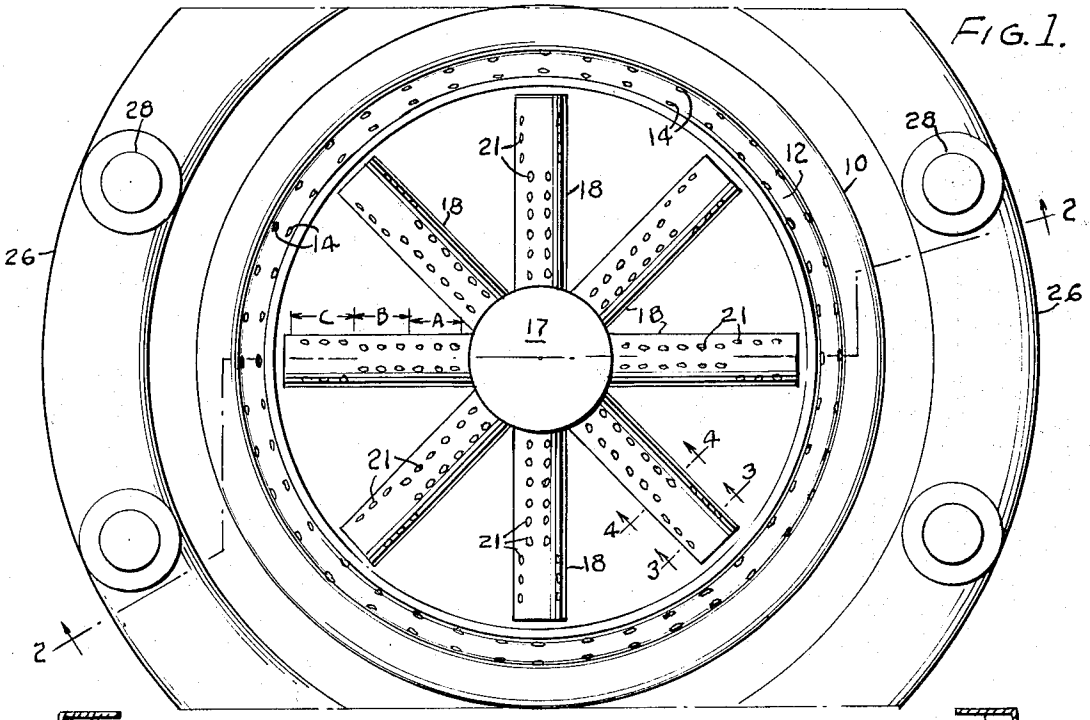
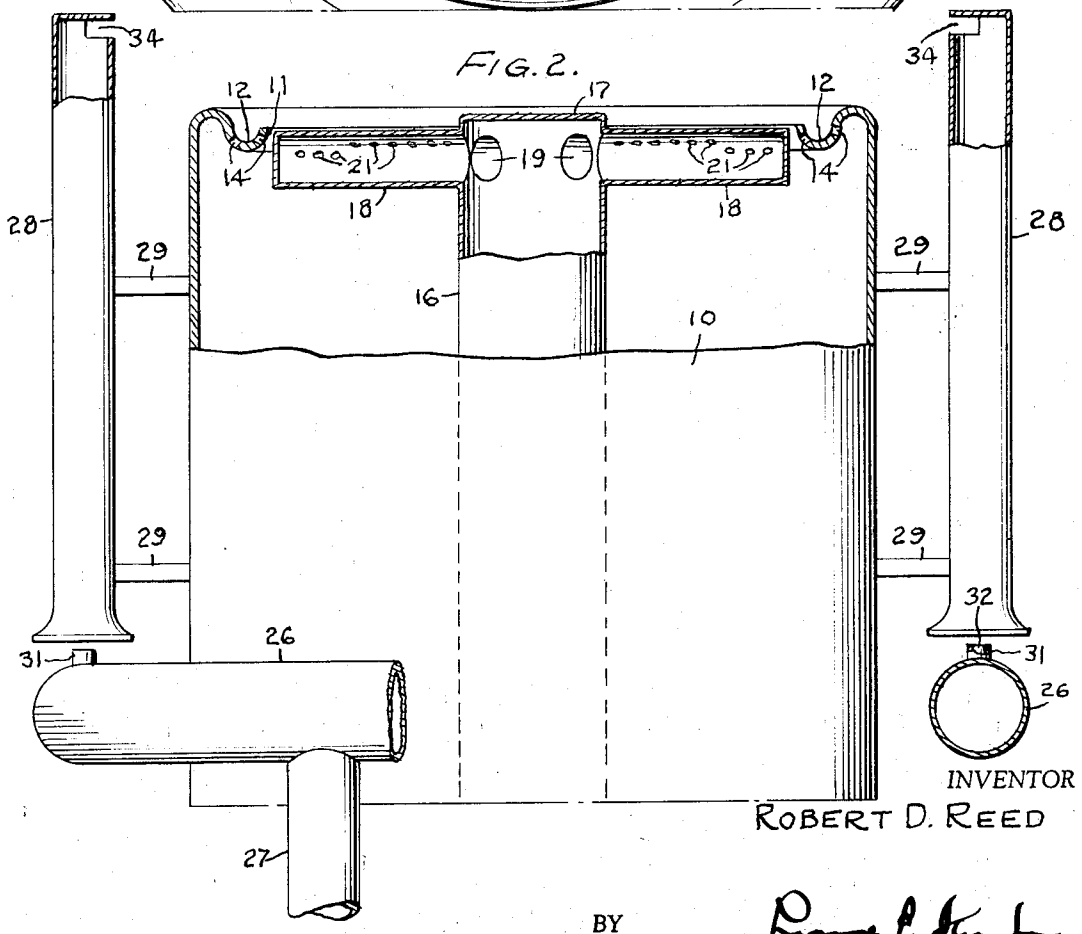


