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FLARE STACK IGNITION

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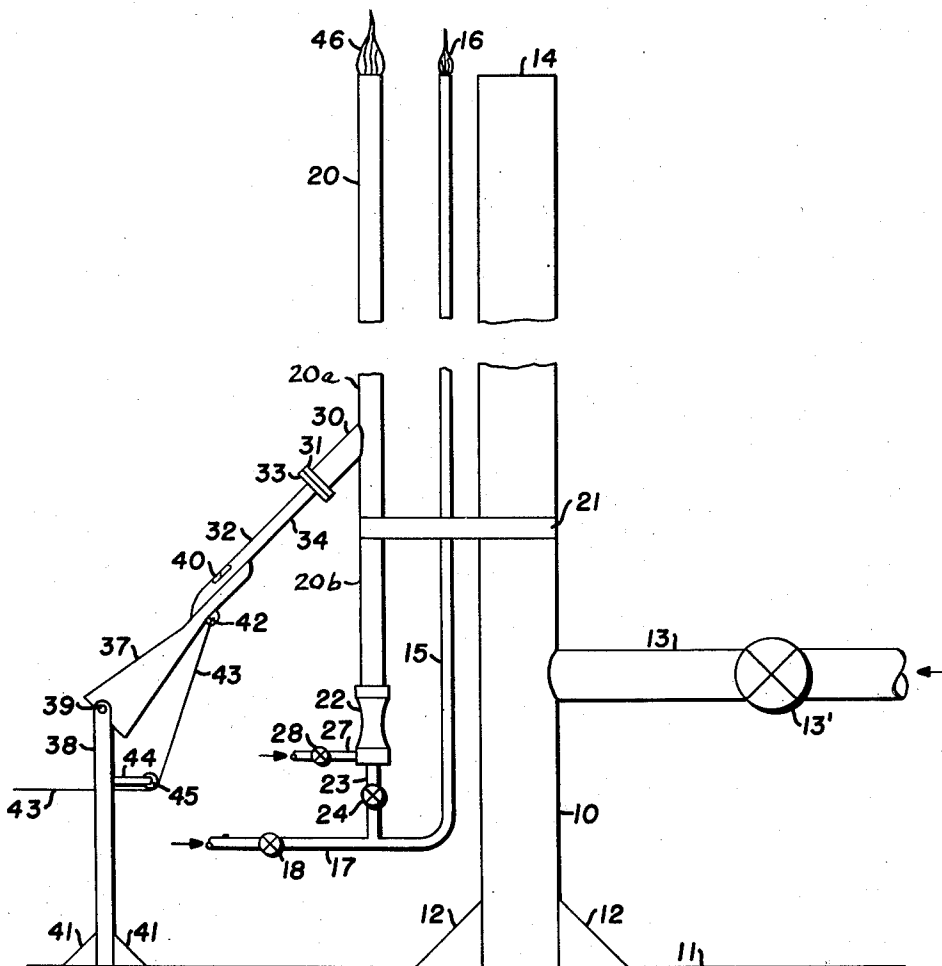


