Sept. 23, 1941. O. A. HANSEN 2,256,673

SUPPORT FOR DOUBLE-WALLED CONTAINERS

Filed Aug. 19, 1939

Fig.1.

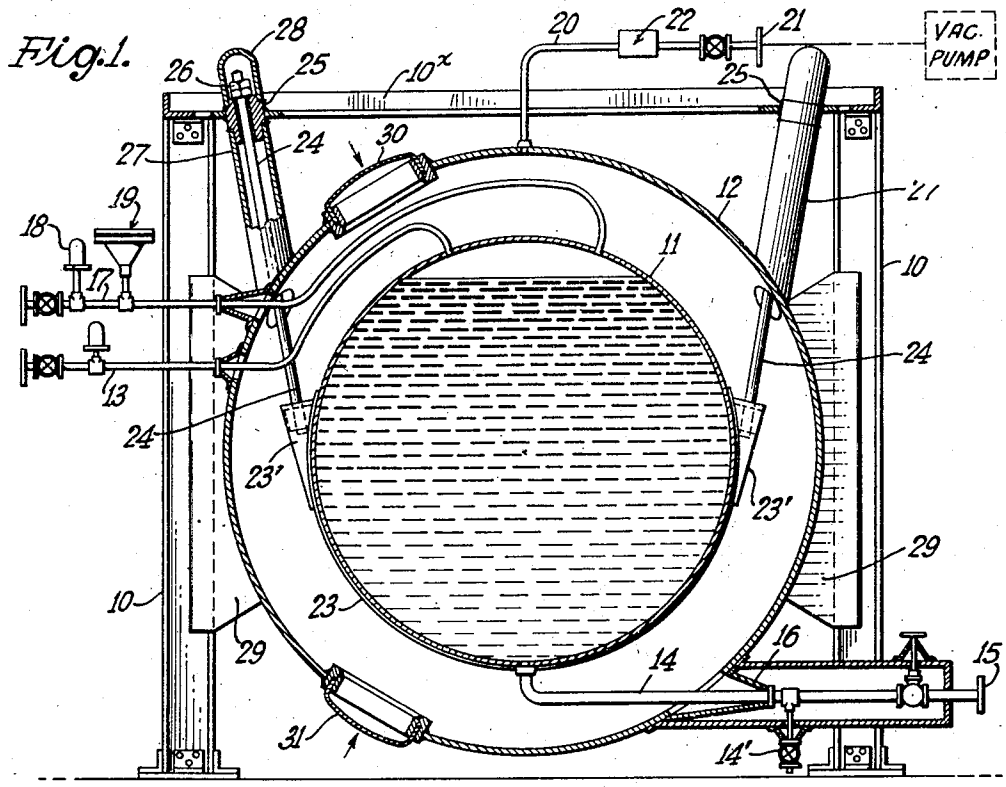


Fig.2.

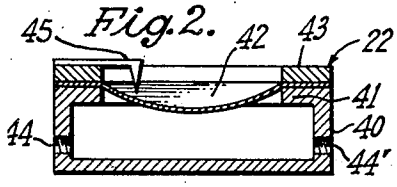


Fig.3.

