GASOLINE STORAGE TANK VENT
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ABSTRACT OF THE DISCLOSURE
A gasoline or other volatile liquid storage tank vent having a body with unobstructed interior to the full size of the tank connection to the vent and a closure movable under influence of gas pressure, such closure being guided onto and off the body (a seal being provided) and being shaped to direct gas flow toward the seal area; the vent, when open, allowing gases over the seal area directly to atmosphere at exceedingly large flow rates for given diameter sizes of vents and tank connections.

DESCRIPTION OF THE INVENTION
This invention is concerned with adequate safety of gasoline storage tanks by providing a vent for volatile hydrocarbon vapors and air which must be vented in order to prevent explosions. There are a multitude of relatively small gasoline storage tanks used to service trucks and, in turn, filling stations throughout the country. American Petroleum Institute (API) safety committees have been concerned with the venting of such tanks in order to prevent pressure build-up from building up during the heat of day, as well as the influx of air to prevent vacuum conditions during the cooling of night. These committees have prescribed venting in terms of flow rates related to wetted areas of the tank walls. It is extremely doubtful that any presently used vents of comparable size meet the standards set forth by the API and now considered as necessary for safety.

In a gasoline storage tank, all area above the liquid surface will be filled with vapor and air. At night, generally some vapor will condense so that air must be admitted to the tank to occupy space. During the day, particularly a warm, summery day, the heat of the sun on the tank causes more gas to pass to vapor stage, thus increasing the pressure within the tank. These tanks are not pressure vessels, so that most all of them are limited to about two and one-half pounds per square inch gauge internal pressure. Vapors and air must be vented to prevent an excessive build-up of pressure and consequent danger.

The primary object of this invention is to provide a storage tank vent of greatly increased flow rate of volatile liquid vapors and air for the size of the vent.

A further object is to provide such a vent having an unobstructed flow path from the tank and air, one that aids laminar flow, thus producing a greater volume of flow per rate of time at given maximum pressures.

A further object is to provide a new and improved vent structure with increased flow rates permitting the use of smaller sizes of vents to achieve desired flow rates and thus reduce the cost of vents to the tank owner while maintaining safety standards.

Further objects, features and advantages of the present invention will be obvious from the description of a preferred embodiment thereof, illustrated in the accompanying drawings, in which:

FIGURE 1 is a central sectional view through the vent and attached pipe flange connection to a storage tank illustrating the vent in closed position, taken substantially along the line 1—1 in FIGURE 3.

FIGURE 2 is a fragmentary sectional view like FIGURE 1 illustrating the vent in a partially open position.

FIGURE 3 is a top plan view of the vent shown in FIGURES 1 and 2, partially broken away.

The present vent is intended for use on gasoline storage tanks which are required to vent at full capacity under two and one-half pounds per square inch. Opening pressure is the first instant at which the vent opens to any extent may be selected by the tank owner. The opening pressure may be just a few inches of mercury or something only slightly less than the two and one-half pounds per square inch that is usually dictated by the construction of the particular tank. The API has expressed its standards in terms of cubic feet per hour of flow for certain tank capacities dependent upon the wetted wall areas of tanks of various shapes. The present vent provides flow rates desired in smaller sized tank connections than heretofore thought possible and exceeds standards set by the API.

The illustrated vent is of an 8" nominal size. Tanks with which the vent may be used generally have a roof of steel plate into which there may be welded a tank connection pipe 10 provided with a threaded or other exposed connection such as the flange 11 to which a vent may be physically attached. The interior of the tank connection pipe 10 is generally unobstructed and leads directly to the interior of the tank, generally close to the highest elevation in the tank so vapors will naturally rise to the vent connection.

The present vent has a body formed with a lower flange 12 mating with the flange 11 of the tank connection and connected thereto by a plurality of bolts 13, as illustrated. Suitable gasketing may be provided but is generally not necessary. The body of the vent is formed by a wall 9 of annular configuration gradually enlarging the cross-sectional area of the gasoline passage from the flange 12 toward the upper end 14 of the body. The vent body may be formed of cast aluminum, brass or steel, depending upon manufacturing convenience and cost. The upper end 14 of the body is circular and the walls of the body are completely unobstructed from the flange to the upper end.

