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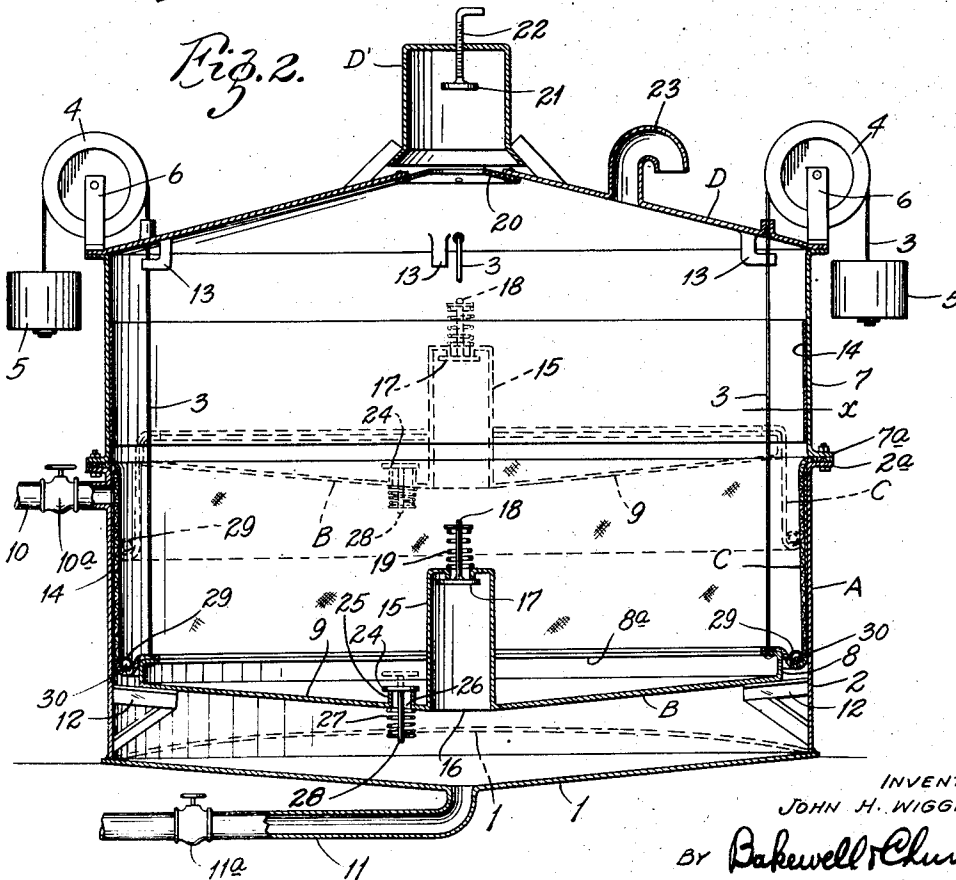
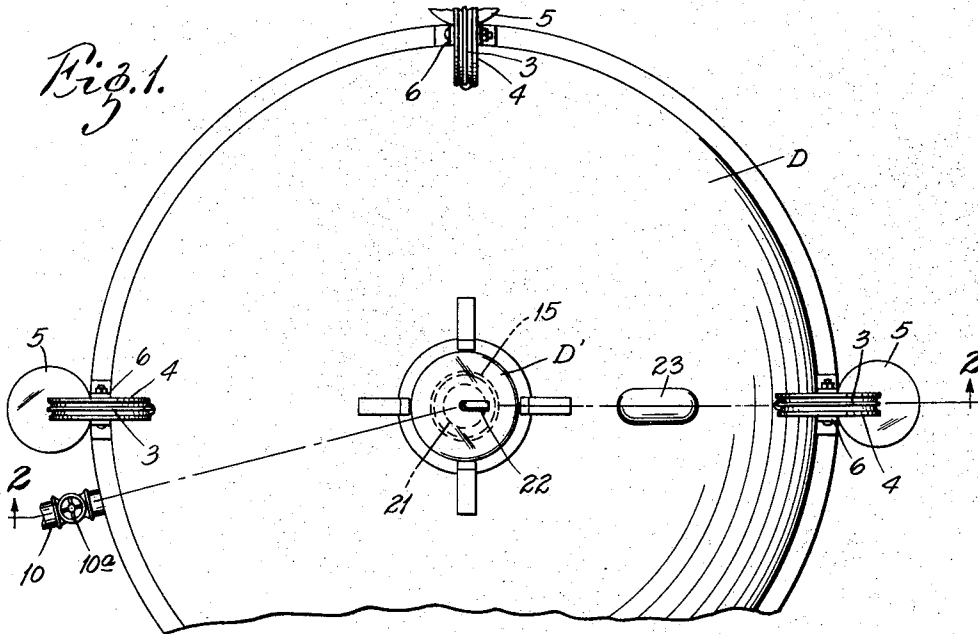
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GAS AND LIQUID STORAGE DEVICE

