May 15, 1928.

1,670,024

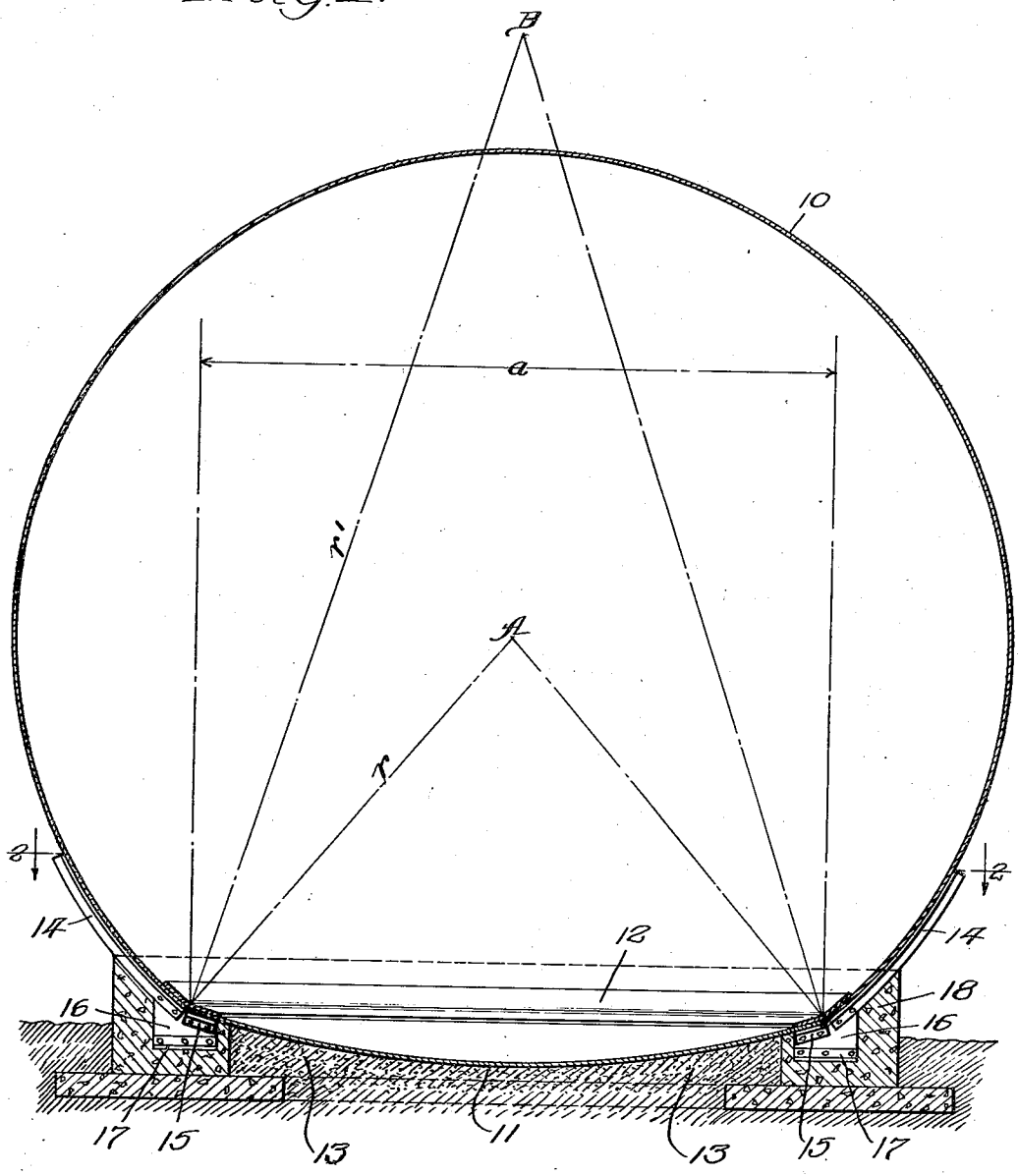
C. L. DAY

CONTAINER

Filed Oct. 16, 1926

2 Sheets-Sheet 1

Fig. 1.



