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CONTAINER FOR LIQUEFIED GAS

Filed Aug. 17, 1960

FIG. 1

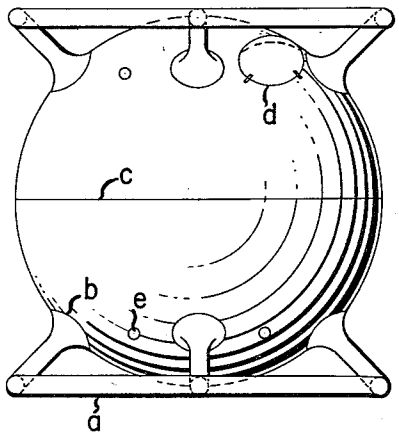


FIG. 2

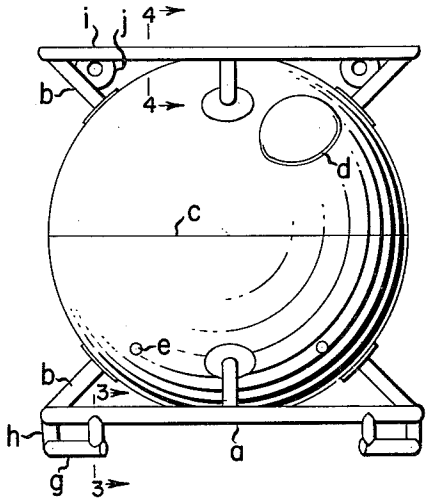


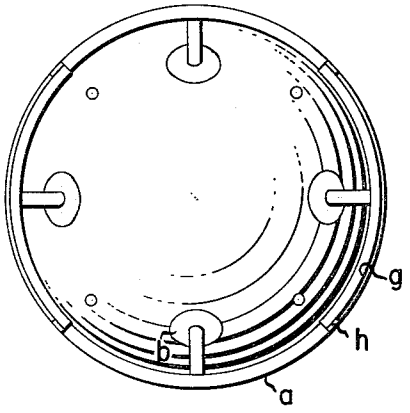
FIG. 3



FIG. 4



FIG. 5



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CONTAINER FOR LIQUEFIED GAS

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This invention is directed to a new type of container for liquefied gases. More particularly, it is concerned with a spherical container for liquefied gases of novel design.

Liquefied gases are generally stored and shipped in cylindrical containers of various dimensions depending on the capacity of the container. Cylindrically shaped containers have several disadvantages. Small cylindrical containers may be stored in either the horizontal or vertical positions but each position requires special racks to prevent movement. Large cylindrical containers must be stored in the horizontal position since the vertical position is too unstable and hazardous without rather bulky supports. Horizontal space storage of large cylinders is space consuming and multilayer storage requires a heavy supporting framework. Even a single layer of large cylinders must be supported in some manner to prevent rolling on uneven surfaces. Large cylinders (i.e. ¼ ton or larger) require a special attachment for lifting and moving with normal type cranes or hoists; without the special attachment, normal cranes or hoists cannot handle large cylinders.

Containers for liquefied gases are heavy due to the rather thick walls required to withstand the internal pressure. Since a fair proportion of the shipping costs for transporting a container filled with liquefied gas is due to the weight of the container (the tare weight) and entirely to the container weight when the empty container is returned to the supplier, containers with lower tare weights per equivalent capacity than cylinders would be advantageous.

It is, therefore, an object of the present invention to provide containers for liquefied gases which are self-supporting and mechanically stable, such a container not requiring special equipment for lifting and moving, said containers weighing less per equivalent capacity than the currently used cylindrical containers.

It is a further object to provide containers capable of being stored in multilayers without supports, said containers being self-supporting in more than one position.

It is another object to provide containers, the valve positions of which may be varied at will to fit particular needs without further modification of the container.

These and other objects will become apparent in the following description and claims.

In the accompanying drawings, forming a part of this application, and in which like numerals are used to designate like parts throughout the same:

FIGURE 1 is a side elevational view of a liquefied gas container according to the present invention.

FIGURE 2 is a side elevational view of a liquefied gas container according to the present invention, such container being modified to facilitate stacking of a plurality of such containers.

FIGURE 3 is a cross-section taken on line 3—3 of FIGURE 2.

FIGURE 4 is a cross-section taken on line 4—4 of FIGURE 2.

FIGURE 5 is a bottom view of the container shown in FIGURE 2.

