

Dec. 6, 1966

R. D. REED

3,289,729

APPARATUS FOR LIMITING ENTRY OF AIR INTO FLARE STACK

Filed Dec. 8, 1964

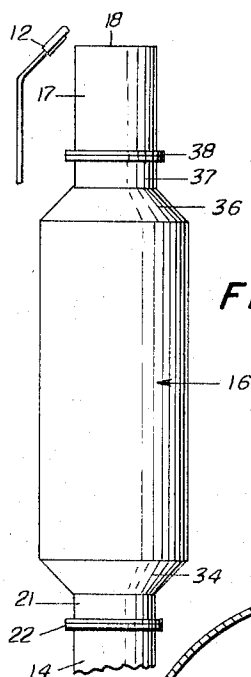


FIG. 1

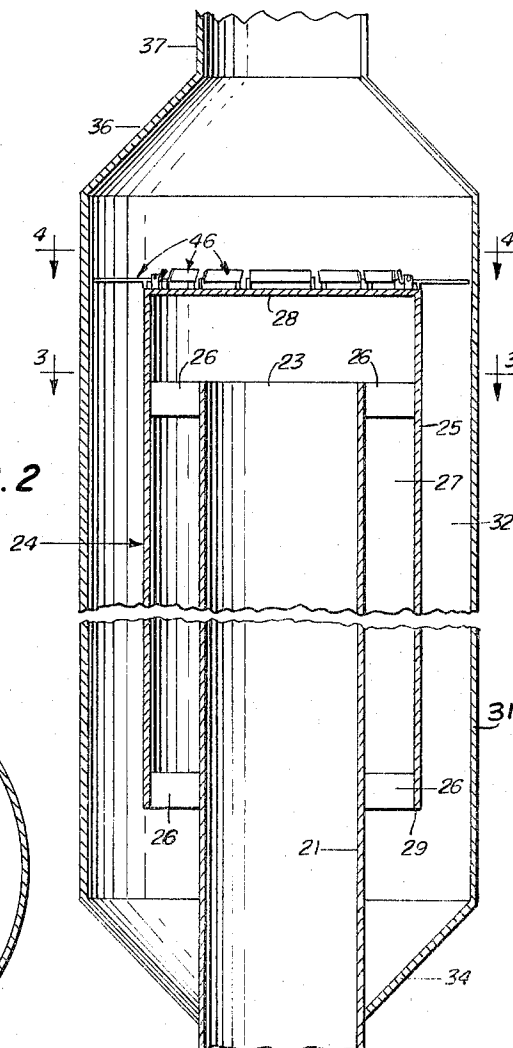


FIG. 2

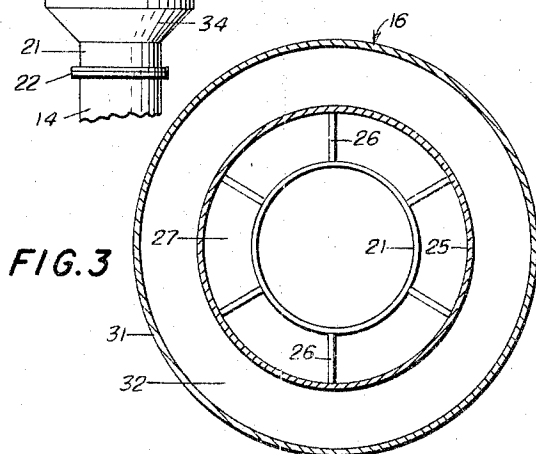


FIG. 3

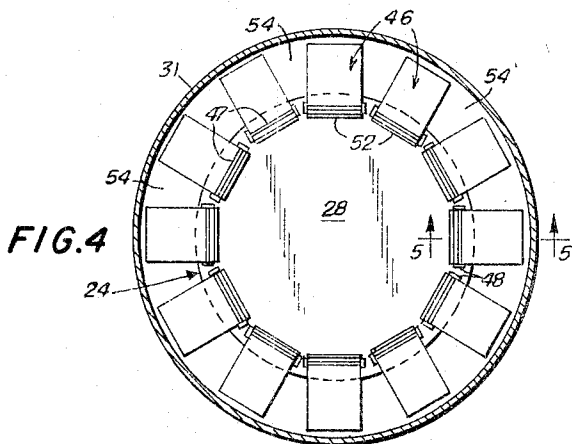


FIG. 4

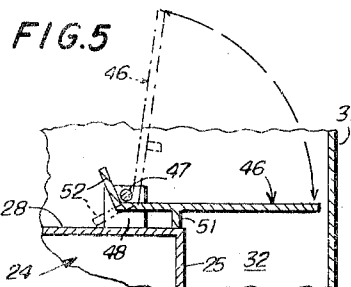


FIG. 5

INVENTOR
ROBERT D. REED

BY

Robert A. Reed
ATTORNEY

1

3,289,729

APPARATUS FOR LIMITING ENTRY OF AIR INTO FLARE STACK

Robert D. Reed, Tulsa, Okla., assignor to John Zink Company, Tulsa, Okla., a corporation of Delaware
Filed Dec. 8, 1964, Ser. No. 416,762
4 Claims. (Cl. 158-99)

The present invention relates to a device for controlling movement of gases and the invention more specifically pertains to a device limiting the volume of air that tends to settle within a flare stack when there is an interruption of the upward flow of waste gas within the vent stack.

In carrying out some industrial processes gases such as hydrogen and hydrocarbons and other gases are produced. These gases are often employed for useful purposes but on occasions or as a result of some emergency it is necessary to vent such gases to the atmosphere. Such dump gases are delivered into the lower portion of a vertically disposed stack so that the gases are burned high above the surrounding terrain. The dump gases are lighter than air and have a molecular weight of twenty-eight or less and many of the gases upon mixture with air become explosive and it is therefore important to avoid the presence of air within the stack to avoid conditions which promote detonations. A flare stack assembly for controlling the entry of air into a flare stack is disclosed in my patent, 3,055,417, granted September 25, 1962. In the operation of the prior assembly air settles in the outer annular chamber of the trap device which produces minor detonations when an upward flow of the waste gas is resumed. The detonations are of a minor nature and no damage has resulted from the explosions within the upper end portion of the flare stack assembly but such detonations are annoying and create alarm.

It is possible with the prior equipment to avoid such minor detonations by supplying purge gas in the flare stack system at a point below the trap device so that there is a constant upward movement of purge gas through the stack assembly. A typical fuel gas is effective for such purposes but such gases are costly particularly when they must be supplied into flare stack over an extended period. The velocity of the upward movement of the purge gas in the outer annular space of the trap device must be maintained at least one foot per second to avoid the presence of air within the outer annular space of the trap device.

