United States Patent [19]

Sauerbrunn et al.

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[45] **Dec. 24, 1974**

[54] **INSULATION FOR LIQUID GAS CONTAINERS, ESPECIALLY SPHERICAL CONTAINERS**

[75] Inventors: **Irmhild Sauerbrunn,** Altenbach/Odw.; **Rudolf Bellemann,** Rot, both of Germany

[73] Assignee: **Rheinhold & Mahba GmbH,** Anlage, Germany

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[21] Appl. No.: **328,397**

[30] **Foreign Application Priority Data**

July 6, 1972 Germany 2233332

[52] **U.S. Cl.** ..... **62/45,** 220/9 LG, 220/9 F, 161/37

[51] **Int. Cl.** **F17c 3/04**

[58] **Field of Search** ..... 62/45, DIG. 13; 220/9 LG, 220/9 A, 9 F, 15; 114/74 A; 52/408; 161/36, 37, 38

[56] **References Cited**

UNITED STATES PATENTS

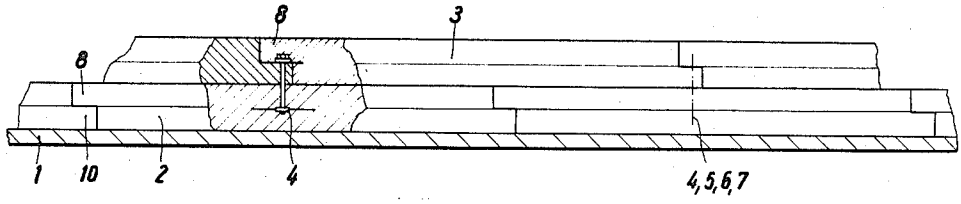
2,928,565	3/1960	Glasoe, Jr.	220/9 A
3,196,622	7/1965	Smith et al.	220/9 LG
3,487,971	1/1970	Kirgis et al.	62/45

Primary Examiner—Meyer Perlin
Assistant Examiner—Ronald C. Capossela
Attorney, Agent, or Firm—Browdy and Neimark

[57] **ABSTRACT**

Insulation for liquid gas container and particularly spherical containers is disclosed. Plastic insulating panels having rabbeted edges are arranged in rows over the surface of the container. Each adjacent row is staggered one half panel length. A fastening element is embedded in the center of each panel. A second layer of panels is superposed over the inner layer such that the panels of the upper layer are staggered with respect to the panels of the inner layer and are held in place by means of the fastening elements fastening the rabbeted edges of the upper layer of panels.

