Aug. 11, 1936. J. H. WIGGINS 2,050,405

GAS AND LIQUID STORAGE DEVICE

Filed April 18, 1935 2 Sheets-Sheet 1

Fig. 1.

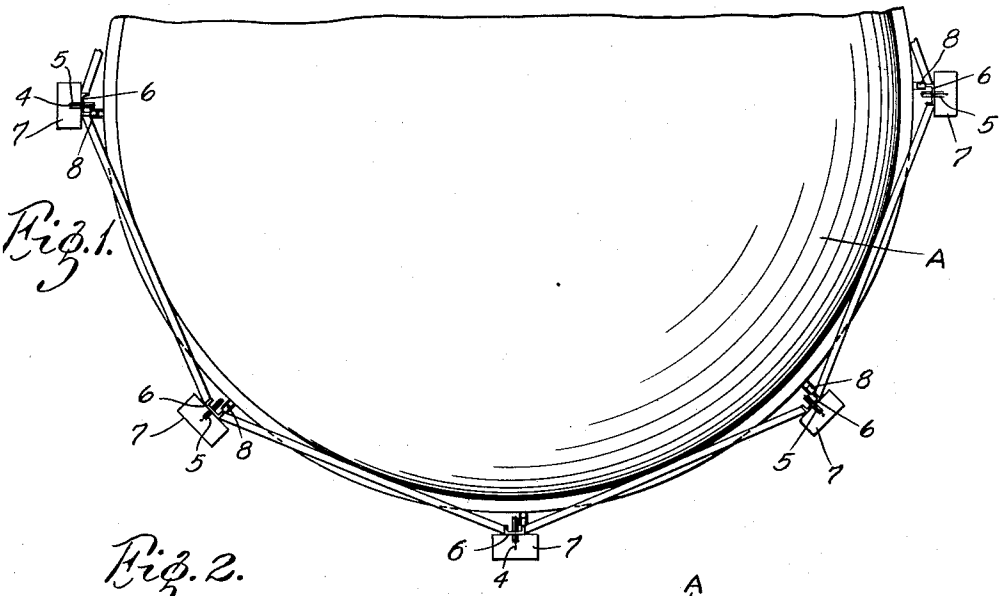


Fig. 2.

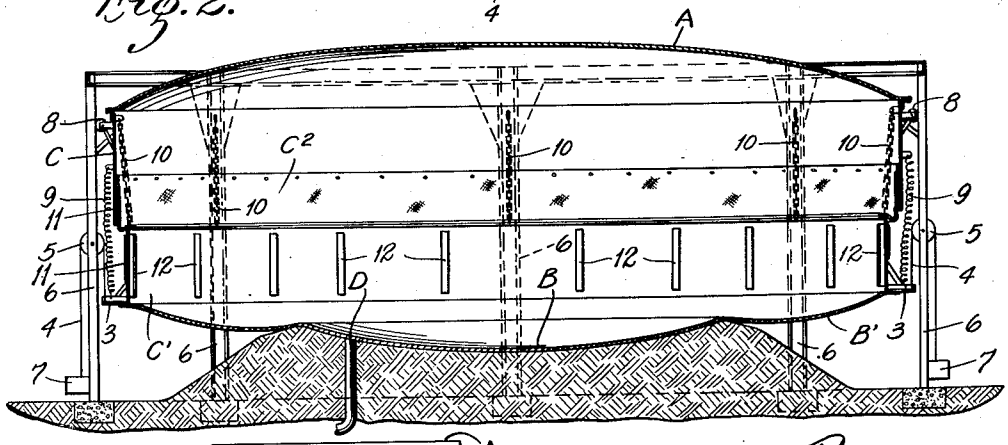


Fig. 6.