A cover seats upon the body closing the vent. The cover may be a one-piece casting, or as illustrated, may be formed of a cast iron weight 15 of circular outer dimension formed with a ledge or small flange 16 seated upon a brass seat ring 17 which is circular and intended to engage and seal against a Teflon ring 18. An anodized aluminum cover 19 of sheet stock is shaped in its medial area to conform generally to the upper shape of the cast iron weight 15 and extends to a rain shield 20 of circular form around the outside of the vent. The cover has a portion 21, immediately over the brass seat ring, which serves to assemble the three parts of the cover with the aid of certain bolts and guide pins. In the present instance, four guide pins 25 are located 90° apart about the body, each being vertically movable through a Teflon sleeve bearing 26, in turn mounted within a boss 27 formed integral with the body of the vent. The upper end of each guide pin or rod is reduced and threaded at 28 in order to pass through an appropriate opening in the seat ring and cover for attachment of the latter to the pins by washers 29 and nut 30, as illustrated. In certain instances, the body may be formed of cast aluminum and the rods may be cadmium plated, avoiding the necessity for utilizing Teflon sleeve bearings 26, the object being to provide movement of the cover relative to the body with little friction. Since the cover may rest upon the vent without opening for considerable time, it is desirable that the parts do not weather or stick together due to long periods of contact. Materials are, therefore, selected which will not oxidize deleteriously or stick together during long periods of inactivity.
3 The Teflon seal 18 may be provided on the cover or on the body, the seal being illustrated as a rectangular cross-sectional seal secured in a slightly dovetailed groove in the upper extent of the body although it may be reversed in position and placed in the cover seated ring part. A bimetal material may be utilized or any other synthetic or polymer which is impervious to the volatile vapors stored in the tank.

In the illustrated construction, the cover and seal ring are secured together by additional bolts (FIGURES 2 and 3) arranged at 45° circumferentially from the guide pins 25. Such additional bolts may be omitted if the cast iron weight is formed as a single piece including the weather seal 20 and the seal ring 17.

In operation, the lower surface of the cast iron weight is somewhat conical in shape, the center surface portion 31 being directly over the middle or center line of the tank connection opening 10. Portions 32 form a somewhat diverging surface which, together with the interior surface 33 of the walls of the vent, form a gradually narrowing flow area from the center of the vent toward the seal area. Referring to FIGURE 2, it may be noted that the flow area A between the cover 19 and adjacent wall of the vent is larger than the restricted opening between the seal and cover at B. Once the vapors pass over the seal, they are immediately exposed to the atmosphere. Tests upon this vent structure have shown that a nominal 8" vent, fully open at 2,554 p.s.i., flows vapors at a rate of about 840,000 cubic feet per hour. This far exceeds the flow rates established by the API for tanks upon which 8" vents have usually been employed. The vent tested had a weight intending to open the vent at approximately one-half pound per square inch and to be fully open at two and one-half pounds per square inch. As shown in FIGURE 1, a threaded opening 35 may be provided in the crown of the weight to receive an upright guide post about which additional cast iron weights may be placed in somewhat the manner of adding weights to a hanger on a beam scale. In the event the tank owner wishes the vent to first open at a higher pressure, additional dead weight may be added to the cover.

The inner surfaces of the body progressively enlarge from the tank connection to the seal area and the cover interior surfaces are complementary thereto to provide somewhat of a Venturi action and laminar flow of the vapors and air through the vent. This structure has been found to produce higher flow rates for the size of the vent than previous constructions known.

