

[54] **GROUND FLARES**

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[51] Int. Cl. **F23d 13/20**

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

[56] **References Cited**

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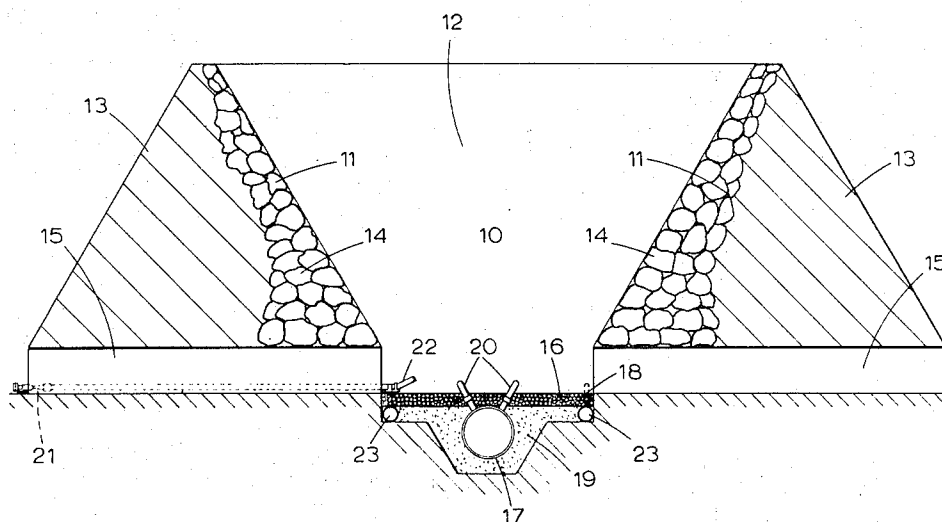
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[57] **ABSTRACT**

A ground flare with a combustion zone defined by a floor and walls constructed from earthen banks, stone, rock, bricks or the like. Tubes leading through the walls into the interior of the flare to convey primary combustion air to the combustion zone. A manifold disposed beneath the floor of the flare leads to a series of nozzles projecting upwardly from the flare which serve to discharge a waste gas into the combustion zone. Pilot burners are provided to ignite the waste gas. Some of the nozzles are each surmounted by an air moving device which is fed with steam. The steam flows over a Coanda annulus and serves to induce ambient air into the waste gas discharged by the nozzle.