8 Claims, 4 Drawing Figures



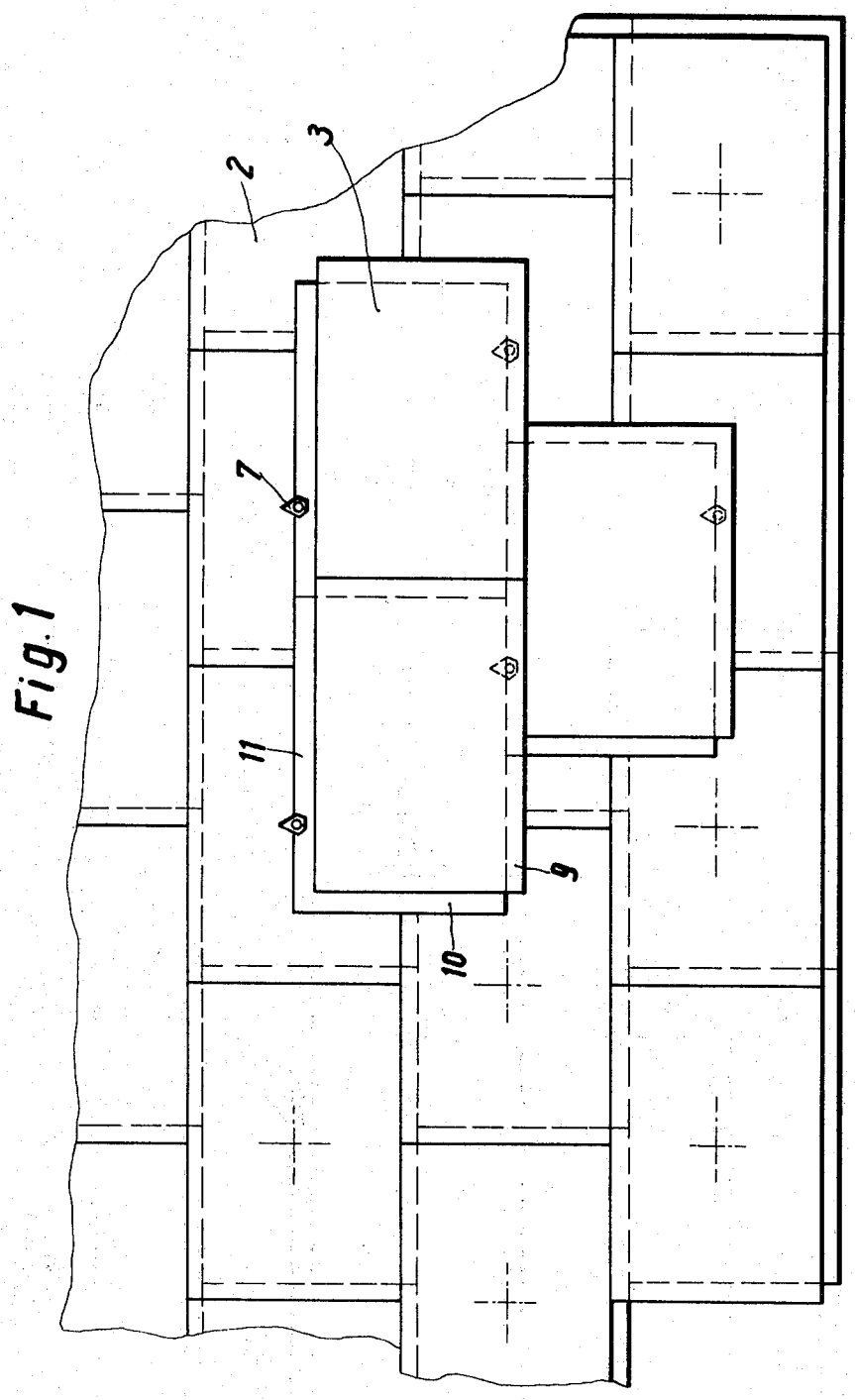


Fig. 1

Fig. 2

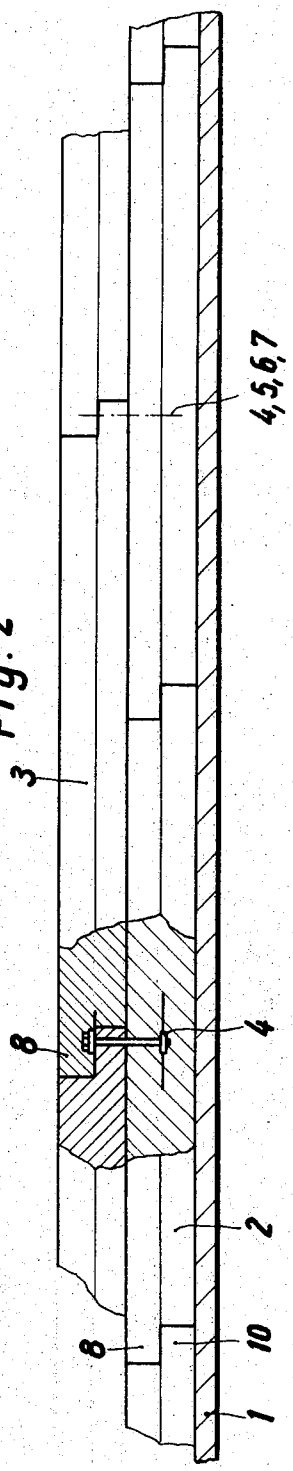


Fig. 3

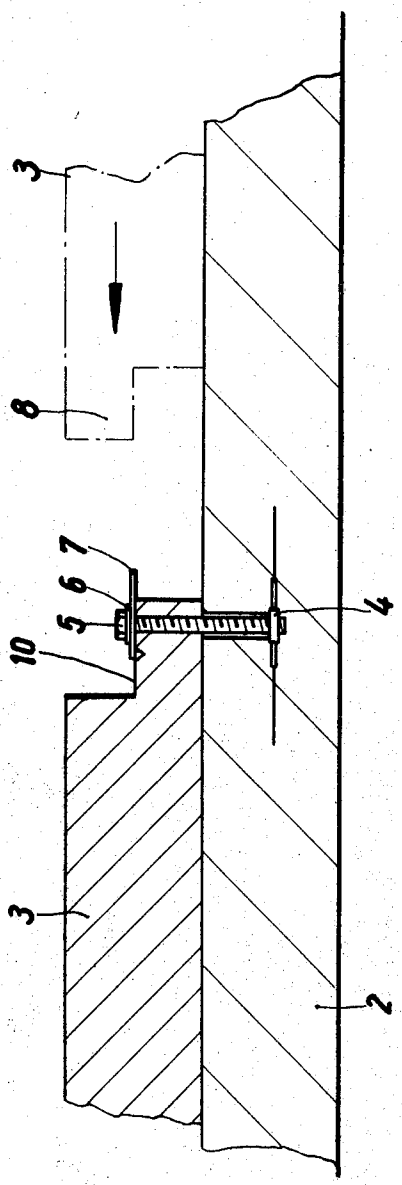
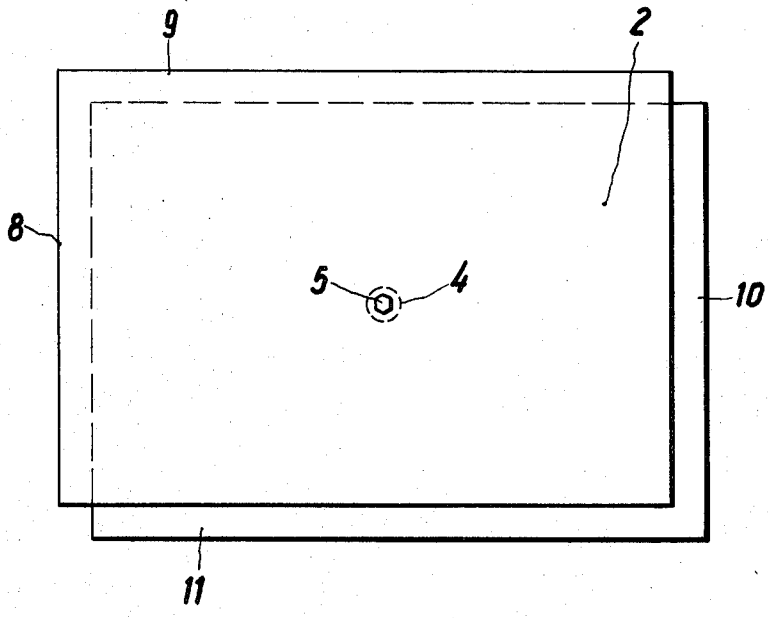


Fig. 4



INSULATION FOR LIQUID GAS CONTAINERS, ESPECIALLY SPHERICAL CONTAINERS

FIELD OF THE INVENTION

The invention concerns an insulation for liquid gas containers, especially spherical containers, consisting of individual insulating panels.

BACKGROUND OF THE INVENTION

Liquified gas, for example natural gas, methane or the like is being transported over long distances and stored in large quantities to an increasing degree. The insulation of transport or storage containers for liquid gas involves considerable difficulties. In the case of cubic or cylindrical containers, costly and difficult designs are required for insulation, since the insulation must be rigid and possess great strength. It is difficult to attach the insulation to the container, since the use of fastening elements welded to the container is usually not allowed and is impossible due to the different degrees of expansion of the different materials at low temperatures. Foam plastics, which have proven to be highly efficient as insulators, have large expansion coefficients (and in the cold, large contraction coefficients) that result in considerable joint formation and cold bridge formation, so that undesirable convection currents develop. The considerable temperature differences also means that the contraction coefficients of the metal and foam are different and in those systems in which individual plastic panels are firmly connected together or which consist of a homogeneous layer of insulation, internal stresses (the additional stresses encountered aboard ships, caused by vibration and rolling) lead to cracking and thus to uncontrolled joint formation.

