Dec. 18, 1962 W. HAUMANN ET AL 3,069,045

THERMALLY INSULATED STORAGE CONTAINER

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Fig. 1.

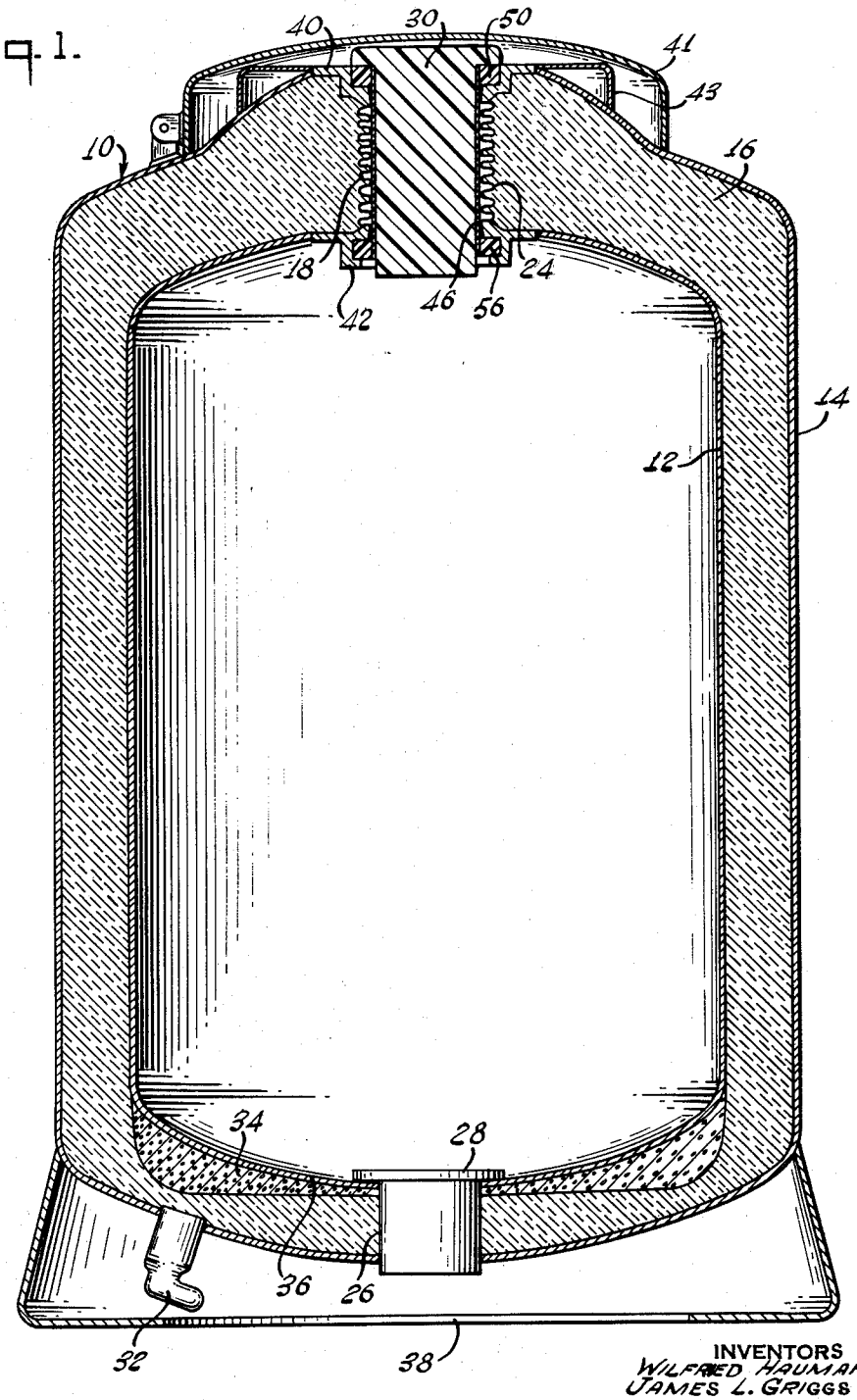

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Fig. 2.

