Feb. 20, 1934. B. M. BLACKBURN 1,947,515

ELEVATED TANK

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Fig. 1.

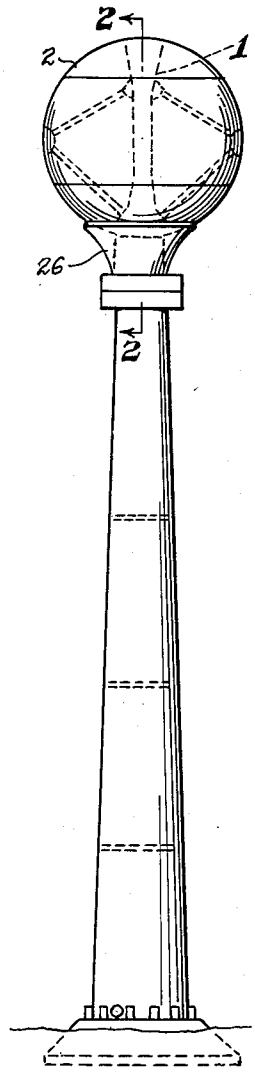


Fig. 3.

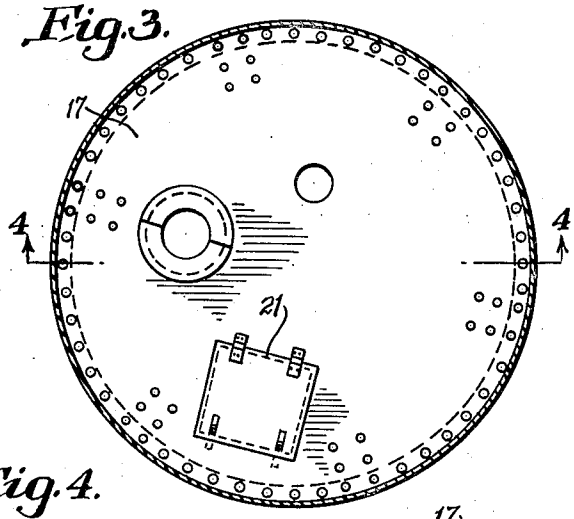


Fig. 4.

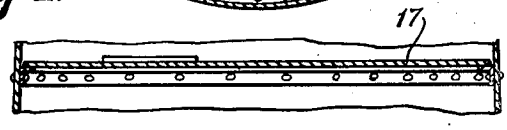


Fig. 5.

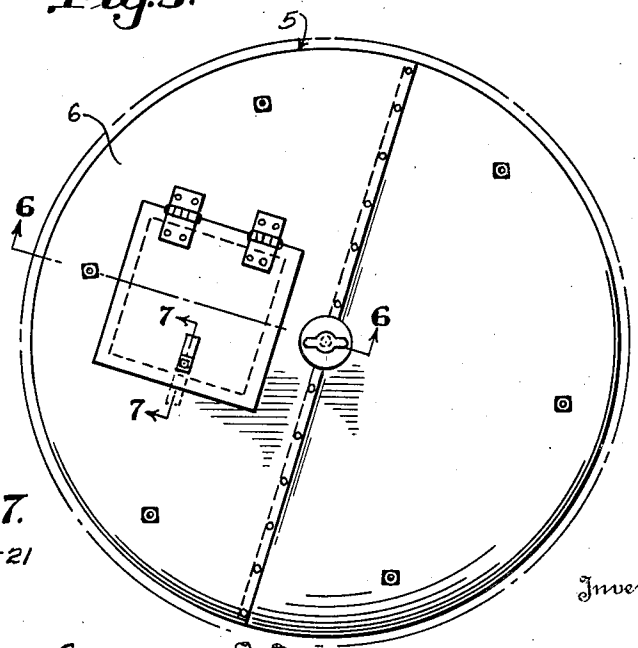


Fig. 7.

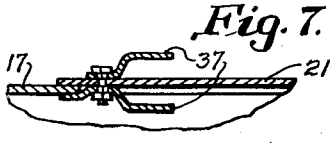
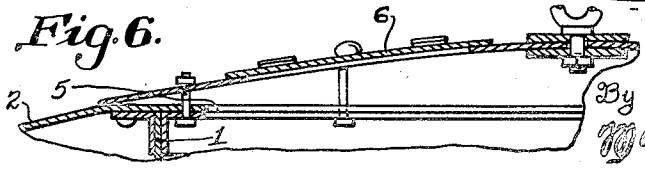


Fig. 6.