FIG.-1

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FLARE STACK IGNITION

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2 Sheets-Sheet 2

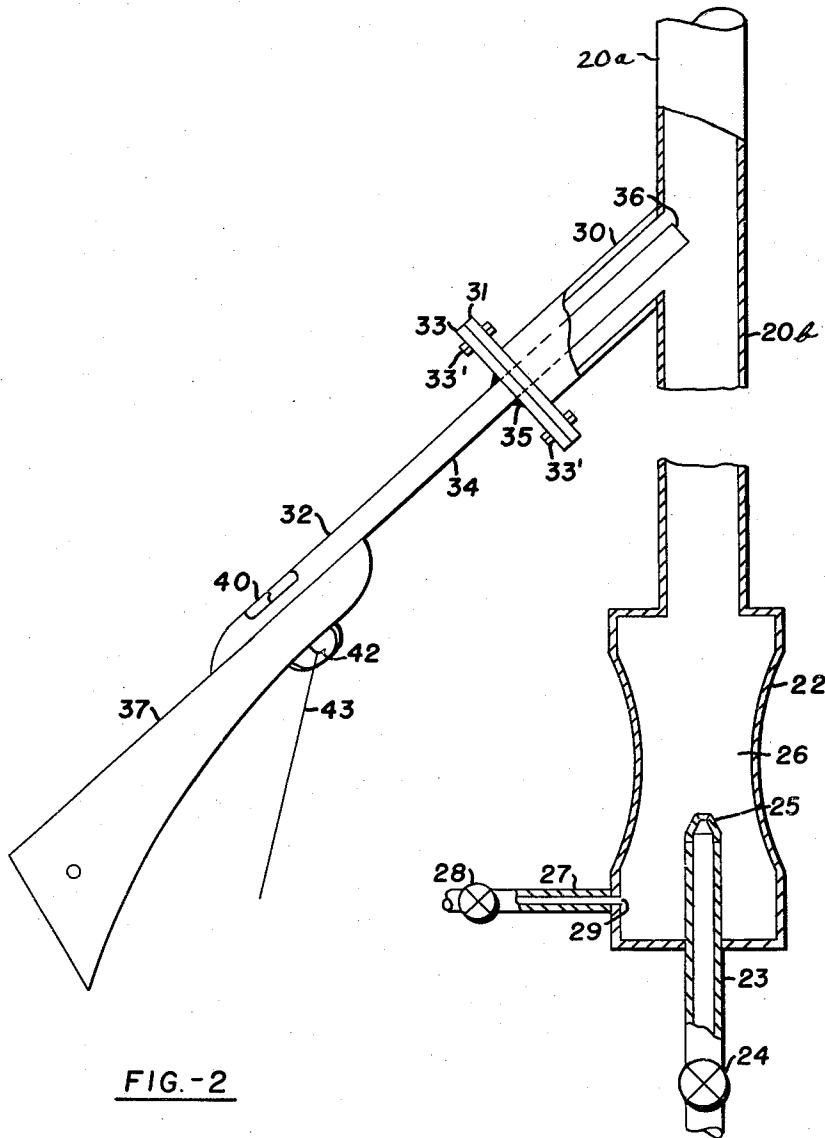


FIG. -2

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1

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FLARE STACK IGNITION

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1 Claim. (Cl. 158—115)

This invention relates to a method and apparatus for lighting a flare stack.

Flare stacks are used extensively in industry today for the burning of waste combustible gases as a safety precaution as well as a means of reducing atmospheric pollution. The burning of these waste combustible gases in tall flare stacks provides a safe and convenient means of disposing of these gaseous products. The petroleum refining industry is an example of an industry wherein flare stacks are employed extensively to dispose of relatively valueless gaseous by-products. The flare stacks in the petroleum refining industry may be operated on either a continuous or intermittent basis. For example, flare stacks may be intermittently operated to dispose of process gases intermittently released from operating units due to either accidental upset process conditions or to intentional release of gaseous products periodically from the operating units. Flare stacks may also be employed to continuously burn gases of relatively low heating value from gaseous recovery units such as absorbers when it is economically unattractive to burn these gases in refinery furnaces.

Because flare stacks are often operated intermittently for burning waste combustible gases, a pilot flare is normally provided adjacent to the opening at the top of the flare stack for the purpose of igniting the combustible gases when they are passed up through the flare stack to the atmosphere. In general, the pilot flare operates continuously. However, the pilot flare may be blown out by high velocity winds or may be extinguished intentionally when repairing the pilot flare stack or main flare stack. In either event when the pilot flare has been extinguished, a relatively difficult problem is involved in reigniting the pilot flare because the tops of the main flare stack and the pilot flare stack have a height which may exceed 250 feet from the ground.