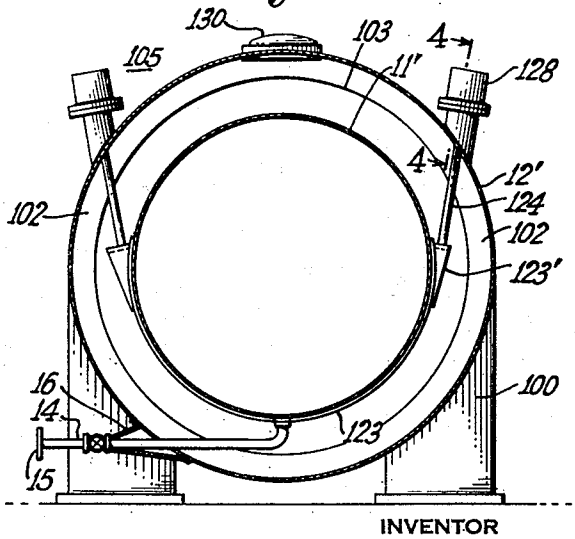
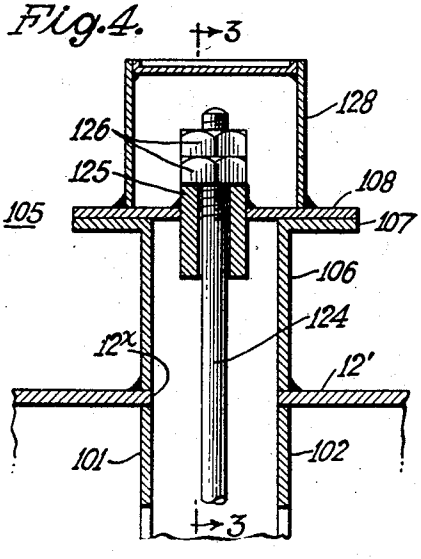


Fig.4.



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SUPPORT FOR DOUBLE-WALLED CONTAINERS

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8 Claims. (Cl. 220—15)

This invention relates to supports for double-walled containers for liquefied gases, and particularly to supporting frames for double-walled containers having an intervening space that may be evacuated, whereby the containers are adapted for storing and/or transporting liquefied gases which have relatively low boiling points at atmospheric pressure, such as liquid air and liquid oxygen.

The invention has for its object generally the provision of an improved construction for supporting frames of the character indicated, which avoids the concentration of stresses in the wall of the outer vessel and employs an arrangement of structural elements for supporting separately the inner and outer vessels.

More particularly, an object of the invention is to provide a double-walled container for liquefied gases of the kind indicated with supporting means which employs an external frame having members so arranged as to become, in effect, an integral part of the wall of the outer vessel whereby the load of the inner vessel may be carried without imposing sever stresses on the wall of the outer vessel.

Another object is to provide an improved arrangement of members for external frames which support a container wall of the character indicated in a manner forming a mechanically rigid structure and which avoids stresses tending to collapse the wall of outer vessels, particularly cylindrical vessels or tending to reduce the insulating efficiency of the space between the walls of double-walled containers when evacuated.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the features of construction, combination of elements and arrangement of parts, which will be exemplified in the construction hereinafter set forth and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawing, in which:

Fig. 1 is a view, partly in elevation and partly in vertical section, showing a double-walled container for a liquefied gas, such as liquid oxygen, constructed in accordance with the invention and adapted to have the insulating space evacuated;

Fig. 2 is an enlarged vertical sectional view showing the construction of a safety relief device that may be employed when an evacuated insulating space is employed in the invention;

Fig. 3 is another view partly in section and partly in elevation, similar to Fig. 1, showing a modified form of the invention; and

Fig. 4 is an enlarged fragmentary sectional view showing a detail in the construction for supporting the inner vessel in the modification shown in Fig. 3.

Referring now to the drawing, and particularly to Fig. 1, 10 denotes generally an exterior frame composed of uprights, or leg members, and relatively stiff connecting or cross-members 10x, from which a wall 11 of an inner vessel of the container is suspended, such vessel being adapted to hold a liquefied gas that is to be placed or stored in the container either with or without the aid of a lining or basket (not shown). Outside of the vessel 11 and disposed in rigid spaced relation with respect thereto is a second or outer vessel 12 which is also supported from the frame 10, the manner of support being described below. The space intervening between the vessels thus provided is a closed space adapted for insulating purposes and preferably has a filling of a powdered insulating material. There being no communication with the outside except that which may be provided through a special connection in the wall of the outer vessel, the intervening space may readily be evacuated when desired.