The present invention is directed, in its broadest scope, to a spherical container for liquefied gases under pressure, said container having at least 1 fixed valve for loading and unloading and two circular rings or disc structures positioned parallel to each other and tangent to opposite poles of said sphere. The present novel structure provides significant stability for storing said spheres, ease of rollability and ease of handling on transportation.

A more specific and preferred embodiment of the present invention is a spherical structure as heretofore described, said structure having additional modifications as represented in FIGURE 2 of the accompanying drawing, the practical significance of this novel structure being that the spherical containers described may be stacked one on top of the other and remain stabilized.

The spherical container of the present invention can be understood by reference to the accompanying drawing setting forth preferred embodiments of this invention. In FIGURE 1, the container consists of a hollow sphere to which are attached two rings as at *a*. Each ring is attached to the sphere by means of four members *b*, the four members being equally spaced around the ring. The two rings *a* are parallel to each other and tangent to opposite poles of the sphere. In the particular embodiment shown in FIGURE 1 the rings *a* consist of pipe or rod, preformed into rings and welded or otherwise joined into a continuous ring. The members *b* are welded or otherwise attached to the spherical container itself. The spherical container is formed from two hemispheres which are welded or otherwise joined together at *c* into a sphere. The sphere is provided with a valve or valves, as at *d*. A variety of different valves may be provided depending on the use for which the spherical container is intended. Often, containers for liquefied gases are provided with two valves, one for withdrawing gas, the other liquid. The mechanics of such valves are well known and will not be further discussed here. To protect the valves from accidental damage during transport, a removable cover is provided. The position of the valves shown in FIGURE 1 is not fixed. They may be placed where most suitable to the user.

For sake of safety, fusible plugs may be provided, as at *e*, when these are required by the regulations of the Interstate Commerce Commission. Their position may also be varied at will.

A second embodiment of the spherical contanier is shown in FIGURE 2. The container itself, the connecting members *b*, the welded joint *c*, the valves and fusible plugs are the same as described in FIGURE 1. In FIGURE 2, the lower ring *a* of FIGURE 1 has been modified by addition of two circular arcs of pipe or rod *g* attached by short members *h* to the ring *a*. Each circular arc *g* is about one-quarter of a complete circle and the two arcs *g* are centered at opposite sides of the ring *a*. A bottom view of the container of FIGURE 2 is shown in FIGURE 5. A cross section of the ring support through plane 3 is shown in FIGURE 3.

The top ring *a* of FIGURE 1 is modified in FIGURE 2 in two respects. The solid rod or pipe of FIGURE 1 is replaced by a semicircular cross section channel *i* in FIGURE 2 attached to the sphere by four members *b*. A cross section of *i* at plane 4 is shown in FIGURE 4. The diameter of *i* is chosen such that the supports *g* will rest in the channel *i*. In this manner, the spherical container of FIGURE 2 may be stacked one on top of another. The spacing between the support *g* and ring *a* is sufficient to allow a fork lift truck to lift the containers when they are stacked one atop another or standing directly on a solid surface.

As shown in FIGURE 2, two rings *j* are attached to two of the members *b*. These rings *j* are used for attaching the container to a double hook hoist for lifting purposes.

In general, containers for liquefied gases are fabricated from steel although nickel, aluminum or other metals

are sometimes used. This type of steel used depends on the pressure which the container must withstand. The composition of the steel used for specific services is, in general, specified by the regulations of the Interstate Commerce Commission.

The spheircal containers as herein described are particularly useful for containing and transporting dichlorodifluoromethane, monochlorodifluoromethane, dichlorotetrafluoroethane, monochloropentafluoroethane, octafluorocyclobutane, anhydrous ammonia, cyclopropane, difluoroethane, chlorodifluoroethane, methyl chloride, methyl mercaptan, monomethylamine, trimethylamine, sulfur dioxide, chlorotrifluoroethylene, vinyl chloride, vinyl methyl ether and liquefied petroleum gases which do not develop vapor pressures greater than 500 pounds per square inch (p.s.i.) at 130° F. (e.g., propane and butane).