An object of the present invention is to provide improvements in such a flare stack assembly to avoid the development of conditions within the system which promote detonations and to reduce the volume of purge gas supplied into the flare stack assembly for upward movement therein when there is an interruption in the supply of dump or waste gases into the lower end of the flare stack.

Another object of the invention is to provide means within a flare stack assembly for partially closing the upper end of the annular space in the trap device and with the closure means of such construction that the elements thereof are shifted to positions where they do not prevent upward flow of waste gases in the flare stack assembly and which return by the action of gravity to positions partially obstructing the outer annular space of the trap device upon interruption of the upward flow of waste or dump gases in the stack assembly.

A more specific object of the invention pertains to the provision of movable flap elements within the trap device of a flare stack assembly which are so arranged as to avoid complete obstruction of the vent stack and to provide flap elements of such construction that they shift to the open positions in response to the pressure at which the waste gases are usually supplied into the lower end of the flare stack and move to their obstructing positions

2

upon interruption of the upward movement of waste or dump gases in the flare stack.

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

In the drawing:

FIG. 1 is a side elevational view of a flare stack assembly which includes a trap device exhibiting the invention in association with the stack structure.

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

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

FIG. 4 is a sectional plan view taken on the line 4-4 of FIG. 2.

FIG. 5 is an enlarged fragmentary sectional view taken on the line 5-5 of FIG. 4.

The dump gases are released into the lower end of a vertically disposed stack for escape through an open upper end thereof. It is often required that the dump gases be burned at the upper end of the stack and a pilot burner represented at 12 is provided for igniting and maintaining ignition of the gases as they are discharged through the upper end 18 of the stack. These gases are often 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 tends to settle in the stack structure. The gas which is not retained in the trap device decants to the top of the stack and is replaced by air. Thus when there is a resumption of flow of dump gas into the lower end of the stack assembly such waste gas mixes with the air present in the outer annular chamber of the trap device and within the flare stack above the trap device and when this mixture moves into the presence of the pilot 12 there is an explosion of small magnitude which expands through the open upper end 18 of the stack without structural damage but such minor detonations are objectionable. These minor explosions have been prevented by supplying a purge gas into the stack assembly below the trap device.