FIG. 2.



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FIG. 3.

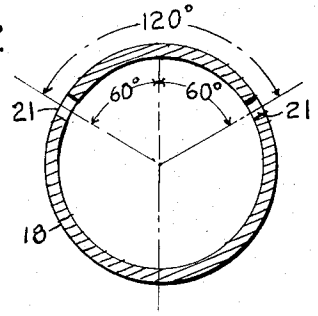


FIG. 4.

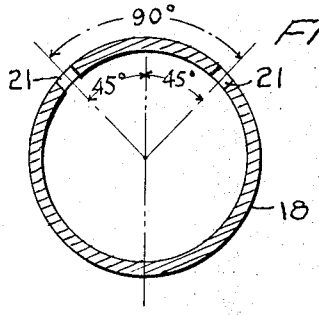


FIG. 5.

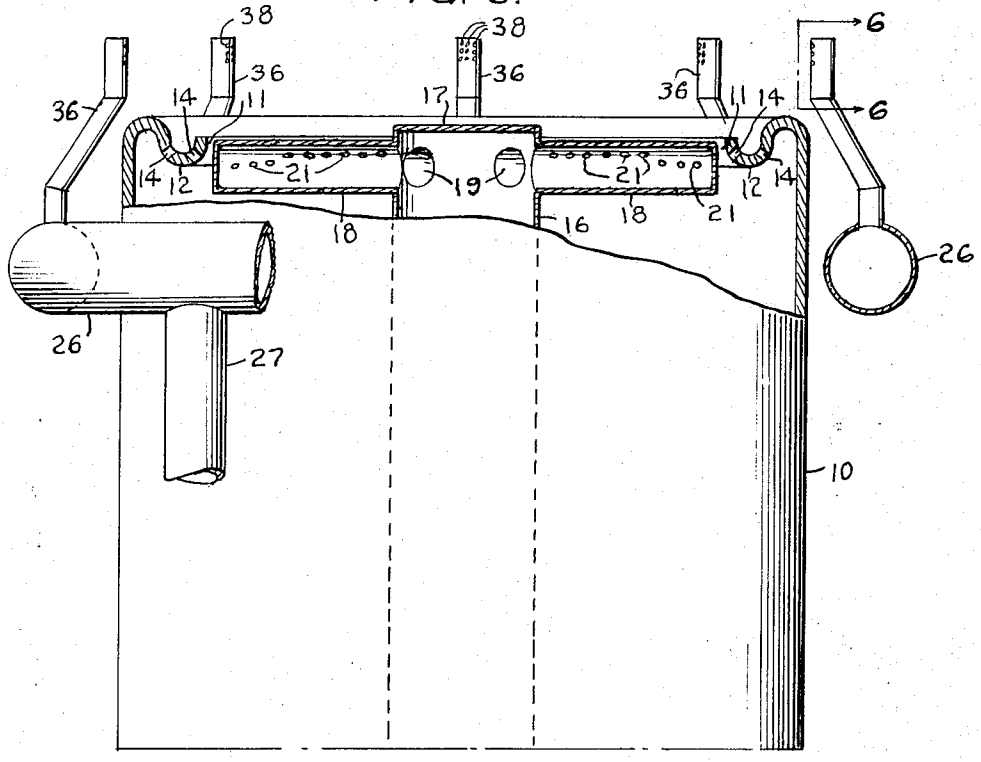


FIG. 6.