16 Claims, 7 Drawing Figures



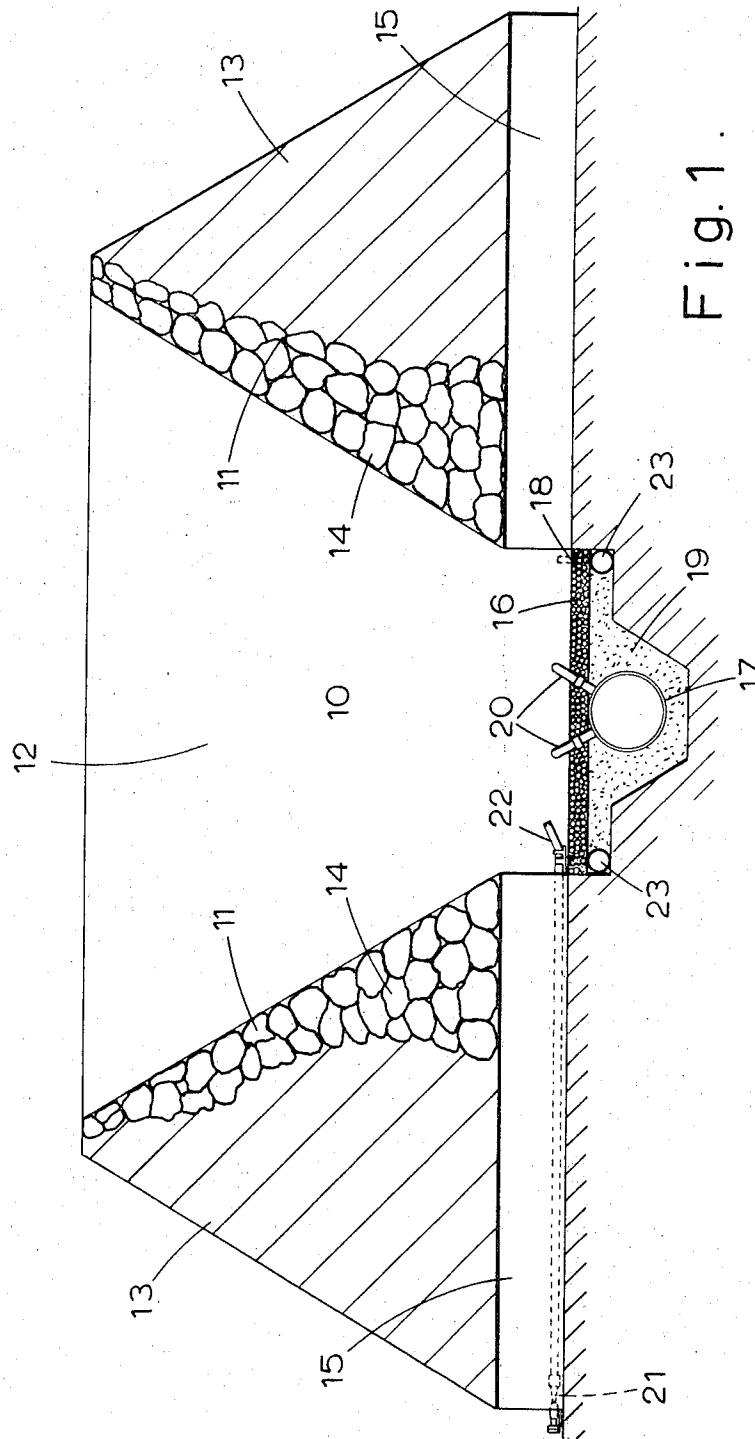


Fig. 1.

