Jan. 19, 1937. F. V. LONG ET AL 2,068,421

FLAME ARRESTER

Filed Nov. 5, 1934

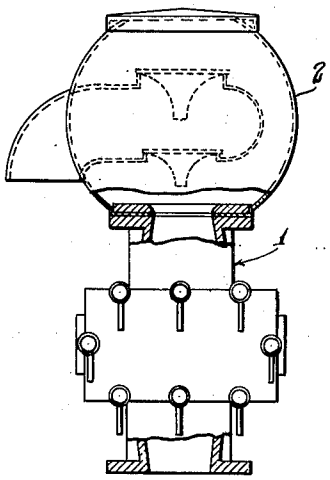


Fig. 1

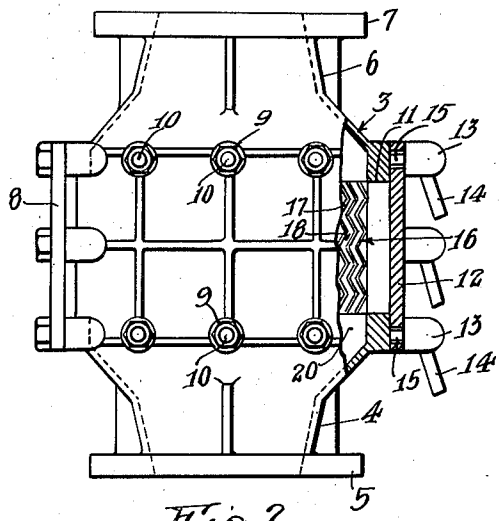


Fig. 2

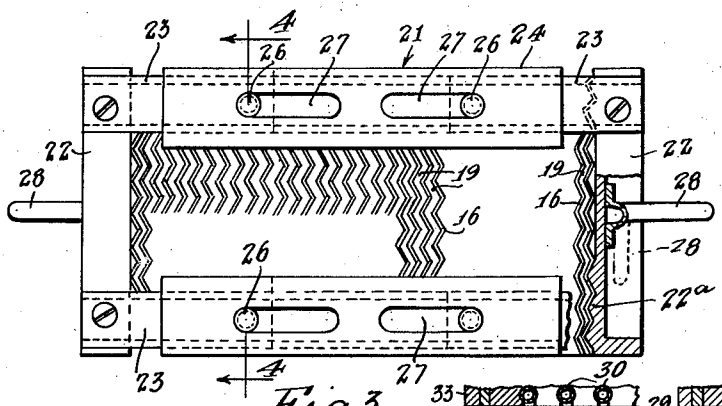


Fig. 3

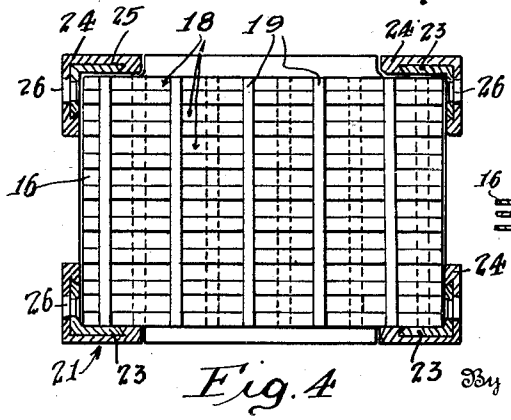


Fig. 4

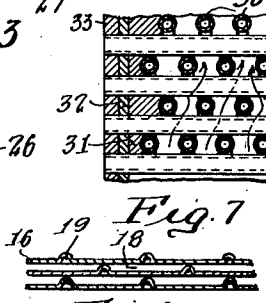


Fig. 5

Fig. 7

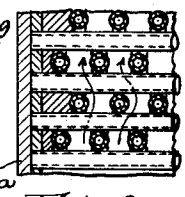


Fig. 6

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FLAME ARRESTER

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19 Claims. (Cl. 220—88)