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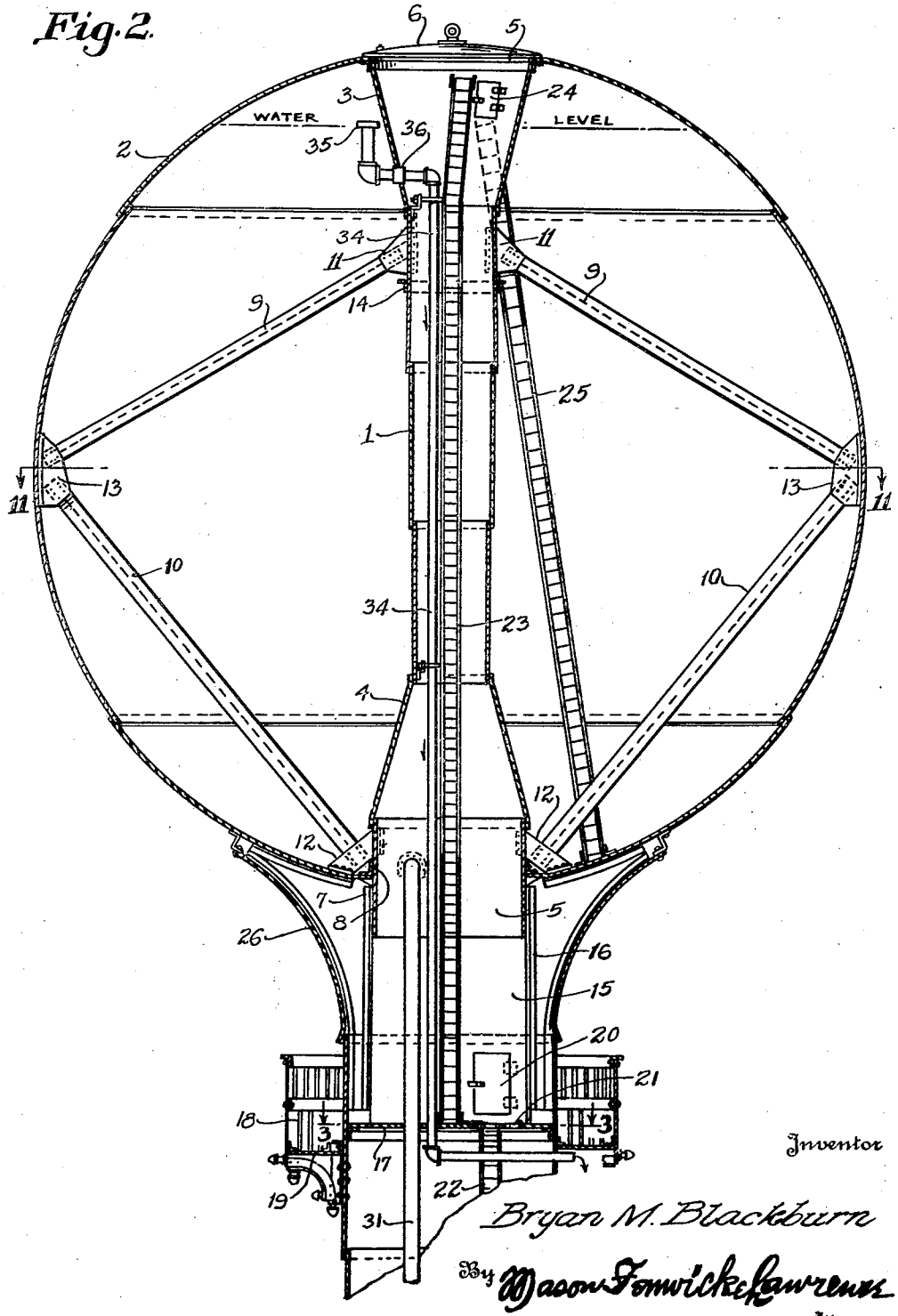
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Fig. 2.