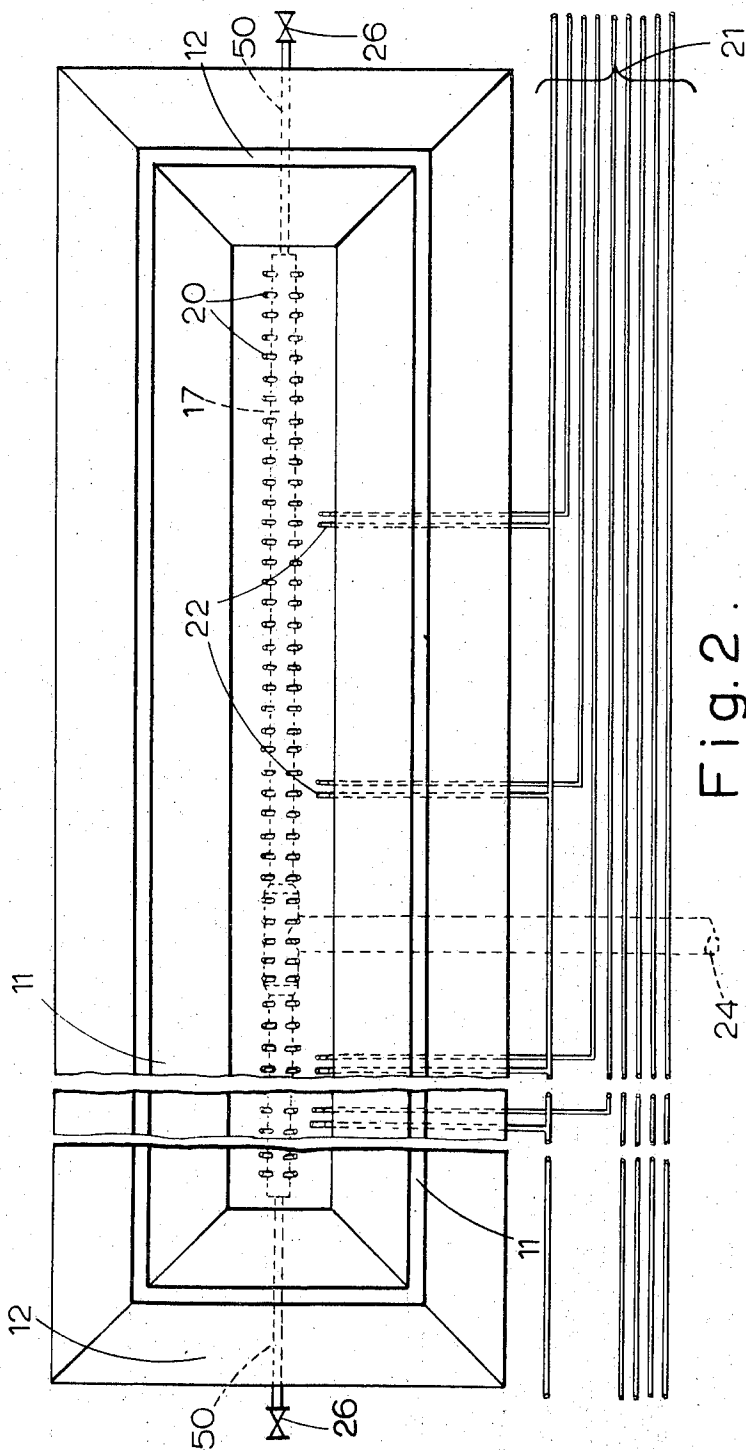
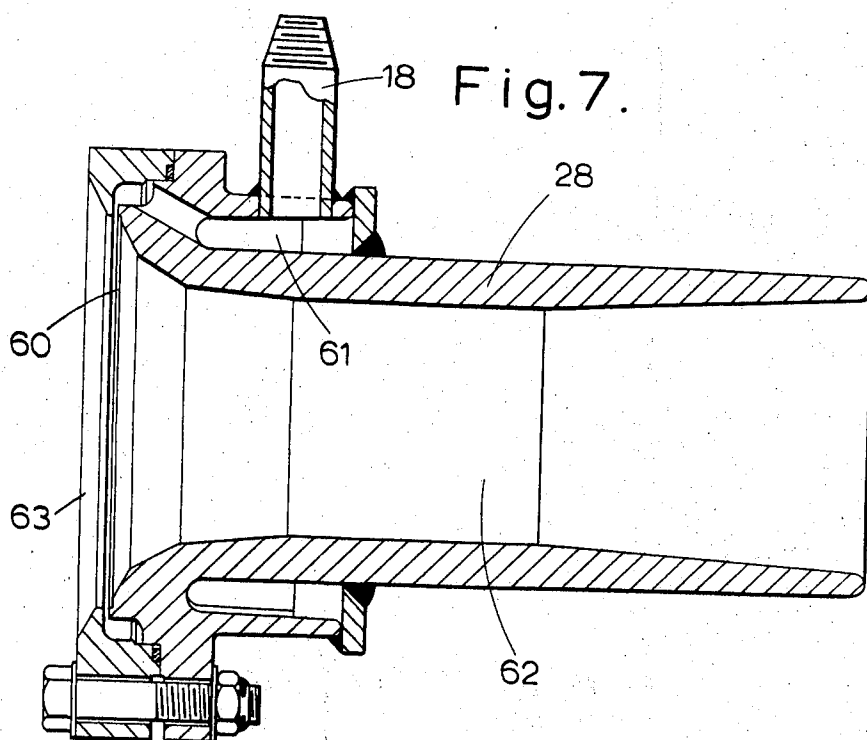