An additional feature of the present vent is the total unobstructed flow area and the ease with which the vent cover may be removed to provide a fully open inspection hatch into the tank. The lower end of the guide rods or pins are provided with washers 36 and retaining pins 37, easily removed, whereupon the entire cover may be lifted off the vent with the guide rods passing out of their bearings whereupon the body of the vent is absolutely unobstructed and open. Other retaining means such as snap rings may be substituted for the washers and pins illustrated if found convenient. Also, a vacuum relief mechanism of known construction may be interposed between the flanges 11 and 12 connecting the vent to the tank connection.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, as some modifications may be obvious to those skilled in the art.

I claim:
1. A volatile liquid storage tank vent having large gas flow rate to size ratio at low gas pressure heads, comprising:
   a hollow vent body having means for tank connection, said body having walls forming a progressively enlarged gas passage away from the tank connection; a movable closure seated upon the body and exposed to gas pressure within the body; a seal positioned at the end of the body remote from the tank connection in the area of closure and body contact, said seal being between and sealingly engaging both the body and closure; the interior of the seal being exposed to gas within the body and the exterior of the seal being in direct exposure to atmosphere whereby movement of the closure off the body provides passage for gas directly to atmosphere over the end of the body in the seal area.
2. A vent as specified in claim 1 wherein the closure interior surface is shaped to direct gas flow toward the juncture of the body and closure at the seal area.
3. A vent as specified in claim 1 wherein the closure incorporates a physical weight and wherein guide means external of the body are connected to the closure confining closure motion in a path toward and away from the body.
4. A vent as specified in claim 3 wherein the guide means comprises a plurality of circumferentially spaced upright pins slidable in bearings secured to the housing with removable stop means on the pins limiting movement of the closure relative to the housing.
5. A vent as specified in claim 1 wherein the exit area for gas to atmosphere between the body and the open closure at the seal location is smaller than the area for gas passage between the body and closure immediately interior to the seal location whereby gas flow velocity through the opening to atmosphere is increased relative to gas velocity approaching the seal location.
6. A vent as specified in claim 1 wherein the guide means include removable stop means attached to the body and closure which limit movement of the closure relative to the body and removal of the stop means permits removal of the closure whereupon the body fully opens the tank connection unobstructedly for tank inspection and like purposes.
7. A vent as specified in claim 2 wherein the closure weight is proportioned to open the vent to full extent at two and one-half pounds per square inch gauge pressure in the body and to flow at a rate in excess of 800,000 cubic feet per hour under such conditions through a nominal eight inch diameter tank connection.
8. A safety vent for bulk gasoline storage tanks comprising:
an annular body having means at one extremity for attachment to a tank for communication of the interiors of the tank and body, said annular body having an annular wall providing an unobstructed interior progressively enlarged in sectional area away from the attachment; an annular seal located at the extremity of the body remote from said attachment, said seal being in an area directly exposed to atmosphere on the outside and to gas in the housing on the inside; a cover over the body having a seal ring portion engaging and mating with said extremity of the body with said annular seal therebetween; a dead weight carried by the cover so that gas pressure inside the body must lift the weight with the cover to disengage said seal engagement with the body and cover; said cover and weight having an interior surface exposed to gas within the body with such surface being opposite and shaped cooperatively with the body wall to direct gas flow toward the seal area; and guide means limiting movement of the cover to straight line motion toward and away from the housing, such guide means being exterior of the housing.
9. A volatile liquid storage tank vent having large gas flow rate to size ratio at low gas pressure heads, comprising:
a hollow vent body having means for tank connection, said body having walls forming a progressively enlarged gas passage away from the tank connection; a movable closure seated upon the body and exposed to gas pressure within the body;
a movable closure seated upon the body and exposed to gas pressure within the body, the closure incorporating a physical weight symmetrically located over the gas passage with the interior surface of the weight shaped to direct gas flow toward the juncture of the body and closure at the seal;  
a seal positioned at the end of the body remote from the tank connection in the area of closure and body contact, said seal being between and sealingly engaging both the body and closure;  
the interior of the seal being exposed to gas within the body and the exterior of the seal being in direct exposure to atmosphere whereby movement of the closure off the body provides passage for gas directly to atmosphere over the end of the body in the seal area.