Inventor:
Clayton L. Day,
By Griswold, Lee, Christie & Wiles,
Attys

May 15, 1928.

1,670,024

C. L. DAY

CONTAINER

Filed Oct. 16, 1926

2 Sheets-Sheet 2

Fig. 2.

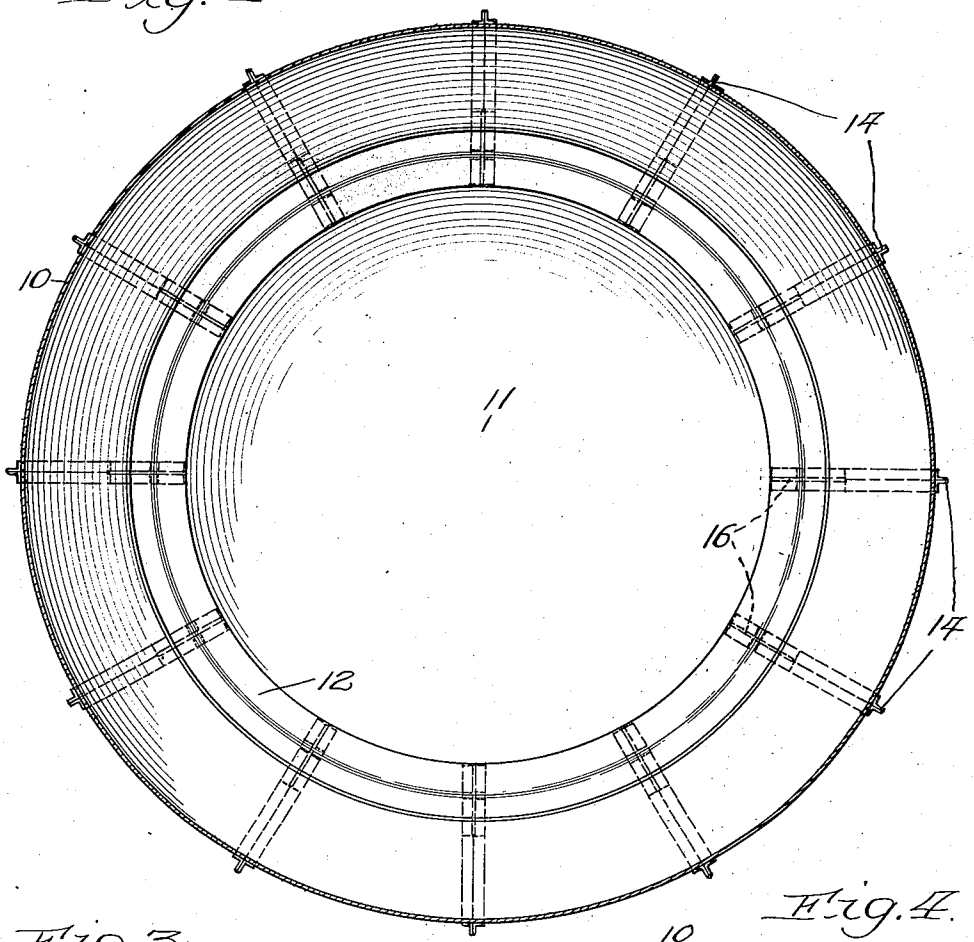


Fig. 3.

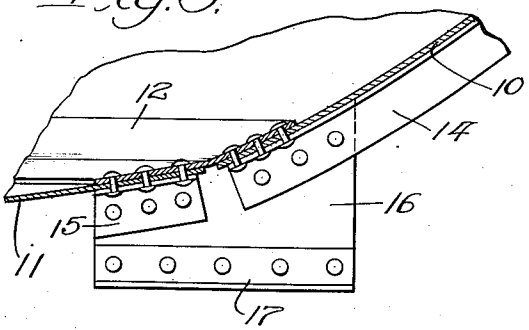
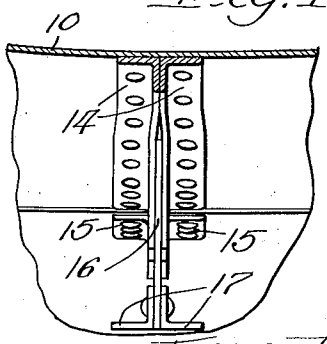


Fig. 4.



