Dec. 14, 1948. J. O. JACKSON 2,456,195

SPHERICAL TYPE INSULATED CONTAINER FOR LIQUEFIED GASES

Filed June 4, 1947 3 Sheets-Sheet 1

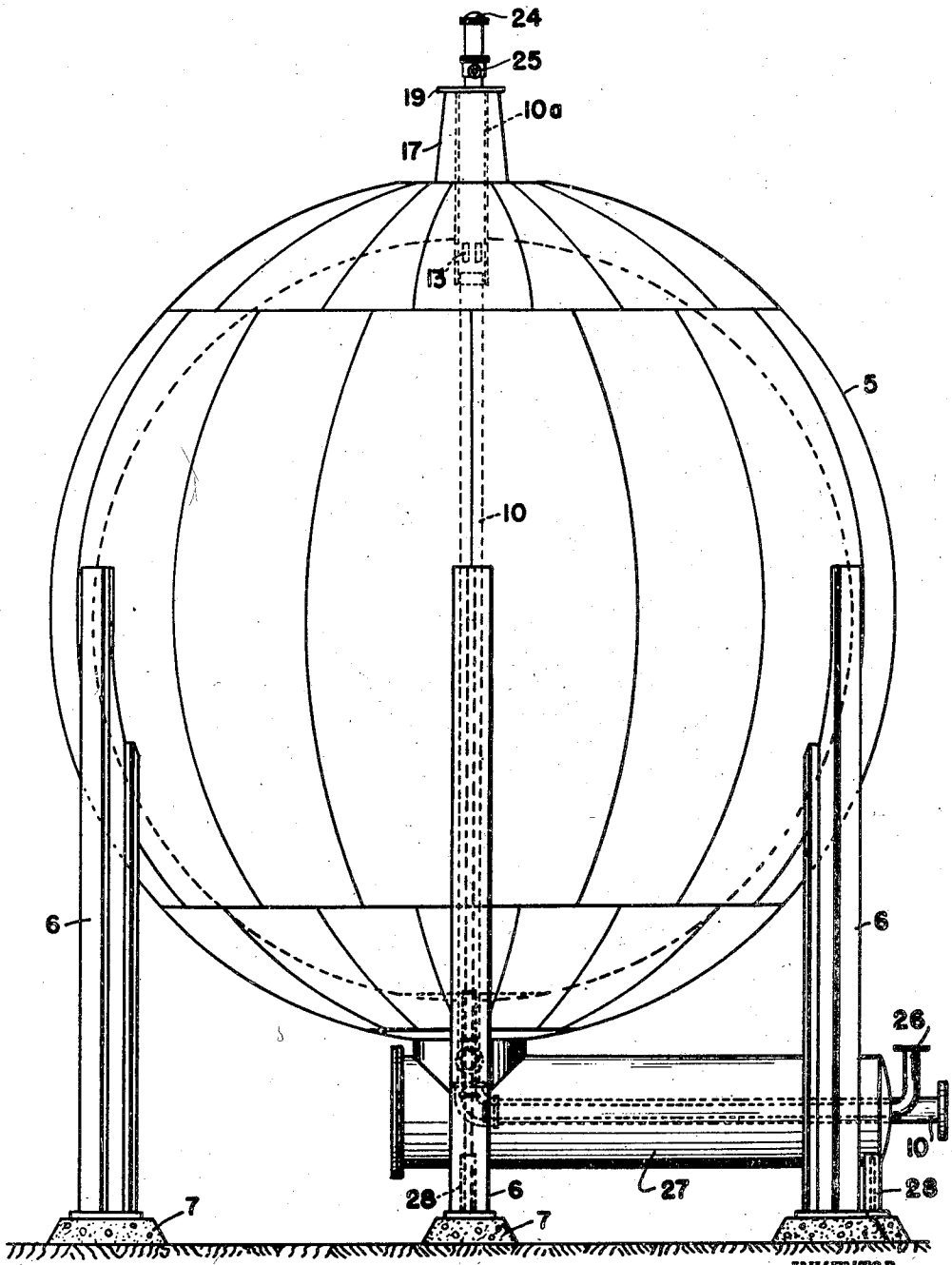


Fig. 1

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Filed June 4, 1947 3 Sheets-Sheet 2