This invention relates to flame arresters such as used on the vents of tanks carrying inflammable volatile liquids, for reducing fire hazards. Such flame arresters are usually constructed with arrester elements so that the passage of gases flowing through the vent, is obstructed so that a plurality of narrow outlet passages are presented, which, in case of fire, prevent the flame from passing down through the vent. The bank of arrester elements is confined in the casing, and heretofore, it has been the practice to construct the casing and the arrester elements of different compositions. The arrester elements are usually made of material having high thermol conductivity and a high coefficient of expansion. Consequently, when the flame arrester becomes highly heated, the arrester elements cannot expand freely, and this has a tendency to cause buckling, which may open up passages of relatively large area through the bank of arrester elements, which might permit the flame to pass down through the vent. If the arrester elements are not constructed of a highly conductive material, and the casing for the bank of arrester elements is not capable of carrying off the heat with sufficient rapidity, the arrester elements may melt and thereby render the flame arrester useless for its purpose.

One of the objects of this invention is to provide a flame arrester which will overcome these defects, and which will provide a construction in which the flame arrester will maintain itself so as to function properly in spite of the high temperature due to a flame directly above or beyond the arrester elements.

A further object of the invention is to produce a flame arrester in which the expansion of the arrester elements under high temperature, will not develop any buckling effects in the arrester elements; in other words, to provide a flame arrester having a construction which will permit free expansion of the arrester elements.

In storage tanks containing volatile liquids, the vapor space becomes more or less saturated with the light and more volatile constituents of the liquid, and in tanks containing petroleum products, this vapor may reach a saturation as high as 15 gallons per thousand cubic feet of vapor, or even a greater amount than this. In certain areas where electric storms are common, the internal temperature in such a storage tank may drop as much as 60° F. in a very short period of time, for example, thirty minutes. These tanks, being constructed of steel, are very sensitive to atmospheric changes, and with such a rapid drop in temperature, a considerable amount of condensation of the liquid may take place in the vapor, taking the form of molecular liquid in suspension in the vapor. Under these conditions, when the tank is being filled with the storage liquid, or if the local temperature immediately rises so rapidly as to prevent these suspended molecules from vaporizing again, a considerable amount of the petroleum product will be lost by exhalation of the tank through the exhaust vent. One of the objects of this invention is to provide a construction for the flame arrester, that will separate these suspended molecules during the exhalation from the tank; in other words, one of the objects is to construct the flame arrester in such a way that suspended molecules in the escaping gas will be separated from it, and eventually drop down into the liquid in the tank.

The arrester elements of a flame arrester are subject to corrosion, and from time to time they should be inspected for cleaning and replacements. One of the objects of this invention is to construct the flame arrester in such a way as to facilitate such an inspection for cleaning or effecting replacements of elements.

A further object of the invention is to provide a construction for the flame arrester, which will enable air to be circulated through the bank of arrester elements for the purpose of preventing overheating.

Further objects of the invention will appear hereinafter.

The invention consists in the novel parts and combination of parts to be described hereinafter, all of which contribute to produce an efficient flame arrester.

A preferred embodiment of the invention is described in the following specification, while the broad scope of the invention is pointed out in the appended claims.

In the drawing:

Figure 1 is a side elevation in partial section through a flame arrester embodying my invention and illustrating the same as located between a tank vent and a breather valve.

Fig. 2 is a side elevation of the casing of the flame arrester illustrated in Fig. 1, and in this view a portion of the casing and an adjacent cover plate is broken away so as to disclose the bank of arrester elements within the casing.

Fig. 3 is a side elevation in partial section, illustrating a bank of arrester elements mounted in a removable carrier, which I prefer to employ in practicing the invention.

Fig. 4 is a vertical section taken on the line 4—4 of Fig. 3, and further illustrating the details of the parts illustrated in Fig. 3.

Fig. 5 is a horizontal section taken through several arrester elements of plate-form, such as illustrated in Figs. 2 and 3. This view is, of course, a fragmentary view, and shows only the edge portions of these plates.