Inventor:

Clayton I. Day,

By Wyman, Smith, Lee, Hamilton & Wiles,

Attys.

Patented May 15, 1928. 1,670,024

UNITED STATES PATENT OFFICE.

CLAYTON L. DAY, OF CHICAGO, ILLINOIS, ASSIGNOR TO CHICAGO BRIDGE & IRON COMPANY, A CORPORATION OF ILLINOIS.

CONTAINER.

Application filed October 16, 1926. Serial No. 141,997.

This invention relates to improvements in containers and is here shown as embodied in a container especially adapted for holding liquids under pressure. For example, in the storage of volatile liquids such as gasoline, crude petroleum and the like, in open tanks there is a certain loss by evaporation. If the tank is closed, this loss by evaporation may be prevented but there is then created in the tank a certain amount of internal pressure depending upon the vapor pressure of the liquid stored. The amount of vapor pressure, of course, depends upon several factors such as the volatility of the liquid and the temperature. If the tank, or container, however, is closed and able to withstand the internal pressure created, loss by evaporation is prevented.

One of the objects of my invention is to design a container which will withstand such vapor pressure. Where the container is designed to withstand a certain maximum vapor pressure, a safety valve, or other suitable vent, may be provided to permit escape of the vapor in the event that the maximum pressure should, for some reason or other, be exceeded.

Obviously, in addition to this vapor pressure which is the same at all points on the shell, there is the additional pressure caused by the weight of the liquid itself or the head. This pressure, obviously depends upon the density or weight of the liquid, and varies at different points on the container depending upon the head of the liquid or height of the liquid above the particular point.

One of the principal objects of my invention is to provide a closed container of the kind described that is substantially spherical in shape and that may rest substantially upon the flat ground. By the use of my invention, no posts, columns, or other similar supporting structures are required for the container. It is adapted to rest on a substantially flat piece of ground and is so constructed that it will retain its shape when filled with liquid or empty, and in either case, with or without internal gas pressure.

In that form of device embodying the features of my invention shown in the accompanying drawings, Fig. 1 is a vertical sectional view of my improved container, Fig. 2 is a view taken as indicated by the line 2-in Fig. 1, Fig. 3 is a fragmentary view similar to Fig. 1 showing the joint with the bottom plate on an enlarged scale, and Fig. 4 is a view in side elevation of one of the anchors.

As shown in the drawings, the container comprises a substantially spherical shell 10 having a somewhat flattened bottom 11. The tank may be built in a variety of ways, for example, by riveting, welding, or otherwise fastening together plates each of which has been previously formed to the required curvature for its position in the completed structure. The details of cutting, shaping, and connecting the plates is not gone into here, as these steps are well known. The essence of this invention is the shape of the container.

A indicates the center of the radius used for the spherical part 10, such radius being indicated by r. B indicates the center used for the curvature of the bottom plate 11 and r' indicates the radius, such bottom plate 11 being also spherical but formed with the radius r' which is somewhat longer than the radius r. The effect of this, in general, is to make the container spherical with a flattened bottom.

The diameter of the bottom plate 11 is indicated diagrammatically in Fig. 1 by the line a. In constructing the tank or container, the distance a is the diameter of a circle whose area multiplied by the sum of the internal gas pressure and the pressure at the bottom from the head of liquid, both in pounds per square inch, equals the entire weight of the liquid plus the entire weight of the metal of the shell 10. In determining the distance a in this manner, the tank is assumed to be filled with a normal liquid and with a normal internal or vapor pressure. If the distance a is so computed, it will be seen that, then, when the container is filled with such normal liquid and with such normal internal pressure, the container will be relatively free from undue stresses and strains and substantially self-supporting. That is, the downward pressure on the bottom plate 11 will be the internal gas pressure and the liquid pressure due to the head of liquid. If both of these pressures are known in pounds per square inch, then multiplying the area of a circle with diameter a by the sum of such pressures will give the total downward pressure on the bottom plate 11. In order to make the tank rela-

tively free from undue stresses and strains and cause the same to be in equilibrium, this entire pressure should be substantially equal to the entire weight of the liquid in the tank plus the weight of the steel in the shell 10.

