

[54] METHOD OF CONSTRUCTING A HEAT INSULATING WALL OF FOAMED SULFUR

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[58] Field of Search..... 161/41, 160, 170; 220/9 F, 220/9 LG, 63; 264/DIG. 5, 45, 297, 332, 42; 156/78

[56]

References Cited

UNITED STATES PATENTS

1,454,344	5/1923	Stewart.....	264/297
2,305,209	12/1942	Treichler et al.	264/332 X
3,337,355	8/1967	Dale et al.	264/DIG. 5
3,619,437	11/1971	McDonald, Jr.	264/45
3,644,168	2/1972	Bonk et al.	264/45 X
3,787,276	1/1974	Jacquelin.....	156/78 X

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[57]

ABSTRACT

A heat insulating wall of low temperature liquefied gas tanks substantially made of sulfur and some crack preventing materials such as glass wool, etc. included in said sulfur layer, the wall being formed by blowing melted sulfur including a foaming agent at the inner surface of an outer vessel of a rigid structure and having the sulfur foamed and solidified to form a substantially continuous wall.

7 Claims, 2 Drawing Figures

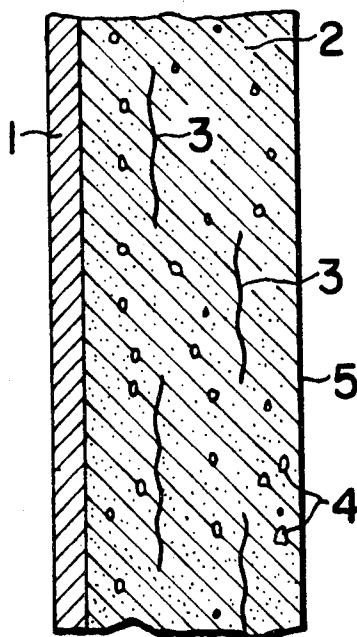


FIG. 1

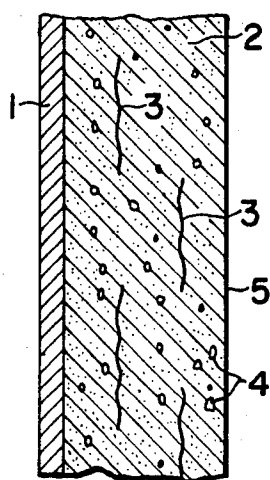
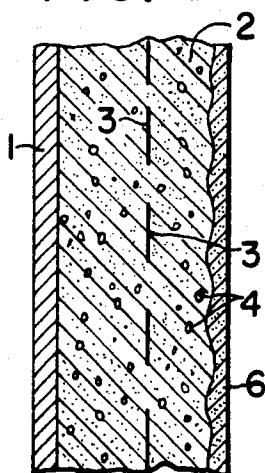


FIG. 2



METHOD OF CONSTRUCTING A HEAT INSULATING WALL OF FOAMED SULFUR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a heat insulating wall for low temperature liquefied gases for storing or transporting low temperature liquefied gases such as liquefied petroleum gases which are in a gaseous state at room temperature and can be liquefied at low temperature under atmospheric pressure, and more particularly a heat insulating wall having a compression resisting structure for the abovementioned application which can support the internal pressure of the tank by itself.

2. Description of the Prior Art

The heat insulating wall of this kind is conventionally formed either of a single material such as foam concrete or perlite concrete, foam glass, hard polyurethane foam, etc. or of a composite heat insulating material composed of a proper compression resisting reinforcing material and a heat insulating material which has a high heat insulating characteristic but is inferior in compression resisting characteristic, such as glass wool, granular perlite, etc.

However, although foam concrete or perlite concrete has a high compression resisting characteristic, they are inferior in heat insulating characteristic, and furthermore, they are hygroscopic. Foam glass or hard polyurethane foam can improve the heat insulating performance of a heat insulating wall, but since these materials are rather expensive, and thus the cost of the heat insulating wall is also correspondingly increased. When the composite heat insulating material as mentioned above is used, a complicated frame structure is required for the heat insulating wall, whereby it becomes difficult to obtain a heat insulating wall which is uniform over the surface thereof regarding the load supporting characteristic. Furthermore, such a structure has a low efficiency of construction, and accordingly, possesses the drawback that the cost of construction is relatively high.

Furthermore, in the case of the conventional heat insulating wall, if a leakage of the low temperature liquefied gases has occurred at an inner vessel containing the liquefied gases, the heat insulating wall will be wetted with the liquefied gases and lose its heat insulating performance, creating the danger that the very low temperature of the low temperature liquefied gases is transmitted to an outer vessel through the heat insulating wall. When the outer vessel is formed of ordinary steel, breakage of the outer vessel can be caused by low temperature brittleness.

SUMMARY OF THE INVENTION

Therefore, it is the object of this invention to solve the abovementioned problems in the conventional heat insulating wall of low temperature liquefied gas tanks and to provide an improved heat insulating wall which has high compression resisting and heat insulating characteristics a high degree of adhesiveness a high resistance to cracking, is impermeable to fluid, especially low temperature liquefied gases, and can be easily be constructed on the site at a very low cost.

The abovementioned object is accomplished, according to this invention, by a heat insulating wall formed by blowing melted sulfur including a foaming agent at the inner surface of an outer vessel of a rigid structure

and having the sulfur foamed and solidified to form a substantially continuous wall, wherein said wall is adapted to include therein crack preventing materials.