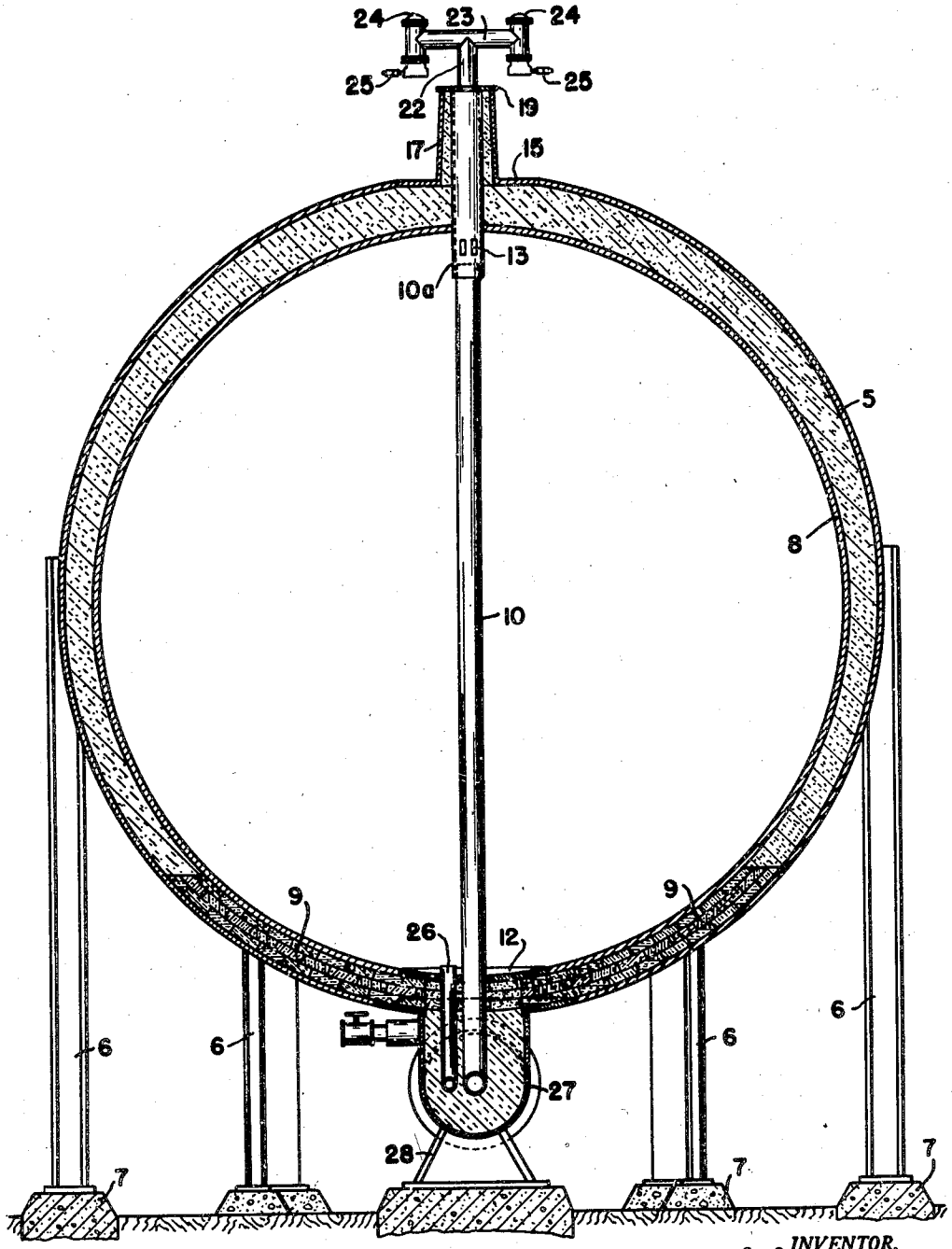


Fig. 2

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Filed June 4, 1947 3 Sheets-Sheet 3