Filed April 18, 1935

2 Sheets-Sheet 1



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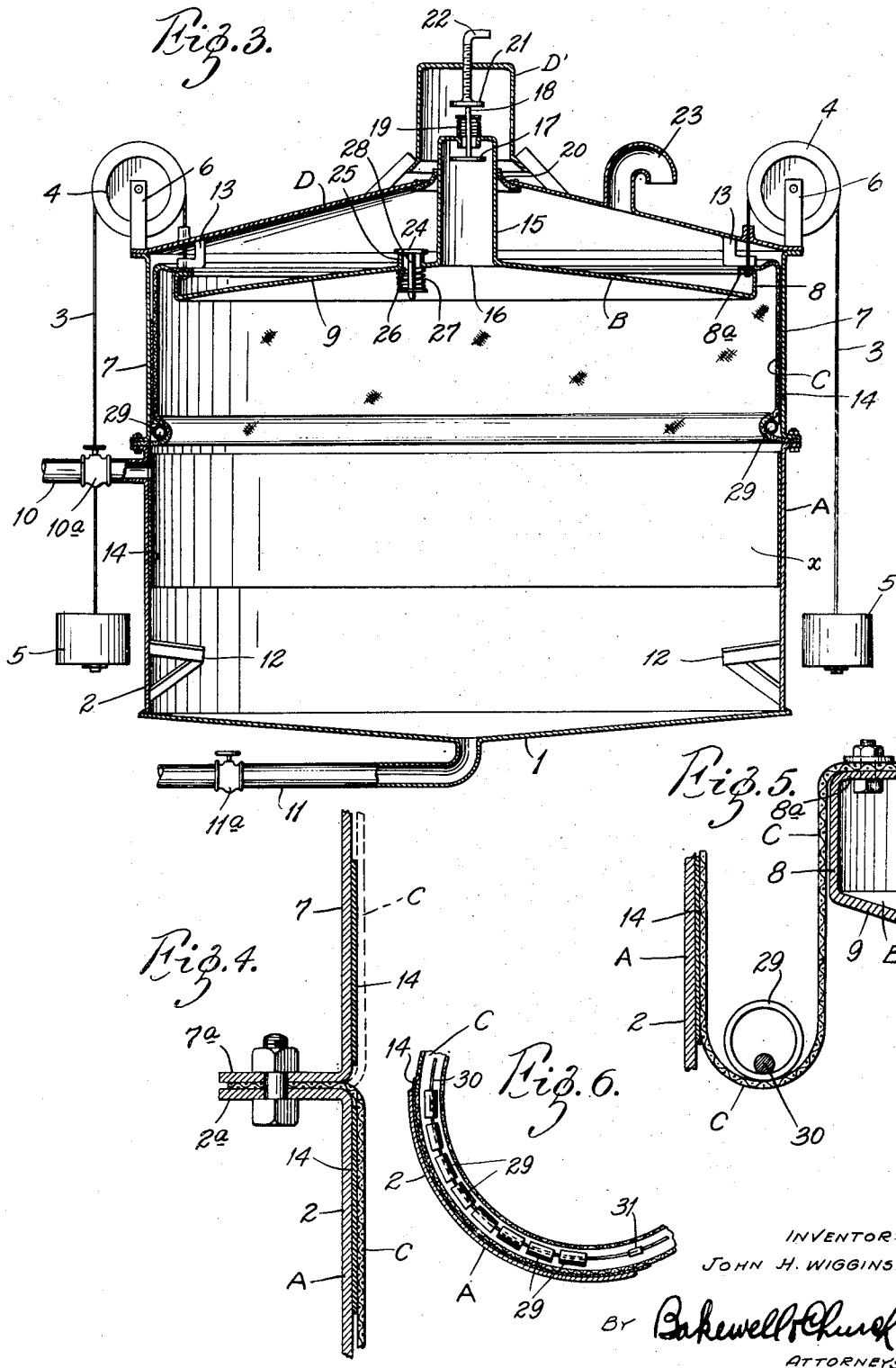
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UNITED STATES PATENT OFFICE

2,050,686

GAS AND LIQUID STORAGE DEVICE

John H. Wiggins, Tulsa, Okla.

Application April 18, 1935, Serial No. 16,995

24 Claims. (Cl. 220—1)

This invention relates to devices for storing gases and volatile liquids, and particularly, gas and/or liquid storage devices of the type in which the gas receiving space or chamber is formed by a container having a side wall, a vertically-movable member in said container that forms the top wall of said chamber, and a sealing element of gas-tight fabric or other suitable flexible or pliable, non-metallic material attached to said side wall and to the peripheral edge of said vertically-movable top wall.