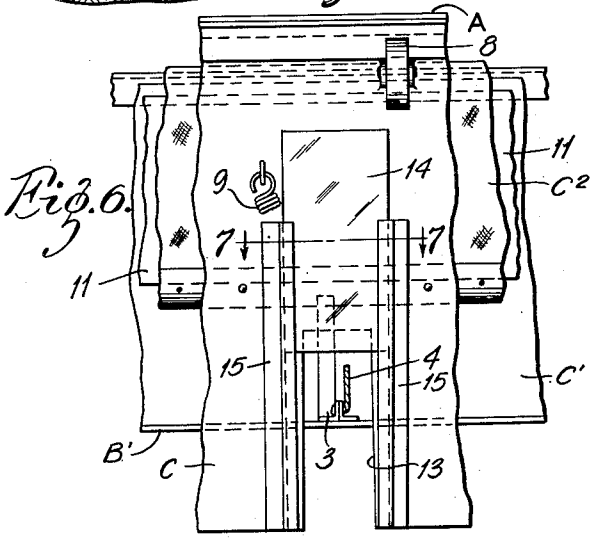


Fig. 7.

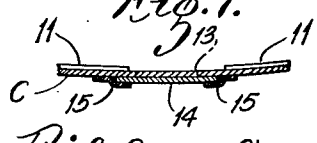
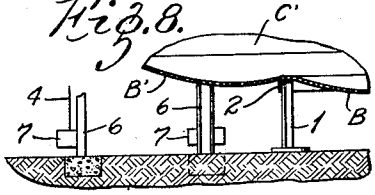


Fig. 8.



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Fig. 3.

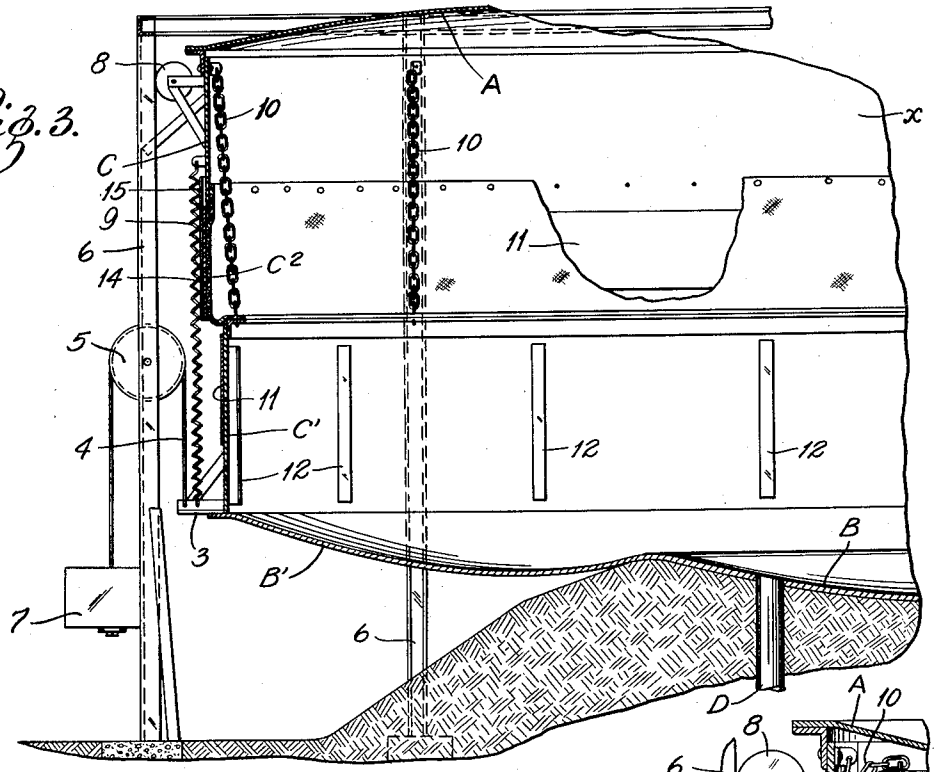


Fig. 4.

