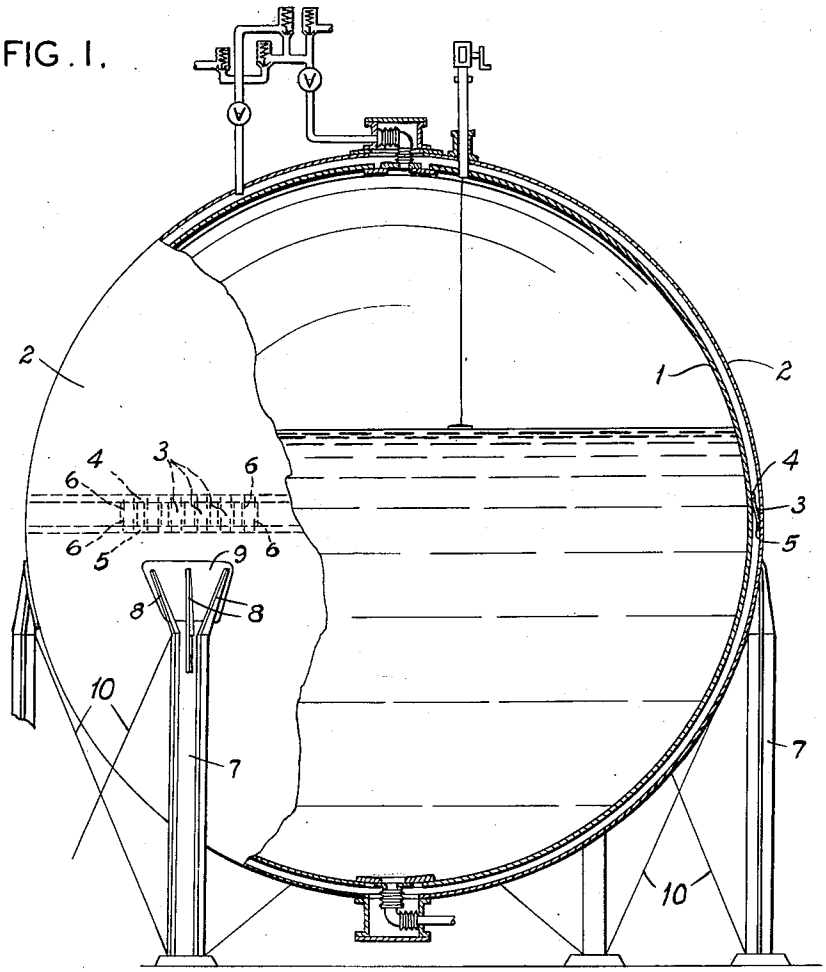
Dec. 4, 1951 J. H. WIGGINS ET AL 2,577,171

MULTISHELL FLUID STORAGE APPARATUS

Filed July 31, 1946 2 SHEETS—SHEET 1

FIG. 1.



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FIG. 2.

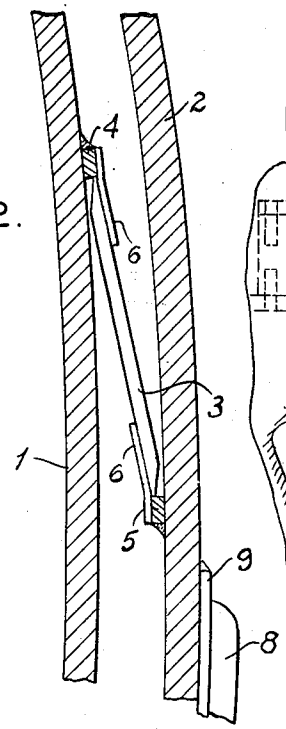
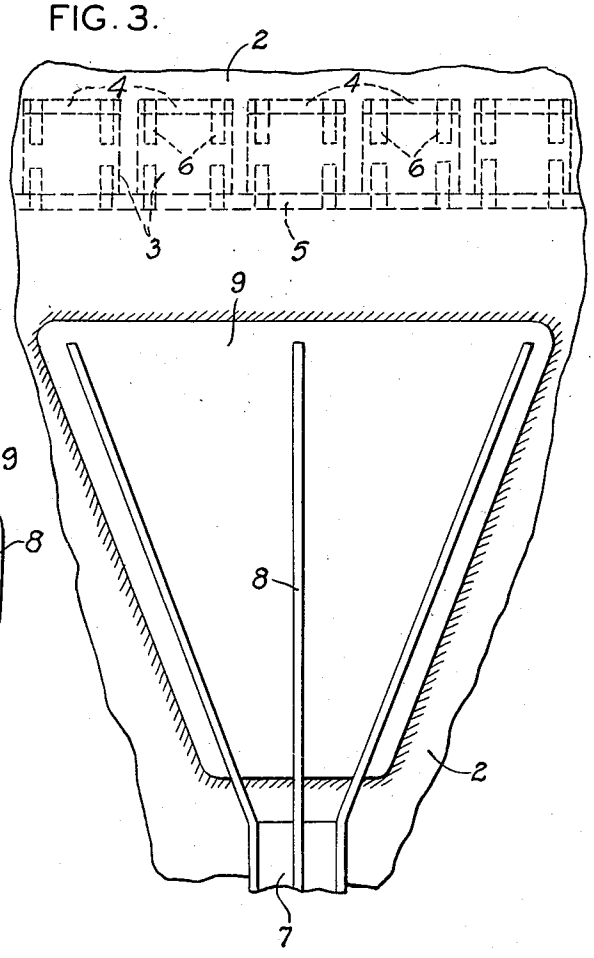