One object of my present invention is to provide a gas or liquid storage device of the general type mentioned, in which the flexing, bending or movement of the sealing element is controlled in a novel manner that materially prolongs the life or period of usefulness of said element.

Another object is to provide a gas or liquid storage device of the general type mentioned, which is of such design or construction that it is practicable to operate the device at practically zero pressure, thereby eliminating strains on the sealing element and making it possible to keep the device in a gas-tight condition, with minimum trouble and expense.

Another object is to provide a storage device that embodies the good features and desirable characteristics of the device described in my pending application for Patent Serial No. 16,994, filed April 18, 1935, but which comprises parts of different construction and arrangement than the parts of the device described in said pending application.

And still another object of my invention is to provide a novel mechanism for venting the gas chamber of a storage device that comprises a weather roof or shield arranged over a vertically-movable member that forms the top wall of the gas chamber. Other objects and desirable features of my invention will be hereinafter pointed out.

The device that forms the subject-matter of my present application is adapted to be used either for storing gases, or for storing gases and also volatile liquids. It is provided with a storage chamber that comprises a stationarily mounted lower portion or member consisting of a tank or container provided with a vertical side wall, and a vertically-movable upper portion or member, constituting the top wall of the storage chamber and made of such diameter that it is telescoped or surrounded by the side wall of said tank when said upper member is in its extreme lower position. Preferably, said vertically-movable upper member is constructed in the form of a so-called "floating deck or roof" of the

general kind used extensively in oil storage tanks, so that when the device is used for holding a volatile liquid, said deck or roof will float upon the surface of the liquid confined in the tank which constitutes the lower portion of the device. The space between the side wall of said tank and the peripheral edge of the vertically-movable member of the device is sealed by an annular-shaped element made of gas-tight fabric or other suitable flexible, non-metallic material, attached to said side wall and vertically-movable member in such a way that when the storage chamber is empty, said element will, in effect, be suspended from said side wall, when said chamber is full of gases, said sealing element will be suspended from the peripheral edge of said vertically-movable member, and when said vertically-movable member moves upwardly, during the operation of admitting gases to the storage chamber, said sealing element will double, fold or assume a loop form. In order that the sealing element will not wear out quickly, due to excessive bending or movement, or to strains exerted on same, I construct the device so that when gases are being admitted to the storage chamber, the sealing element will hang downwardly in a substantially flabby condition, and will have no tendency to flex upwardly into a position above the top wall of said chamber. This highly desirable result is attained by employing a means, separate and distinct from the internal pressure of the storage chamber, to cause or assist the top wall of said chamber to move upwardly during the admission of gases to said chamber, the said means preferably consisting of a counterweighting mechanism attached to the vertically-movable top wall of the storage chamber and arranged so that it also tends to hold said vertically-movable top wall in approximately concentric relation with the side wall of the storage chamber. In the particular form of my invention herein illustrated a stationary weather roof or shield is provided for preventing rain, snow and the like from collecting on the sealing element and on the vertically-movable member that constitutes the top wall of the gas storage chamber.

Figure 1 of the drawings is a fragmentary top plan view of a gas and/or liquid storage device constructed in accordance with my present invention.

Figure 2 is a transverse sectional view of said device, showing the vertically-movable upper member in its extreme lower position.

Figure 3 is a view similar to Figure 2, showing

said vertically-movable upper member in its extreme upper position.

Figure 4 is a detail sectional view, illustrating the preferred arrangement of the insulating material that is used to prevent the sealing element from sticking to or freezing on the metal parts of the device which back up said sealing element and protect it against injurious strains.

Figure 5 is a detail vertical sectional view, illustrating the principle of operation of the means that is used to control the flexing or bending of the sealing element; and

Figure 6 is a fragmentary horizontal sectional view, illustrating the construction of said means.