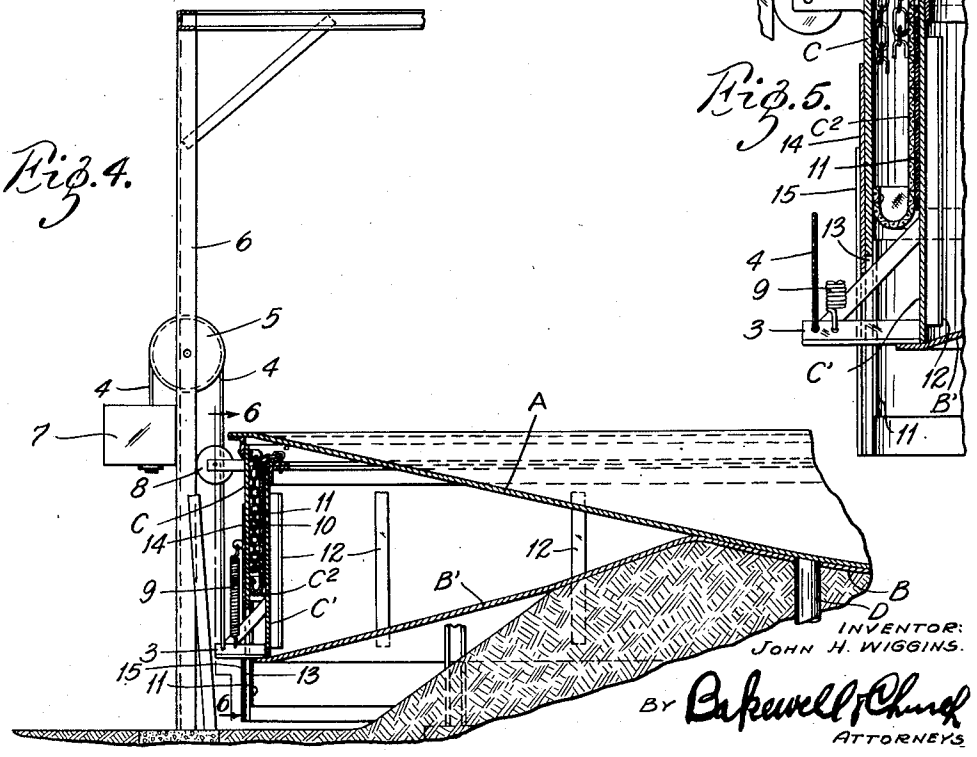


Fig. 5.

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UNITED STATES PATENT OFFICE

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GAS AND LIQUID STORAGE DEVICE

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Application April 18, 1935, Serial No. 16,996

17 Claims. (Cl. 220—1)

This invention relates to gas and liquid storage devices of the general type described in my prior Patents Nos. 1,930,493, 1,930,494, and 1,930,495, dated October 17, 1933, my present invention being an improvement upon storage devices of the particular type in which the gas-receiving space or chamber is provided with a "breather type" top wall or roof that is capable of bodily vertical movement, so as to vary the volume of said chamber.

The main object of my present invention is to materially increase the storage capacity of a gas or liquid holder of the particular type mentioned, without adding greatly to the cost of construction or incorporating features in the construction of the device that might tend to make it less efficient, or which might interfere with the operation of the device.

Another object is to increase the degree of bodily vertical movement of the top wall or upper portion of a storage device of the type mentioned, without increasing the overall height of the storage chamber when it is empty or substantially empty. Other objects and desirable features of my invention will be hereinafter pointed out.

To this end I have devised a gas and/or liquid storage device in which the gas-receiving space or chamber comprises a bottom, a top wall or roof of the breather type that is capable of moving bodily in a vertical direction relatively to at least a portion of the bottom of said chamber, and a collapsible or extensible side wall structure joined or attached to said bottom and to said top wall and adapted to form a relatively high or deep side wall for the gas space or chamber, when said top wall moves upwardly to its extreme upper position. The particular construction of said extensible or collapsible side wall structure is immaterial, so far as my broad idea is concerned, but I prefer to construct it from one or more pairs of annular shells arranged in telescopic relation and combined with a gas-tight sealing element of fabric or other suitable flexible or pliable, non-metallic material, said shells and sealing element being connected with each other and with the top and bottom walls of the gas chamber in such a way that when said top wall rises and falls, due to the admission or withdrawal of the medium confined in said chamber, said shells will telescope or untelescope and said sealing element will maintain a gas-tight joint between said shells. In order to prevent the sealing element from being subjected to forces or pressures tending to strain, tear or disrupt same, means is provided for backing up the sealing element in such a way when the gas chamber is under a positive pressure or a minus pressure, that said element cannot flex or move in a direction or to an extent, sufficient to set up an abnormal tension in said element or cause it to be strained. In addition to being protected against strains tending to tear or disrupt the same, the sealing element is so arranged that it is effectively protected from rain or snow. In the particular form of my invention herein illustrated, which is intended to be used for storing gases, the peripheral portion of the bottom of the gas space or chamber is so constructed that it can move vertically, thus increasing or decreasing the volume of the gas chamber by varying the distance between the top wall and the stationary central portion of the bottom of said chamber, and counterweights or an equivalent means are provided for assisting the vertical movement of the peripheral portion of the bottom of the gas chamber.

