Sept. 25, 1962 R. D. REED 3,055,417

APPARATUS FOR CONTROLLING FLOW OF GASES

Filed March 20, 1959

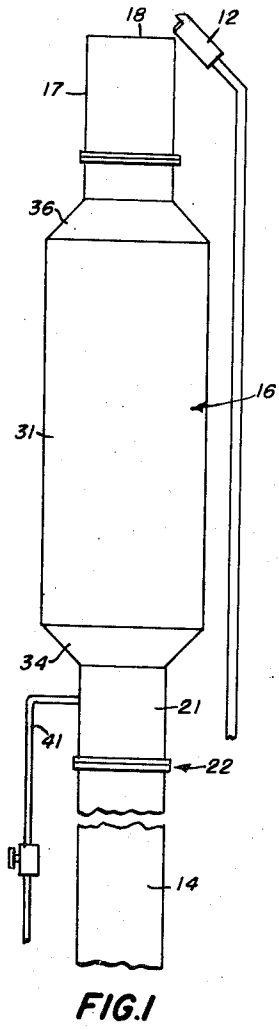


FIG. 1

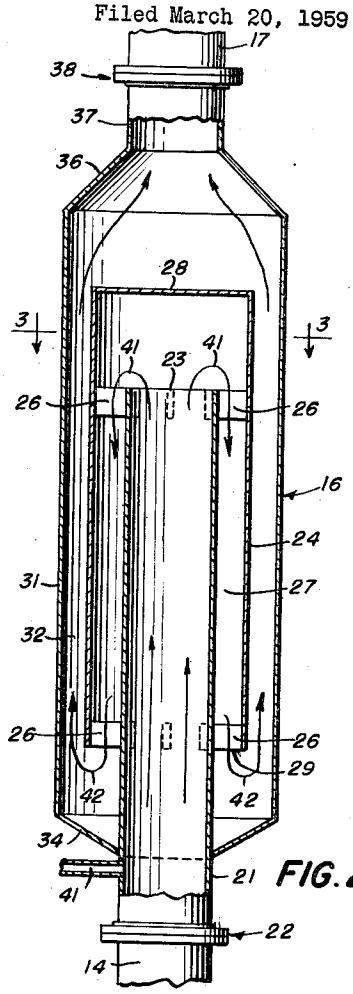


FIG. 2

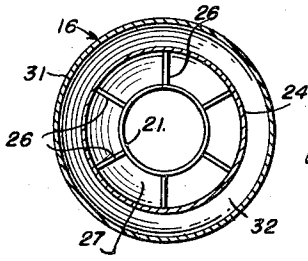


FIG. 3

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United States Patent Office 3,055,417 Patented Sept. 25, 1962

3,055,417
APPARATUS FOR CONTROLLING FLOW OF GASES

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Filed Mar. 20, 1959, Ser. No. 800,738
2 Claims. (Cl. 158—99)

The present invention relates to a device for controlling movement of gases and the invention more specifically pertains to apparatus for preventing downward movement of a gas such as air within a vertically disposed conduit which serves to guide gases upwardly therethrough.

In carrying out some industrial processes gases such as hydrogen and hydrocarbons and other gases are produced. These gases are customarily employed for useful purposes but on occasions or as a result of some emergency it is necessary to vent such gases to the atmosphere. These dump gases are delivered into the lower portion of a vertically disposed stack so that the gases are released at a significant elevation above the surrounding terrain. Such gases are often burned at the upper end of the stack and one type of equipment for disposing of such gases is disclosed in the Zink and Reed Patent 2,779,399. These dump gases are in general lighter than air and have a molecular weight of twenty-eight (28) or less and many of the gases upon mixture with air are explosive and it is therefore important to avoid the presence of air in the lower portion of the stack to avoid conditions which promote explosion.

It is accordingly an object of the present invention to provide means in a vertically disposed conduit assembly such as employed in a flare stack burner to prevent downward flow of air into the conduit assembly after an interruption in the upward flow of the dump gases therein to avoid filling the flare stack with air and to prevent the accumulation of air in the lower portion of the stack.

A more specific object of the invention pertains to the provision of a device adjacent the upper end of a flare stack which provides for the entrapment of a quantity of gas therein even when the gas has a molecular weight less than that of air and in such a manner that the trapped gases serves as a seal to prevent air from filling the flare stack below the device and thereby prevent admission of air to the lower portion of the flare stack.

Other objects and features of the invention will be appreciated and become apparent to those skilled in the art to which the invention pertains as the present disclosure proceeds and upon consideration of the following detailed description taken with the accompanying drawing wherein an embodiment of the invention is disclosed.