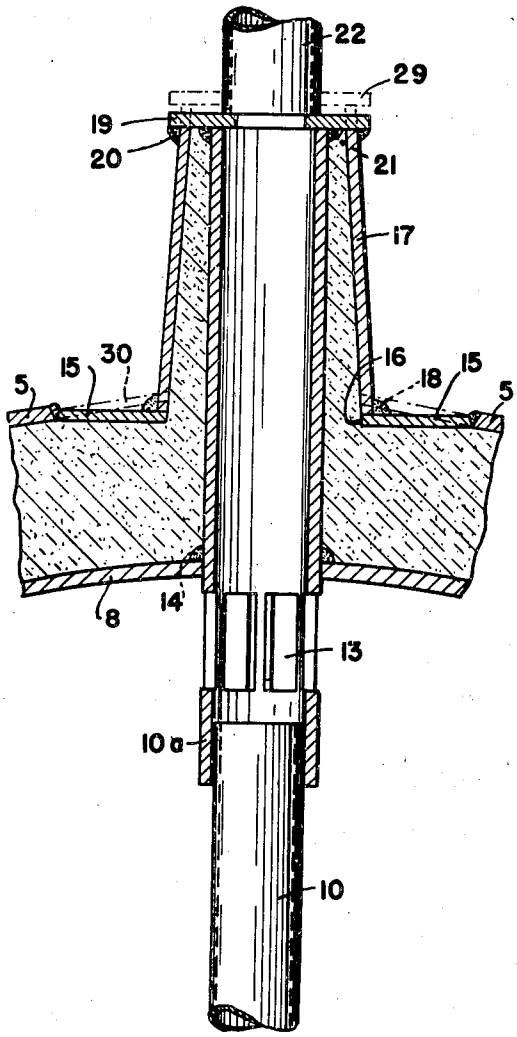


Fig. 3

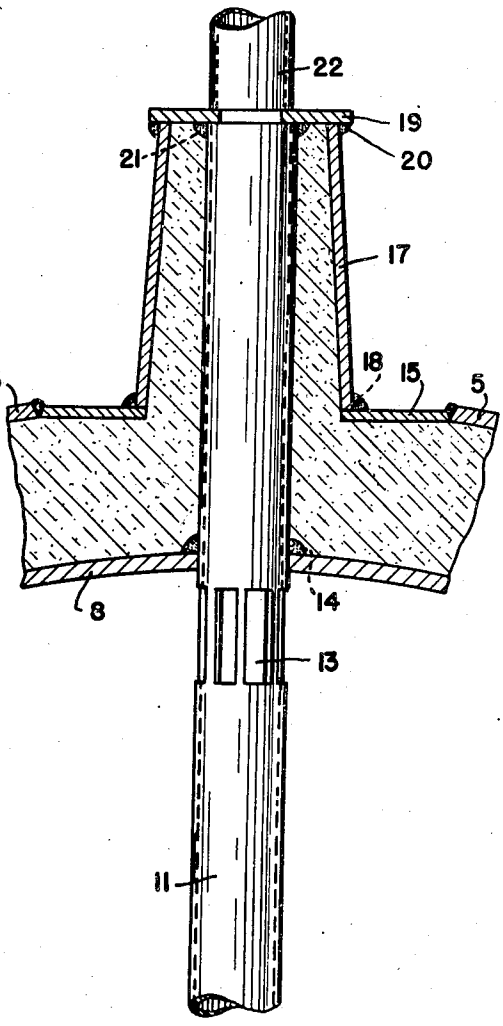


Fig. 4

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Patented Dec. 14, 1948 2,456,195

UNITED STATES PATENT OFFICE

2,456,195

SPHERICAL TYPE INSULATED CONTAINER FOR LIQUEFIED GASES

James O. Jackson, Crafton, Pa., assignor to Pittsburgh-Des Moines Company, a corporation of Pennsylvania

Application June 4, 1947, Serial No. 752,517

12 Claims. (Cl. 62—1)

1

This invention relates to insulated tanks or containers and more particularly to double-walled insulated tanks or containers for storing, at about atmospheric pressure, relatively great quantities of liquefied gas such as liquefied natural gas.