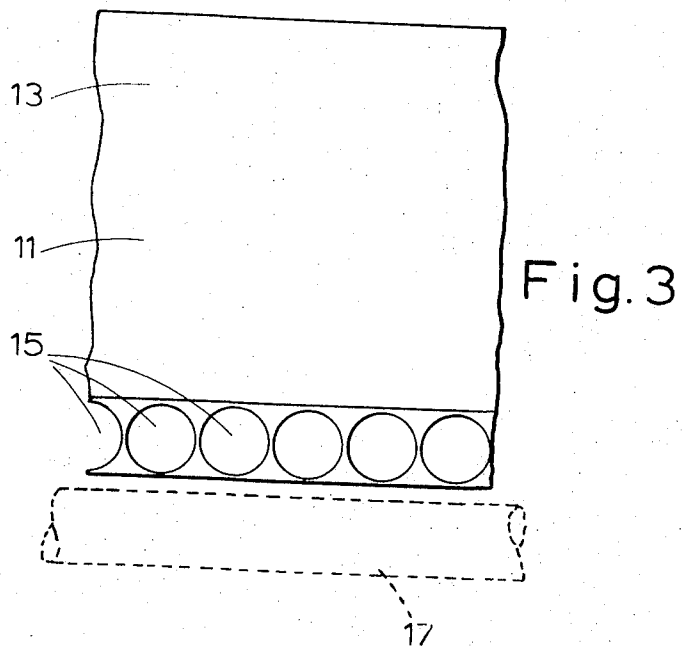