Fig. 6 is a fragmentary view and is a vertical section through a cover plate of the casing, and illustrating an embodiment of the invention in which the arrester elements are of tube-form. In this view the flame arrester is not constructed so as to permit air circulation through the horizontal tubes.

Fig. 7 is a view similar to Fig. 6, but illustrating a construction in which air circulation is possible through the gangs of tubes of the bank.

Before proceedng to a more detailed description of the invention, it should be stated that in accordance with my invention, I provide a casing in which the bank of arrester elements is supported, and the composition of the metal of the casing and of the arrester elements is substantially the same, so that the coefficient of expansion of the arrester elements is substantially the same as that of the casing. Under these circumstances, in case of fire and the development of a high temperature in the casing and in the arrester elements, the bank of arrester elements is free to expand. Consequently, no buckling will take place, and the tortuous passages which characterize the bank of arrester elements, will be maintained intact. These passages, of course, must be of relatively small width.

The interior of the flame arrester is preferably constructed of a bank of arrester elements in which the elements are alike in form, or substantially so, and the entire bank is preferably mounted in a unitary carrier so that upon the removal of a cover plate on one side of the casing, the entire bank of arrester elements can be removed for inspection. The arrester elements may be of any desired form, and in the present specification we have described them as being in the form of plates, or in the form of gangs of tubes. It is preferable to provide a construction which will enable air circulation through, or between, the arrester elements. While this effect can be accomplished in the plate type of flame arrester, it is most readily accomplished in the tubular type by having the ends of the gangs of tubes extend through the cover plates of the casing. The flame arrester in any event, is constructed so that a plurality of tortuous passages are provided for the gases passing out through the vent on which the arrester is placed.

In Fig. 1, we have illustrated a flame arrester 1 embodying our invention mounted under a breather valve 2, but it should be understood that in practice, the flame arrester may be used as a direct outlet to the atmosphere and without any connection to a breather valve.

The flame arrester includes a body or casing 3, which is preferably formed below into a neck 4 having a flange 5 for securing it to a vent, or a vent pipe. In practice, this flange 5 would usually be secured to the cover of a tank at a vent in the cover. The body or casing 3 preferably includes an upper neck 6 similar to the neck 4 and surmounted by a flange 7 which may form the seat for a connected part such as the breather valve 2. On three sides this casing 3 is closed by side plates 8, which are permanently secured in place by means of nuts 9 applied on studs 10. On the remaining fourth side the casing 3 is formed with an opening 11, which is closed by a removable cover 12 provided with nut heads 13 having handles 14 for securing the same on studs 15, that project outwardly from the side of the casing. On the interior of the casing 3 we provide the bank of flame arrester elements, and in the embodiment of the invention illustrated in Figs. 2 and 3, this bank 16 consists of a plurality of plates 17, the material of said plates being offset laterally into wave form so that they cooperate when placed together to produce a plurality of tortuous passages 18 that abruptly change their direction to and fro between the plates. These passages are quite narrow so as to prevent the passage of a flame down through them.

In the present instance, these plates 17 are formed with corrugations extending horizontally across the same and located so that the plates will nest together.

In order to hold the plates a slight distance apart (see Fig. 5), the plates are formed with vertical ribs 19, which are pressed into them, and the ribs of adjacent plates are "staggered" and located out of line with corresponding ribs on the adjacent plates. In this way, when the plates are stacked together the ribs will hold them a slight distance apart to form the passages 18 between the plates. This bank 16 of plates completely fills the space through which gases pass up through the flame arrester. In other words, they extend completely across the opening 20 at the upper end of the neck 4.

