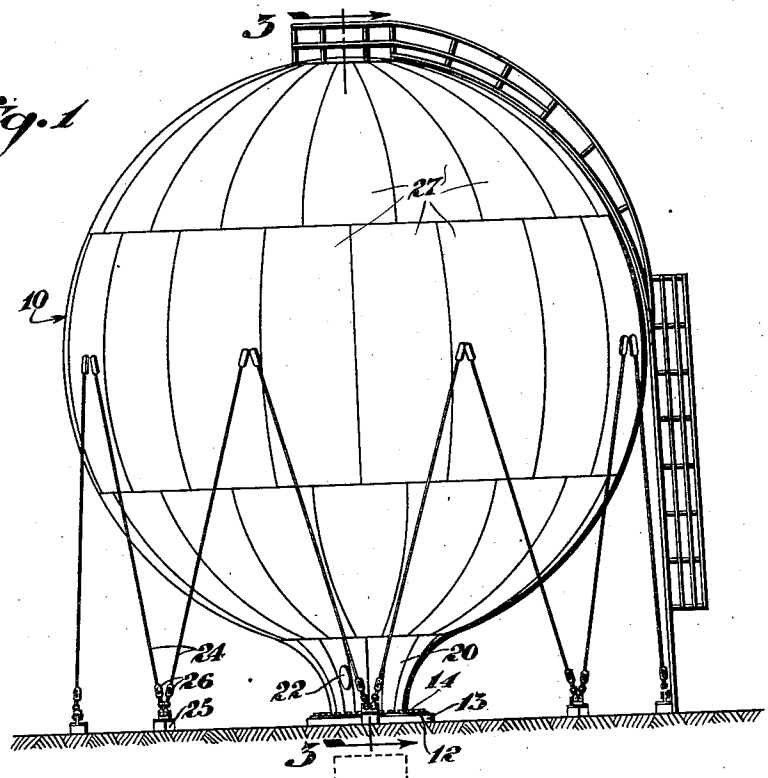
Sept. 8, 1942. H. C. BRINKMAN 2,295,514

STORAGE TANK

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Fig. 1



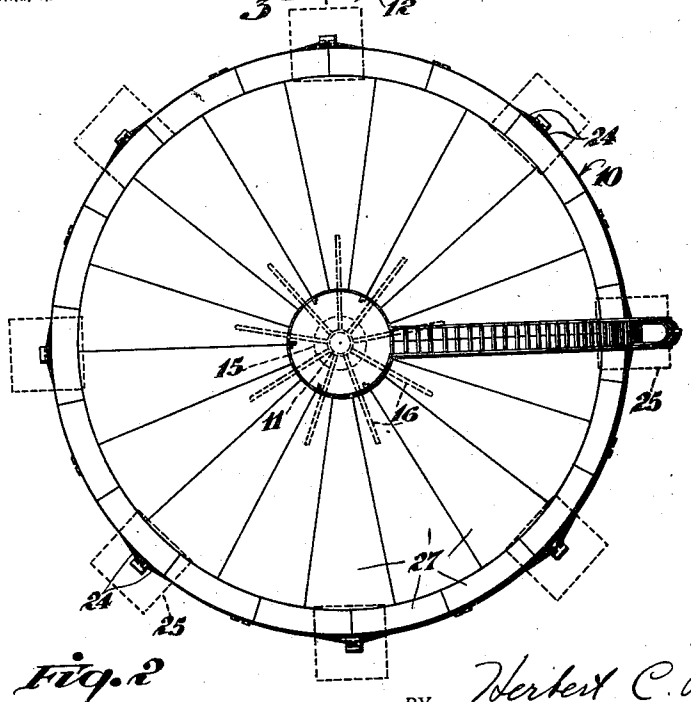


Fig. 2

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Sept. 8, 1942. H. C. BRINKMAN 2,295,514