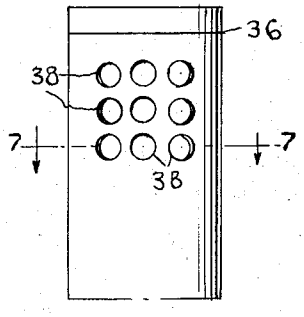
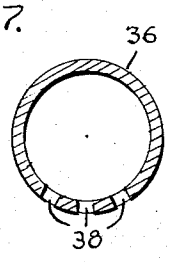


FIG. 7.



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BURNER ASSEMBLY FOR FLARE STACK

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Int. Cl. F23d 13/20
U.S. Cl. 23—277 C 10 Claims

ABSTRACT OF THE DISCLOSURE

A burner assembly for the upper end of a flare stack designed for the combustion of gases at significant elevations above the surrounding terrain wherein a smoke suppressant is thoroughly mixed with the gas prior to the burning reactions and to a structural arrangement which distributes the smoke suppressant in volumes proportional to the quantity of the gases to be burned.

The present invention pertains to a burner assembly for the upper end portion of a stack through which dump or waste gases are guided and the invention more specifically relates to the structure at the upper end of the stack for insuring substantially smokeless combustion of the gases with small quantities of a smoke suppressant.

It is known to add water vapor to a hydrocarbon in order to reduce the smoke resulting from the combustion of the gas. Steam is used for this purpose and it is an object of the present invention to provide a burner assembly for the upper end of a flare stack which will provide for the thorough mixing of the steam with the gas prior to the development of the burning reactions.

Another object of the invention is to provide structure at the upper end of a flare stack which will deliver quantities of a smoke suppressant in proportion to the quantity of the gas moving through different portions of the flare stack to promote thorough mixing of the smoke suppressant with the gas and to reduce the quantity of water vapor that is required to provide smokeless combustion of the gas.

Other objects and features of the invention will be appreciated and become apparent as the present disclosure proceeds and upon consideration of the accompanying drawings taken with the following detail description wherein several embodiments of the invention are disclosed.

In the drawings:

FIG. 1 is a plan view of the upper end of flare stack and the burner assembly embodying the invention;

FIG. 2 is an elevational view of the flare stack with the portions shown in section and taken on the line 2—2 of FIG. 1;

FIG. 3 is a sectional view taken on the line 3—3 of FIG. 1;

FIG. 4 is a similar view taken on the line 4—4 of FIG. 1;

FIG. 5 is an elevational view of an upper portion of the flare stack showing a modified arrangement for the delivery of steam into combustion zone;

FIG. 6 is an elevational view of one of the steam distributing nozzles and taken on the line 6—6 of FIG. 5; and;

FIG. 7 is a sectional view taken on the line 7—7 of FIG. 6.

This invention is directed to a burner assembly for the combustion of gas at the upper end of a stack wherein a smoke suppressant such as steam is mixed with the gas prior to the burning reactions and thoroughly mixed with the gas in order to promote smokeless combustion of the gas at significant elevations above the ground level.

There is shown at 10 the upper portion of a stack

which is in the form of a vertically disposed tubular member and may extend upwardly from the surrounding terrain to any desired height. The upper end portion of the tubular member is provided with an opening 11 through which the gas may escape. An inturned flange 12 defines the perimeter of the opening 11. A plurality of ports 14 are provided in the flange 12 for the purpose of maintaining ignition at the upper end of the stack.

A pipe 16 extends upwardly within the tubular member 10. Steam is delivered into the pipe 16 at pressures greater than twice absolute atmospheric pressure. The upper end of the pipe 16 terminates in a hub portion 17 which serves to support a plurality of radially disposed hollow arms 18. The arms 18 receive the steam under pressure through openings 19 in the hub portion 17. The arms 18 are disposed below the lip of the flange 12 which defines the opening 11.

Each hollow arm 18 is provided with a plurality of discharge ports 21 for the escape of the steam. Such arm is considered to have three zones A–B–C as indicated in FIG. 1. The discharge ports 21 throughout zones A and B of each arm are displaced from each other by ninety degrees, as shown in FIG. 4. The discharge ports 21 in the zone C of each arm are displaced from each other by approximately one hundred and twenty degrees, as shown in FIG. 3. This structural arrangement provides a horizontal component for the steam escaping through the ports 21 in zone C of each hollow arm 18 for penetration into the gas moving toward the opening 11 adjacent the perimeter of the stack.

Another feature of the discharge ports 21 and the arrangement thereof along each hollow arm is that the area of the ports in the zones A–B–C is proportional to the volume of the gas that moves upwardly over the different portions of each hollow arm. The total area of the ports 21 in the zone A of each arm amounts to approximately 0.182 of the total area of the ports in one arm 18. The total area of the ports 21 in the zone B of each arm is approximately 0.349 of the total area of the ports in each arm. The total area of the ports 21 in zone C of each arm amounts to approximately 0.469 of the total area of the ports in each arm. Thus the quantity of steam injected into the gas in each zone is proportioned to the quantity of the gas moving upwardly in the areas between the radially disposed hollow arms 18.