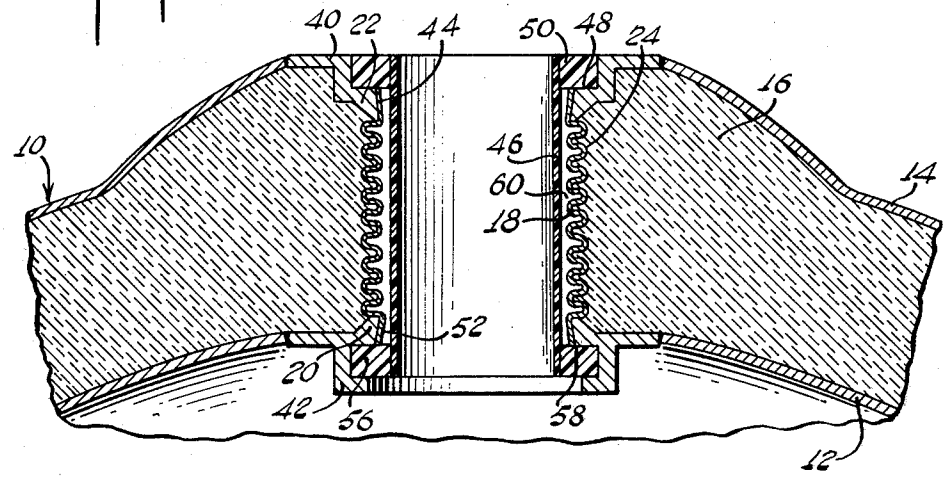
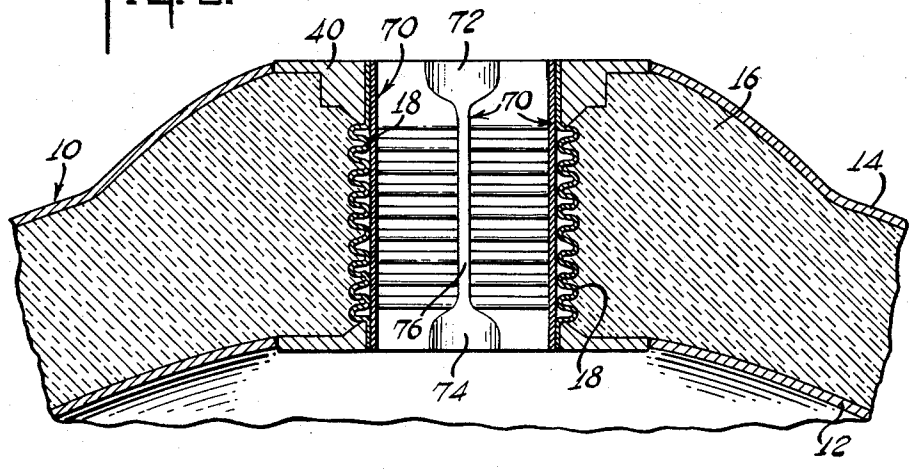


Fig. 3.



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THERMALLY INSULATED STORAGE CONTAINER

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This invention relates to an improved container for the storing of liquid refrigerants or of perishable commodities under refrigeration, such as bovine semen and biologicals, and more particularly concerns a portable container for such service having a relatively large access opening with minimized heat in-leak.

The containers usually employed for handling and storing low temperature liquids have generally consisted of a double-walled vacuum insulated copper vessel supported within an outer protective shell. In order to minimize the heat leak into the inner vessel of the double-walled container, the prior art has employed relatively long inlet or neck tube passages. These containers were nortoriously fragile in that the container often ruptured along the narrow neck portion due to rough handling. In addition to having a fragile, narrow neck-tube, these prior containers were excessively tall due to the length of the narrow neck tube which extended above the main body of the storage container, the purpose of the long neck section being primarily to afford a longer metal path over which the heat must travel.

Another disadvantage of the prior containers was the relatively small neck tube access passage diameters employed to minimize heat leak through this opening. Such small passage of about ⅜-in. dia. presented problems while charging liquid refrigerants, such as liquid nitrogen, and also caused "slugging" when liquid was poured out. The small neck opening also prevented the use of such prior containers for direct storage of materials, such as bovine semen and biologicals, inside the container. This is rather important as the semen is preferably kept in individual capsules to permit removal of only so much of said semen as is required.

It is, therefore, an important object of the present invention to provide an improved insulated storage container having a sufficiently low rate of heat leak to enable liquid refrigerants or perishable products under refrigeration, such as bovine semen and the like, to be stored therein at low temperatures for prolonged periods of time while permitting an adequate opening for passage of the products.