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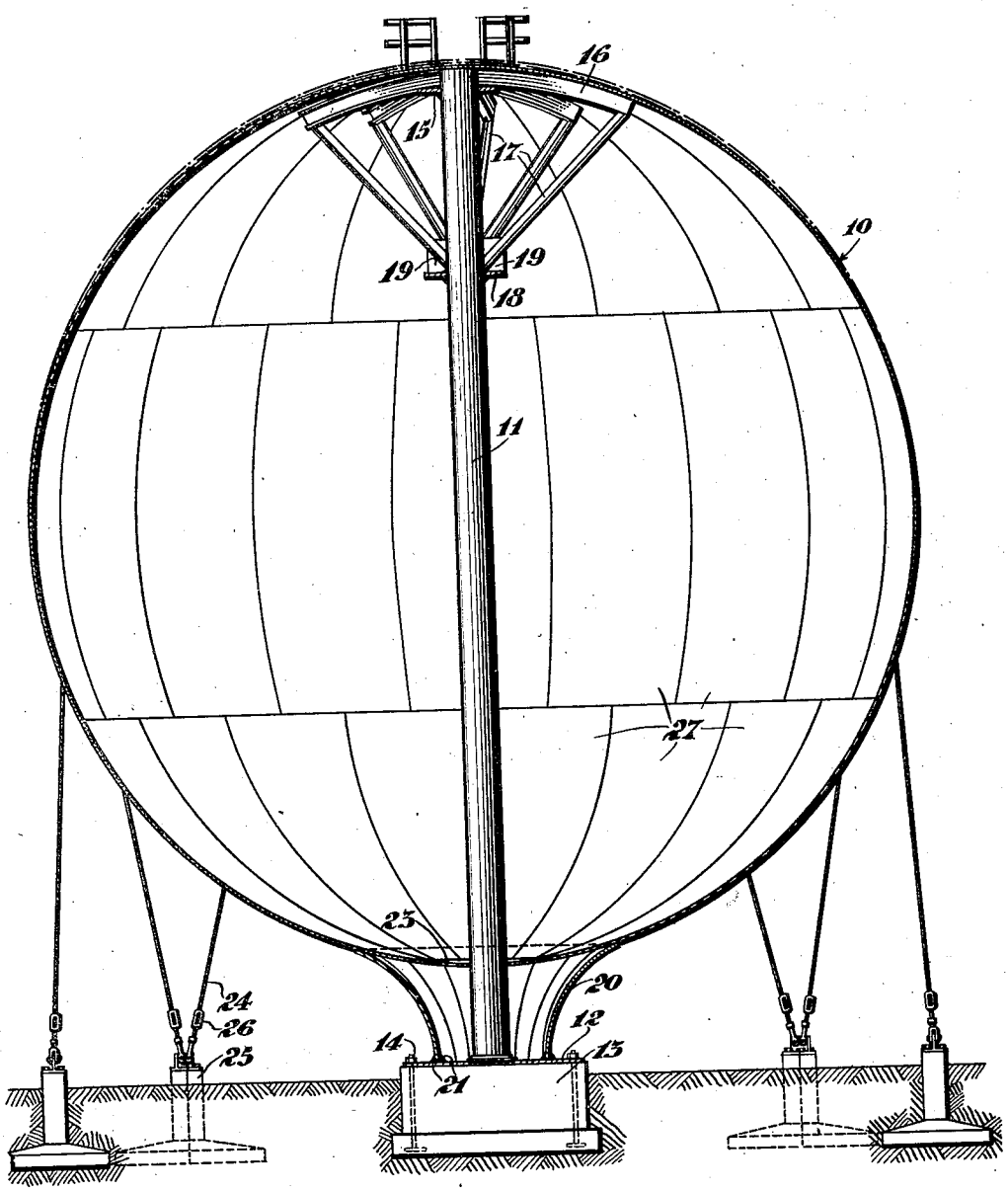