A number of different methods have been employed to ignite the pilot flare or flare stack. For example, recourse has been made to raising a burning torch on a cable or to employing gas fire ladders. In another method, tracer bullets and flares have been shot from the ground through the gas issuing from the top of the pilot flare stack or main flare stack to thereby ignite the gas. More recent developments in flare stack ignition have incorporated a flame propagation igniter device in which a vertical pipe extending to the top of the flare stack or pilot flare stack is filled with a combustible mixture and the gaseous mixture is ignited in the vertical pipe by means of a sparking mechanism or heating element. The sparking mechanism or heating element causes a flame to form at the point of ignition and this flame propagates upwardly and passes through the upper open end of the vertical pipe in close proximity to the upper opening of the pilot flare stack or main flare stack to thereby ignite the gases emitting therefrom. However, these particular flame propagation ignition devices are relatively complicated and require relatively expensive electrical equip-

2

ment for ignition. Also, these devices have proved to be undependable due to fouled spark plugs, burned-out heater elements, etc.

The present invention is designed to overcome the above-mentioned disadvantages of the prior art devices. Briefly, the present invention is as follows. A combustible gaseous mixture of fuel and air is introduced into the bottom of a vertical igniter tube which extends from ground level to the top of a pilot flare stack and which is positioned in close proximity to the pilot flare stack. After a uniform combustible mixture is distributed throughout the igniter tube, an explosive charge is fired into the bottom portion of the igniter tube. This explosive charge immediately ignites the combustible gaseous mixture in the igniter tube and the resultant flame propagates to the top of the igniter tube where the flame causes the pilot flare to be lighted.

It is an object of the present invention to provide a simple, inexpensive, and dependable method and apparatus for lighting flare stacks.

Other objects of this invention will be apparent from a reading of the specification which will be best understood by reference to the drawings, in which:

Fig. 1 is a diagrammatic illustration of a conventional flare stack employing a pilot flare, in combination with the ignition apparatus of the present invention, and

Fig. 2 is an enlarged detailed diagrammatic illustration of the ignition apparatus of the present invention shown in partial cross section.

Referring now to Fig. 1, reference character 10 designates a conventional flare stack which is supported at ground level 11 by supports 12. Flare stack 10 which is cylindrical extends upward from ground level 11 substantially vertically for a height which may exceed 250 feet. Waste combustible gases which are desired to be disposed of by burning are introduced into the bottom portion of flare stack 10 by means of inlet conduit 13 which is provided with a valve 13' for regulating the flow of waste gas through conduit 13. Valve 13' is closed when flare stack 10 is being repaired. The waste gases entering flare stack 10 through inlet conduit 13 flow upwards in flare stack 10 and are released to the atmosphere through outlet or upper open end 14 of flare stack 10. Flare stack 10 is shown broken to indicate that it may be of any height. During operation of flare stack 10, a flame (not shown) will be emitted from opening 14 of flare stack 10.

Because flare stack 10 may be employed intermittently to burn waste gases, a conventional pilot flare stack 15 is employed to provide a substantially continuous ignition means for the waste gases when they are emitted from opening 14 of flare stack 10. Pilot flare stack 15, which is cylindrical and smaller in diameter than flare stack 10, is in parallel-spaced relation to flare stack 10 and its upper open end is positioned in close proximity to open end 14 of flare stack 10. In general, flame 16 is constantly emitted from the upper end of pilot flare stack 15. Flame 16 is produced by burning a gaseous fuel introduced to the bottom of pilot flare stack 15 through inlet line 17. The gaseous fuel introduced through line 17 is obtained from a constant pressurized source of the gaseous fuel, and its rate of introduction into inlet line 17 is controlled by means of valve 18. A gaseous fuel rich in ethane and propane is normally employed for this purpose.

In accordance with the present invention, a vertical igniter tube 20 is arranged in parallel-spaced relation to and substantially coextensive with pilot flare stack 15 with the upper open end of igniter tube 20 in close proximity to the upper open end of pilot flare stack 15. Igniter tube 20 and pilot flare stack 15 may be attached to flare

stack 10 by supporting means such as brace 21. The lower end of igniter tube 20 is about 3 feet from ground level 11 and communicates with the upper discharge end of venturi tube 22. The lower intake end of venturi tube 22 communicates with line 23 which in turn communicates at its lower end with inlet line 17 for the purpose of introducing a portion of the gaseous fuel from line 17 into igniter tube 20 through venturi tube 22. Line 23 is provided with valve 24 for controlling the flow of fuel gas to venturi tube 22 and igniter tube 20. The bottom of venturi tube 22 also communicates with line 27 which opens directly to the atmosphere and which is provided with valve 28. Line 27 provides a means of introducing air into venturi tube 22 wherein the air is combined with the fuel gas from line 23 to produce a combustible mixture for introduction into igniter tube 20.