In the accompanying drawings which illustrate my present invention, A designates as an entirety a stationary metal tank that forms the lower portion of the storage space or chamber x of the device, B designates as an entirety a vertically-movable member that forms the roof or top wall of said chamber, and C designates a flexible or pliable, non-metallic, gas-tight sealing element of annular shape, that joins or connects said members A and B and cooperates with the same to form a storage chamber whose volume will change as the member B rises and falls or moves vertically relatively to the stationary lower portion A of the device. The vertically-movable upper member B is of less diameter than the tank A, so that said upper member can move downwardly in said tank into close proximity to the bottom 1 of same, as shown in Figure 2, thus forming a storage chamber of relatively small volume, and said upper member B is so constructed and arranged that it can move upwardly, as shown in Figure 3, into a position considerably above the top edge of the side wall 2 of the tank A, so as to form a storage chamber of relatively great volume. In order that the member B will move upwardly at substantially zero internal pressure of the gas storage chamber during the admission of gases to said chamber, the member B is suspended from four counterweighted cables 3 that travel over sheaves 4, said cables having attached thereto counterweights 5 which are constructed so as to equal or be slightly greater than the dead weight of the member B and the parts carried by same. The sheaves 4 may be mounted in any suitable way, as, for example, on brackets 6 carried by a weather roof or shield D, which, in turn, is supported by a cylindrical shell 7 attached to and projecting upwardly from the top edge of the side wall 2 of the tank A, said weather roof being provided with rain-proof runways or openings through which the cables 3 pass. The side wall 2 of the tank A is gas-tight, and the gas-tight sealing element C is connected by gas-tight joints to said side wall and to the peripheral edge portion of the vertically-movable member B. In the device herein illustrated one edge of the sealing element C is clamped between outwardly-projecting flanges 2^a and 7^a on the side wall of the tank and on the shell 7, respectively, and the other edge of said sealing element is clamped to the top side of the peripheral edge portion of the vertically-movable member B. The cylindrical shell 7 and the weather roof D sustained by said shell do not have to be gas-tight, due, of course, to the fact that when the member B is in its extreme upper position, as shown in Figure 3, the upper portion of the storage space is formed by the member B and the seal C. At such times the shell 7 acts as a backing or abutment surface for the sealing element C which effec-

tively protects said element from strains that tend to tear or disrupt the same, when the internal pressure is plus, and when the vertically-movable member B is in its extreme lower position, the side wall 2 of the tank acts as a backing or abutment surface for the sealing element, when the internal pressure is minus.

In order that the device may be used for holding volatile liquids, or volatile liquids and gases, the vertically-movable member B is constructed so that it is capable of floating on liquid in the tank A, thus forming what is commonly referred to as a "floating deck or roof", said member B being provided at its peripheral edge with an upwardly-projecting rim 8 of sufficient height or depth to prevent the liquid from overflowing onto the top side of the roof or deck. In accordance with usual practice, the rim 8 is reinforced and strengthened in any suitable way, as, for example, by forming a horizontally-disposed flange 8^a on same. Preferably, the floating deck or vertically-movable member B is composed of or formed by a limber metal diaphragm 9 that is capable of flexing upwardly and downwardly so as to vary the volume of the storage chamber x , and thus produce a "breather type" roof for the storage chamber. Under certain conditions, the top diaphragm 9 is flexed downwardly, as shown in Figure 2, and under other conditions, said diaphragm is flexed upwardly, as shown in Figure 3. The bottom 1 of the tank A may either be rigid or flexible, depending upon whether the device is to be used as a gas holder or as a combined gas and liquid holder. When the device is intended to be used either as a gas holder or as a combined gas and liquid holder, I prefer to form the bottom 1 of the tank A from a limber metal diaphragm that is normally flexed downwardly, as shown in solid lines in Figure 2, but which is capable of flexing upwardly, as shown in broken lines, in the event a minus pressure or vacuum is created in the storage chamber of the device during the operation of withdrawing the gases from the same.

A combined gas inlet and discharge pipe 10 is attached to the side wall 2 of the tank A adjacent the upper end of said side wall, and a combined liquid supply and discharge pipe 11 is attached to the bottom 1 of the tank A, said pipes being provided with control valves 10^a and 11^a. Supporting devices 12 are arranged inside of the tank A, adjacent the bottom of same, so as to sustain the vertically-movable member B when said member is in its extreme lower position, and the weather roof D is provided on its underside with depending stops 13 that limit or arrest the upward movement of the member B. Insulating material 14 of the kind described in my pending application for patent previously referred to, is provided for preventing the sealing element C from sticking to or freezing on metal parts of the device that serve as backing members for said sealing element. In the device herein illustrated insulating material is applied to more or less of the inner surfaces of the shell 7 and the side wall 2 of the tank, as shown in Figure 4.

A venting mechanism is provided for venting the storage chamber x to relieve an abnormal pressure therein when the member B is in its extreme upper position, and also to admit air to said chamber to relieve a dangerous vacuum or minus pressure in said chamber when the member B is in its extreme lower position. The venting mechanism herein illustrated is novel, in that it is