Fig. 5

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2,295,514

UNITED STATES PATENT OFFICE

2,295,514

STORAGE TANK

Herbert C. Brinkman, Cincinnati, Ohio, assignor to Stacey Brothers Gas Construction Company, Cincinnati, Ohio, a corporation of Ohio

Application June 29, 1939, Serial No. 281,935

3 Claims. (Cl. 220—1)

This invention relates to gas storage reservoirs of the rigid type, as distinguished from the usual water holders in which an inverted cup-shaped dome, its lower edge immersed in water, rises and falls in relation to changes in the volume of gas being stored, or the later type dry gas holder in which a sealing piston rises and falls within a cylindrical or polygonal shell as the volume of gas varies. The fixed volume type of holder in the past has been built in the shape of a sphere or in the shape of a cylindrical shell with dished or hemispherical heads, in some cases, of a configuration somewhat resembling a bullet or projectile. The type or holder of the present invention is distinguished by a shape of configuration different from those constructed in the past and is capable of storing a greater volumn of gas for the area occupied, than the holders of the past.

In the spherical gas holders well known in the art, a metallic sphere is mounted upon a foundation, usually consisting of a plurality of pedestals rising from the ground in a circle. The present invention is an improvement over this type of structure in many respects: First, a portion of the space between the sphere and the ground is utilized for the storage of gas; second, the entire weight of the sphere, when empty, is supported at the center on one centralized relatively small foundation pier as opposed to a series of independent foundations or piers where the settlement of one and not others will cause one or more of the piers to take an abnormal load and cause strains in the holder; third, the holder is more securely mounted and moored than has been possible in the past; fourth, the weight of the tank, when empty, is more efficiently supported and, when filled, is supported on the gas itself; and fifth, the holder has a more pleasing appearance than any heretofore constructed. For this latter reason, it may be placed in a residential district without complaint.

The holder of the present invention consists of a main body portion or bulb portion which preferably is spherical, or approximates a sphere in shape. This bulb portion is connected to the foundation by means of a tubular member or axially disposed enclosure which performs the double function of mooring the bulb portion to the foundation and of storing additional gas.

If the holder be constructed of sufficiently heavy or rigid material, no additional support means is required, nor would it be necessary to observe any particular relationship between the size of the bulb portion of the holder and the size of the tubular portion of the holder, other than as required by the nature and strength of the materials used in the fabrication. However, as a practical matter, it is extremely important to make a holder of this type as light as possible in order to reduce the amount of metal going into it, the cost of fabrication, and the size of the foundation required. In the present case, two expedients are recommended to permit this lightening of the structure, and these may be used alternatively or conjointly.

A central standard or support is built inside of the holder, preferably in the center of the foundation so that it rises axially through the tubular portion of the holder and lies in the vertical axis for the spherical part of the holder. The top of this central standard is spread out to provide an enlarged support area at the top of the central standard. Obviously, the utilization of a central standard of this type partially or entirely relieves the lower part of the holder of the weight of the upper part of the holder and particularly tends to take weight or force or stress off of the tubular portion of the holder which is immediately connected to the foundation. If desired, this standard may be built to such a height that the holder is vertically hung from the central standard, rather than mounted upon the tubular neck of the holder. Alternatively, the diameter of the tubular portion of the holder is predetermined in relation to the cubic volume of the holder, so that when the holder is inflated with gas to the desired pressure, the column of gas within the tube actually supports the holder, and the tubular neck is under a slight stretching tension rather than under compression due to the weight of the metal of the holder.

Preferably the diameter of the tubular portion at the base of the holder may be such that the total gas pressure on the base plate will be slightly in excess of the dead load of the shell when the holder is subjected to its maximum gas pressure.

This action may best be visualized if one pictures a child's small rubber balloon of the type normally inflated through a neck portion. If it be blown up to sufficient pressure, the neck becomes, to all intents and purposes, rigid so that it, or rather the column of gas within it, supports the bulb portion of the balloon.