A valve controlled filling connection 13 is provided leading from a suitable point without the outer vessel through the intervening space to a point within the inner vessel. Similarly, a valve controlled withdrawal connection 14 is provided leading from a point near the bottom of the vessel 11 through the intervening space to a suitable external point and has a suitable coupling means 15 by which it may be connected to a suitable discharge receiving device at a place of use. Each pipe connection here employed is provided, at the point where it passes through the wall of the vessel 12, with sealing means that transmits relatively little heat to the connection. Such means is here depicted, by way of example, in detail on the connection 14, and consists of a conical wall 16 of a material having a relatively low thermal conductivity and shaped to interpose a relatively large amount of thermal resistance to the passage of heat from the vessel 12 to the connection 14; the cone being welded or otherwise integrally attached both to the wall of vessel 12 and to the connection 14. Such connection is preferably so shaped and disposed that expansion, contraction, and other stresses are accom-

modated without liability of incurring a break in what is intended to be a hermetically sealed wall. There may be also connected, in association with the connection 14, or otherwise, one or more trycocks, such as shown at 14'. Other standard accessories, such as a liquid-level gauge, may also be connected to the inner vessel.

The inner vessel 11 is here provided with a conventional blowdown or evaporation connection 17 which is valve controlled and when closed is adapted to afford relief for any excess of pressure that may accumulate, through a safety valve 18 that is connected thereto; there being also preferably attached a bursting diaphragm device 19, of any known construction. By such means quick relief is afforded in the event of any rise in pressure in the vessel 11.

In order that the space between the walls of the vessels 11 and 12 may be evacuated after assembly, or while in service, a valved connection 20 is attached to the outer vessel 12 and arranged to communicate with the space within. The outer end of connection 20 has a coupling 21 adapted for attachment to a suitable vacuum pulling means, indicated diagrammatically in the drawing as a pump. A suitable vacuum pulling means of this character may be, for example, a mechanical vacuum pump. To the connection 20 there is preferably attached a vacuum space relief device 22 that has a diaphragm adapted to be burst should any undesired pressure occur in the space between the walls of the vessels 11 and 12. Any suitable device of this latter character may be employed, for example, that shown in Fig. 2.

In the construction here shown, the inner vessel 11 is so supported that the load is carried directly by the frame 10 and not from the inner surface of the walls of vessel 12. To this end, the inner vessel 11 has suspending means attached to cross-member 10x comprising a girth member 23 having a bracket or lug, as shown at 23', at each end, such means being made fast to the outer surface of vessel 11 if desired. Attached to the lugs are suspending rods or cables 24, each of which extends generally upwardly and outwardly and is secured in suitable means, such as a collar 25, made fast to cross member 10x closely adjacent a leg member. The rods 24 are preferably also of relatively low thermal conductivity and may be constructed of a material having such property, as well as a high tensile strength, for example, of stainless steel. Each such rod 24 is passed through the collar and is threaded at its upper end for engagement with one or more nuts 26 which are screwed on the end of the rod. The collar is preferably secured to the frame by brazing or welding and has a reduced lower end for the reception of a sleeve 27 which houses the rod 24 and is brazed or welded at its lower end onto the wall of vessel 12 and may be similarly attached to the collar itself.

In order that this structure may be hermetically sealed against the passage of gas into or out of the space between vessels 11 and 12, a housing or cap 28 is disposed over the nuts 26 and soldered onto the collar 25; the joint between collar and cap being shown as made by reducing the top of the collar sufficiently to fit snugly into the cap, the joint being preferably closed by soldering or brazing.

To provide a rigid support for the vessel 11 in the above-described manner at least three rods or cables are required, the support thus provided being advantageous for spherical vessels. Four or more cables, however, may be employed, especially where the frame 10 is square or rectangular in plan. Still more, for example, six or eight, may be employed when the nested vessels have the form of elongated vessels with spherical ends, or have the shape of oblate ellipsoids.

To support the outer vessel 12 in place, additional supporting means are provided between the frame 10 and the outer wall of vessel 12, such means being structurally independent of the support for vessel 11. Such means as here shown comprises not only sleeves 27 but web members 29, interposed as shown, each having one edge bolted or welded to a leg member of frame 10 and an opposite edge in rigid contact with or made fast to the outer wall of vessel 12. The web members thus complete a triangular structure with the frame that holds the outer vessel rigidly. In cases where the collars are substantially over the leg members, the webs may be dispensed with. In such case it may be convenient or desirable to braze or weld the wall of the outer vessel directly to the leg members.