constructed in such a manner that the gases released from the storage chamber to relieve the internal pressure of said chamber or reduce the volume of the gases confined in said chamber, will escape to the atmosphere without danger of collecting in the space between the vertical member B and the weather roof D, and thus producing a combustible mixture that might explode. Thus, as shown in Figures 2 and 3, the member B is provided, preferably at the center of said member, with an upwardly-projecting neck or tubular device 15 that surrounds a vent opening 16 in the diaphragm 9, and which is provided at its upper end with a vent valve 17 disposed so that it will be held seated by the internal pressure of the storage chamber *x*, said valve having an upwardly-projecting stem 18 on which a spring 19 exerts pressure in a direction tending to hold said valve closed. The weather roof D is provided at its center with an opening up through which the tubular valve carrying neck 15 projects when the member B is in its extreme upper position, and said opening is surrounded by a flexible sealing device 20 disposed so as to contact with or wipe upon the outer surface of said device 15, and thus produce a tight joint between said device and the weather roof up through which the device 15 projects. The center opening in the weather roof is normally shielded or protected by a canopy D', and a tripping device 21 is mounted in said canopy in such a position that it will be engaged by the stem 18 on the vent valve 17, when the member B is in its extreme upper position, providing said member B is flexed upwardly by an abnormal pressure created in the storage chamber, thereby causing the valve 17 to open and vent said chamber, after which the member B will move downwardly sufficiently to permit said valve to close. The tripping device 21 is herein illustrated as being carried by a screw-threaded adjusting device 22 on the canopy D', that can be manipulated to raise or lower the tripping device, and thus accurately control the unseating and seating of the vent valve 17. The lower end of the canopy D' is maintained in spaced relationship with the top side of the weather roof D, so that the gases which enter the canopy from the tubular valve-carrying device 15, can escape freely to the atmosphere. If desired, the roof D may be provided with a stationary, weather-proof vent 23. The venting mechanism also comprises a vacuum relief valve 24 arranged so as to seat against the top edge of an annular valve seat 25 on the top side of the vertically-movable member B, that surrounds an air inlet 26 in said member, said vacuum valve being normally held seated by a spring 27 and being provided with a depending stem 28. When the storage chamber is under a positive pressure, the valve 24 remains closed, but if a vacuum is created in said chamber when the member B is in its extreme lower position shown in Figure 2, as, for example, during the operation of withdrawing gases from the storage chamber, the bottom 1 of the tank A will flex upwardly, as shown in broken lines in Figure 2, and exert an upward force or thrust on the valve stem 28, thus causing the valve 24 to open and admit air to the storage chamber before the vacuum in said chamber becomes great enough to strain the walls of said chamber.

The weight of the fabric or other material from which the sealing element C is constructed, tends to hold said sealing element in approximately parallel relation with the side wall 2 of the tank A when the member B is in its extreme

lower position, and also tends to cause said sealing element to fold or double intermediate its edges when the member B moves upwardly, as indicated in broken lines in Figure 2. However, in order to insure proper flexing or bending of the sealing element C and prevent the doubled or overlapping portions of said sealing element from rubbing against each other during the rise and fall of the member B, I prefer to arrange a circular row of weights 29 in the looped portion of the sealing element C that surrounds the peripheral edge of the vertically-movable member B, so that when said member B is moving vertically in the zone of the side wall 2 of the tank, the downward force which the weights 29 exert on the sealing element will insure proper folding or unfolding of the sealing element C, as the member B rises and falls. Bearing in mind that the member B is counterweighted, it will be obvious that when said member B moves upwardly from the position shown in full lines in Figure 2, the sealing element C will naturally fold or double to form a loop whose outer portion hangs downwardly in a substantially flabby condition, from the top edge of the side wall 2 of the tank and whose inner portion hangs downwardly from the peripheral edge of the member B, the weights 29 always remaining at the lower, closed end of the loop, and thus tending to prevent the two parallel portions of the loop from rubbing against each other, as well as tending to hold the sealing element in a downwardly hanging position, even though there be a very slight pressure in the storage chamber. The weights 29 are of such form, that they will roll on the sealing element as said element changes its position during the rise and fall of the vertically-movable member B, and in practice I prefer to form the roller weights 29 from short pieces of metal pipe that are strung upon an annular-shaped rod 30 equipped preferably with an adjustable coupling device 31 that can be adjusted to vary the diameter of the ring-shaped carrier or supporting member for the weights 29.

When the device is used for storing gases, the member B will occupy its extreme lower position with the diaphragm 9 of said member flexed downwardly, when the storage chamber *x* is empty. As previously stated, the counterweighting mechanism is so designed as to equal or be slightly greater than all of the dead weight of the vertically-movable member B and its attachments. Therefore, when gas is admitted to the device through the pipe 10, the member B starts to rise, but the diaphragm 9 of said member will remain in its downwardly flexed position. At such times there is not enough pressure on the sealing element C to draw said sealing element inwardly, or cause it to wrinkle, and consequently, the sealing element C simply hangs in a more or less flabby condition. As the gases continue to flow into the storage chamber, the member B continues to rise, and as said member moves upwardly, it takes up more and more of the sealing element C, with the result that the weight of said sealing element acts as a balancing means to keep the member B in a substantially level position. As the member B rises nearly to its maximum height, the only increase in internal pressure of the storage chamber, is that required to lift the weight of the sealing element C, which internal pressure is practically nothing. When the member B reaches its extreme upper position, the rim 8 at the peripheral edge of said member comes into engagement with the stops

