VENTING ARRANGEMENT FOR STORAGE TANKS
4 Claims, 3 Drawing Figs.

ABSTRACT: Petroleum storage tanks or the cargo tanks of a tankship have an upwardly directed minimum velocity escape valve in the vent line or lines. During filling this ensures that no flammable concentration of petroleum vapors forms below the valve, e.g. at the deck level of a tankship.

A suitable valve has a tapered sleeve which cooperates with a pointed core. The sleeve lifts to provide a larger annular opening to prevent too high pressure drop at high mass flow rates and falls to reduce the opening to keep a high velocity at lower mass flow rates.
VENTING ARRANGEMENT FOR STORAGE TANKS

This invention relates to venting arrangements for storage tanks which contain liquids which produce flammable vapors. In particular it relates to venting arrangements for the cargo tanks of tankships.

In general, the tanks of tankers which have discharged their cargos are ventilated to remove flammable vapors during an empty passage. When tankers are loading crude petroleum or products obtained therefrom there is a fire hazard in that flammable vapors arise because a volatile cargo attempts to vaporize as soon as it enters an empty tank and there is sufficient vaporization to represent a fire hazard when the air originally present in the tank and contaminated by vapor during loading is discharged from the vent pipe as loading proceeds. The discharge of this vapor constitutes a hazard in that flammable (which includes explosive) mixtures of petroleum vapors and air may form at deck level. A similar fire hazard occurs when large storage tanks of land installations are refilled with volatile, flammable materials. It is an object of the present invention to reduce this hazard.

According to the invention a storage tank is provided with an upwardly directed minimum velocity escape valve in every vent line, each minimum velocity escape valve being so constructed that dangerous quantities of flammable vapor are upwardly directed with sufficient velocity to prevent the formation of a flammable air/vapor mixture at or below the level of the vent.

The invention is particularly suitable for application to tankships and a tank according to the invention is provided with an upwardly directed minimum velocity escape valve in every vent line to its cargo tanks, each minimum velocity escape valve being so constructed that dangerous quantities of flammable vapor are upwardly directed with sufficient velocity to prevent the formation of a flammable air/vapor mixture at deck level.

Every cargo tank may be provided with its own separate vent line and in this case the minimum velocity escape valves are conveniently situated at or near deck level. Alternatively several or all the cargo tanks may share the same vent line and in this case the minimum velocity escape valves (or valve when all the cargo tanks share the same vent line) are preferably situated as high above the deck as possible, e.g. at masthead level.

The arrangement described above ensures sufficient velocity of escape for petroleum vapors without creating undesirable pressure drops in the vent lines.

A suitable form of minimum velocity escape valve comprises a sliding member having a tapered, e.g. frustoconical portion, which cooperates with a pointed core to define a variable aperture, the slidable member, in the use of the valve, being lifted by the flow of gas whereby sufficient escape velocity is maintained without creating undesirable pressure drops.

The invention will now be described by way of example with reference to the accompanying drawings in which:

FIG. 1 is a diagrammatic cross section of a tank vessel; FIG. 2 is a perspective, cutaway view of a minimum velocity escape valve; and
FIG. 3 is a vertical cross section through a valve similar to the one shown in FIG. 2.

The tankship illustrated in FIG. 1 comprises cargo tanks 10 whose individual vents 11 are all connected to a common header 12 which connects to a common vent line in the hollow interior of the mast 13 terminating in a minimum velocity escape valve 14 situated at the masthead. Alternatively the common header 12 may be abolished and separate minimum velocity escape valves fitted in every vent line 11.

During loading, which may take place at 5,000 tons per hour, considerable quantities of petroleum vapors are displaced from the tanks and all of these are discharged via the minimum velocity escape valve 14 (or valves for the alternative system) which ensures a gas discharge velocity of at least 150 f.p.s. in an upward direction and this velocity is sufficient to ensure that dangerous quantities of vapor do not diffuse back to deck level. If the rate of loading becomes very low, and hence the rate of volume discharge of petroleum vapors becomes low, the linear velocity of escape may fall well below 150 f.p.s. in spite of the minimum velocity escape valve. However this only happens at such low rates of loading that the total quantity of vapors discharged is not sufficient to create a hazardous concentration at deck level.

The constant velocity escape valve 14 of FIG. 1 is shown in greater detail in FIG. 2. It comprises a core member 20 whose upper end is provided with a conical point 21. The core member 20 is surrounded by a slidable member 22 which has a frustoconical portion 23 which cooperates with the conical point 21. The whole arrangement is surrounded by a cylindrical shield 24.

During loading the slidable member 22 is lifted by the flow of gas and the greater the flow of gas the further the slidable member 22 is lifted thereby providing a greater effective opening. This prevents undesirably high pressure drops with high rates of discharge. On the other hand when the rate of discharge falls there could be a danger of petroleum vapors diffusing back to deck level but the slidable member 22 falls thereby decreasing the effective aperture. This has the effect of maintaining the pressure drop and also the velocity of discharge so that there is no danger of petroleum vapors diffusing back to deck level in spite of the decreased rate of discharge.

As has been mentioned above the valve may fail to maintain high velocities for rates of discharge which are too small to constitute a hazard.

In the modification shown in FIG. 3 the slidable member 22 is attached to the shield 24 by means of extendable cylindrical bellows 25. This does not alter the basic operation of the valve but it ensures that all the gas flows through the slidable member 22. To ensure adequate centering the slidable member 22 carries tapered guide vanes 26. (Since these are thin plates parallel to the direction of flow they offer substantially no resistance.)

For protection the valve has a lid 27 (shown in the open position). When the valve is not in use, e.g. at sea, the lid is closed so that the operative parts of the valve are not open to sea or weather.

We claim:

1. In a storage tank for volatile liquids which give rise to flammable vapors, said tank being provided with at least one vent line for the escape of vapors while refilling, the improvement of an upwardly directed minimum velocity escape valve in every vent line, each minimum velocity escape valve comprising a fixed pointed core member and a slidable member surrounding said core member and having a tapered portion, said tapered portion cooperating with the point of said core member to define a variable aperture for the escape of vapor, whereby dangerous quantities of flammable vapor are upwardly directed with sufficient velocity to prevent the formation of a flammable air/vapor mixture at the level of the vent.
2. In a tankship for carrying volatile liquids which give rise to flammable vapors, said ship having a plurality of cargo tanks and a venting system which provides a plurality of vent outlets for the escape of vapors from the cargo tanks while loading, the improvement of a plurality of minimum velocity escape valves one of which is positioned in each vent outlet, each minimum velocity escape valve comprising a fixed pointed core member and a slidable member surrounding said core member and having a tapered portion, said tapered portion cooperating with the point of said core member to define a variable aperture for the escape of vapor, whereby dangerous quantities of flammable vapor are upwardly directed with sufficient velocity to prevent the formation of a flammable air/vapor mixture at deck level.
3. In a tankship for carrying volatile liquids which give rise to flammable vapors, said ship having a plurality of cargo tanks and a venting system which connects all of said tanks to a single vent outlet for the escape of vapors from the cargo tanks while loading, the improvement of a minimum velocity escape valve situated in said outlet and comprising a fixed
pointed core member and a slidable member surrounding said core member and having a tapered portion, said tapered portion cooperating with the point of said core member to define a variable aperture for the escape of vapor, whereby dangerous quantities of flammable vapor are upwardly directed with sufficient velocity to prevent the formation of a flammable air/vapor mixture at deck level.

4. A tankship according to claim 3, in which the minimum velocity escape valve is situated at masthead level.