The bank of arrester elements or plates 17, is preferably mounted in a carrier 21 (see Figs. 3 and 4), which may be slid into the interior of the casing 3 when the cover 12 has been removed. This carrier is preferably constructed so that it is extensible and preferably comprises two headers or heads 22, having short side bars 23 at their corners. These side bars project toward each other, and are preferably of angular form in cross section (see Fig. 4). Furthermore, these side bars are connected by extension bars 24, which are also preferably of angular form and formed with slots 25 on the inside flanges to receive the flanges of the bars 23. The bars 23 are connected to the extension bar 24 by pins 26 running in slots 27. In Fig. 3 the carrier is illustrated completely extended. By forcing the heads 22 toward each other, the carrier will telescope and be short enough to permit it to be slid into the casing, and the bank will be compact.

The upper and lower portions of the heads 22 are preferably formed with transverse horizontal ribs 22a that conform to the convolutions of the plates 17 (see Fig. 3). Each head 22 is provided on its outer side with a handle 28, which is preferably pivotally secured to the plate, and these handles are useful in extending the carrier. When the carrier is within the casing, these handles fold down against the outer sides of the heads as indicated in dotted lines at the right of Fig. 3.

When it is necessary to inspect the plates 17 to ascertain whether they are corroded, the carrier should be removed from the casing and then extended as indicated in Fig. 3. This will enable the plates to be opened up to provide a space between them through which their faces can be observed, and also enabling the faces of the plates to be brushed off and cleaned if this is necessary.

Regardless of whether the plates are mounted in a carrier such as described, these plates should

be of the same composition as the casing **3**. The carrier and the casing are preferably formed of aluminum of substantially the same composition. Aluminum is very desirable for constructing the plates, because it resists corrosion, and furthermore, it has a high conductivity for heat. This adapts the flame arrester for carrying off heat which would be developed by a flame formed from gases burning at the point where they issue from the flame arrester. By having plates and the carrier of the same composition as the casing, the expansion of all these parts will be substantially the same, and this enables the plates to completely fill the interior of the casing, but permits them to expand without being restricted by the casing. If they were so restricted, this would tend to cause buckling in the plates, which might develop a wide passage through the bank of plates and through which a flame could pass down through the flame arrester into the tank.

One of the features of my invention is that we may construct the bank of arrester elements in such a way as to permit air circulation through them for cooling purposes. This would assist in keeping down the temperature in case of an accidental fire, and prevents any possibility of fusing the elements. While this may be accomplished in a plate type flame arrester by constructing the same on the same principle as automobile radiators, and leaving off certain of the side plates **8** of my casing, it is preferable to accomplish this result by constructing the bank of arrester elements out of tubes. This is illustrated in Fig. 7, in which **29** indicates tubes disposed in horizontal rows extending in one direction, and **30** indicates similar tubes extending at right angles to the tubes **29** and located intermediately with relation to the other tubes that extend in the same direction. In other words, each gang of tubes is spaced intermediately with respect to the adjacent upper and lower gangs. This gives a circuitous passage for gases passing up through the bank. Between the tubes at the ends, blocks **31** are provided as spacers, and these blocks may fit up against the side plates such as the plate **32** of the carrier that carries the bank of tubes. If air circulation is desired, the ends of these tubes pass through the cover plates such as the cover plate **33** of the casing.

Fig. 6 illustrates a construction similar to that illustrated in Fig. 7, but in which the tubes do not pass through the cover plate **33a**.

By reason of the fact that the passages for the gases are circuitous and baffled in their form so that the gas is constantly impinging against faces that deflect it, this flame arrester operates as an entrainment separator for separating out any molecules of liquid which are carried in the gas. These molecules fall back by gravity in the tank, and this results in considerable economy in the operation of a storage tank in which my improvement is applied.

It is understood that the embodiment of the invention described herein is only one of the many embodiments this invention may take, and we do not wish to be limited in the practice of the invention, nor in the claims, to the particular embodiment set forth.

What we claim is:—

1. In a flame arrester for a vent, the combination of a casing and a bank of arrester elements mounted in the casing cooperating to form a plurality of tortuous passages leading through the casing, and inclining alternately toward opposite ends of the arrester at a plurality of points throughout their length, said casing and said arrester elements being constructed of material having substantially the same coefficient of expansion when heated.