Figure 1 is a top plan view of a gas holder embodying my present invention.

Figure 2 is a vertical transverse sectional view of the device shown in Figure 1.

Figure 3 is an enlarged fragmentary vertical transverse sectional view, with the parts of the device in the positions they assume when the storage chamber is full of gases.

Figure 4 is a view similar to Figure 3, illustrating the parts of the device in the positions they assume when the storage chamber is empty.

Figure 5 is a fragmentary vertical sectional view slightly enlarged so as to more clearly illustrate the construction and arrangement of the sealing element.

Figure 6 is a view taken on the line 6—6 of Figure 4, looking in the direction indicated by the arrows.

Figure 7 is a sectional view, taken on the line 7—7 of Figure 6, looking in the direction indicated by the arrows; and

Figure 8 is a detail sectional view, illustrating the stationary central portion of the bottom of the storage chamber, mounted on a frame-work or supporting structure, instead of being mounted directly on the ground, as illustrated in the other figures of the drawings.

Many of the features and details of construction of the device herein illustrated are the same as those of the device described in my prior Patent No. 1,930,495, the principal difference between the two devices being that in the device herein illustrated the gas storage space or chamber x is provided with a collapsible or extensible gas-tight side wall that provides for or permits

additional vertical movement of the top wall of the storage chamber relatively to the stationary central portion of the bottom of said chamber. In other words, instead of connecting the flexible peripheral portion of the bottom of the storage chamber and the peripheral edge of the top of said chamber rigidly to each other, or to a cylindrical shell interposed between said parts, I connect the flexible peripheral portion of the bottom of the storage chamber to a telescoped, collapsible or extensible structure that is joined to the peripheral edge of the top wall of the storage chamber, thereby permitting said top wall to move upwardly a distance equal to the rise of the flexible peripheral portion of said bottom, plus the distance said telescoped or collapsible structure can elongate or distend. In this way I materially increase the storage capacity of the device, and I attain this result without adding greatly to the cost of construction, or reducing the efficiency of the device, by equipping the side wall of the storage chamber with a sealing element of gas-tight fabric or similar material so constructed and arranged that it is never placed under abnormal tension or subjected to forces or pressures which tend to strain or disrupt the same. Any suitable or preferred means may be used for handling rain water that falls onto the device and for venting the storage chamber to relieve a dangerous or abnormal positive pressure or minus pressure.

The top wall of the gas storage space or chamber x is formed by a flexible metal diaphragm A, and the bottom B of said chamber is provided with a flexible peripheral portion B' that is capable of assuming a downwardly pitched or downwardly flexed position, as shown in Figure 4, when the storage chamber is empty, or an upwardly flexed position, as shown in Figures 2 and 3, when said chamber is full of gases, the gases being admitted to and withdrawn from the storage chamber through a combined inlet and discharge pipe D attached to the bottom B of the storage chamber at a point some distance inwardly from the peripheral edge of same. The bottom B of the storage chamber may be supported by the ground, as shown in Figure 2, or it may be mounted on a frame-work composed of short uprights 1 that carry an annular-shaped member 2, as shown in Figure 8, this method of supporting the bottom B of the storage chamber being employed in instances where the device is constructed in the form of a relatively small device or device of small storage capacity.