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ELEVATED TANK

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Fig. 9.

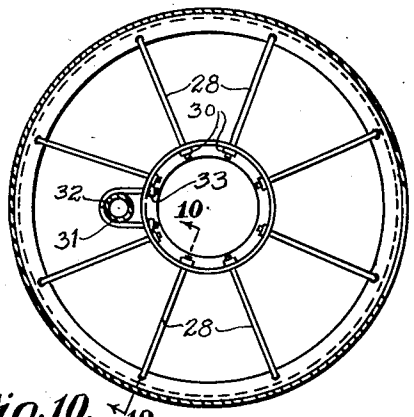


Fig. 10.

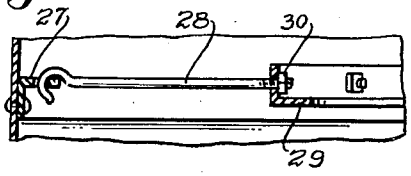


Fig. 11.

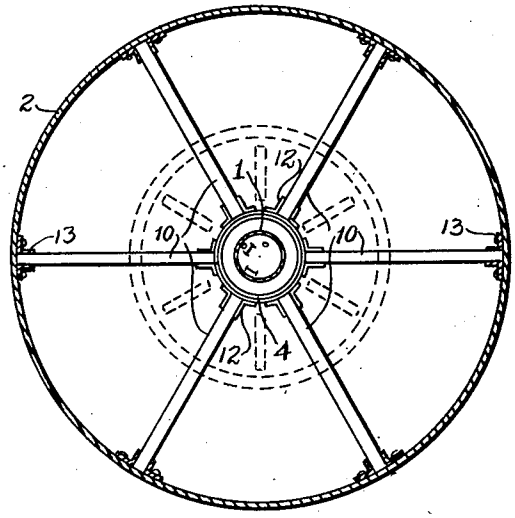
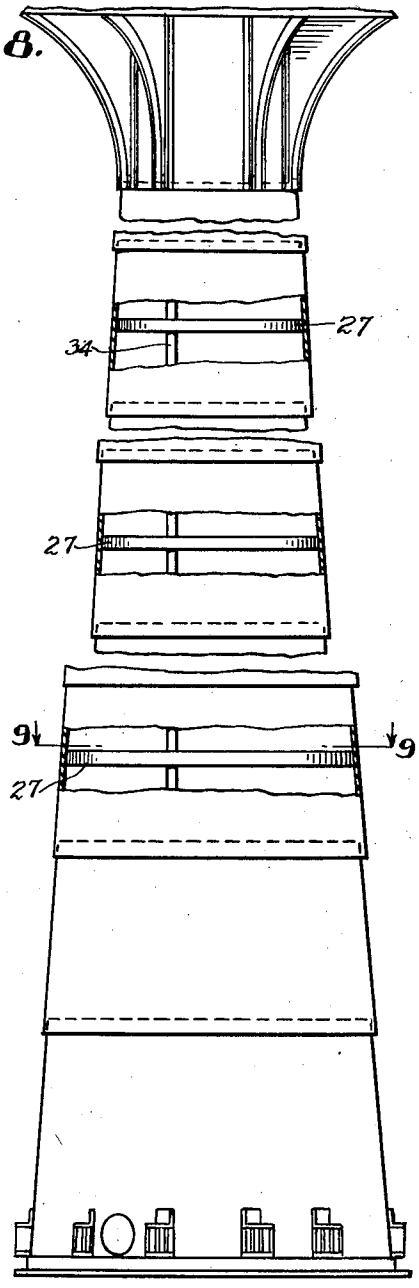


Fig. 8.



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Patented Feb. 20, 1934 1,947,515

UNITED STATES PATENT OFFICE

1,947,515

ELEVATED TANK

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Application September 21, 1933
Serial No. 690,494

9 Claims. (Cl. 220—1)

This invention relates to elevated tanks for the storage of water or other liquids. It has for its principal object the construction of a tank of substantially spherical contour deriving its support solely from a central tower, and being characterized by the absence of any other external supporting columns or framework.