FIG. 3.



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MULTISHELL FLUID STORAGE APPARATUS

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2 Claims. (Cl. 220—15)

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This invention relates to containers of the general type or kind that comprises a plurality of gas-tight shells arranged one inside of the other in spaced relationship.

One object of our present invention is to provide a novel means or mechanism for combining the shells of such a container or apparatus, in such a way as to allow for differential expansion and contraction, due to temperature changes and differential pressures on the shells of the apparatus, thereby eliminating high local stresses on the shells.

Another object is to reduce the cost and simplify the procedure of constructing an apparatus of the general type or kind above mentioned. Other objects and desirable features of our invention will hereinafter be pointed out.

We have herein illustrated our invention applied to or embodied in a pressure vessel for storing propane, butane, and other highly volatile liquids, composed of two shells arranged one inside of the other, with a gas or vapor space between said shells, and equipped with a valve mechanism for establishing and cutting off communication between said gas or vapor space and the inner shell, which constitutes the storage chamber of the apparatus. However, the particular purpose for which the apparatus is employed is immaterial, and the apparatus may comprise more than two shells arranged one inside of the other in spaced relation. The shells of the apparatus may be of spherical shape, cylindrical shape, or of various other forms.

Figure 1 of the drawings is an elevational view, partly in vertical transverse cross section, of an apparatus embodying our invention, and composed of two spherical shells arranged one inside of the other in spaced relation.

Figure 2 is an enlarged, fragmentary sectional view through the two shells, showing one of the rocker plates that forms part of the supporting means for the inner shell, and showing one of the supporting legs that is attached to the outer shell; and

Figure 3 is an enlarged, fragmentary view, showing one of the supporting legs in front elevation, and showing a plurality of the rocker plates in broken lines.

Referring to the drawings, the reference characters 1 and 2 designate two gas-tight, spherical shells, arranged one within the other with a gas or vapor space between said shells. The inner shell 1, which constitutes the storage chamber of the apparatus, is supported from the outer shell 2 by a plurality of radially-movable members 3 arranged in spaced relation in a horizontal row

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or in a plurality of horizontally-disposed groups, around the circumference of said shells at or adjacent the horizontal equator of the shells, as shown in broken lines in Figures 1 and 3. So far as our broad idea is concerned, the radially-movable supports 3 for the inner shell may consist of elements rockably combined with or pivotally connected with both shells, or attached rigidly to one shell, and rockably combined with the other shell. Preferably, the inner shell supports 3 consist of stiff metal plates, usually about 10 inches square and approximately ⅜ of an inch in thickness, arranged with their lower ends rockably mounted on a horizontally-disposed bearing ring or other suitable supporting abutment member 5 welded to the inner side of the outer shell 2, and having their upper ends in rockable engagement with a laterally-projecting abutment means 4 on the exterior of the inner shell 1. Usually, the laterally-projecting abutment means 4 on the inner shell that co-acts with the rockable, radially-movable elements 3 to support the inner shell from the outer shell, will consist of a plurality of horizontally-disposed bars welded to the exterior of the inner shell. In order to hold the supporting plates 3 in rockable engagement with the abutment members 4 and 5 on the shells, between which said supporting plates 3 are interposed, restraining strips or retainers 6 made of relatively thin metal are welded or otherwise attached to said abutment members, so as to lap over the rocker plates 3, as shown in Figure 2.

The restraint strips 6 are subjected to some bending, due to movement of the rocker plates 3, but being thin, they have little resistance to such bending. In this way, the inner shell 1 can move relatively to the outer shell 2 without putting bending stresses in the rocker plates 3. This is very desirable, since any bending in these plates weakens them as a compression member, and also they would give some resistance to the relative movement of the two shells, due to the stiffness of the rocker plates 3 in resistance to the bending. Preferably, the rocker plates 3 have beveled ends, as shown in Figure 2, so as to provide for local yielding of the rocker plates to equalize the load on each of them in case some rocker plates are installed with closer contact than others, due to erection discrepancies. The particular dimensions and shape of the rocker plates 3 are not essential, but when fairly wide, rectangular-shaped rocker plates are used, said plates effectively prevent the inner shell from shifting sidewise, as each rocker plate 3 has a relatively long, horizontal bearing area on the

supporting ring 5 on the outer shell (usually about 10 inches), and hence, cannot tilt sidewise to the right or left. With a supporting means of the construction above described, the weight of the inner shell insures that it will be kept centered with relation to the outer shell.