The invention is directed to improvements in a trap device 16 positioned near the upper end of a flare stack structure to limit the volume of purge gas required and to limit the volume of air that tends to settle into the outer annular space of the trap device. As shown in FIG. 1 a vertically disposed pipe 14 forms a lower part of the stack and it is adapted to receive the dump gases at its lower end. The trap device 16 is mounted on the pipe 14 and positioned adjacent 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. The pilot 12 provides ignition of the waste gases escaping through the open upper end 18 of the stack.

The trap device 16 includes a tube 21 which may be of the same diameter as the pipe 14 and connected thereto by a flange structure 22. The tube 21 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 25 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 member 28. The lower end 29 of the cylindrical wall 25 is open and unobstructed except for the radially disposed arms 26.

The trap device 16 includes a housing 31 which is of cylindrical shape and surrounds the cylindrical wall 25

3

in spaced relationship to provide a second and an outer annular space 32 therebetween. Sheet material 34 of the inverted frusto-conical shape connects the lower end of the housing 31 with the exterior of the tube 21. Sheet material 36 of the frusto-conical shape connects the upper end of the housing 31 with a tubular element 37 and a flange structure 38 connects the trap device 16 to the pipe 17 which forms the upper end portion of the stack structure.

When gases to be dumped are supplied into the lower portion of the stack these gases flow upward and pass into the tube 21. The gases turn 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 and flows upwardly in the outer annular space 32 and moves into the pipe 17 for escape through an open end 18 of the stack assembly. The gas is ignited by the pilot 12 and burns at the upper end of the stack. As long as the waste gas continues to flow through the open upper end of the stack assembly all portions of the trap 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 having a molecular weight less than twenty-eight within the annular space 32 and thereabove pours off gently to the atmosphere through the open upper end 18 and is replaced by air. The annular space 27 remains filled with gas and the tube 21 remains filled with waste gas and the tube 21 remains filled with gas even after the pressure in the tube 21 reaches atmospheric pressure at the level of the lower end 29 of the wall 25. 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.

The area of the outer annular space 32 is relatively large and with this space filled with air and if there is a resumption of the flow of waste gases upwardly through the stack assembly the air within the annular space 32 mixes with such gases to promote minor detonations in the upper end of the stack structure. Such explosions may be prevented by supplying purge gas into the flare stack assembly below the trap device 16 so that there is a constant upward movement of the purge gas in the annular space 32.

The present invention pertains to means for limiting the volume of air that may settle in the second annular space 32 with a minimum volume of upwardly moving purge gas and at the same time avoid positive closure of the upper end of the stack structure such as by a conventional check valve mechanism. In carrying out the invention means is provided for partial obstruction of the upper end of the second annular space 32 and of such design that an upward movement of the purge gas within the annular space 32 results in a pressure drop across the partial closure means which makes it impossible for air to move downward into the outer annular space 32 because the inertia of the pressure drop across the obstruction means exceeds the weight of the air.

The means for partially obstructing the upper end of the annular space 32 includes a plurality of plate shaped flap elements 46 which are circumferentially spaced from each other as shown in FIG. 4 adjacent the upper end of the inverted cup-shaped member 24. Each flap element 46 has a generally rectangular shaped plate portion so that when the flap elements are in horizontal positions the annular space 32 is approximately two-thirds obstructed by the plate portions of the flap elements 46 and about one-third of the annular space 32 remains unobstructed. The unobstructed areas between the adjacent flap elements 46 satisfies a requirement of industry that there should be no complete blockage of flow in a flare stack assembly.