Fig. 2.



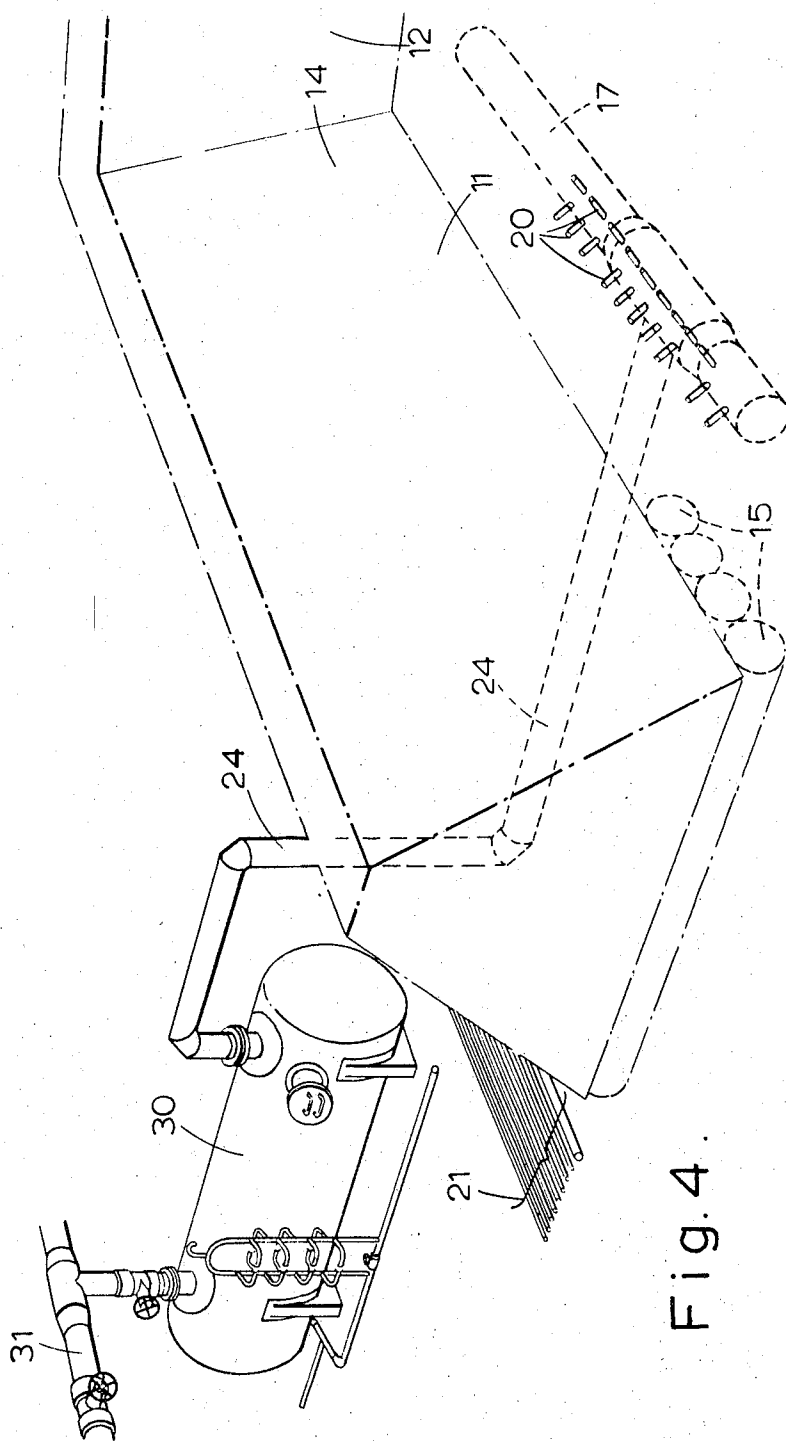


Fig. 4.

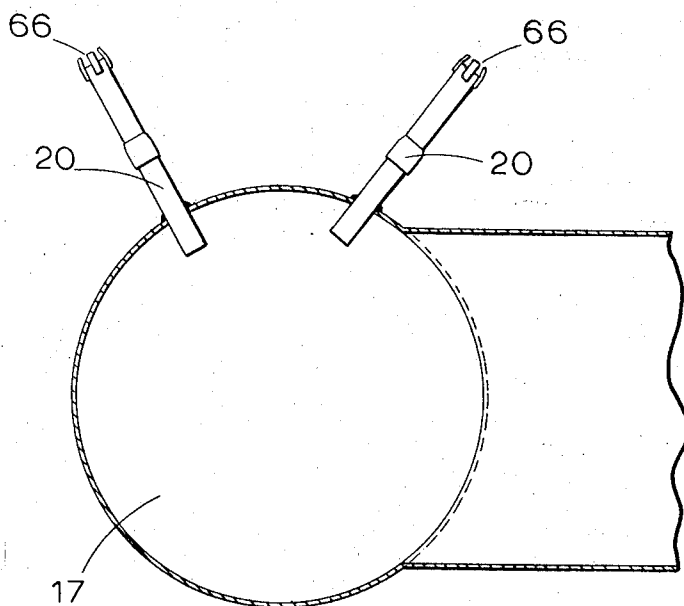


Fig. 5.

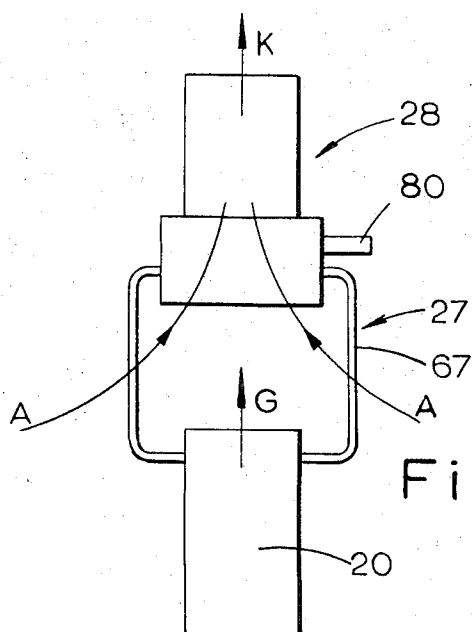


Fig. 6.

GROUND FLARES

BACKGROUND OF THE INVENTION

The present invention relates to ground flares for disposing of waste or dump gas primarily in the petrochemical field.

Flares are widely used for disposing of waste gas and generally such flares are classed as ground or elevated flares.

A general object of the invention is to provide an improved ground flare with particular regard to achieving substantially smokeless combustion.

SUMMARY OF THE INVENTION

In its broadest aspect the invention provides a ground flare comprising means for defining a combustion zone, and a plurality of nozzles for discharging a combustible waste gas into said zone, at least one of the nozzles being operably associated with an air moving or inducing device which operates in the manner known as the Coanda effect.