Another object of the present invention is to provide a low temperature storage container having a low thermal conductive neck opening with a sufficient diameter to permit adequate access to the container interior.

Still another object is to provide a low temperature storage container having decreased overall height as compared with prior containers of the same storage capacity.

Other objects, features and advantages of the present invention will be readily apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a view in vertical cross-section of an improved container embodying one form of the present invention;

FIG. 2 is a view on an enlarged scale in partial cross-section showing in detail another embodiment of the invention;

FIG. 3 is a view on an enlarged scale in partial cross-section showing details of still another embodiment of the invention.

In brief, the invention contemplates an insulated container for storing materials at low temperature which comprises an inner storage vessel, an outer shell surrounding the inner vessel, defining an evacuated insulation space therebetween, and a conduit section communicating with the outer shell and the inner vessel to provide an access passage for charging and discharging material to and from the inner vessel. The conduit comprises in combination a thin walled, substantially non-load supporting tubular member fabricated from low thermally conductive and gas impermeable material, together with a tensionally rigid member or members cooperatively disposed therewith for supportably positioning the inner vessel relative to the shell.

As shown in FIG. 1, a container **10** according to the present invention consists of an inner vessel **12** and an outer shell **14**, outwardly spaced therefrom, both of which members are preferably constructed from a metal such as aluminum, aluminum alloys, or stainless steel. The intervening space **16** defined by the inner vessel **12** and outer shell **14** is maintained under vacuum pressure to provide an insulating zone having substantial resistance to heat leak therethrough. The term "vacuum" when used in connection with the present invention refers to a pressure not substantially greater than 50 microns of mercury.

A conduit **18** cooperatively associated with said inner and outer container members extends between them, and is end sealed to the outer shell **14** and inner vessel **12** respectively to provide an access passage therebetween. The conduit itself comprises an elongated non-rigid member sufficiently large in diameter to provide adequate and convenient means for charging and discharging the inner vessel with a refrigerant, such as liquid nitrogen, and materials to be stored at low temperature, such as bovine semen and biologicals. The conduit **18** may be fabricated from a low thermally conductive and gas impermeable material such as stainless steel. The respective joints **20** and **22** formed by the conduit and outer shell **14** and inner vessel **12** respectively, must be leak-tight in order to maintain vacuum pressure inside the insulation space **16**.

A preferred embodiment of the disclosed container neck section employs circumferential parallel corrugations **24** formed into the wall of the conduit **18** similar to a bellows, thereby providing a desirable feature in that the actual wall length of the conduit **18** is compressed into an effective shorter length between joints **20** and **22**. In this manner the metallic conductive heat leak path from the outer shell **14** to the inner vessel **12** is maintained over an extended path to minimize total heat transfer, while the effective physical length is reduced to maintain the overall container height at a minimum. It has been found that by employing a corrugated conduit **18** as here described, the effective distance from the outer shell **14** to the inner vessel **12** along the access passage is reduced to about half the actual conductive heat transfer path. The reduced effective distance will also increase visibility to the stored material.

The present invention is principally useful for storage containers having a capacity of about 5 liters or more. In such service the conduit **18** is incapable of supporting the entire load of the inner vessel and auxiliary support means are required. One form of auxiliary support, as shown in FIG. 1 consists of a hollow tubular column **26** positioned in the insulation space **16**, at the lower portion of the container. The column is preferably fabricated from low thermally conductive organic thermosetting resin, such as phenolformaldehyde, reinforced with fabric, glass fibers or paper. It may be conveniently attached by adhesive or cement such as epoxy type resin to the outer shell **14** and may fit into a depression **28** of the inner vessel **12** for positioning purposes. In this manner column **26** can also resist lateral movement of the inner vessel.

Referring to FIG. 1, heat leak through the container access passage can be minimized by using a low thermally conductive plug **30** which fits loosely into and substantially blocks the access passage. The provision of the plug **30** to occupy the majority of the free space in this passage is desirable for obtaining maximum advantage of the present invention. The primary function of plug **30** is to cause any refrigerant vapor, which is generated by unavoidable heat leak to the refrigerant stored within the inner vessel, to channel or flow upwardly, close to and in contact with the walls of the access passage. The rising vapor thereby absorbs and carries outward a substantial amount of the heat which could otherwise be conducted along the walls of the passage. In this manner the net heat conductivity is effectively reduced.