Any suitable means can be used to support the outer shell above the surface of the ground, on which the apparatus is erected. In the form of our invention herein illustrated, the outer shell 2 is supported by posts or legs 7, each of which is provided with a plurality of branched or laterally flared brackets 8 that spread the load over a large area of the shell surface, thus reducing the concentration of load entering the shell, the brackets 8 being attached to a reinforcing plate 9, which is welded to the exterior of the shell, as shown in Figure 3. Preferably, said supporting posts or legs are attached to the outer shell at a point adjacent to but below the horizontal equator of said shell. If desired, inclined bracing rods 10 may be combined with the supporting posts 7, so as to resist lateral wind forces.

In an apparatus of the construction above described, no appreciable inward or outward forces are induced in the shells. The small amount of inward push on the inner shell and outward push on the outer shell, due to the slope of the rocker plates 3, will add small stresses to the shells, which can be easily resisted. It is also to be noted that the rocker plates 3 are preferably arranged in groups, in the area where the supporting post or legs 7 are attached to the outer shell, this arrangement being desirable, as it helps to transfer the load directly to said posts.

In building the above described apparatus, the preferred procedure is to erect the lower half of the outer shell on the supporting posts 7 and complete the welds or seams between the plates of which it is constructed, so as to produce a liquid-tight, hemispherical-shaped member having an annular ring or abutment member 5 on the inner surface of same at or adjacent its top edge. The inner shell is then erected on temporary supports sustained by the lower half of the outer shell, and during the operation of fabricating the inner shell, water is introduced into the lower half of the outer shell, so as to float or sustain the inner shell and enable it to be rotated or turned upside down, into the position most favorable for producing gas and liquid-tight joints between the plates from which the inner shell is constructed. In the case of a welded, spherical shell, all the welding can be done in a down hand position from both sides of the plates, by simply rotating or turning said shell relatively to the stationary lower half of the outer shell containing the water on which the inner shell is floating. In fabricating the inner shell, the top sides of all seams are welded to produce water-tight joints between the plates, and thereafter said inner shell is rotated so that the opposite sides of the seams are now on the top side, thereby enabling said seams to be welded in a down-hand position. When floating, the inner shell, it can be floated six or seven feet above its normal position, so that any projections thereon, such, for example, as manholes, will easily clear the outer shell, even though the normal space between the shells is only two inches, which is too small to provide sufficient clearance to enable the inner shell to be rotated relatively to the outer shell. After the inner shell is completely welded, it can be floated to correct position relatively to the outer shell, by simply lowering the water in the outer shell to the proper level. The rocker plates 3 are then set in proper position on the abutment member 5 on the outer shell, and the abutment bars 4 are welded to the exterior of the inner shell, but at this time the weight or load of the inner shell is not imposed on the rocker plates. After all the rocker plates 3 are in place, the liquid is withdrawn from the lower half of the outer shell, thereby causing the abutment bars 4 on the inner shell to come into contact with the rocker plates 3, and cause each rocker plate to have an equal bearing, inasmuch as the inner shell was not distorted in any way when said rocker plates were installed. Preferably, an individual abutment bar 4 is provided for each rocker plate 3, so as to insure that each of the radially-movable supporting elements 3 for the inner shell will accurately fit or properly engage the laterally-projecting abutment piece 4 on the shell with which it co-acts. After the inner shell has been completed, the top half of the outer shell is erected and joined to the lower half of the outer shell, thereby producing a structure composed of a gas-tight inner shell, a gas-tight outer shell surrounding said inner shell and separated from same by a gas or vapor space, and radially-movable supporting elements (the rocker plates 3) interposed between said shells and co-acting with abutment members on the exterior of the inner shell and on the interior of the outer shell, to transfer the weight or load of the inner shell to the outer shell in such a manner as to effectively prevent differential expansion and contraction, due to temperature changes and differential pressure on each shell, from causing the shells to be subjected to abnormal or dangerous stresses.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:

1. A fluid storage apparatus, comprising two shells arranged one within the other in spaced relationship, an abutment means projecting laterally from the exterior of the inner shell, an abutment means projecting laterally from the interior of the outer shell, said abutment means being in vertical, spaced relation with respect to each other, and radially-movable, stiff, plate-like supporting devices in unattached, rockable engagement with the lower abutment means on one of said shells and with the upper abutment means on said other shell.

2. An apparatus of the kind described in claim 1, in which said radially-movable, plate-like supporting devices are of rectangular shape and of a width sufficient to prevent them from tilting laterally relatively to their radial direction of movement.

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