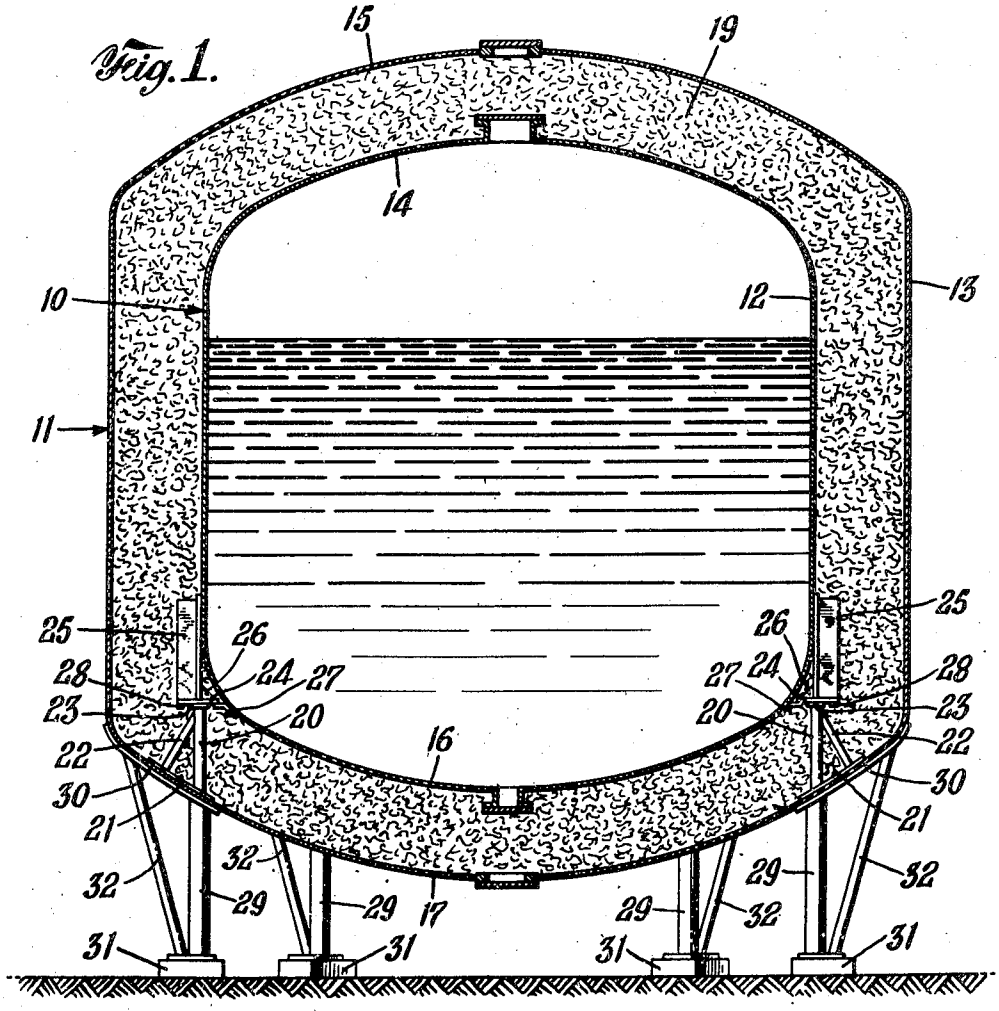
Feb. 1, 1949. H. C. KORNEMANN 2,460,355

CONTAINER FOR LIQUEFIED GASES

Original Filed July 11, 1942

Fig. 1.



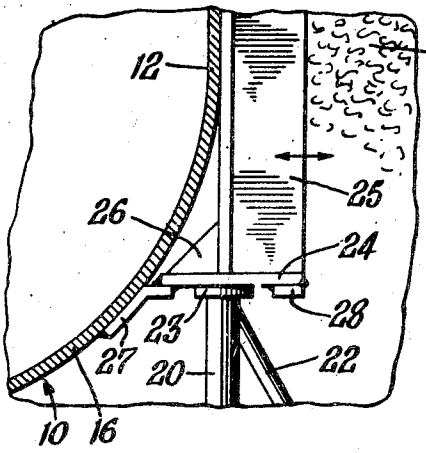


Fig. 2.