Sulfur is by itself superior in compression resistance as well as heat insulating characteristics, has a high adhesiveness, and is anti-wearing. Furthermore, sulfur is non hygroscopic and is a very stable material.

Since, according to this invention, sulfur is mixed with a foaming agent and is in a fluidal state blown at the inner surface of a rigid outer vessel thereby to foam and thereafter solidify to form a continuous layer, the heat insulating wall is easily constructed on the site. The foams generated in the layer form a number of independent spaces within the continuous layer, whereby the heat insulating characteristic of the wall is improved, while maintaining the impermeability of the wall to humidity, and at the same time reducing the specific weight of the heat insulating layer.

Since a continuous layer is formed by blowing melted and fluidal sulfur, the wall is provided with a uniform load supporting characteristic. By mixing some fibrous crack preventing materials such as glass wool in the continuous layer of sulfur, the strength of the wall, especially its anticracking characteristic is very much improved.

Furthermore, the heat insulating wall according to this invention may preferably be provided with a fluid-tight surface layer of sulfur at the inner surface portion of the continuous layer. Although the continuous layer made of the foamed sulfur according to this invention has by itself impermeability to fluid since the foamed spaces left in the layer are respectively independent, the above-mentioned surface layer of sulfur provides a more favorable inner surface condition of the continuous layer by covering therewith edge portions of the crack preventing materials or broken edges of the foamed spaces exposed to the surface of the continuous layer.

More particularly, sulfur becomes fluidal by being heated up to a relatively low temperature such as 110 degrees centigrade and has a high adhesiveness so that it sticks firmly to the same or foreign materials. Therefore, the abovementioned surface layer of sulfur can be easily formed by attaching fluid sulfur at the inner surface of the continuous layer in the manner of coating or plastering, whereby the attached layer of sulfur is firmly held there and cannot be removed, even under the application of vibrations or shocks. Thus, the safety of the heat insulating layer is further improved by the addition of such an inner surface layer.

The heat insulating layer composed of the foamed sulfur layer and the solid inner surface layer of sulfur provides a sufficiently high impermeability to low temperature liquefied gases so that the low temperature liquefied gases to be stored in the tank can be directly held by the inner surface of the inner surface layer of the heat insulating wall. When the heat insulating wall of the abovementioned structure is used as a heat insulating layer for supporting an inner membranous vessel of a low temperature liquefied gas tank of the membrane type, the heat insulating layer provides a smooth supporting surface for the inner membranous vessel and at the same time operates as a secondary barrier wall for provisionally checking leakage of the liquefied gases when a leakage has occurred at the inner membranous vessel.

BRIEF DESCRIPTION OF THE DRAWING

In the accompanying drawing, FIGS. 1 and 2 are partial views in section of two embodiments of the heat insulating wall according to this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following, this invention will be described in more detail of some preferred embodiments with reference to the accompanying drawing.

In the embodiment shown in FIG. 1, a rigid outer vessel 1 made of normal steel, compression resisting concrete, etc. is attached with a continuous heat insulating layer 2 formed by blowing melted sulfur including a foaming agent at the inner surface of the outer vessel and having the melted sulfur foamed and solidified, said continuous layer 2 including therein a crack preventing material 3 such as glass wool. In the continuous layer 2, there are generated a number of independent foams 4 which, after the solidification of the sulfur, leave corresponding foamed spaces. As the crack preventing material 3, other materials such as plywood, wire net, etc. may also be used. In the embodiment shown in FIG. 1, the inner surface 5 of the continuous layer 2 is not perfectly smooth due to the projections of some end portions of the crack preventing material and the presence of some foamed spaces which are partly exposed to the inner surface 5.

In the embodiment shown in FIG. 2, the inner surface of the continuous layer 2 is covered with a fluid-tight solid layer 6 of sulfur which has been formed by coating the inner surface 5 by melted sulfur.

The heat insulating walls as shown in FIGS. 1 and 2 are usually used as a compression resisting heat insulating wall for supporting an inner membranous vessel (not shown) of a low temperature liquefied gas tank of

a membrane type, but in some cases the low temperature liquefied gases may be directly stored at the inside of the continuous layer 2 or the inner surface layer 6.

I claim:

1. A method of constructing a heat insulating wall of foamed sulfur which comprises blowing, in the form of a layer, melted sulfur containing a foaming agent to the inner surface of an outer vessel of a rigid structure, said sulfur foaming and solidifying upon its application to said surface to form a substantially continuous wall.
2. The method of claim 1, wherein the melted sulfur contains a crack-preventing material.
3. The method of claim 2, wherein the crack-preventing material is glass wool.
4. The method of claim 1, wherein the layer of foamed sulfur is further covered with a layer of solid sulfur material.
5. A method of constructing a high compression resisting, heat-insulating wall of foamed sulfur having a high degree of adhesiveness, a high resistance to cracking, is impermeable to fluids, especially low-temperature liquefied gasses and can be constructed at the site location which comprises blowing, in the form of a layer, melted sulfur containing a foaming agent and a crack-preventing material to a rigid structure, said sulfur foaming and solidifying upon its application to said rigid structure to form a substantially continuous wall thereon, said wall having a plurality of relatively small, substantially uniform, closed-cell voids uniformly dispersed throughout the sulfur layer.
6. The method of claim 5, wherein the crack-preventing material is glass wool.
7. The method of claim 5, wherein the crack-preventing material is randomly dispersed throughout the foamed sulfur layer.

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