Types of insulation are already known that consist of particularly costly designs, e.g., laminated plywood panels with polyurethane foam and balsa wood, which are used especially for cubic containers.

It has also been proposed to insulate the containers on the site with plastic foam and thus to apply the insulating covering as a whole. It has been found, however, that in the course of time cracks develop at point that cannot be checked, which are hard to detect and can run from the cold side to the warm side.

Attempts have also been made to overcome these difficulties with loose insulation, thereby doing away with crack formation. In order to overcome difficulties in moving the container during the cooling and heating processes, intermediate layers of mineral fibers have been provided. It is still unclear, however, how long the elasticity of this fiber material is retained.

Finally, it has been attempted to avoid convection in the spaces by filling the joints between the individual panels with elastic fiber insulators and providing flexible buffers between the panels. The flexible buffers become useless, however, if ice forms through convection in the joints at low temperatures; the ice is deposited on the fiber insulation and makes the fibers brittle, so that they break during movement, e.g. when the panels are shifted by expansion.

SUMMARY OF THE INVENTION

An object of the present inveniton is to make an insulating material for containers used to transport and/or store very cold liquids, said insulation possessing a certain stiffness that prevents the formation of through cracks, with the resultant number of joints being exactly definable both as to position and dimensions, and also possessing technical advantages with respect to both insulation and assembly, especially a facilitation of assembly with regard to precision and freedom from flaws.

This purpose is accomplished according to the invention primarily by the fact that at least two layers of plastic panels are provided that have rabbeted edges and have fastening elements at their centers, said panels being mounted in two superposed layers. The central fastening elements of the inner panels fit into the rabbeted edges of the outer panels and the panels in the inner layer are staggered with respect to each other and with respect to the panels of the outer layer.

In this manner, all through joints are eliminated. The combination of punctiform fastenings in the insulation itself avoids through heat bridges. It is important in this regard that the central fastening elements face the cold side of the insulation, so that these panels can contrast toward the center. With such an insulation according to the invention, self-supporting domes can also be made for insulating spherical containers, said containers being insulated on all sides without additional fastening means. No forces are transmitted from the container to the insulation during the cooling and warming processes.

It is particularly advantageous if the insulating panels have rabbeted edges such that molded shoulders are formed where two edges butt against each other. This ensures a very tight connection between abutting insulation panels and avoids through cracks in one layer.

According to a further feature of the invention, known force-accepting elements can be molded into the centers of the panels, at approximately half the thickness of said panels, and connected to the fastening and holding elements. Such known force-accepting elements require a relatively small panel area for fastening and allow distribution of force over a large area, so that relatively large forces can be withstood even when applied vertically to the panel plane, without the force-accepting elements being torn out of the panels. The relative movements of the inner layer that result from expansion due to heat and contraction due to cold can act on the fastening points on the centers of the elements.

It is especially advantageous if the panel elements in one layer are arranged in rows and each row is staggered by one-half the panel length with respect to the adjacent row. A further advantageous embodiment of the invention consists in that the panel elements and rows of the outer layer are applied so as to be staggered with respect to the panel elements in the lower layer on all sides.

Further features and advantages of the invention will be described in more detail with reference to the drawing, which schematically shows sample embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1: Arrangement of insulating elements, top view.

FIG. 2: Cross section through the arrangement in FIG. 1.

FIG. 3: A detail of the connection between the two layers on an enlarged scale, and

FIG. 4: Schematic representation of an insulating panel element according to the invention.

It is clear from FIG. 1 that the insulation consists of individual insulating panels 2 and 3 that are arranged in sequential rows and in adjacent rows, with adjacent rows being staggered approximately half a panel length with respect to each other. It is also evident that the insulation consists of two layers with the panels in the outer layer being staggered with respect to the plates in the inner layer with respect to both length and width and also staggered with respect to the adjacent rows of panels in the outer layer. The panels in the inner layer have fastening means in their centers; the prongs 7 of said fastening means can be seen in FIG. 1, and fit into the rabbeted edges 11 of the outer panel 3.