13, thereby causing the upward movement of the member B to be arrested, whereupon the internal pressure of the storage chamber increases, thus causing the sealing element C to be forced outwardly against the inner face of the side wall of the shell 7. The upward movement of the member B causes the valve carrying neck 15 on said member to project upwardly into the hood D' carried by the weather roof D, and hence, if the internal pressure of the storage chamber becomes great enough to cause the diaphragm 9 of the member B to flex upwardly, as shown in Figure 3, the stem 18 of the vent valve 17 will strike against the tripping device 21, with the result that the valve 17 will open and vent the storage chamber. The gases which escape from the storage chamber when the valve 17 opens immediately pass to the atmosphere without liability of collecting in the space between the member B and the stationary weather roof, because said space is effectively sealed or cut off from the interior of the hood D' by the sealing device 20 that wipes against the outer surface of the valve carrying neck 15 on the member B. This is a very desirable feature or characteristic of my improved storage device, as it eliminates the possibility of an explosive mixture accumulating under the stationary weather roof of the device. As soon as the internal pressure of the storage chamber is relieved, the diaphragm 9 will flex downwardly sufficiently to permit the valve 17 to close, and in the operation of withdrawing gases from the storage chamber, the member B moves downwardly. In the event a vacuum or minus pressure is created in the storage chamber when the member B is in its extreme lower position shown in full lines in Figure 2, the bottom 1 of said chamber will flex upwardly into the position shown in broken lines in Figure 2, and in so doing, will engage the stem 28 of the valve 24 and move said valve upwardly off its seat, thus permitting sufficient air to enter the storage chamber to relieve the vacuum. From the foregoing it will be seen that in my improved storage device the sealing element C is never subjected to strains or pressure tending to disrupt the same or set up tension in said element, because an outward thrust exerted on the sealing element C when the member B is in its extreme elevated position is effectively taken up or absorbed by the shell 7 that acts as a backing for the sealing element. Similarly, if a vacuum or minus pressure is created in the storage chamber when the member B is in its extreme lower position, the side wall 2 of the tank A acts as a backing or abutment surface to protect the sealing element C against strains tending to tear or disrupt same. During the rise and fall of the member B the sealing element C will fold or unfold in an orderly manner, and the roller weights 29 that are positioned in the loop of said element exert a sufficient downward pull on said sealing element to prevent the doubled portions of said element from rubbing on each other or against the tank side wall 2 or shell 7 over which the sealing element travels when the member B rises and falls. The cables 3 and counterweights 5, in addition to assisting the vertical movement of the member B, also tend to hold said member in approximately concentric relationship with the tank A, for if the member B attempts to move sideways, a horizontal component is set up in the cables 3 directed towards the center of the member B in such a way as to cause it to return to its central position.

If a liquid is to be stored in the device, the liquid is admitted to the tank A through the pipe 11, the liquid being pumped into the tank until the maximum height of the liquid is just below the gas pipe 10, the member B floating upon the surface of the liquid and rising and falling in the tank A as the level of the liquid varies. If gases are to be stored, the gases are admitted through the pipe 10, thus causing the member B and the parts associated with same to function in the manner previously described. While the device herein illustrated is similar to the device described in my pending application for patent previously referred to, in that it comprises an abutment surface for backing up and protecting the sealing element against strains tending to tear or disrupt the same when the vertically-movable top wall of the gas storage chamber is in its extreme elevated position, my present device operates on a different principle, inasmuch as it is equipped with a means separate and distinct from the internal pressure of the gas storage chamber to cause or assist the member B to move upwardly during the admission of the gases. Several desirable results are attained by constructing the device in this manner, i. e., it is not necessary to equip the member B with a relatively high or deep rim 8 for backing up the sealing element and protecting it against strains when the member B is in its extreme lowermost position and during the first portion of the upward movement of said member, thereby reducing the quantity of metal in the device and cutting down the overall height of the device; and the device can be operated so that the gas storage chamber is under a slight vacuum most of the time, thereby materially reducing the trouble and expense of keeping the device in a gas-tight condition, due to the fact that if shellac or a similar substance is applied to the outer surface of the walls of the storage chamber, any leaks that develop in said walls will automatically be sealed by the natural tendency of the shellac or other material to fill said leaks, due to the minus pressure in the storage chamber. While the device is intended to operate at practically zero pressure, during the operation of admitting gases to the storage chamber, nevertheless it is of such construction that even if a relatively high or great positive pressure is created in the storage chamber when the member B is in its extreme elevated position, no dangerous or destructive strain will be exerted on the sealing element, due to the fact that at such times the shell 7 acts as a backing member or abutment surface for the sealing element which prevents said element from flexing outwardly.