A manifold 26 surrounds the tubular member 10 adjacent the upper end of a stack. Steam is delivered into the manifold through a supply pipe 27. A plurality of circumferentially spaced aspirating tubes 28 are disposed in vertical positions above the manifold 26. These aspirating tubes may be supported by brackets 29 which project from the stack structure. The aspirating tubes 28 are desirably located midway between projections of the hollow arms 18 as shown in FIG. 1, but may be mounted in other portions relative to the hollow arms 18. A nozzle 31 is provided on the manifold 26 adjacent the lower end of each aspirating tube 28. An orifice 32 in each nozzle provides for the escape of a jet of steam into the lower end of each aspirating tube 28. The low pressure condition developed around each of the escaping jets draws air into the lower end of each aspirating tube. The air and steam is mixed as it moves upwardly through each aspirating tube. A discharge opening 34 at the upper end of each aspirating tube directs a mixture of steam and air in horizontal direction over the upper end of the flare stack. A mixture of steam and air is delivered into the areas between and adjacent the outer end portions of the hollow arms 18 for mixture with the gas.

A modification is shown in FIGS. 5, 6 and 7, wherein tubes 36 extend upwardly from the manifold 26 so that the steam escapes into these tubes. The upper end portion of each tube 36 is provided with a plurality of dis-

charge orifices **38**. The tubes **36** are circumferentially spaced about the upper end portion of the flare stack and the tubes may be disposed intermediate the hollow radial arms **18** to deliver steam into the gas escaping through the opening **11** between the outer end portions of the arms **18**. The upper end portions of the tubes **36** are disposed closely adjacent the perimeter of the stack so that the energy of the escaping steam is utilized in promoting turbulence and the mixture of the steam with the gas.

While the invention has been described with reference to particular features and with regard to several organizations of elements it will be appreciated that changes may be made in the components as well as the over-all assembly. Such modifications and others may be made without departing from the spirit of the invention.

What is claimed and desired to be secured by Letters Patent is:

1. A flare stack comprising an upright tubular member having an upper end with an opening therein for the escape of gas, means adjacent to said opening for igniting the gas, a pipe extending upwardly within said tubular member, a hub member carried by the upper end of said pipe, a plurality of arms extending radially from said hub member terminating adjacent the perimeter of said opening, means supplying steam under pressure into said pipe and into said hollow arms, said arms having a plurality of discharge ports therein, the total area of said discharge ports in the vicinity of the hub being less than the total area of the ports near the outer end of each arm, and means for delivering steam radially inward over the upper end of the tubular member.

2. The flare stack of claim **1** wherein the area of the discharge ports in a zone near the outer end of each arm is approximately 0.469 of the total area of the ports in the associated arm.

3. The flare stack of claim **1** wherein the discharge ports adjacent the outer end of each arm are displaced from a vertical plane through the center of each arm at a greater angle than the displacement of the discharge ports near the hub member.

4. The flare stack of claim **1** icnluding means for mixing air with the steam delivered over the upper end of the stack.

5. A flare stack comprising an upright tubular member having an opening in the upper end thereof for the escape of gas, means adjacent to the said opening for igniting the gas, a pipe extending upwardly within said tubular member, a plurality of arms extending radially from the pipe and terminating adjacent to the perimeter of said opening, means for supplying steam under pressure into said pipe and into said hollow arms, a plurality of discharge ports in each of said hollow arms with those discharge ports adjacent to the outer end of the arm being displaced from a vertical plane through the center thereof at a greater angle than the displacement of the discharge ports adjacent to the said pipe, the total area of the said ports adjacent the discharge end of the arm being about 0.47 and the total area of the remaining ports being about 0,53 of the area of all the ports in the arm, and means for delivering a mixture of air and steam radially inwardly over the upper end of the tubular member.

6. The flare stack of claim **1** wherein said discharge ports are disposed in circumferentially spaced rows of radially spaced ports.

7. The flare stack of claim **6** wherein the said rows of discharge ports adjacent to the perimeter of the opening are spaced circumferentially a greater distance than the rows of ports adjacent to the said pipe.

8. The flare stack of claim **1** wherein said igniting means defines the perimeter of said opening and has a plurality of circumferentially spaced ignition ports therein.

9. The flare stack of claim **1** wherein the said means for delivering steam radially inwardly over the upper end of the tubular member comprises a plurality of aspirating tubes disposed in vertical positions about the said opening.

10. The flare stack of claim **9** wherein said aspirating tubes are supported above a manifold about said tubular member.

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U.S. Cl. X.R.

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