In the drawing:

FIG. 1 is a side elevational view of a stack for dump gases illustrating a device exhibiting the invention in side elevation and in association with the stack assembly.

FIG. 2 is an enlarged axial sectional view of the device for controlling movement of gases.

FIG. 3 is a transverse sectional view taken on the line 3—3 of FIG. 2.

When it is necessary or desirable to deliver the gases produced by the process industries to waste they are often released in the lower end of a vertically disposed stack for escape through an open upper end and which is positioned at a significant elevation above the surrounding terrain. It is often required that such dump gases be burned at the upper end of the stack and a pilot burner diagrammatically represented at 12 is provided for igniting and maintaining ignition of the gases as they are discharged through the open upper end of the stack. These gases are under normal conditions put to useful purposes and when the circumstances which required dumping no longer exist the upward flow of gas through the flare stack

is interrupted. Air then enters the open upper end and moves downwardly in the stack at atmospheric pressure. The gas or gases remaining in the stack and which are lighter than air decant to the top of the stack and are replaced by air. In a short period the entire vertically disposed conduit is filled with air. This condition occurs at the conclusion of each discharge of dump gases. Thus when there is a resumption of flow of dump gases for venting to the atmosphere the gases mix with the air which is present in the vertically disposed stack. As this gas-air mixture comes into contact with the flame produced by the pilot 12 there is danger of explosion.

The invention is directed to a device positioned adjacent or near the upper end of a flare stack burner to prevent filling of the vertically disposed conduit assembly and to limit the volume of air settling into the stack upon interruption of the upward flow of dump gases in the conduit means. Thus upon resumption of the upward movement of dump gases through the stack the pilot at the upper end upon ignition provides a flame front which extends downwardly only as far as the air extends and thus through a limited portion of the upper end of the stack to avoid damage.

An assembly embodying the invention is shown in FIG. 1 which includes a vertically disposed pipe 14 forming a part of the stack and it is adapted to receive dump gases at its lower end. The means or device for blocking downward movement of air in the stack is indicated generally at 16. This device 16 comprises a conduit assembly mounted on the pipe 14 and positioned near the upper end of the stack which is completed by a pipe 17 having an open upper end 18 for the escape of the dump gases. A pilot 12 is provided for igniting and maintaining ignition of the gases escaping through the open upper end 18 of the stack. The device or conduit assembly 16 is best shown in FIGS. 2 and 3 and includes a tube 21 which may be of the same diameter as the pipe 14 and connected thereto by flange structures 22. The tube 21 is of cylindrical shape and has an open upper end 23. An inverted cup-shaped member 24 is provided over the tube 21. It is supported and maintained in position by means of radially disposed arms 26 carried by the tube 21. The inverted cup-shaped member 24 has a cylindrical wall which surrounds the periphery of the tube 21 in spaced relationship to provide an annular space 27. The upper end of the cylindrical wall is closed by means of a disc-shaped plate 28. The lower end 29 of the cylindrical wall is open and unobstructed except for the radially disposed arms 26 which support the inverted cup-shaped member 24 on the tube 21. In one embodiment the area of the annular space 27 is three times the area of the interior of the tube 21.

The device 16 for controlling the flow of gases having different molecular weights includes a housing 31 which is of cylindrical shape and surrounds the cylindrical wall of the inverted cup-shaped member 24 in spaced relationship to provide an annular space 32 therebetween. In one embodiment the area of the annular space 32 is twice that of the annular space 27 and the area of the annular space 32 is six times the area of the interior of the tube 21. Sheet material 34 of inverted frusto-conical shape connects the lower end of the housing 31 with the exterior of the tube 21. Sheet material 36 of frusto-conical shape connects the upper end of the cylindrical housing with a tubular element 37 and flange structures 38 connect the device to the pipe 17 forming the upper end of the stack assembly.

In operation and when gases such as hydrogen which has a molecular weight of two (2) or hydrocarbons or mixtures are to be dumped and having a molecular weight of twenty-eight (28) or less are supplied into the lower end of the stack 14 these gases flow upward and pass into

the tube 21. The gases turn in the direction of the arrows 41 and move downwardly in the annular space 27 and escape through the open lower end 29 of the inverted cup-shaped member 24. The gas then turns upwardly in the direction of the arrows 42 and flow upwardly in the annular space 32 and move into the pipe 17 for escape through an open end 18 of the stack assembly. The gas is ignited if desired by the pilot 12 and burns at the upper end of the stack.