The flap elements 46 are each mounted for pivoting

4

movement and in one embodiment a shaft 47 is secured to the inner end of the plate portion such as by welding. Each shaft 47 is mounted for rotational movements in a pair of bearing blocks 48 secured to the closure member 28 of the inverted cup-shaped member 24. The flap elements 46 are thus mounted so that they swing downwardly by gravity action in the absence of an upward flow of waste gases to partially obstruct the upper end of the annular space 32. A lug 51 carried by each flap element engages the upper surface of the member 28 whereby the plate portion assumes a substantially horizontal position as shown in FIG. 5. The flap elements 46 and their pivotal mountings are such that each swings to a position indicated by dotted lines in FIG. 5 when the waste or dump gases move upwardly in the flare stack assembly. The waste or dump gases are usually released at pressures of from two to four inches of water. Such pressures acting on the under surface of the plate portions of the flap elements 46 are sufficient to shift them to positions where they do not obstruct the upper end of the annular space 32. Each flap element 46 is provided with an arm 52 which is adapted to engage the upper surface of the member 28 to limit the rotation of the shaft 47 and thus maintain the flap elements in positions when they will return to the obstructing positions by the action of gravity when the upward flow of waste or dump gases is interrupted.

When venting of waste or dump gases ceases air settles into the pipe 17 and tends to move downwardly into the annular space 32 with any waste gas in the annular space 32 decanting to atmosphere through the open upper end 18 of the stack. The flap elements 46 are then in horizontal positions as shown in FIGS. 2 and 5 and about one-third of the area of the annular space 32 is unobstructed. A reduction in the flow area for a purge gas is thus provided. The velocity of flow of the purge gas in the open areas 54 (FIG. 4) between the flap elements 46 is then approximately three times greater than in the annular space 32 below the flap elements 46. A velocity of about one foot per second is required to prevent air from settling into the stack. When the purge gas moves upwardly at this rate below the closure means the velocity across edges of the plate portions of the flap elements 46 amounts to about three feet per second. The purge gas does not swing the flap elements from their horizontal positions partially obstructing the annular space 32. Since the purge gas need move only at about one foot per second the flap elements 46 make it possible to reduce the rate of movement of the purge gas to about six inches per second and at the same time to provide a flow rate of about one and one-half feet per second over edges of the flap elements to prevent air from settling into the annular space 32 below the closure means. It is thus possible to reduce the volume of the purge gas to about one-half of that required if the flap elements were not provided and at the same time to provide improvements in the factor of safety.

While the invention has been described with reference to particular structure for the flap elements it will be appreciated that changes may be made in the structure of these elements along with the manner in which they are mounted in the trap device. Such changes 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. In a flare stack assembly, a vertically disposed flare stack having an open upper end, a vertically disposed tube forming a part of said stack and positioned near the upper end thereof for receiving waste gas at its lower end having a molecular weight less than that of air, said tube having an open upper end for escape of said waste gas, an inverted cup-shaped member having a closed upper end spaced above and over the upper end

5

of said tube and a cylindrical wall surrounding the exterior of said tube in spaced relationship providing a first annular space between the exterior of said tube and the interior of said cylindrical wall in which the waste gas escaping through the upper end of said tube may move downwardly, a housing surrounding said cylindrical wall in spaced relationship providing a second annular space between the interior of the housing and the exterior of said cylindrical wall in which the waste gas escaping through the lower end of the first annular space may move upwardly, means closing the lower portion of said housing with respect to said tube, means closing the upper end of said housing with respect to said flare stack so that the waste gas from the second annular space may escape through the open upper end of the flare stack, a plurality of elements circumferentially spaced from each other adapted to partially obstruct the upper end of said second annular space, means supporting said elements for movement to positions unobstructing said second annular space in response to the flow of waste gas, and said elements being arranged to move to positions to partially obstruct the upper end of said second annular space upon interruption of the upward flow of waste gas.

2. In a flare stack assembly according to claim 1

6

wherein said elements are mounted for upward pivoting movements to the unobstructing positions, and means limiting the arc of upward pivoting movement whereby the elements return to the obstructing positions by action of gravity.

3. In a flare stack assembly according to claim 1 wherein the elements are arranged in a substantially horizontal plane when in the obstructing positions and close approximately two-thirds of the area of said second annular space.

4. In a flare stack assembly according to claim 1 wherein said elements have plate portions which are mounted on said inverted cup-shaped member for pivoting movements, and means supporting said plate portions in substantially horizontal positions partially obstructing the upper end of said second annular space.

References Cited by the Examiner

UNITED STATES PATENTS

1,196,117	8/1916	Kiefer	-----	126—285
1,473,716	11/1923	Willcox.		
1,865,295	6/1932	Arper	-----	126—285

JAMES W. WESTHAVER, *Primary Examiner*.