Another object of the invention is the provision of a spherical tank having a hollow hub extending therethrough from pole to pole and constituting not only a balanced buttress for a shape-sustaining system of internal struts, but also providing a shaft-way segregated from the water space within said tank and giving access to the interior of said tank by way of a passage located above the water level.

A further object of the invention is the arrangement of the overflow pipe which determines the maximum water level with the major portion thereof extending through said hub or shaft-way so that it is accessible for repairs without the necessity of a person entering the water space or draining the tank.

Another object of the invention is the provision of what may be termed an access chamber at the base of the tank and in continuation of said hub which may be entered either by way of a door opening on to a balcony which surrounds the tower or through a trap door in the floor of said chamber approached by a suitable ladder extending from the base of said tower, the floor of said access chamber affording a safety means to prevent one who enters the door from the balcony from falling downward through the tower, and the lateral walls of said access chamber constituting a support for brackets which in part uphold the spherical shell of the tank.

Still another object of the invention is the provision of novel structure means for reinforcing and stiffening the tower and affording support for the supply riser.

Other objects of the invention will appear as the following description of a preferred and practical embodiment thereof proceeds.

In the drawings which accompany and form a part of the following specification and throughout the several figures of which the same characters of reference have been employed to designate identical parts:

Figure 1 is a longitudinal elevation of a tank embracing the principles of the present invention, part being shown in phantom;

Figure 2 is a vertical diametrical section through the tank, and through that portion of the tower immediately below it and denominated in the present description as the access chamber;

Figure 3 is a cross section taken along the line 3—3 of Figure 2;

Figure 4 is a cross section taken along the line 4—4 of Figure 3;

Figure 5 is a plan view of the cover plate at the top of the tank showing the trap door by means of which access is had to the exterior;

Figure 6 is a cross section taken along the line 6—6 of Figure 5;

Figure 7 is a cross section taken along the line 7—7 of Figure 5;

Figure 8 is a longitudinal elevation, part being shown in section of the tower and part broken away;

Figure 9 is a cross section taken along the line 9—9 of Figure 8;

Figure 10 is a cross section taken along the line 10—10 of Figure 9; and

Figure 11 is a cross section taken along the line 11—11 of Figure 2.

Referring now in detail to the several figures, Figure 1 represents a fabricated sheet metal reservoir or storage tank, primarily intended for water, although it is, of course equally well adapted for the storage of other liquids as well. It is designed to be made particularly in large sizes such as for example, a diameter of 60 feet and a capacity of 500,000 pounds or more.

It is customary to make tanks of this capacity cylindrical in shape with perhaps a convex bottom and a convex or conical top and to support them by a system of columns or girders extending from the lower peripheral portion of the bottom of the tank. In such structures, the mechanical expedients employed for the support of the tank as well as the intrinsic shape of the latter subordinates the ornamental features which might otherwise grace the tank, to features purely utilitarian so that such tanks are as a rule extremely unsightly, and their presence depreciates the value of adjacent property.

This tank is characterized by the complete absence of any external supporting columns other than the central tower itself. The self-support of the tank is accomplished by means shown in detail in Figures 2 and 11, and comprises essentially a tubular core or hub 1 located vertically and axially with respect to the spherical tank 2. The intermediate portion of the core is fabricated of sheet metal sections welded or riveted together in known manner and incidentally it may be stated that the shell of the tank as well as that of

the central tower is constructed in like manner, and no claim is laid to the shape or method of uniting of the sheet metal segments.

The upper and lower end portions 3 and 4 of the core or hub are composed of frusto-conical sections with their flaring ends directed oppositely as shown and with their convergent ends united to the adjacent ends of the intermediate cylindrical portion. The upper flared end is suitably secured to the edges of the shell of the tank which surround a polar opening 5. The said polar opening is closed by a cap 6 which may be removed upon occasion to give access to the upper convex portion of the tank for painting, etc., and the interior of the core or hub portion is segregated from the water space within said tank so that one may climb throughout the diametrical height of the tank without the necessity of having the tank emptied. The lower flared portion 4 is suitably secured to a cylindrical section 7 forming the connecting member between the tank and the tower and which is secured in leak-tight manner as by the ring 8 of angle cross section, to the encompassing edge of the shell of the tank.