In the preferred embodiment of the invention, a central standard support is used in conjunction with the balloon phenomena discussed in the preceding paragraph. In this preferred embodiment, the height of the standard is so adjusted as to support the weight of the shell of the holder

when empty. Accordingly, substantially all of the weight of the holder is transmitted to the foundation, through the central standard.

When the holder is inflated with gas to the desired pressure, the shell plates are subjected to tensional stresses due to the gas pressure. The diameter and also the actual surface areas of the sphere increase in proportion to the tensional stresses. Thus, as soon as the gas within the holder is under even a low pressure, the dead load on the center column is reduced by the amount of the total gas pressure exerted on the base. The top portion of the holder then rises clear of the central standard so that it is supported on the column of gas enclosed by the tubular portion of the holder. As pointed out before, however, the diameter of the base of this tubular portion of the holder exposed to effective gas pressure, must be adjusted in relation to the weight of the holder so that the area of the tubular base times the pressure of the gas per unit area is equal to the weight of the holder.

Obviously the broad invention set forth herein does not require the use of the central standard or post. In other words, the walls of the tank may be of sufficient rigidity and the tubular portion of sufficient mass to support the dead load of the holder. In the preferred embodiment, or in the embodiment shown in the drawings, supplemental peripheral moorings may be used if desired.

Other objects and certain advantages of the invention will be more fully apparent from a description of the following drawings in which:

Figure 1 is a side elevation of the improved gas holder.

Figure 2 is a top plan view thereof.

Figure 3 is a sectional view taken on line 3—3, Figure 1, showing the internal structure of the holder and detailing the anchorage means.

Referring to the details of the drawings, the wall of the round or globular tank is generally indicated at 10. A standard 11 is disposed within the holder on the vertical axis thereof. This standard rests upon and is secured to a plate 12. The plate 12 rests upon and is attached to a block of concrete 13 imbedded in the ground. The plate is secured by means of anchor bolts 14.

The upper end of the standard is provided with a head, which may be a plate, or the elements of which may be arranged somewhat after the manner of the stays and braces of an umbrella, as shown herein. A disc 15 is fixed by welding close to the upper end of the tubular standard. Arcuate ribs 16, formed of channel iron, extend radially from this disc, being attached thereto at their inner ends. These ribs are formed on a curvature corresponding to that of the holder wall when deflated. Accordingly, the wall is supported evenly on the ribs. The outer ends of the radial ribs or stays are supported by means of angular braces 17 converging upon the standard.

Another disc is welded to the standard and a series of radial fins 19 are welded to the standard and disc and extend out to the peripheral margin of the disc. Each brace consists of two angle iron pieces, one on each side of the respective fins. All of these parts are secured together by welding. The standard is of such a height that the holder wall is supported essentially on the umbrella when deflated.

The lower end of the holder is anchored by means of a tubular element 20, which also constitutes the means for extending the gas enclosure downwardly so that the gas is in direct contact with the base plate 12.

This element 20 may be flared, as indicated, so as to curve neatly into the curvature of the holder wall, to which it is welded. The lower end of the tube is welded to the plate as at 21 so as to provide a gas tight seal. The tubular standard passes loosely through the wall of the sphere.

A manhole 22 is provided for access to the interior of the tubular element. This manhole may include the means for delivering the gas to the tank and for drawing it off. The portion of the holder wall within the area of the tubular support is provided with an opening 23 of about the same size as the manhole. This hole permits the gas to flow freely between the spherical part of the holder and the tubular part. At the same time, it is large enough to permit the attendant to enter the spherical part of the tank through the tubular part when the tank is not in use.

Tie rods 24 are attached to the holder around its great circle. These tie rods or cables are arranged angularly so that pairs of them may be said to be attached to a common anchorage of concrete 25 imbedded in the ground. Turn buckles 26 are provided, permitting variation in the tension in the cables or rods.

The holder may be made up of segments 27 of metal formed of the correct curvature, as shown. The holder is preferably formed of two or more sections joined on horizontal planes. The segments of each section have their longitudinal edges formed on circumferential or girth lines. This arrangement may vary.