Referring now to Fig. 2, the venturi tube 22 is shown in greater detail. It will be noted that line 23 partially extends into the necked down throat 26 of venturi tube 22 and that line 23 is provided at its upper discharge end with nozzle 25. The upward flow of fuel gas through line 23 and nozzle 25 into throat 26 of venturi tube 22 inspirates air into venturi tube 22 through opening 29 of inlet line 27. Venturi tube 22 provides an effective means of thoroughly mixing the fuel gas from line 23 and the air from line 27 for passage up into the bottom of igniter tube 20. The relative amounts of air and fuel gas mixed in venturi tube 22 are controlled by means of valves 28 and 24 in lines 27 and 23, respectively.

Referring again to Fig. 1, igniter tube 20 is provided in its lower portion with tube 30 which preferably extends downwardly at an angle and which communicates with the interior of igniter tube 20. In the arrangement as shown, the connection of the tube 30 with the igniter tube 20 forms an inverted Y-branch connection. In this connection, the portions of tube 20 designated by the numerals 20a and 20b, form two continuous legs of the Y-branch connection, and are in substantially axial alignment. The tube 30 forms a third leg portion extending angularly downward from its junction with the tube 20. Tube 30 is positioned about 6 feet from ground level 11 so that it is readily accessible to a person operating the ignition device of the present invention. The lower end of tube 30 is provided with annular flange 31. A firearm or firing device, which is capable of setting off an explosive charge, such as sawed-off 16-gauge shotgun 32 shown in Fig. 1 is aligned at its discharge end within tube 30. It is to be understood that the firing device of this invention may comprise any type of firearm such as a shotgun, rifle, revolver, etc. Flange 33 which is provided on barrel 34 of shotgun 32 is bolted to flange 31 of tube 30 to thereby support gun 32. Stock 37 of shotgun 32 is connected to support 38 by bolting means 39 to also support gun 32. Support 38 is held by supports 41 at ground level 11. Attached to trigger 42 of gun 32 is firing cord 43 which extends downwardly at an angle and passes over pulley 45 which is attached to support 44 which in turn is attached to support 38. Firing cord 43 extends substantially horizontally from pulley 45 to a safe distance from the apparatus of Fig. 1. Firing cord 43 is pulled by a person to thereby actuate trigger 42 in order to detonate shell 40 which causes an explosive charge to be fired through barrel 34 and tube 30 into the combustible mixture of fuel and air in igniter tube 20.

Referring now to Fig. 2, the firing mechanism of the present invention is shown in greater detail. It will be noted that flange 33 is rigidly attached to barrel 34 by means such as weld 35. Further, it will be noted that flange 33 is positioned on barrel 34 such that when flanges 31 and 33 are connected to each other by means of bolts 33', muzzle 36 of barrel 34 extends into the interior of igniter tube 20 so as to insure ignition of the combustible mixture in igniter tube 20 when shell 40 is detonated to

fire the resultant explosive charge into igniter tube 20 through barrel 34. The detonation of shell 40 causes flame 46 to be emitted from the upper end of igniter tube 20. Tube 30 is connected to barrel 34 by means of flanges 31 and 33 to provide a convenient means of disassembling the firing device of the present invention.