In practice, space **16** defined by the inner vessel **12** and shell **14**, is evacuated through a line **32** which, to maintain an air tight space, is thereafter sealed. Since this insulation space is not intended to be reevacuated, it is preferred that an adsorbent **34** be placed inside space **16** to adsorb any gas which manages to leak into the space. Since most adsorbents are more effective at low temperatures, the adsorbent is supported in close proximity to the cold inner vessel **12** by means of a gas permeable support **34**. U.S. 2,900,800 more completely discloses the use of selective adsorbents such as synthetic zeolites, which are adaptable to the present container. The container **10** can be conveniently supported in an upright position by a foot ring **38** or a similar stand positioned on the container under surface. Also, a top closure such as cap **41** which is hinged at **42**, may be provided to cover the access passage and plug **30** to protect the contents during container handling.

While the insulation space **16** can employ a straight vacuum with polished wall surfaces, it is preferred that an opacified insulation be used in the evacuated space. Such opacified insulation comprises a two-component system made up of low conductive, radiation permeable material, such as silica powder or glass fiber, and a radiant heat impervious material, such as aluminum or copper flakes or foil, the combination being capable of reducing the passage of radiant heat without significantly increasing the thermal conductivity of the insulating system. Such opacified insulations systems are described more fully in copending applications SN 580,897 of L. C. Matsch et al. and SN 597,947 of L. C. Matsch.

The enlarged embodiment of a container neck section or access port shown in FIG. 2 illustrates another form of such auxiliary support useful with the present invention. As illustrated, both the vessel **12** and shell **14** are generally circular in character, each having a top opening in substantial axial alignment with a corresponding opening in the other. The outer shell top opening is provided with a formed terminal collar **40** and the inner vessel top opening is similarly provided with a collar **42**. In the instance of an aluminum container, the collars are preferably constructed of aluminum and fixedly positioned by welding to form a gas tight seal. The low heat conduit **18**, preferably constructed of stainless steel, is terminally joined to the respective upper and lower aluminum collars by a suitable method of forming dissimilar metal joints. The upper terminal collar **40** is provided with a central bore **44** for registering a hollow tubular support member **46** therein, while a formed seat **48** supportably accommodates an upper ring member **50** in said seat. When properly positioned, the diameter of said ring member **50** is slightly larger than bore **44** and fastened to the outer surface of the tubular support member **46** by an adhesive or other appropriate means.

The lower terminal collar **42**, in substantial vertical alignment with the upper collar **40**, defines a central opening **52** for registering the lower portion of the hollow tubular support member **46**. This collar as seen in FIG. 2 is also adapted to accommodate and retain a ring member **56** within a suitable circumferential groove **58**, which ring is in turn fixedly positioned to the tubular support member **46**. The upper ring **50**, lower ring **56** and the tubular support member **46** may comprise a single molded neck member; but as described above, these individual parts are preferably fabricated from a low thermally conductive, high strength organic thermosetting resin, such as phenol-formaldehyde, reinforced with paper or fabric and joined by suitable means such as a high strength epoxy resin.

The substantial rigid tubular support member intermediate the inner vessel and outer shell, not only provides access means to the vessel interior but also resists relative lateral movement between the container components. A further function of said member resides in its cooperative relation to conduit **18** whereby heat leak downwardly through the entire neck portion of the container is reduced.

Referring to FIG. 2, when properly positioned, the adjacently disposed conduit **18** and tubular support member **46** define an annular space **60** therebetween having the upper and lower ends closed, which space serves to establish a substantially placid fluid barrier and avert heat leak which might otherwise take place into the container interior through convection currents. While the annular space **60** need not be gas tight, by precluding the fluid therein from swirling or moving about when the plug **30** is removed, the heat leak to the contents may be minimized.

An alternative support and conduit means embraced by the present invention is illustrated in FIG. 3. In this embodiment a low thermally conductive, high strength material, such as stainless steel, is provided in the form of one or more support bars or tension members **70** extending longitudinally through the access passage. In accordance with the invention, a plurality of such members preferably at least a pair, diagonally positioned are soldered or welded to the respective terminal collars **40** and **42** along the inner periphery thereof. The metal members are found to be quite satisfactory for providing the required supporting strength in containers having a capacity exceeding about 10 liters. Said members are preferably formed from a flat metal sheet and shaped to provide relatively broad fastening surfaces **72** and **74** at the extremes thereof, with an arrow or necked down intermediate portion **76** which serves to minimize the amount of heat transmitted longitudinally therethrough. These support members **70** may also comprise a thin wire or rod rather than the shaped article shown in FIG. 3. Any combination of the tension members shown in FIGS. 2 and 3 as well as the lower tubular support member **26** may be used depending upon the amount of strength and rigidity that is required.