The flow area in the annular space 27 is greater than the area within the tube 21. The flow area in the annular space 32 is greater than the area of the annular space 27. This relationship of areas for flow avoids excessive pressure drops through the device. As long as the gas continues to flow through the open upper end 18 of the stack assembly all portions of the device 16 are filled with gas and no air can be present therewithin. If the flow of the dump gas is interrupted air begins to settle in the stack. The gas which is lighter than air pours off gently to the atmosphere through the open upper end 18 from the annular space 32 and is replaced by air. The annular space 27 remains filled with gas and the tube 21 remains filled with gas even after the pressure in the tube 21 reaches atmospheric pressure at a point level with the lower end 29 of the cylindrical wall of the inverted cup-shaped member 24. Within a short period the annular space 32 is filled with air at atmospheric pressure. The gas within the tube 21 and within the closed end of the inverted cup-shaped member 24 and within the annular space 27 prevents entry of air into the annular space 27.

If the gas flowing upwardly through the tube 21 is at less than ambient temperatures it will expand until such time it attains ambient temperatures at which point the conditions of balanced pressures will exist. If the gases flowing upwardly in the tube 21 are at greater than ambient temperature the gas will contract upon cessation of the flow. If upon interruption of the flow of dump gas and in the event that the gas trapped in the tube 21 and the annular space 27 contracts as a result of lowering of temperature there is a possibility that air may be drawn into the entire conduit assembly or system. In order to avoid this condition during the cooling cycle a quantity of gas may be admitted through a tube 41 at pressures greater than atmospheric. The quantity of gas admitted through the tube 41 is such as to be not less than 1.25 times the reduction in volume as a consequence of the cooling of the gas in the tube 21 and the annular space 27. The gases admitted through the tube 41 must have a mean molecular weight of twenty-eight (28) or less. While the flow of gases through the tube 41 into the tube 21 provides a condition where the pressure balance previously referred to cannot occur the seal against entry of air as a result of the relationship of the inverted cup-shaped member 24 and the tube 21 will exist because of the buoyancy of the gas entering the tube 21 through the tube 41.

While the invention has been shown and described with reference to particular structural elements and with regard to one general organization it will be appreciated that changes may be made in the details as well as the combination. Such modifications and others may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

What I claim and desire to secure by Letters Patent is:

1. Apparatus for limiting the volume of air entering the open upper end of a vertically disposed flare stack comprising, a flare stack, a vertically disposed tube forming a part of the stack positioned near the upper end thereof receiving gas at its lower end having a molecular weight less than that of air, said tube having an open upper end for the upward escape of said gas, an inverted cup-shaped member having an impervious upper end spaced above and over the open upper end of said tube and having a cylindrical wall surrounding the exterior of said tube in spaced relationship providing an annular space between the exterior of said tube and the interior of said cylinder wall in which gas escaping through the upper end of said tube may move downwardly, a housing surrounding said inverted cup-shaped member in spaced relationship providing a second annular space defined by the interior of the housing and the exterior of said cylindrical wall in which the gas escaping through the lower end of the first annular space may move upwardly, means closing the lower portion of the housing with respect to said tube, impervious means joining the upper end of said housing with said flare stack so that the gas in the second annular space may escape through the open upper end of the flare stack whereby the buoyancy of the gas trapped within the upper end of said tube and within the upper end of said cup-shaped member and within the upper portion of the first annular space develops a gas pressure matching atmospheric pressure upon interruption of the supply of gas to the lower end of said tube to thereby limit the volume of air at atmospheric pressure entering the open upper end of said flare stack assembly.

2. Apparatus for limiting the volume of air entering the open upper end of a vertically disposed flare stack comprising, a flare stack, a vertically disposed tube forming a part of the stack positioned near the upper end thereof receiving gas at its lower end having a molecular weight less than that of air, said tube having an open upper end for the upward escape of said gas, an inverted cup-shaped member having an impervious upper end spaced above and over the open upper end of said tube and having a cylindrical wall surrounding the exterior of said tube in spaced relationship providing an annular space between the exterior of said tube and the interior of said cylinder wall in which gas escaping through the upper end of said tube may move downwardly, a housing surrounding said inverted cup-shaped member in spaced relationship providing a second annular space defined by the interior of the housing and the exterior of said cylindrical wall in which the gas escaping through the lower end of the first annular space may move upwardly, means closing the lower portion of the housing with respect to said tube, impervious means joining the upper end of said housing with said flare stack so that the gas in the second annular space may escape through the open upper end of the flare stack whereby the buoyancy of the gas trapped within the upper end of said tube and within the upper end of said cup-shaped member and within the upper portion of the first annular space develops a gas pressure matching atmospheric pressure upon interruption of the supply of gas to the lower end of said tube to thereby limit the volume of air at atmospheric pressure entering the open upper end of said flare stack, and means for admitting gas having a molecular weight less than that of air from an auxiliary source into said tube at a point below the lower end of said cylindrical wall when said trapped gas is at a temperature greater than ambient temperature.

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