The bottom plate 11 may be attached to the shell 10 in any suitable manner, for example, by the use of a circular overlapping plate 12 which may be welded, riveted, or otherwise fastened to the portions 10 and 11. The tank is adapted to rest upon a substantially flat piece of ground having an area substantially the same as the bottom plate 11, such ground being indicated by 13, 13 in Fig. 1.

Where the parts 10 and 11 are joined, suitable stiffening members may be employed. I have here shown twelve pairs of angle irons 14, fastened near the lower edge of the shell 10 and corresponding pairs of angle irons 15, 15 adjacent to the same attached near the outer edge of the bottom plate 11. Between the two angle irons of each pair is fastened a flattened piece of sheet metal 16 having two angle irons at its lower edge with their flanges turned outwardly as indicated by 17, 17 which act as anchors.

As stated before, the tank is adapted to rest on the bottom plate 11 which is carried practically on a similarly curved piece of ground 13. In addition to this, a concrete foundation 18 may be formed around the tank under the joint between the parts 10 and 11, and in such case, the plates 16 with the angle irons 17, 17 act as anchors in such foundation 18.

The diameter should be large enough or else the concrete foundation 18 should be built out far enough so that when there is no gas pressure in the sphere and the same is filled with liquid, compression in the shell of the sphere due to the liquid outside of the foundations will not be excessive.

What I claim as new, and desire to secure by Letters Patent, is:

1. A closed container adapted to hold a normal liquid and a normal internal or vapor pressure, such container being substantially spherical in shape and having a flattened bottom, the diameter of such flattened bottom being substantially the diameter of a circle whose area, multiplied by the sum of the normal gas pressure and the normal liquid pressure on the bottom due to the head of liquid, both in pounds per square inch, equals the entire weight of the liquid plus the weight of the metal in the shell excluding the weight of the metal in the bottom.

2. A closed container adapted to hold a normal liquid and a normal internal or vapor pressure, such container being substantially spherical in shape and having a flattened bottom, the area of said flattened bottom being large enough to support substantially the entire weight of liquid plus the weight of the metal in the shell, excluding that in the bottom, when the container is substantially filled with said normal liquid at said normal internal or vapor pressure.

3. A closed container adapted to hold a normal liquid and a normal internal or vapor pressure, such container being substantially spherical in shape and having a curved flattened bottom, the diameter of such flattened bottom being substantially the diameter of a circle whose area, multiplied by the sum of the normal gas pressure and the normal liquid pressure on the bottom due to the head of liquid, both in pounds per square inch, equals the entire weight of the liquid plus the weight of the metal in the shell excluding the weight of the metal in the bottom.

4. A closed container adapted to hold a normal liquid and a normal internal or vapor pressure, such container being substantially spherical in shape and having a curved flattened bottom, the area of said flattened bottom being large enough to support substantially the entire weight of liquid plus the weight of the metal in the shell, excluding that in the bottom, when the container is substantially filled with said normal liquid at said normal internal or vapor pressure.

5. A closed container adapted to hold a normal liquid and a normal internal or vapor pressure, such container having its major portion substantially spherical in shape and having a curved bottom, the radius of curvature of the bottom being greater than the radius of curvature of such major portion, the diameter of such bottom being substantially the diameter of a circle whose area, multiplied by the sum of the normal gas pressure and the normal liquid pressure on the bottom due to the head of liquid, both in pounds per square inch, equals the entire weight of the liquid plus the weight of the metal in the shell excluding the weight of the metal in the bottom.

6. A closed container adapted to hold a normal liquid and a normal internal or vapor pressure, such container having its major portion substantially spherical in shape and having a curved bottom, the radius of curvature of the bottom being greater than the radius of curvature of such major portion, the area of said bottom being large enough to support substantially the entire weight of liquid plus the weight of the metal in the shell, excluding that in the bottom, when the container is substantially filled with said normal liquid at said normal internal or vapor pressure.

In testimony whereof, I have hereunto set my hand and seal this 12th day of October, A. D. 1926.

CLAYTON L. DAY.