From the above description it will be seen that the present invention provides an improved container for storing low temperature refrigerants or perishable products under refrigeration for relatively long periods without excessive heat leak to the stored material. The improved large diameter, low heat leak access conduit allows vacuum insulated containers of the type described to be used for handling liquid refrigerants as well as for direct storage of perishables. Exemplary of the container's efficiency, a 10-liter container, constructed according to the present invention having an access passage about 1½-in. diameter with the overall dimensions of the container being about 17 in. high and 10-in. diameter, satisfactorily stored liquid nitrogen for a 20 day period without excessive vaporization losses to the liquid.

While the apparatus has been described particularly in relation to a thermally insulated container, it is understood that various modifications and changes may be made in the actual conduit section and inner vessel supporting means without departing from the scope of the present invention.

What is claimed is:

1. In an insulated container having an inner vessel and a shell outwardly spaced therefrom defining an intermediate insulating space, a conduit for providing access to said inner vessel, said conduit being impermeable to gas and having low thermally conductive characteristics, said conduit comprising an elongated non-load supporting metallic tubular member extending intermediate said vessel and shell in sealable relation therewith to provide a gas impervious access passage, and a low thermally conductive load supporting tubular member disposed inwardly of, and being slightly spaced from said non-load supporting tubular member, said load supporting member being terminally fastened to said vessel and shell to provide a substantially fixed spatial relationship therebetween.

2. In an insulated container having an inner storage vessel and a shell outwardly spaced therefrom defining an evacuable intermediate insulating space therebetween, a conduit extending between said vessel and shell providing access to the inner vessel storage area, said conduit means comprising in combination a pair of concentrically disposed tubular members, the outer of said members fabricated from a low heat conductive metal and sustaining no longitudinal loading stresses, one end of said outer member sealably joined to an opening in said inner vessel, the other end of said outer member sealably joined to a corresponding opening in said shell to gas-tightly seal said insulating space, the other of said tubular members positioned inwardly adjacent but spaced slightly from said outer member and terminally fixed to said inner vessel and shell respectively thereby defining an annular heat leak barrier extending longitudinally of and intermediate said pair of tubular members.

3. In an insulating container substantially as described in claim 2 wherein the conduit means comprises an outer bellows member of a low thermally conductive metal, the opposed ends thereof being sealably joined to aligned openings in the inner vessel and shell respectively, the inner tubular members comprising a low heat conductive load supporting conduit disposed inwardly of said bellows member and terminally fixed to said inner vessel and shell thereby defining an annular heat leak barrier intermediate said tubular members.

4. In an insulating container substantially as described in claim 2 wherein the conduit means comprises an outer bellows member the opposed ends thereof being sealably joined to vertically aligned openings in the inner vessel and shell respectively, the inner of said tubular members comprising a reinforced, thermosetting phenolic resin tubular member disposed inwardly adjacent said bellows member defining therebetween a heat leak barrier, the ends of said tubular member being terminally fixed to openings in said vessel and said shell respectively thereby providing an access passage to said inner storage vessel and supportably positioning said vessel in relation to said shell.

5. In a thermally insulated container comprising an inner storage vessel and an outer shell spaced therefrom to provide an evacuable insulation space therebetween, the inner vessel and outer shell each having a concentric aligned opening therethrough to provide access into the inner vessel storage space, the combination with such container of a conduit section connecting the inner vessel and outer shell openings to provide an access passage into said inner vessel storage space which comprises a relatively high thermally conductive thin walled substantially non-load supporting gas impervious metallic tubular member gas tightly connected to said inner vessel and outer shell and a relatively low thermally conductive load supporting tubular member connected to said inner vessel and outer shell openings, the metallic member being positioned such that the inner surface thereof and the outer surface of the load supporting member are adjacent.

References Cited in the file of this patent

UNITED STATES PATENTS

707,634	Place	Aug. 26, 1902
2,000,882	Comstock	May 7, 1935
2,722,336	Wexler	Nov. 1, 1955
2,776,776	Strong	Jan. 8, 1957