An object of this invention is to produce an insulated container capable of safely and economically storing for long periods a relatively great quantity of liquefied gas such as liquefied natural gas.

Liquefied natural gas at atmospheric pressure has a temperature far below 0° F. (actually about —258° F.) and is subject to some evaporation and another object of this invention is to produce means that will safely and economically take care of the gas resulting from evaporation of a liquefied gas such as liquefied natural gas stored in an insulated container of relatively great size.

These and other objects I attain by means of the structure described in the specification and illustrated in the drawings accompanying and forming part of this application.

In the drawings:

Figure 1 is a side elevational view of an insulated tank or container embodying this invention;

Fig. 2 is a sectional view of the container of Fig. 1 taken at right angles to the view of Fig. 1;

Fig. 3 is an enlarged fragmental view of the upper part of the vent conduit of the tank or container shown in Figs. 1 and 2; and

Fig. 4 is a view similar to Fig. 3, but illustrates a modified way of constructing the vent conduit.

The container of this invention comprises inner and outer spaced apart spherical type metal shells. The outer shell which is numbered 5, is supported above the ground by spaced columns or column-like members 6 which are secured to the outer shell and are supported by foundation members 7.

I preferably utilize rolled structural members for columns 6 and trim the upper portions of these members to conform to the curvature of the outer shell so that they can be readily welded to such shell. Inner shell 8 is preferably supported from the outer shell 5 by an insulating cradle 9 formed of material such as corkboard. The space between the shells may be evacuated and above cradle 9 may be filled with finely divided insulating material such as granulated cork. If desired, the outer surface of the inner shell may be given a mirror-like finish.

In order to allow the gas, due to evaporation within the container, to continuously pass out of the container, I provide a vent conduit 10. This can either comprise telescopically arranged parts as shown in Figs. 2 and 3 or can comprise a single tube 11 as shown in Fig. 4. Of whichever construction, the vent conduit extends vertically at the center of the container. It passes through the lower polar saucer 12 of the inner shell 8 and is welded to such saucer to form a fluid-tight joint therewith.

2

The upper part 10a of conduit 10 is provided with inlet openings 13. Upper part 10a is welded to the inner shell as at 14 in a fluid-tight manner and extends upwardly well beyond the top of outer shell 5. Outer shell 5 at its upper polar region is provided with an annular metallic member 15 which is preferably somewhat thinner than the main part of the outer shell and serves as a flexible diaphragm. The inner peripheral edge 16 of this diaphragm is spaced from conduit extension 10a, and an upwardly tapered hood-like member 17 which surrounds such extension, has its lower edge secured to diaphragm 15 adjacent its peripheral edge by weld metal 18. A top or cover 19 for hood-like member 17 is welded to the hood, as at 20, and to extension 10a as at 21. This top is annular as shown in the drawings and supports an upright pipe 22 which carries a cross pipe 23. The opposite ends of cross pipe 23 carry vacuum and pressure relief devices numbered 24—24 and 25—25 respectively, which connect with the interior of the inner shell 8 through pipes 22 and 23 and extension 10a of conduit 10.

Devices 24—24 can take the form of rupture disks, while devices 25—25 can take the form of spring-loaded pressure relief devices. A pipe 26 which extends through saucer 12 and is welded thereto in a fluid-tight manner, serves both as the inlet and discharge pipe for the liquefied gas. Conduit 10 and pipe 26 extend downwardly through an opening in outer shell 5, out of contact with such outer shell and, making right angled turns, extend through and beyond the end of a boot 27 which is preferably formed of metal and is welded to outer shell 5.

The horizontal portions of vent conduit 10 and outlet pipes 26 both located within boot 27 are arranged side by side in heat transferring relation and are insulated from the boot by finely divided insulating material such as granulated cork.

Boot 27 is supported by means of supports 28—28 which are mounted on suitable foundations as shown and are secured to the boot adjacent its ends.