Heretofore, in low temperature apparatus, such as double-walled receptacles for a liquefied gas where insulation was provided by the evacuation of the space between the inner and outer walls, the evacuated space has nevertheless had an undesirably high heat transfer capacity. The transfer or passage of heat across the space between inner and outer walls of such vessels or receptacles when at different temperatures takes place in three ways, namely, by convection, conduction, and radiation. Where a highly evacuated insulating space is employed for insulating double-walled vessels or receptacles, the transfer of heat is chiefly by radiation. To reduce this transfer, it has heretofore been necessary to make the inner surfaces of the two walls highly reflecting. In metal walled receptacles, this has been accomplished by polishing. For large commercial vessels for storing or transporting a liquefied gas, such as liquid oxygen, polishing is a relatively expensive item in manufacture. Also the maintenance of a relatively high vacuum is inconvenient in ordinary commercial practice.

In order to convert the insulating space between the walls of containers 11 and 12 into one in which the heat transfer occurs substantially entirely by conduction, the space is first filled with a finely divided or comminuted substantially dry insulating material, such as asbestos fiber, magnesium carbonate, or the like, and thereafter evacuated.

When such material has been properly disposed in the space between the walls of vessels 11 and 12, and distributed so as to avoid uneven packing or the formation of pockets, a vacuum of sufficiently low value is pulled by suitable vacuum pulling means attached through the connection 20 until the thermal conductivity of the insulating space is of a desired low value, for example, the conductivity provided when a vacuum of an order of 0.1 mm. of mercury is pulled; the employment of vacuum of this order for the purpose of increasing the efficiency of powder filled insulating spaces being taught and claimed in copending application, Serial No. 307,945, filed on December 7, 1939 in the name of L. I. Dana.

To permit ready access to the space between the vessels 11 and 12 for the purpose of filling and disposing desired comminuted or powdered insulating material therein, as here proposed, one or more openings are provided in the wall of vessel 12 which preferably have flanges to which a cover may be brazed or welded when it is de-

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sired to close or hermetically seal the same. Two such openings are shown for the vessel 12 in the drawing, one at 30 for the top and one at 31 for the bottom.

The container of the present invention when thus equipped is not only capable of operating at high efficiencies for long periods of time but also meets all the safety requirements for devices of this character and avoids substantially all possibility of damage arising from possible sudden rises in pressure in either the inner or the outer vessel.

The vacuum space relief device shown generally at 22 may be of any suitable form but is preferably that disclosed in copending application, Serial No. 307,564, filed December 5, 1939 in the name of H. C. Kornemann and shown in detail in Fig. 2, where it is seen to consist of a chamber 40 which also has an open side surrounded by a flange 41 on which a diaphragm 42 rests, the diaphragm being held in place by means of a retaining member 43 adapted to clamp the edge of the diaphragm and fit over the flange 41. This chamber has openings 44 and 44' through which it is attached or inserted in the conduit 20. Thus the space within the chamber 40 is subject to a vacuum of the same degree that obtains in the space between the walls of vessels 11 and 12. A cutting member 45 is associated with the device in such a manner that it is adapted to cut or pierce the diaphragm 42 in the event that it springs upward by reason of pressure accumulating in the space between the walls of vessels 11 and 12. Any convenient form of cutting or piercing member 45 may be here employed, for example, a cutting edge on an arm that is attached to the ring 43 over the diaphragm 42.

In operation, the container is filled by connecting the connection 13 to a source of supply of the liquefied gas, such as liquid oxygen, which is to be stored in vessel 11. The flow of the liquefied gas into the container may be controlled by manipulating the valve in connection 13. In order to permit the liquid thus introduced to displace any gaseous filling that may be in the inner vessel, the evaporation connection 17 is opened to the atmosphere, or connected to a gasometer, in the event that it is desired to conserve the gas thus displaced. Liquid may be withdrawn from the container in the usual manner by opening the withdrawal connection 14. In the interim it may be desired to maintain the vessel 11 closed to the atmosphere. This, of course, is accomplished by closing the valve in the evaporation connection 17.