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Patented Feb. 1, 1949 2,460,355

UNITED STATES PATENT OFFICE

2,460,355

CONTAINER FOR LIQUEFIED GASES

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Original application July 11, 1942, Serial No. 450,644. Divided and this application November 4, 1944, Serial No. 561,869

2 Claims. (Cl. 220—15)

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This invention relates to containers for holding cold liquids and more particularly to apparatus for the storage of a liquefied gas having a relatively low boiling-point temperature such as liquid oxygen.

In order to store liquefied gases having boiling-point temperatures below 233° K. such as liquid oxygen at atmospheric pressure or at pressures slightly above atmospheric pressure, it is necessary that the vessel holding the liquefied gas be well protected from the heat of the atmosphere so that losses due to evaporation are maintained at a low value. It is customary to envelope completely the liquid-holding vessel with a relatively thick layer of insulating material, and thoroughly protect such insulation from the effects of atmospheric moisture by providing a closed outer shell about the vessel and insulation. The insulating material customarily employed for a liquid oxygen container is a loose powder such as magnesium carbonate or a fibrous material such as mineral wool or a combination of such materials. Such insulation has a density such that it is only self-supporting and cannot provide any support for the inner vessel. For moderate sized liquid oxygen containers the inner vessel is customarily supported in suspension by rods or cables secured to the outer shell or to a frame associated with the outer shell. For relatively large liquefied gas storage containers such method of supporting the inner vessel would require the provision of excessively heavy side walls for the outer shell or expensive and heavy bracing and frame construction.

Principal objects of the present invention are: to provide an improved construction for containers for the storage of liquefied gases and particularly for containers of relatively large sizes; and to provide improved means for supporting the inner vessel of a liquefied gas storage container which shall permit free expansion and contraction of the inner vessel due to temperature changes, which shall avoid the transfer of excessive heat to the inner vessel, and which shall maintain the thickness of insulation around the lateral sides of the inner vessel substantially equal irrespective of the expansion and contraction due to temperature changes.

These and other objects and novel features of the invention will become apparent from the following description and accompanying drawing, in which:

Fig. 1 is a view mainly in vertical section of a relatively large liquefied gas storage container

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embodying the principles of the present invention; and

Fig. 2 is an enlarged fragmentary view of the upper portion of one of the supporting members for the inner vessel.

Referring now to the drawing, the inner vessel 10 and outer shell 11 are preferably in the form of upright cylinders having cylindrical side walls 12 and 13 respectively, but provided with dished upper and lower heads 14, 15 and 16, 17, respectively. The outer shell 11 is larger in all dimensions than the inner vessel 10 by an amount sufficient to provide an adequate insulation space between the walls 12 and 13, the upper heads 14 and 15 and the lower heads 16 and 17. Such insulation space is filled with suitable insulating means 19. In some instances, however, it may be desirable to employ a vacuum between the inner vessel and the outer shell for purposes of heat insulation. In such case the surfaces of the insulation space should be highly polished. For vessels of relatively large size, however, it is difficult and expensive to provide polished surfaces that will adequately control heat flow by radiation and it has been found preferable not only to evacuate the insulation space but also to fill it with a suitable finely divided insulating means such as is disclosed in U. S. Patent No. 2,396,459 issued March 12, 1946 to L. I. Dana. This form of the invention is suitable for the employment of the powder-in-vacuum type of insulation because the outer shell can be constructed so as to withstand the external atmospheric pressure.

The inner vessel 10 is supported in desired relation to the outer shell 11 by a series of piers or supporting members 20, preferably spaced circumferentially around the lower end of the cylindrical side wall 12. The supporting members 20 are secured to the lower head 17 by suitable means such as by welding the member to a reenforcing plate 21 secured against the inside surface of the head 17. An outwardly extending angular brace 22 may also be provided to maintain the supporting members 20 in the vertical position. Such supporting members may preferably have a tubular form and be composed of a metal having a relatively low heat conductivity, such as stainless steel. The upper ends of the supporting members 20 are provided with flat horizontal plates 23, the upper surfaces of which are smooth to form bearing surfaces. Corresponding bearing surfaces on the inner vessel 10 are provided on the lower surfaces of horizontal plates 24 secured in the proper positions to the