The primary function of the core or hub is that of a balanced buttress for a system of struts comprising a plurality of upper and lower members respectively designated by the numerals 9 and 10, said members being radially arranged, the upper members being secured at their inner ends to the upper portion of the core 1 by suitable gussets 11 while the lower members are similarly secured by gussets 12 to the connecting section 7 and the adjacent portion of the tank shell. Both of the upper and lower sets of struts are connected in common at their outer ends to gussets 13, arranged at spaced intervals about the horizontal grate surface of the tank. The upper struts are tension members while the lower ones resist compression and in this manner the spherical shape of the tank is maintained without the aid of the customary columns extending from the lower portion of the tank to the ground. It will be observed that the interest of stiffness the core is surrounded by a reinforcing ring 14 of angular cross section at a point beneath the upper series of gussets 11, this ring ensuring the maintenance of the cylindrical shape of that section of the core to which the said gussets 11 are attached, bracing said section against windage which is the only unbalanced force to which it can be subjected.

The upper portion of the tower is constructed to form an access chamber 15 composed of a cylindrical wall 16 erected upon a floor 17 and having its upper end telescoping upon the lower portion of the connecting section 7. A balcony 18 surrounds the lower portion of the access chamber, the floor 19 of which balcony extends at a plane perpendicular to the wall of the tower and functions in conjunction with the floor 17 as a stiffening element. A door 20 leads from the balcony into the access chamber. The floor 17 is provided with a trap door 21, normally closed, but through which entrance may be had to the access tower by way of the ladder 22 reaching to the bottom of the tower. The floor 17 together with the closed trap door 21 affords a safety means to prevent one who may enter the access chamber from the balcony door 20 from falling downward through the tower. A ladder 23 reaches from the floor of the access chamber to a point adjacent the top of the core at which point is located a trap door 24 which may be opened to give access to the water space. The trap door 24 is above the level of the water in the tank so that no special precautions need be taken to make the trap door 24 water-tight. A ladder 25 in the water space of the tanks extends downward from the trap door 24 to the floor of the tank, giving ample access for repairs. It will be noted that the trap door 21 has a latch 37 with a handle on both sides so that the trap door can be opened either from above or below.

A system of radial brackets 26 surrounds the access chamber, being secured to the walls thereof and to the lower wall of the tank shell 2, the function of said brackets being to make a rigid connection between the tank 2 and the tower.

The tower is constructed of sections fabricated from sheet metal segments in well known manner as described, the gage of the metal being such as to enable the tower to support the load of the tank and contents. The major problem in a tower having this tank supporting function is to keep the walls cylindrical, and consequently at suitable intervals a ring 27 preferably of angle cross section is riveted or welded circumferentially within the tower, being suitably apertured at regular intervals forming the connecting means for a series of radial tie rods 28, the inner ends of which are secured to a floating ring 29. Figure 8 shows three of these shape-preserving arrangements, although the number is not critical depending upon the height of the tower, the superposed load and the gage of the sheet metal of which the tower is constructed. The thread and nut construction 30 at the inner ends of the tie rods permits all or any of them to be taken up from time to time in order to be stressed uniformly throughout the peripheral extent of the tower.

A riser 31 traverses the length of the tower and the access chamber, being angularly offset adjacent the top of the latter and entering the wall of the connecting section 7, opening into the water space of the tank. The head rings afford an efficient and convenient means against which to anchor the riser, this being done by U-bolts 32 shown in Figure 9 surrounding the riser and being adapted to be pulled into clamping relation to said riser by means of the nuts 33.

An overflow pipe 34 is also provided, the upper end 35 of which determines the maximum liquid level within the tank. The overflow pipe is angularly deflected a short distance from the inner end and passes into the chamber of the core through a suitable fluid-tight fitting 36 arranged in the walls of the flared portion 3. The overflow pipe then extends downwardly within the core 1 and through the access chamber into the floor thereof, said overflow pipe being deflected laterally and extending through the side of the tower just beneath the balcony. The arrangement of the major portion of the length of the overflow pipe within the core of the access chamber makes it possible and convenient to repair the same without disturbing the water in the tank.