The following method may be employed to ignite pilot flare 15. Initially, valves 13', 18, 24, and 28 are closed so that there are no flames at the upper open ends of either flare stack 10, pilot flare stack 15, or igniter tube 20. Valve 18 in line 17 is then opened to permit the flow of fuel gas through line 17 to pilot flare stack 15 so that fuel gas is discharged from the upper open end of pilot flare stack 15. Valve 24 is then opened to permit the flow of fuel gas into throat 26 of venturi tube 22 through line 23, and valve 28 is opened to permit inspiration air into venturi tube 22 through line 27. The air-to-fuel ratio is adjusted by means of valves 24 and 28 so that the air-fuel mixture contains about 3-10% of fuel by volume. The air-fuel mixture is allowed to flow upwards through igniter tube 20 until a uniform composition is obtained throughout the entire length of igniter tube 20. Shell 40 is then inserted in gun 32. Thereafter, firing cord 43 is pulled to actuate trigger 42 to detonate 16-gauge shotgun shell 40. Shell 40 may be any shell suitable for gun 32. However, it is of course necessary to employ a blank shell. The detonation of shell 40 produces an explosive charge which passes through barrel 34 of gun 32 and which is discharged into igniter tube 20 through muzzle 36. The discharge of the explosive charge into igniter tube 20 ignites the gaseous combustible mixture in igniter tube 20 to produce a flame in igniter tube 20 in the vicinity of muzzle 36. This flame propagates upwards in igniter tube 20 and is discharged from the upper open end of igniter tube 20 as flame 46. Flame 46 ignites the fuel gas discharging from pilot flare stack 15 to produce flame 16 at the upper open end of pilot flare stack 15. Flame 46 is extinguished shortly thereafter, and pilot flame 16 is left burning. After ignition of pilot flare stack 15, valve 24 in line 23 is closed and valve 13' in line 13 may be opened to permit the passage of waste gases up flare stack 10 where they will be ignited at opening 14 by flame 16 from pilot flare stack 15.

It is to be understood that the present invention is not limited to the specific apparatus shown in Figs. 1 and 2. Any equivalent firing mechanism, for example, may be employed which will discharge an explosive charge into igniter tube 20 for the purpose of igniting the combustible mixture therein. Also it is to be understood that the ignition device of the present invention may be employed with a flare stack which is not equipped with a pilot flare stack to thereby directly light the flare stack itself. It is to be further understood that the ignition device of the present invention may be utilized with a ground flare of any other burning device which may be operated by the flame propagation method.

What is claimed is:

In a flare stack igniter, which includes a vertical, elongated, igniter tube adapted to be supported in substantially parallel co-extensive juxtaposition to a flare stack structure, said tube having an upper outlet end adapted to be disposed substantially at the level of the upper end of said stack structure, and an inlet means at the lower end of said igniter tube adapted to introduce a combustible mixture of a gaseous fuel and air into said tube, a means to ignite said combustible mixture and to facilitate propagation of a flame upwardly through said tube which means essentially consists of an inverted Y-branch connection having two leg portions in substantially axial alignment and forming substantially integral continuous portions of said tube, and a third leg portion having an outer end, and an inner end communicating with said tube by way of a junction with said other leg portions, said Y-branch connection being disposed longi-

5

itudinally of said tube at a level spaced above said tube inlet means, said third leg portion extending outwardly and downwardly in angular relation to the axis of said tube and said other Y-branch leg portions, a first annular flange radially of the outer end of said third leg portion, a firearm, including a barrel, a breech, a firing mechanism including a trigger, and a stock, a second annular flange, adapted for fluid tight face to face connection to said first flange, secured in fluid tight, radial relation to said barrel, said second flange being spaced from the muzzle of said barrel by a distance substantially equal to the length of said third leg portion, whereby said muzzle opens directly into said other leg portions included in said tube, and whereby said breech, firing mechanism and stock are disposed outwardly beyond said third leg portion, a support engaging said stock in substantially fixed relation, said support and said second annular flange cooperating to maintain said firearm in fixed relation to said third leg portion, and a firing cord at least partially carried by

6

said support and attached at one end to said trigger whereby to permit actuation of the firing mechanism from a point removed therefrom, to discharge an explosive blank cartridge, insertable in said breech, into the other legs of said Y-branch connection included in said tube, and into the combustible gaseous mixture therein, whereby to ignite said mixture and to facilitate propagation of the resulting flame upwardly through said tube.

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