To illustrate the advantage in tare weight gained by use of the spherical containers, the following specific example is cited. A spherical container with a 45-inch internal diameter of the type shown in the drawings has a water capacity of 1688 pounds and a tare weight of approximately 600 pounds. Such a container would contain 2000 pounds of dichlorodifluoromethane. A cylindrical container of the same capacity has a tare weight of approximately 1200 pounds. Thus, the tare weight is reduced by 50%. The shipping costs of empty containers are therefore reduced by 50% while the shipping costs of full containers are reduced by 15%, certainly a significant amount. A similar sphere 36 inches in diameter contains 844 lb. of water or 1000 lb. of dichlorodifluoromethane; a sphere 30 inches in diameter contains 422 lb. of water or 500 lb. of dichlorodifluoromethane. The weight of any particular substance which a container will hold depends on the material in question, being fixed by law to a certain percentage of the water capacity. Suffice it to say here, that spherical containers for any particular quantity of any acceptable material may be fabricated by merely varying the internal diameter to the proper size. Thus, if the container is to hold W pounds of a material, the diameter=

$$\sqrt[3]{\frac{W\times 6}{f\times P\times \pi}}$$

where P is the density of water and f is the percentage of the water capacity allowed for the material in question (the units of W and P must be consistant).

The other advantages of spherical containers of this invention are apparent from the descriptions and drawings. The supports shown in FIGURES 1 and 2 will not allow the container to roll or tip. Since either ring may be used as a base, the container may be located with the valves at either top or bottom as desired. No special racks are necessary to support these spherical containers since they are self-supporting and stable. These spherical containers require less space for storage, e.g., the sphere for 2000 lbs. of dichlorodifluoromethane described above is 45 inches in diameter, the corresponding cylinder is 80 inches long. The spherical cylinders can be stacked one on top of the other without supporting racks. The support rings, since they are parallel, can act as wheels so that the container may be rolled from one position to another. Unlike cylinders, the spherical containers are readily lifted and carried by fork lift trucks or similar devices (particularly the embodiment shown in FIGURE 2). Ordinary hook type cranes or hoists can be used to lift and transport the containers; cylinders require special cranes or special attachments for normal cranes.

The modified spherical containers heretofore described and specifically set forth in the drawing represent specific embodiments of the present invention and are not to be considered limiting as equivalent units obvious to one skilled in the art after considering this disclosure can readily be substituted for the support ring structures herein described. For example, the specifically described support rings can be replaced by metal disc structures or other alternative units to achieve the same practical effects accomplished by the specific structures set forth in the accompanying drawing. It is understood, of course, that the positions of valves and fusible plugs may be varied and that the materials of construction may be varied within the scope of one skilled in the art to achieve substantially the same results.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that this invention is not limited to the specific embodimens thereof except as defined in the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A spherical container for liquefied gases under pressure, said container having at least one fixed valve means, two ring-type circular supporting structures of substantially the same diameter, and of larger diameter than the diameter of said container, said circular supporting structures being positioned with their planes parallel to each other and attached to the container with their centers aligned with the axis of said spherical container, said axis of said spherical container being perpendicular to the said planes of said supporting structures and thereby forming a rolling means for said spherical container when the planes of said circular supporting means are vertical.

2. A spherical container for liquefied gases under pressure, said container having at least one fixed valve means, two ring-type circular supporting structures of the same diameter, and of larger diameter than the diameter of said container, said circular supporting structure being positioned with their planes parallel to each other and attached with their planes tangent to the outer surface of said container with the centers of said circular supporting structures aligned with the axis of said spherical container, said axis of said spherical container being perpendicular to said planes of said supporting structures thereby forming a rolling means for said spherical container when the planes of said circular supporting means are vertical, two arcuate supporting means disposed in an opposing spaced relationship in a plane parallel to the plane of one of said ring-type supporting structure, said arcuate supporting means having the same radius of curvature as said circular supporting structure and the center of curvature along the same axis as the center of curvature of said circular supporting structure, each of said arcuate supporting means being of a length equal to approximately one-quarter of said circular supporting structure, the other of said circular supporting structures of said spherical container having its exterior face channeled and opening away from said spherical container and adapted to receive the arcuate supporting means of another spherical container, thereby forming stacking means when the planes of said circular supporting means are horizontal.

References Cited in the file of this patent

UNITED STATES PATENTS

D. 142,954	Hansen	Nov. 20, 1945
2,113,060	Sandberg	Apr. 5, 1938
2,118,388	Zerbe	May 24, 1938
2,279,717	Oliver	Apr. 14, 1942
2,596,005	Barrow	May 6, 1952
2,673,010	Barrow	Mar. 23, 1954

FOREIGN PATENTS

172,469	Switzerland	Jan. 2, 1935
137,720	Australia	June 26, 1950