A modified form of the invention is shown in Fig. 3, with certain details in Fig. 4. In this form, a supporting arrangement is shown, which is advantageous in connection with double-walled containers of relatively large capacity, especially with cylindrically shaped containers. Here, stiffening means for the wall of the outer vessel, such as interiorly disposed rings, are employed, and are arranged to act as load or thrust transmitting members for the exterior frame that supports the inner vessel. In this modification, the wall of the inner vessel is shown at 11', while that of the outer vessel is shown at 12'. The supporting frame comprises a plurality of relatively short leg members 100 disposed respectively somewhat under and on opposite sides of the outer vessel, the legs being made fast to the outer vessel by welding or brazing. Within the vessel 12' and embracing the portion of the wall supporting the leg members 100 are disposed a pair of stiffening rings 101 and 102. These rings are preferably parallel and have their central portions cut away so as to clear the vessel 11' by a considerable distance, the inner edge being indicated at 103. This arrangement provides strength without unduly adding to the exterior construction and at the same time avoids unduly reducing the insulating value of the intervening space.

To support the inner vessel in position, a girth member 123 is provided, which has lugs 123' at its ends to which are attached suspending rods or cables 124, the latter passing upwardly and out through openings in the wall of the outer vessel. These rods or cables are anchored in suitable external terminal structures which also cooperate with the stiffening rings and are shown generally at 105 in the drawing. An opening in the wall of the outer vessel for passing a rod or cable into the terminal structure is shown at 12x in Fig. 4, together with further details of the terminal structures.

In Fig. 4, the terminal structure is seen to consist of an annular member or bushing 106, brazed or welded over the opening 12x, its wall at diametrically opposite points being preferably arranged to be in line with, and serve as a continuation of the interior stiffening rings 101 and 102. The latter are seen to fit snugly against the wall of the vessel 12' and are adapted to transmit the weight and other stresses to the leg members 100. The bushing 106 has a flange 107 to which is affixed a top plate 108 which is perforated in order to receive a supporting collar 125, brazed in place and provided with an opening through which the rod or cable 124 passes. The upper end of the rod or cable is threaded and provided with suitable holding means, such as a plurality of nuts 126 that are disposed thereon and bear on the collar 125. In order that this structure may be gas-tight, a cap 128 is disposed thereover and soft soldered in place.

Where the container of the present invention is intended for transport service, the external frame is, of course, constructed to be mounted on a portable device, such constructions being well known in the art.

Since certain changes may be made in the above construction and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a double-walled container for liquefied gases, the combination comprising an inner vessel for holding the liquefied gas, an outer vessel surrounding and spaced from said inner vessel thereby providing an intervening space for insulating purposes, a supporting frame comprising external compression members attached to said outer vessel, wall supporting rings within said outer vessel at points associated with said compression members, supporting sleeves disposed in the wall of said outer vessel over said supporting rings, supporting brackets associated with the wall of said inner vessel, and supporting connections extending from said brackets through said sleeves and made fast and sealed in said sleeves.

2. In a double-walled container for liquefied gases, the combination comprising an inner vessel for holding the liquefied gas, an outer vessel surrounding and spaced from said inner vessel

thereby providing an intervening space for insulating purposes, a supporting frame comprising external compression members attached to said outer vessel, wall supporting rings within said outer vessel disposed at points associated with said compression members, supporting sleeves sealed in the wall of said outer vessel at points adapted to transmit compression stresses directly to said supporting rings, brackets disposed in supporting relation to the wall of said inner vessel, supporting connections extending from said brackets through said sleeves and anchored therein, and means for hermetically sealing said connections in said sleeves.

3. In a double-walled container for liquefied gases, the combination comprising an inner vessel for holding the liquefied gas, an outer vessel surrounding and spaced from said inner vessel thereby providing an intervening space for insulating purposes, a frame at least having a part externally associated with said outer vessel, means on said frame extending into engagement with the wall of said outer vessel for supporting the same, other means including rods provided with anchoring means on said frame and extending therefrom into supporting engagement with said inner vessel through openings provided in the wall of said outer vessel, rigid sleeve-like members additionally supporting said outer vessel and disposed about said other means and extending continuously from said anchoring means to and welded in said openings, and means for hermetically sealing the outer ends of said sleeve-like members.