2. A combined entrainment separator and flame arrester for a vent, comprising a bank of nested plates, said plates having convolutions cooperating to produce a plurality of tortuous passages passing upwardly through the bank of plates, and a casing for confining said bank of plates, said casing and said plates being constructed of material having substantially the same coefficient of expansion when heated, whereby buckling of the bank of plates is prevented when the casing and plates are subjected to a high temperature.

3. A combined entrainment separator and flame arrester for a vent, comprising a bank of nested plates, said plates having convolutions cooperating to produce a plurality of tortuous passages passing upwardly through the bank of plates, and a casing for confining said bank of plates, said casing and said plates being constructed of aluminum and having substantially the same coefficient of expansion when heated, whereby buckling of the plates is prevented when the casing and plates are subjected to a high temperature.

4. A combined entrainment separator and flame arrester for a vent, comprising a bank of nested plates, said plates having convolutions cooperating to produce a plurality of tortuous passages passing upwardly through the bank of plates, and a casing for confining said bank of plates, said casing and said plates being constructed of aluminum and having substantially the same coefficient of expansion when heated, whereby buckling of the plates is prevented when the casing and plates are subjected to a high temperature, and removable cover plates secured to the outer sides of said casing.

5. A combined entrainment separator and flame arrester for a vent, comprising a bank of nested plates, said plates having convolutions cooperating to produce a plurality of tortuous passages passing upwardly through the bank of plates, and a casing for confining said bank of plates, said casing and said plates being constructed of material having substantially the same coefficient of expansion when heated, whereby buckling of the bank of plates is prevented when the casing and plates are subjected to a high temperature, and a removable carrier for said plates, enabling the bank of plates to be removed as a unit from said casing for inspection.

6. A combined entrainment separator and flame arrester for a vent, comprising a bank of nested plates, said plates having convolutions cooperating to produce a plurality of tortuous passages passing upwardly through the bank of plates, and a casing for confining said bank of plates, said casing and said plates being constructed of material having substantially the same coefficient of expansion when heated, whereby buckling of the bank of plates is prevented when the casing and plates are subjected to a high temperature, and a carrier for said bank of plates removably mounted in the casing, said carrier comprising relatively movable sections enabling the carrier to be extended after removal in a direction substantially at right angles to the plane in which said plates extend.

7. A combined entrainment separator and flame arrester for a vent, comprising a bank of

nested plates, said plates having convolutions cooperating to produce a plurality of tortuous passages passing upwardly through the bank of plates, a casing for confining said bank of plates, and a carrier for said plates for supporting the same with the plates extending in a substantially vertical plane, said carrier comprising two extensible sections adapted to collapse to hold the plates in close contact with each other and capable of being extended to facilitate access to the plates from above for inspection and for cleaning the same.

8. A combined entrainment separator and flame arrester for a vent, comprising a bank of nested plates, said plates having convolutions cooperating to produce a plurality of tortuous passages passing upwardly through the bank of plates, a casing for confining said bank of plates, and a carrier for said plates for supporting the same with the plates extending in a substantially vertical plane, said carrier comprising two extensible sections adapted to collapse to hold the plates in close contact with each other and capable of being extended to facilitate access to the plates from above for inspection and for cleaning the same, each of said sections having a head seating against the outermost adjacent plate of the said bank.

9. A combined entrainment separator and flame arrester for a vent, comprising a bank of nested plates, said plates having convolutions cooperating to produce a plurality of tortuous passages passing upwardly through the bank of plates, a casing for confining said bank of plates, and a carrier for said plates for supporting the same with the plates extending in a substantial vertical plane, said carrier comprising two extensible sections adapted to collapse to hold the plates in close contact with each other and capable of being extended to facilitate access to the plates from above for inspection and for cleaning the same, each of said sections having a head seating against the outermost adjacent plate of the said bank, each of said heads having projections on the inner faces thereof fitting into the convolutions of said outermost plates.