The invention also provides a ground flare comprising means for defining a combustion zone, means for conveying air to said zone, a plurality of nozzles for discharging a waste gas for combustion in said zone, air inducing devices which operate on the Coanda principle operably associated with at least some of the nozzles and means for feeding an inducing medium, preferably steam, to each of said devices to induce air to mix with the gas discharged from the nozzle associated therewith, whereby to effect substantially smokeless combustion.

Although steam is a preferred inducing medium any fluid generally having a higher pressure than that of the waste gas can be used.

In a preferred arrangement each nozzle having an air inducing device associated therewith discharges gas into the air inducing device and the device in turn discharges a mixture of gas, air and the inducing medium into the combustion zone. Combustion of the resultant mixture together with waste gas discharged by others of the nozzles is effected by means of pilot burners known per se. A ground flare made in accordance with the foregoing is found to achieve substantially smokeless combustion, and this can be controlled by varying the pressure of the inducing medium so as to cause more or less air to be introduced into the combustion zone.

The combustion zone may be substantially rectangular in plan view and defined by walls fabricated from earth banks lined with a refractory material. It is also possible for the zone to be defined by metallic walls forms as a box again lined with a refractory material. In this latter construction the walls may be fabricated on a modular basis with standard units joined end-to-end to form a zone of the desired size and capacity.

In a ground flare made in accordance with the invention the nozzles may be arranged in rows at ground level and fed with gas from an underground manifold. Some of the nozzles perhaps every other one or two in a row would have an air inducing device assembled therewith while the remaining nozzles serve simply to discharge gas directly into the combustion zone with the existing devices inducing air into the gas discharged from those nozzles also. In a further modification some of the simpler nozzles may be provided with sealing

means adapted to open only when the quantity of gas to be disposed of rises above a pre-determined amount.

In a preferred form the, or each, air inducing device has a body with a central bore of aerofoil section communicating with an air inlet at one end of the body, a chamber with an outlet adapted to receive inducing medium, and an internal "Coanda" annulus over which the inducing medium flows to induce air flow through the bore in combination with the inducing medium.

The device may then be supported on its associated nozzle and spaced apart therefrom to permit waste gas discharged from the nozzle to enter the inlet in addition to the air so that the device discharges a mixture of the waste gas, air and the inducing medium into the combustion zone.

In one ground flare made in accordance with the invention the maximum quantity of gas that can be handled is typically 90 tons per hour but there is no strict limitation on this figure.

The invention may be understood more readily, and various other features of the invention may become more apparent, from consideration of the following description.

BRIEF DESCRIPTION OF DRAWINGS

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings, wherein:

FIG. 1 is a part-sectional end view of a ground flare made in accordance with the invention;

FIG. 2 is a plan view of part of the ground flare;

FIG. 3 is a side view of part of the ground flare;

FIG. 4 is a perspective view showing part of the flare in conjunction with the associated pipework and pressure vessel;

FIG. 5 is an enlarged sectional end view of the gas manifold of the flare showing simple forms of outlet nozzles;

FIG. 6 is a diagrammatic representation of an assembly of a gas nozzle and an air moving device; and

FIG. 7 is a longitudinal sectional view of the air moving device shown in FIG. 6.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring initially to FIGS. 1 to 3, the ground flare has a combustion zone 10 which is of generally rectangular configuration in plan view. The zone 10 is defined by side walls 11 and end walls 12. The zone 10 has a floor 16 formed from a layer of aggregate 18 laid onto a bed 19 of sand. The walls 11, 12 are constructed above ground level from an earthen bank 13 lined internally with a course of stone, rock, brick or the like. The internal lining, denoted 14, can be a refractory material and is inclined upwardly and outwardly from the floor 16 of the zone 10 as can be best seen in FIG. 1.

At the base of each side wall 11 there is provided a series of parallel tubes 15 set in concrete and arranged transversely to the longitudinal axis of the floor 16. The tubes 15, which are open at both ends, serve to convey primary combustion air into the zone 10.