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

1. A storage device, comprising a container, a vertically-movable member in said container that forms the top wall of a storage chamber, a non-metallic, flexible sealing element attached to said vertically-movable member and to the side wall of said chamber, and means for folding said sealing element into a loop which depends from said top wall during the operation of filling and emptying said chamber.

2. A storage device, comprising a container, a vertically-movable member in said container that forms the top wall of a gas storage chamber, a non-metallic flexible sealing element attached to said vertically-movable member and to the side wall of said chamber and disposed so that when the chamber is empty said sealing element will

hang downwardly from said side wall and when said top wall moves upwardly said sealing element tends to fold or double, and means for insuring proper folding or doubling of said sealing element.

3. A storage device, comprising a container, a vertically-movable member in said container that forms the top wall of a storage chamber, a flexible, non-metallic element for sealing said chamber, attached to the side wall of said container and to the peripheral edge of said top wall, and means for folding said sealing element and causing it to be maintained in a suspended condition, hanging downwardly from one or the other of the parts to which it is attached during the operation of filling the storage chamber.

4. A storage device, comprising a container having an upright side wall, a vertically-movable member in said container that forms the top wall of a gas storage chamber, a non-metallic, flexible sealing element attached to the peripheral edge of said vertically-movable member and to the lower edge of the side wall of said container and disposed so as to hang downwardly below the lower edge of said side wall when the chamber is empty and hang downwardly from the edge of said vertically-movable member when the chamber is full of gases, and a weight combined with said sealing element so as to insure said element assuming the form of a downwardly-disposed loop, as distinguished from an upwardly-projecting loop, when the level or horizontal position of said vertically-movable member is such that said sealing element tends to double or form a loop.

5. A storage device of the kind described in claim 2, in which said vertically-movable member comprises a metallic portion that is capable of flexing to vary the volume of the storage chamber.

6. A storage device of the kind described in claim 2, in which the portions of the device that constitute the top and bottom of the storage chamber are formed of metal and are capable of flexing so as to permit said chamber to "breathe".

7. A storage device of the kind described in claim 2, in which the vertically-movable member is constructed in the form of a "floating roof" that is capable of floating on liquid confined in said container.

8. A storage device of the kind described in claim 2, in which the vertically-movable member is constructed in the form of a breather type floating roof that is adapted to rest and float upon liquid confined in said container.

9. A storage device of the kind described in claim 2, in which the bottom of said container is formed by a limber metal diaphragm and the vertically-movable member is composed principally of a limber metal diaphragm, both of which diaphragms are adapted to "breathe" in the normal operation of the device.

10. A storage device of the kind described in claim 2, comprising counterweighting mechanism attached to the peripheral edge of said vertically-movable member and disposed so as to tend to hold said member centered with relation to the side wall of said container.

11. A storage device of the kind described in claim 2, equipped with sheaves supported in an elevated position, cables attached to the peripheral edge of said vertically-movable member and leading upwardly from same over said sheaves, and counterweights attached to said cables and proportioned so as to equal or be slightly greater

than all of the dead weight of said vertically-movable member.

12. A storage device, comprising a stationary tank or container having an upright side wall that forms part of the storage chamber of the device, a stationary weather roof or shield arranged above said tank, a vertically-movable member that forms the top wall of the storage chamber, a gas-tight sealing element of fabric or the like attached to said vertically-movable member and to the side wall of said tank, and means separate and distinct from the sealing element for preventing said sealing element from being subjected to forces or pressures tending to strain the same when the device is functioning.

13. A storage device, comprising a stationary tank or container provided with a gas and liquid tight side wall that forms part of the storage chamber of the device, a stationary weather roof or shield, a vertically-movable member that forms the top wall of the storage chamber, a sealing element of gas-tight fabric or the like attached to said vertically-movable member and to said side wall and disposed so that said side wall will back up said sealing element and prevent it from flexing in one direction, in certain positions of said vertically-movable member, and an independent backing for said sealing element when said vertically-movable member is in its extreme elevated position.

14. A storage device of the kind described in claim 13, provided with means for preventing a dangerous positive pressure or a dangerous minus pressure from being created in the storage chamber of the device.