inner vessel 10. The plates 24 are secured preferably by welding to the lower ends of angular brackets 25, the upper ends of which are secured to the cylindrical side wall 12. The brackets 25 are braced by gusset plates 26 to the dished head 16. The inwardly extending edges of the plates 24 are welded to angle plates 27 which are secured against the shoulder of the dished head 16. A lubricating material such as graphite is interposed between the bearing surfaces of the plates 23 and 24. The amount of relative travel permitted between the plates 23 and 24 is preferably limited by suitable stops. Thus, a stop block 28 is secured against the under surface of the plate 24 adjacent its outer edge while the bracket 27 secured to the under surface of the plate 24 adjacent its inner edge acts to prevent overtravel in the other direction.

The outer shell may be supported by any suitable means. As shown in Fig. 1 the outer shell is supported on columns 29 which are preferably positioned substantially directly below the supporting members 20. The columns 29 are secured at their upper ends to an external reenforcing plate 30 on the head 17 and are mounted at their lower ends on suitable foundation piers 31. Angular braces 32 extending from piers 31 to a point adjacent the joint between the head 17 and the side wall 13 of the outer shell are also preferably provided. The foundation piers 31 should extend into the ground to a depth below the normal frost line.

Connections for the supply and withdrawal of liquid, the withdrawal of gas, safety valves, and other auxiliary equipment may be provided as is customary with liquefied gas storage tanks. Such equipment forms no part of the present invention and is therefore not illustrated.

It will be seen that certain features of the invention may be used independently of others and that changes may be made in certain features of the apparatus without departing from the essentials of the invention. For example, the inner vessel 10 or both the inner vessel 10 and the outer shell 11 may be of spherical form instead of cylindrical.

This application is a division of the abandoned joint application of James G. Van Vleet, George W. Patch, Jr., and Henry C. Kornemann, Serial No. 450,644, filed July 11, 1942.

What is claimed is:

1. Apparatus for the storage of liquefied gas at temperatures below 233° K. comprising a closed inner vessel for holding the liquefied gas, a completely closed gas-tight outer shell around the inner vessel and spaced therefrom to provide an insulating space; supporting members spaced outwardly from the center of the bottom of said inner vessel and extending upwardly from the bottom or floor of the outer shell, said supporting members being provided with smooth, flat horizontal upper bearing surfaces; supports for holding said outer shell in upright position, said supports being positioned under said supporting members; horizontal flat bearing surfaces on said inner vessel positioned to rest on said upper surfaces of said supporting members, the construction and arrangement of said supporting members and horizontal surfaces being such as to

support the inner vessel in desired spaced relation to the outer shell; movement-restraining means associated with said bearing surfaces on said inner vessel and positioned to cooperate with said supporting members for substantially centering said inner vessel with respect to said outer vessel when said inner vessel has contracted a predetermined amount due to introduction of liquefied gas; and anti-friction means between the bearing surfaces of said inner vessel and the corresponding surfaces of said supporting members, said anti-friction means being of a character having adequate anti-friction properties at the temperature of said liquefied gas whereby said inner vessel may freely contract radially and be centered with respect to said outer shell.

2. Apparatus for the storage of liquefied gas at temperatures below 233° K. comprising a closed inner vessel for holding the liquefied gas; said inner vessel having a side wall of substantially vertical cylindrical form; a plurality of brackets secured externally at spaced points to the lower portion of said side walls, said brackets each having a horizontal bearing surface; a closed gas-tight outer shell enveloping said inner vessel and spaced therefrom to provide an evacuatable insulating space; supporting members secured to and extending upwardly from the lower portion of said shell, one such supporting member being disposed under and cooperating wtih each of said bearing surfaces; anti-friction means between each of said supporting members and the corresponding bearing surface whereby said inner vessel may freely contract and expand radially with respect to said outer shell; supporting columns for said outer shell positioned substantially under said supporting members so that the weight of the inner vessel and contents creates substantially no bending forces in the outer shell; and outer and inner stop means associated with said bearing surfaces for preventing excessive relative horizontal displacement between the inner vessel and outer shell and acting in cooperation with said anti-friction means to center the inner vessel when it contracts upon introduction of a charge of said liquefied gas, whereby the heat insulating efficiency of said insulating space is at its highest value when the inner vessel is charged.

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