It is clear from FIGS. 2 and 3 that the panels 2 of the inner layer are mounted above the container wall 1 in such a fashion that projection 8 on panel 2 is slid over shoulder 10 on a second panel 2, thus avoiding a through joint. Plates 2 on the inner layer have force-accepting elements 4 molded approximately in the center of the panel, said elements having hexagon-head screws 5 and fastening prongs 7 and lock washers 6 on said hexagon-head screws. After installation of the inner panel layer the panels of the outer layer are applied and placed with shoulders 10 in the vicinity of the fastening means 5,6,7. When screw 5 is tightened prongs 7 are pressed into panel 3 and then an adjacent panel 3 is slid on so that the corresponding projection 8 comes to rest on shoulder 10 on the first panel. Since the fastening means for the panels in the two layers are completely contained inside the insulating layer, through cold or heat bridges are completely avoided.

As soon as container 1 is filled with a very cold liquid, a temperature gradient is created inside the insulation, with the temperature decreasing steadily from the outer surface toward the container wall 1. The result is that the panels in the inner layer undergo a greater degree of contraction than the panels in the outer layer. This creates individual wedge-shaped spaces between the individual panels, but the spaces are always staggered with respect to each other and involve only a fraction of the insulating layer thickness. By means of this arrangement and mounting of the insulating panels an inherently rigid connection is achieved without heat bridges and without formation of through joints. Thus, it is also advantageously achieved that a plywood covering, which might be applied in addition on top of the outer layer (or a fireproofing layer so applied), cannot rupture in the region of the joints.

The container wall 1 is a part of a relatively large sphere with a large radius so that the individual panels 2,3 can be viewed practically as flat panels. The invention is not limited to the sample embodiments shown and described. It includes all advantageous and expert modifications as well as all partial and subcombinations of the described and/or shown features and measures.

What is claimed is:

1. Insulation for liquid gas containers comprising:
- a plurality of molded inner foamed synthetic insulating panels each having rabbeted edges, each having a fastening element at the center thereof projecting upwardly from approximately halfway through the thickness thereof and each having a force-accepting element embedded in the center of each panel during molding thereof at approximately half the thickness of said panel;
- said inner insulating panels being adapted for arrangement on a gas container with each panel being staggered with respect to at least one of the next adjoining panels and interlocking therewith;
- a plurality of outer insulating panels having rabbeted edges;
- said outer insulating panels being adapted for arrangement on said inner insulating panels with each outer panel being staggered with respect to at least one of the next adjoining outer panels and interlocking therewith and each said outer panel being staggered with respect to said inner panels; and
- wherein said fastening elements of said inner panels fit into the rabbeted edges of said outer panels.

2. Insulation in accordance with claim 1 wherein said fastening element comprises a clamping screw and fastening prong which are linked to said force-accepting element.

3. Insulation in accordance with claim 1 wherein said inner panels and said outer panels are arranged in rows and each row is staggered with respect to the next adjoining row by half a panel length.

4. Insulation in accordance with claim 1 wherein said outer panels are staggered on all sides with respect to said inner panels.

5. A device as set forth in claim 1, further comprising:
- a container for storing or transporting liquid gas, said container having a spherical wall the outer surface of which lies against the inner surface of said inner panels.

6. Insulation in accordance with claim 1 wherein said inner and outer insulating panels are plastic.

7. Insulation in accordance with claim 1 wherein said rabbeted edges of said inner and said outer panels comprise flange projections on two adjacent edges and flange-receiving shoulders for receiving and interlocking with flange projections on the other two adjacent edges of adjoining panels.

8. Insulation in accordance with claim 7 wherein said fastening elements fit into said flange-receiving shoulders of the superjacent panel layer.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,855,811 Dated December 24, 1974

Inventor(s) Sauerbrunn et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

[73] Assignee: Rheinhold & Mahla GmbH.
Mannheim, Augusta-Anlage, Germany

Column 2, line 21, "contrast" should read --contract--

Signed and sealed this 6th day of May 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks

FORM PO-1050 (10-69)

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