15. A storage device, comprising a tank or container having a gas and liquid-tight side wall, a weather roof or shield, a floating roof in said tank adapted to be sustained either by liquid confined in said tank or gases confined under said floating roof, a sealing element of gas-tight fabric or the like attached to said tank side wall and to the peripheral edge of said floating roof, a counterweighting mechanism for said floating roof constructed so as to tend to hold said floating roof centered with relation to said tank when said floating roof is supported by gases to a point considerably above the side wall of the tank, and a backing member for the sealing element arranged between said weather roof and tank side wall and disposed so as to prevent said sealing element from flexing outwardly with relation to the side wall of the tank when the floating roof is in its extreme upper position.

16. A storage device, comprising a stationary tank or container provided with an upright side wall, a vertically-movable member in said tank that forms the top wall of the storage space, an annular-shaped sealing element of gas-tight fabric or the like, attached to said tank side wall and to said vertically-movable member and adapted to fold and unfold as said vertically-movable member rises and falls, and weights combined with said sealing element and disposed so as to tend to maintain said sealing element in a downwardly-disposed condition, even when the storage space is under a slight positive pressure.

17. A storage device, comprising a stationary tank or container provided with an upright side wall, a vertically-movable member in said tank that forms the top wall of the storage space, an annular-shaped sealing element of gas-tight fabric or the like, attached to said tank side wall and to said vertically-movable member and adapted to fold and unfold as said vertically-

movable member rises and falls, and a means combined with said sealing element for controlling the bending and flexing of same and for imposing a load on said vertically-movable member tending to maintain it in a balanced condition when said member moves upwardly under the influence of gases confined on the underside of same.

18. A storage device, comprising a stationary tank or container provided with an upright side wall that forms part of the storage space of the device, a vertically-movable member in said tank that forms the top wall of the storage space, an annular-shaped sealing element of gas-tight fabric or the like, attached to said tank side wall and to said vertically-movable member and adapted to assume the form of a loop which folds and unfolds as said vertically-movable member rises and falls, and a circular row of weights mounted in the looped portion of said sealing element.

19. A storage device, provided with a vertically-movable member that forms the top wall of a gas and liquid tight storage chamber, said member being adapted to rise and fall so as to vary the volume of said chamber, a stationary weather roof or shield arranged over said vertically-movable member, a vent valve for said chamber, and means on said vertically-movable member for carrying said vent valve and causing the same to be disposed above or on the outside of the weather roof when said valve opens, whereby gases will be permitted to escape from the storage chamber to the atmosphere without liability of collecting in the space between said vertically-movable member and weather roof.

20. A storage device, provided with a vertically-movable member that forms the top wall of the storage chamber of the device and which is adapted to rise and fall so as to vary the volume of said chamber, a stationary weather roof or shield arranged over said vertically-movable member, a vent valve for said chamber, an upwardly-projecting, hollow portion on said vertically-movable member that is adapted to project upwardly through said weather roof when said vertically-movable member is in its extreme upper position, and an automatically operating vent valve in said hollow portion disposed so as to discharge gases at a point outside of said weather roof.

21. A storage device, comprising a stationary tank or container provided with an upright side wall that forms part of the storage chamber of

the device, a flexible metal bottom for said tank, a top wall for said storage chamber formed by a vertically-movable, limber metal diaphragm, a stationary weather roof or shield arranged above said tank, a volume control or pressure relief mechanism operated by the flexing of said top wall for permitting gases to escape from said chamber to the atmosphere without liability of collecting in the space between said top wall and weather roof, and means operated by the flexing of the bottom of said chamber for admitting air to the storage chamber to relieve a vacuum therein.

22. A storage device, comprising a tank provided with an upright side wall, a cylindrical shell mounted on said side wall and projecting upwardly above the same, a stationary weather roof or shield carried by said shell, a vertically-movable member in said shell that forms the top wall of the storage chamber and which is adapted to rise and fall to vary the volume of said chamber, said vertically-movable member being capable of flexing so as to permit said storage chamber to "breathe", an annular-shaped sealing element of gas-tight fabric or the like attached to the tank side wall and to the peripheral edge of said vertically-movable member, roller weights arranged in a looped portion of said sealing element, a positively-operated volume control or pressure relief mechanism for the storage chamber, and a positively operated vacuum relief mechanism for said storage chamber.

23. A storage device, comprising a container, a vertically-movable member in said container that forms one wall of a storage chamber, and a flexible sealing element attached to said vertically-movable member and to the side wall of said chamber, said sealing element being adapted to fold into a loop which depends from said vertically-movable member during the vertical movement of said member.

24. A storage device, comprising a container, a vertically-movable member in said container that forms one wall of a storage chamber, a flexible sealing element attached to said vertically-movable member and to the side wall of said chamber, said sealing element being adapted to fold into a loop which depends from said vertically-movable member during the vertical movement of said member, and means for counterweighting said vertically-movable member, whereby the pressure in the storage chamber will be held at a point at which it will not substantially deform said depending loop.

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