A similar boot, operating in a similar manner, but of slightly different construction, is disclosed in my Patent 2,386,958 of October 16, 1945.

The upper half of outer shell 5 is spaced further away from inner shell 6 than the lower half; such spacing increasing from the mid section of the container to the top thereof. This provides extra insulation for the upper part of the container, which is desirable since the upper part of the outer shell, when subjected to the sun's rays will absorb more heat than the lower part.

In Figs. 1 to 4 inclusive, diaphragm 15 is shown as it will appear when the tank or container is serving as a reservoir for storing liquefied gas. At such time, the diameter of inner shell 6 and the length of conduit 10, including its extension 10a, are reduced, thus flexing diaphragm 15 from the position shown by dot and dash lines 30 in Fig. 3 to the full line position of Figs. 1 to 4 inclusive. At the same time, hood 17 with its top 19 has been moved down from dot and dash line position 29 to the full line position of said figures.

This application is filed as a continuation-in-part of my copending application Serial No. 435,749, filed March 21, 1942, now abandoned.

What I claim is:

1. A container for storing a relatively great quantity of liquefied gas, comprising inner and outer spaced apart metallic shells, a vent-gas conduit communicating with the interior of the inner shell adjacent its top, extending through and beyond openings in the top and bottom of such inner shell and to a distance beyond the top and bottom of the outer shell and being secured in a fluid-tight manner to the top and bottom of the inner shell; the upper polar region of the outer shell being formed as an annular metallic diaphragm which surrounds and has its inner peripheral edge spaced from such conduit and which is capable of being flexed toward and from the common center of such shells, and a hood-like member having its lower edge secured to such diaphragm adjacent its inner peripheral edge and its top secured to the upper end of such conduit, and vacuum and pressure relief devices carried by such hood-like member and communicating with such conduit; the construction and arrangement being such that as the temperature of the inner shell and such conduit is lowered to a point such that the diameter of the inner shell and the length of that portion of such conduit between its upper end and the top of the inner shell is reduced, such annular diaphragm will flex to accommodate such reduction.

2. A structure as defined in claim 1, in which the shells are spherical and the vent-gas conduit embraces the vertical axis of the container.

3. A structure as defined in claim 1, in which the space between the inner and outer shells is substantially filled with insulating material.

4. A structure as defined in claim 1, in which the space between the inner and outer shells is evacuated.

5. A structure as defined in claim 1, in which the space between the inner and outer shells is evacuated and the outer surface of the inner shell has a mirror-like finish.

6. A structure as defined in claim 1, in which the outer shell is supported above the ground and the inner shell is supported by insulating material carried by such outer shell.

7. A structure as defined in claim 1, in which the distance between the inner and outer shells is greater above the horizontal center of the container than below such center.

8. A structure as defined in claim 1, in which each of the shells are substantially spherical and the distance therebetween increases from the horizontal center of the container to the top thereof.

9. A structure as defined in claim 1, in which the vent-gas conduit is continuous from end to end.

10. A structure as defined in claim 1, in which the vent-gas conduit is formed in two telescopically arranged sections.

11 A structure as defined in claim 1, in which the vent-gas conduit is formed in two telescopically arranged sections with the inlets for vent gas formed in the upper section below the top of the inner shell.

12. In an insulated container of the type utilized for storing liquid at a different temperature from that of the surrounding atmosphere and having inner and outer spaced apart metal shells with a boot-like extension attached to the bottom portion of the outer shell; means supporting the outer shell above the ground, means located between the inner and outer shells for supporting the inner shell from the outer shell, a vertical vapor outlet conduit having an extension thereof projecting above the top of the outer shell; said conduit extending through an opening in the top of the inner shell, through the bottom of the inner shell to which it is secured and through and out of contact with the outer shell and into said boot, a flexible annular diaphragm secured to the top of the outer shell adjacent its center and surrounding and out of contact with said vapor conduit extension, and a hood carried by said diaphragm and surrounding said extension and to the upper end portion of which it is secured.

JAMES O. JACKSON.

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