10. In a flame arrester for a vent, the combination of a casing and a bank of tubes disposed in substantially parallel gangs, said tubes cooperating to form tortuous passages passing upwardly outside the tubes through the casing.

11. In a flame arrester for a vent, the combination of a casing, and a bank of tubes consisting of a plurality of gangs of tubes extending across the interior of the casing, the tubes in each gang extending in a different direction from the tubes in an adjacent gang, and said tubes being disposed close together so as to form a plurality of tortuous passages outside the tubes leading from the vent through the casing.

12. In a flame arrester for a vent, the combination of a casing and a bank of tubes disposed in substantially parallel gangs, said tubes cooperating to form tortuous passages passing upwardly through the casing outside of the tubes, said tubes being open on their ends to permit circulation of air through the bank of tubes to cool the same.

13. A flame arrester for a vent, having a plurality of plates located in a substantially parallel relation, said plates being offset laterally at a plurality of points so as to present faces inclining alternately toward the opposite ends of the flame arrester and forming tortuous passages between the plates.

14. In a flame arrester for a vent, the combination of a casing, a bank of arrester elements composed of a plurality of like elements disposed close together and cooperating to form a plurality of tortuous passages inclining alternately toward opposite ends of the arrester and passing through the casing, and a removable carrier supporting said bank and removable from said casing as a unit with the said element.

15. In a flame arrester for a vent, the combination of a casing, a bank of arrester elements composed of a plurality of like elements disposed close together and cooperating to form a plurality of tortuous passages inclining alternately toward opposite ends of the arrester and passing through the casing, a removable carrier comprising end plates with telescoping bars capable of telescoping together to enable the end plates to clamp the elements in close formation, said carrier being extensible and said elements being freely removable from the carrier when the same is extended and after the carrier has been removed bodily from the casing.

16. In a flame arrester for a vent, the combination of a casing, a bank of arrester elements composed of a plurality of like elements disposed close together and cooperating to form a plurality of tortuous passages inclining alternately toward opposite ends of the arrester and passing through the casing, a removable carrier comprising end plates with telescoping bars capable of telescoping together to enable the end plates to clamp the elements in close formation, said carrier being extensible and said elements being freely removable from the carrier when the same is extended and after the carrier has been removed bodily from the casing, said casing having a removable wall to abut against one of the end plates of the carrier and hold the carrier in its telescoped condition within the casing.

17. In a flame arrester for a vent, the combination of a casing, a bank of arrester elements composed of a plurality of like elements disposed close together and cooperating to form a plurality of tortuous passages inclining alternately toward opposite ends of the arrester and passing through the casing, a removable carrier comprising end plates with telescoping bars capable of telescoping together to enable the end plates to clamp the elements in close formation, said carrier being extensible and said elements being freely removable from the carrier when the same is extended and after the carrier has been removed bodily from the casing, said casing having a removable wall to abut against one of the end plates of the carrier and hold the carrier in its telescoped condition within the casing, said elements, said carrier, and said casing being all constructed of a material having the same coefficient of expansion.

18. A flame arrester having a casing, a carrier removable bodily from the casing, a bank of arrester elements supported in the carrier, said carrier having relatively movable sections, each section having a head at its outer end for pressing against the arrester elements to clamp the same together, said carrier having overlapping extensions with means associated therewith for limiting the relative outward movement of the said sections with respect to each other, said arrester elements being freely movable when the said sections are pulled apart, said arrester elements being unattached to the carrier so as to permit them to be lifted vertically out of the carrier.

19. A flame arrester having a casing, a carrier within the casing and removable bodily from the same, a bank of imperforate arrester plates carried in the carrier, said carrier having relatively movable sections extending under the lower edges of the plates at their ends for supporting the same, and capable of clamping the plates close together, said sections being capable of relative movement to separate the same so as to render the faces of said plates accessible, means for limiting the separating movement of the said sections, said carrier being unattached to said plates so as to enable the plates to be removed by lifting the same vertically out of the carrier.

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