When the holder is erected and completed, it is preferable that the entire dead load, including the reaction from the initial tensions of the tie rods, is carried on the umbrella or enlarged top of the column or standard, assuming, of course, that the interior of the sphere is at atmospheric pressure. As stated, the sphere and tubular element are made gas tight by welding the tubular element to the base plate. Thus the tubular element or column base enclosure also carries all the shear resulting from horizontal forces, due to wind or seismic loading.

Under internal gas pressure, the gas pressure on the column base plate relieves the load on the standard or column. If the gas pressure is sufficient, the entire dead load may be carried by the gas and the standard entirely relieved of the load. The umbrella or top of the standard is not connected to the spherical shell for the reason that the shell must be free to move under variations in gas pressure and temperature. Also, the initial tension in the tie rods is increased by the internal gas pressure for the sphere tends to rise as the gas pressure is asserted on the base plate.

Otherwise expressed, the structure is comprised of a gas-tight sphere or globe, a foundation plate and a conduit interconnecting the foundation plate to the sphere or globe. For sustaining the dead weight of the holder when it contains no gas, or when the pressure of the gas within it is very low, a pedestal is provided to extend from the base plate within the conduit and upwardly within the sphere, so as to support or sustain it in umbrella fashion.

On the other hand, when gas under higher pressure is introdced into the holder this gas itself sustains the weight of the holder by exerting a force against the base plate. In other words, the load of the holder is borne by the gas with which it is filled, this gas, in turn, tending to press

the base plate against its foundation, so as to relieve the conduit from structural loading. The sphere thus tends to float upon the base, depending upon the pressure of the gas within the holder. Therefore, it is not requisite that structural load sustaining elements be located about the periphery of the holder for sustaining it.

Horizontal forces, resulting from wind or other causes are resisted by a horizontal shear at the column base enclosure and the overturning force resulting from these horizontal forces, is resisted by the tie rods, resulting in an increase of tie rod tension on the windward side with a corresponding decrease on the leeward side. If the initial tension on the tie rods is sufficient, no change in the load on the central column will occur.

In the instances of the larger installations, as is shown in the drawing, a ladder is provided extending vertically to the great circle and around the curvature of the sphere to the upper pole.

Having described my invention, I claim:

1. A gas holder comprising a base plate, a tubular member having its axis disposed vertically, said member resting upon and in gas-tight connection with said base plate, a spherical tank mounted upon said tubular member and being in communication therewith, the predetermined normal operating pressure within the tank and the area of said base plate exposed to said pressure being so related that the weight of the spherical tank is equal to the total pressure on said base plate.

2. A container for gas comprising a spherical tank, a base plate for supporting said tank, an axial extension on said tank providing a tubular conduit having its lower end in gas-tight connection with the base plate for permitting the exertion of gas pressure against the base plate, the predetermined normal operating pressure within the tank and the area of said base plate exposed to said pressure being so related that the weight of the spherical tank is equal to the total pressure on said base plate, and a support extending axially upwardly from the base plate through the axial extension and normally supporting the upper portion of the spherical tank when the tank does not contain gas under pressure, said tank adapted to move out of contact with said support when the tank contains gas under pressure.

3. A container for gas comprising a spherical tank, a base plate for supporting said tank, said tank including an axially extended tubular conduit having its lower end in gas-tight connection with the base plate for permitting the exertion of gas pressure against the base plate, the predetermined normal operating pressure within the tank and the area of said base plate exposed to said pressure being so related that the weight of the spherical tank is equal to the total pressure on said base plate, a support extending axially upwardly from the base plate through the conduit and having a broadened upper end normally supporting the upper portion of the spherical tank when the tank does not contain gas under pressure, said tank adapted to move out of contact with said broadened upper end when the tank contains gas under pressure and a series of tie rods extending from the girth of said spherical tank to points of attachment on the ground for stabilizing said spherical tank against wind pressures.

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