A manifold 17, in the form of a pipe closed at its ends, is disposed below ground level and at the longitudinal centre of the floor 16. The manifold 17 communicates with a supply pipe 24 extending transversely thereto and exteriorly of one of the walls 11. The pipe

24 serves to convey a combustible waste gas to the manifold 17 for disposal in the zone 10. The upper peripheral part of the manifold 17 is provided with two rows of inclined nozzles 20 which project above the floor 16. Each row of nozzles 20 is disposed along a line disposed parallel to and laterally offset from the longitudinal axis of the floor 16. The nozzles 20 are generally directed towards the inner surfaces 14 of the walls 11. The nozzles 20 communicate with the interior of the manifold 17.

A drain cock 26 also communicates with the manifold 17 via an inclined drain pipe 50 at each end of the manifold 17. These drain cocks 26 serve to allow liquid condensate to be removed from the manifold 17.

Laid along the outside of one of the walls 11 there are groups of conduits 21. The conduits 21 include gas and air conduits leading to pilot burners 22, via some of the tubes 15, and a steam conduit leading to a steam manifold 23 by means of one or more sub-conduits laid below the ground level. The manifold 23 is, in this construction, formed from two interconnected tubes disposed beneath the floor 16 at the bases of the side walls 11.

As shown in FIG. 4, the pipe 24 feeding the manifold 17 is taken above ground level to a pressure vessel 30. The vessel 30 is part filled with water and forms a water seal generally known per se. The vessel 30 is in turn fed from a pipe 31 leading to a main waste gas supply pipe.

The nozzles 20 take two basic forms one of which is shown in FIG. 5. In this form the nozzle 20 is a simple open ended tube set in an aperture in the manifold 17 and affixed thereto. A flame retention head 66 is provided at the outer end of the nozzle 20.

In the second form the nozzle 20 shown in FIG. 5, but without the head 66 is supplemented by an air moving or inducing device. The resultant assembly is depicted in FIGS. 6 and 7. As shown in FIG. 6, the nozzle 20 is surmounted by a bracket 27, composed of rods 67, attached to the upper end of the nozzle 20. The bracket 27 is used to support an air moving device 28.

This device 28, which is shown in more detail in FIG. 7, has an inlet 80 which is fed with steam from the steam manifold 23. The flow path of the steam induces air, depicted by the arrow A, and supplied from the pipes 15 to enter the device 28 and mix with the waste gas, depicted by the arrow G, discharged from the nozzle 20 therebeneath. The steam actually mixes with the air and gas so that the device 28 discharges from its upper end a mixture of gas, air and steam, depicted by the arrow K, which mixture is subsequently combusted in the zone 10 and substantially in a smoke-free manner. Referring now to FIG. 7, the device 28 has a body with a central bore 62 of aerofoil section communicating with an air inlet 63 at one end of the body. The device has an internal "Coanda" annulus, denoted 60, over which steam introduced into a chamber 61 via the inlet 80 flows to induce air to flow into the inlet 63 and through the bore 62 in combination with the steam. The inducement of the air to flow as a stream through the device 28 by the passage of the steam in this manner is known as the Coanda effect. The device 28 thus operates in the manner known as the Coanda effect to induce air to flow through the device by utilizing steam as an inducing medium.

Some of the nozzles 20 may be provided with the device 28 and some of the nozzles 20 would take the form

illustrated in FIG. 5 since one device 28 may be sufficient to supply air and steam for several nozzles. A further refinement would be to provide each of a further group of the single nozzles 20 (FIG. 5) with a weighted sealing cap or some other sealing means. This sealing means would normally close the nozzle 20 associated therewith and would only open when the pressure of the gas in the manifold rose above a pre-set level. In this way the group of nozzles 20 having these caps can be used as auxiliary gas discharge nozzles.