4. In a double-walled container for liquefied gases, the combination comprising an inner vessel for holding the liquefied gas, an outer vessel surrounding and spaced from said inner vessel thereby providing an intervening space for insulating purposes, a frame at least having a part externally associated with said outer vessel, means on said frame extending into engagement with the wall of said outer vessel for supporting the same, other means including rods of a material having a relatively low thermal conductivity and coefficient of expansion having their lower ends extending into supporting engagement with said inner vessel through openings provided in the wall of said outer vessel, anchoring means on said frame for the upper ends of said rods, rigid sleeve-like members additionally supporting said outer vessel and disposed about said other means including said rods and extending continuously from said anchoring means to and welded in said openings, and means for hermetically sealing the outer ends of said sleeve-like members.

5. In a double-walled container for liquefied gases, the combination comprising an inner vessel for holding the liquefied gas, an outer vessel surrounding and spaced from said inner vessel thereby providing an intervening space for insulating purposes, a frame at least having a part externally associated with said outer vessel, means on said frame extending into engagement with the wall of said outer vessel for supporting the same, other means including a plurality of rods each provided with an anchoring means on said frame and arranged to depend therefrom through openings respectively provided in the wall of said outer vessel, a corresponding number of brackets disposed in supporting engagement with the outer wall of said inner vessel attached to the lower ends of said rod means, rigid cylindrical sleeves additionally supporting said outer vessel and disposed about each of said rod means extending continuously from said anchoring means to said openings and secured therein by welding, and means for hermetically sealing the outer ends of said sleeves.

6. In a double-walled container for liquefied gases, the combination comprising an inner vessel for holding the liquefied gas, an outer vessel surrounding and spaced from said inner vessel thereby providing an intervening space for insulating purposes, a frame at least having a part externally associated with said outer vessel, means on said frame extending into engagement with the wall of said outer vessel for supporting the same, other means including a plurality of rods each provided with an anchoring means on said frame and arranged to depend therefrom through openings respectively provided in the wall of said outer vessel, a corresponding number of brackets disposed in supporting engagement with the outer wall of said inner vessel attached to the lower ends of said rod means, rigid cylindrical sleeves additionally supporting said outer vessel each surrounding a rod of said other means and extending continuously from said anchoring means to said openings and secured therein by welding, means for hermetically sealing said sleeves, and filling and withdrawal connections for said inner vessel passed hermetically through the wall of said outer vessel.

7. In a double-walled container for liquefied gases, the combination comprising an inner vessel for holding the liquefied gas, an outer vessel surrounding and spaced from said inner vessel providing an intervening space for insulating purposes, wall supporting rings on the interior of said outer vessel, supporting compression members attached to said outer vessel in the region of and associated with said rings, supporting sleeves secured to said outer vessel over said supporting rings and extending outwardly from said outer vessel, and supporting connections for said inner vessel extending between spaced ones of said rings and out through the corresponding said sleeve and made fast and sealed in said sleeve.

8. In a double-walled container for liquefied gases, the combination comprising an inner vessel for holding the liquefied gas, an outer vessel surrounding and spaced from said inner vessel providing an intervening space for insulating purposes, a pair of wall supporting rings on the interior of said outer vessel, supporting compression chambers attached to said outer vessel underneath it in the region of said rings, supporting sleeves secured to said outer vessel, supporting connections for said inner vessel extending upwardly between said rings and out through the sleeve members and secured therein, said sleeve members being positioned to transmit the supporting stresses from said connections to said rings.

ODD A. HANSEN.

CERTIFICATE OF CORRECTION.

Patent No. 2,256,673. September 23, 1941.

ODD A. HANSEN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 24, for the word "sever" read --severe--; page 4, second column, line 60, claim 8, for "chambers" read --members--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of October, A. D. 1941.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)