It will appear from the above description of a preferred and practical embodiment of the invention that it possesses adequate strength for the purpose for which it is intended, and is entirely shape-sustaining and self-supporting from within excepting of course insofar as the ultimate load is carried externally by the central column.

It is to be understood also that the details of construction as herein shown and described are merely by way of example, and not be construed

as limiting the scope of the invention as defined in the appended claims.

What I claim is:

1. Self-shape sustaining substantially spherical elevated storage tank comprising a shell, a vertical tubular buttress arranged axially within said shell and secured adjacent the poles thereof, and a system of radially disposed struts within said shell secured thereto at intervals in a zone adjacent the equator of said shell and reacting against said buttress.

2. Self-shape sustaining substantially spherical elevated storage tank comprising a shell, a vertical tubular buttress arranged axially within said shell and secured adjacent the poles thereof, and an upper and lower series of radially disposed struts within said shell secured thereto at intervals in a zone adjacent the equator of said tank and secured at their inner ends in zones respectively above and below said equator.

3. Shelf-shape sustaining substantially spherical elevated storage tank comprising a shell, and a vertical tubular buttress arranged axially within said shell, said buttress being fabricated of sheet metal sections, the intermediate portion being cylindrical and the upper and lower end portions flaring toward the poles of said shell, the upper flared portion being secured to said shell and the lower flared portion being secured relative to said shell, upper and lower series of struts within said shell and secured thereto at their outer ends in a zone adjacent the equator of said shell, the inner ends of the upper ends of said struts reacting against said buttress adjacent the upper part of the cylindrical portion and the lower series of struts being secured adjacent the bottom of said buttress.

4. Self-shape sustaining substantially spherical elevated storage tank comprising a shell, a vertical tubular buttress arranged axially within said shell and secured direct to said shell at its top, a cylindrical connecting member secured to said shell at the bottom, and to the lower end of said buttress, the latter providing a vertical passage-way through said tank and being open above the water level, to the water space within said tank, and a series of radially disposed struts secured to said shell at intervals in a zone adjacent the equator of said tank and reacting against said buttress adjacent the upper end thereof.

5. Self-shape sustaining substantially spherical elevated storage tank as claimed in claim 4, said buttress comprising a cylindrical intermediate portion to the upper part of which the inner ends of said struts are secured, and a stiffening flange surrounding said cylindrical portion in the vicinity of the points of securement of said struts.

6. Self-shape sustaining substantially spherical elevated storage tank comprising a shell, a vertical tubular buttress arranged axially within said shell and secured adjacent the poles thereof, said shell affording a vertical passage-way through said tank, said buttress being provided with an opening above the water level giving access to the water space in said tank, an overflow pipe having its open upper end within said water space and determining the water level, said overflow pipe passing through the wall of said buttress near the top thereof and extending downwardly through said passage-way.

7. Self-shape sustaining substantially spherical elevated storage tank comprising a shell, a tower co-axial with said shell and affording the sole support for the latter, a cylindrical section passing through a cylindrical opening in the bottom of said tank and secured thereto intermediate its ends in fluid-tight manner, means forming a tubular buttress secured to the upper end of said cylindrical section and extendng to the upper pole of said tank, a balcony surrounding said tower near the upper end and having an encompassing floor secured to the wall of said tower and extending in a transverse direction, forming a stiffening flange, a floor within said tower adjacent said stiffening flange, means extending between said cylindrical section and said floor defining an access chamber, a door in said floor establishing communication between the lower part of said tower and said access chamber, a door through the wall of said access chamber to said balcony, an opening in the upper part of said buttress above the liquid level in said tank, giving access to the water space within said tank, and a ladder leading from said access chamber to said opening.

8. Self-shape sustaining substantially spherical elevated storage tank as claimed in claim 7, including an overflow pipe within said tank and determining the liquid level therein, said overflow pipe extending through the wall of said buttress near its upper end and extending downwardly within said buttress and access chamber in adjacency to said ladder.

9. Self-shape sustaining substantially spherical elevated storage tank as claimed in claim 7, said tower being provided at vertical intervals with centrally located head rings, and a plurality of equally spaced radially extending tie rods secured to said ring and to the peripheral wall of said tank.

BRYAN M. BLACKBURN.