The actual numbers and positionings of the nozzles 20 which take the forms represented in FIGS. 5 to 7 and the modified form as discussed above depends upon a variety of factors and would be determined by design and particular requirements. The operation of the ground flare is as follows:

In a typical petro-chemical installation the waste or dump gas supply arrangement would feed the ground flare as well as one or more elevated flares sometimes called flare stacks. These elevated flares would normally operate where higher quantities of waste gas have to be disposed of. The ground flare would normally operate with lower quantities of waste gas say typically 5 - 10 tons per hour. The vessel 30 effectively forms a one-way valve which only permits waste gas to flow in the direction of the manifold 17. Where the latter is fed with gas this gas is discharged by at least some of the nozzles 20 incorporating the devices 28 (FIGS. 6 and 7) into the zone 10 and is supplemented by gas discharged from the simple nozzles 20 (FIG. 1). The resultant mixture of steam, gas and air discharged into the zone 10 is combusted by operating one or more of the pilot burners 22. The subsequent combustion is substantially smoke free even with heavier waste gases and by controlling the pressure of the steam, (say from 10 to 100 lbs. per square inch) the amount of air entering the zone 10 for supporting combustion and hence the combustion process itself can be controlled. However the effect of varying the steam pressure also enables the smokeless form of combustion to be controlled for various types and mixtures of waste gases.

We claim

1. In a ground flare comprising a combustion zone, means for conveying air to said combustion zone and means for conveying a waste combustible gas to said combustion zone; the improvement comprising a plurality of nozzles for discharging the combustible waste gas into the combustion zone with at least one of the nozzles being operably associated with an air inducing device which operates in the manner known as the Coanda effect.

2. A ground flare according to claim 1, wherein some of the plurality of nozzles are each associated with an air inducing device.

3. A ground flare according to claim 1, and further comprising means for feeding an inducing medium to the air inducing device.

4. A ground flare according to claim 1, and further comprising means for feeding steam to the air inducing device, the steam serving to induce air to mix with the gas so that a mixture of gas, air and steam is discharged from the associated nozzle into the combustion zone.

5. A ground flare according to claim 3, wherein there is provided means for varying the pressure of the inducing medium to control the combustion process.

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6. A ground flare according to claim 4, wherein there is provided means for varying the pressure of the steam to control the combustion process.

7. A ground flare according to claim 1, and further comprising pilot burners for igniting the waste gas.

8. A ground flare according to claim 1, wherein the combustion zone is rectangular in plan view and is defined by walls lined internally with a refractory material, the nozzles projecting upwardly from the floor of the zone and communicating with a manifold laid below ground level.

9. A ground flare according to claim 8, wherein some of the walls have tubes extending therethrough, the tubes constituting means for conveying air to the zone.

10. A ground flare according to claim 8, wherein the nozzles are arranged in rows extending longitudinally of the zones and each nozzle is inclined towards one of the side walls.

11. A ground flare according to claim 8, wherein the manifold communicates with a waste gas feed pipe taken above ground level exteriorly of the walls and leading to a pressure vessel incorporating a water seal.

12. A ground flare according to claim 8, wherein the manifold communicates with one or more drain pipes and drain cocks permitting liquid to be drained from the manifold.

13. A ground flare according to claim 1, wherein

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some of the nozzles have sealing means adapted to open when the quantity of waste gas to be disposed of rises above a predetermined amount.

14. A ground flare according to claim 1, wherein the air inducing device has a body with a central bore of aerofoil section, communicating with an air inlet at one end of the body, a chamber with an outlet adapted to receive inducing medium, and an internal "Coanda" annulus over which the inducing medium flows to induce air to flow through the bore in combination with the inducing medium.

15. A ground flare according to claim 14, wherein the air inducing device is supported on its associated nozzle and spaced apart therefrom to permit waste gas discharged from the nozzle to enter the inlet in addition to the air so that the device discharges a mixture of the waste gas, air and the inducing medium into the combustion zone.

16. A ground flare comprising means for defining a combustion zone, means for conveying air to said zone, a plurality of nozzles for discharging a waste gas for combustion in said zone, air inducing devices which operate on the Coanda principle operably associated with at least some of the nozzles and means for feeding an inducing medium, to each of said devices to induce air to mix with the gas discharged from the nozzle associated therewith whereby to effect substantially smokeless combustion.

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