The flexible peripheral portion B' of the bottom of the gas chamber x is so constructed and arranged that it is capable of flexing upwardly and downwardly a certain degree, and it is joined to the peripheral edge of the top wall A of the storage chamber by a telescoped, collapsible or extensible side wall structure made up of two cylindrical metal shells C and C' arranged in telescopic relationship and joined together by a sealing element C^2 made of fabric or other suitable flexible or pliable, non-metallic material treated or constructed so as to render it gas-tight. The shell C, which is attached to the top part A of the storage chamber, is of greater depth or height than the shell C' attached to the flexible bottom part B' of said chamber, and the sealing element C^2 is connected by a gas-tight joint to the inner side of the shell C at a point above the bottom edge of said shell. The other edge of said sealing element laps over and is connected in a gas-tight manner to the upper edge portion of the shell C'. The shells C and C' are of such relative diameter and the sealing element C^2 is arranged in such relationship with said shells, that when the storage chamber x is empty, the top wall A of said chamber will rest upon or be supported by the stationary central portion of the bottom B of said chamber, and the sealing element C will lie between the shells C and C', as shown more clearly in Figure 5. In this position of the sealing element, the shell C' acts as a backing or abutment surface for said sealing element that effectively absorbs any forces or strains exerted on the sealing element in a direction tending to flex or force it inwardly, i. e. towards the shell C'. Similarly, if the sealing element C^2 is subjected to a force (vacuum in the storage chamber) tending to flex or move it in the opposite direction, the shell C will act as a backing or abutment surface to protect the sealing element against strains. When the top wall A of the storage chamber rises or moves upwardly, the sealing element C^2 will be removed progressively or stripped off of the outer face of the shell C' and applied progressively to the inner face of the lower portion of the shell C located below the point at which the sealing element is attached to the shell C. Thus, when the storage chamber is full of gases, as indicated in Figure 3, the lower portion of the shell C surrounds the sealing element and constitutes a backing or abutment surface that prevents the sealing element from being flexed outwardly, and thus strained by the pressure of the gases in the storage chamber.

The vertically-movable peripheral portion of the structure is counterweighted or combined with a means that assists the vertical movement of same, and in the form of my invention herein illustrated the shell C' is provided adjacent its lower end with laterally-projecting brackets 3 to which are attached cables 4 that lead over sheaves 5 mounted on vertically-disposed guides 6, counterweights 7 being suspended from said cables. The vertically-movable top wall A of the storage chamber is held centered with relation to the bottom of said chamber by guide rollers 8 on the exterior of the shell C that travel on the inner sides of the vertical guides 6, and means is provided for maintaining the roof A in a substantially level plane, or for tending to stabilize said roof and maintain it in proper balance, when it is rising and falling, the means herein illustrated for this purpose consisting of contractile springs 9 attached at their lower ends to the laterally-projecting brackets 3 on the shell C' and attached at their upper ends to laterally-projecting brackets on the exterior of the shell C, as shown clearly in Figure 3. Various means may be used to restrict or limit the upward movement of the shell C relatively to the shell C', so as to prevent the sealing element C^2 from being stretched vertically or subjected to strains tending to pull said element away from the shells to which it is attached, but I prefer to employ a limiting means consisting of chains or cables 10 attached to the upper end portions of the shells C and C' and made of such length that they will be stretched taut before the shell C moves upwardly relatively to the shell C', high enough to exert a dangerous or abnormal endwise strain on the sealing element. Owing to the fact that the sealing element C^2 is arranged on the inside of the gas chamber when said chamber is full of gases, and is housed between the shells C and C' when said chamber is empty,

ice or snow cannot collect on the sealing element, and thus interfere with the operation of the device. In order to prevent the sealing element from sticking to or freezing against the metal shells that act as backing members or abutment surfaces for said sealing element, said shells or the sealing element, are faced with insulating material that will prevent dew from collecting on the metal backing members that co-act with the sealing element. In the form of my invention herein illustrated more or less of the outer surface of the shell C' and the inner surface of the shell C are faced with insulating material 11, as illustrated in Figure 5. If desired, the shell C' may be reinforced and strengthened by braces 12 attached to the inner side of said shell. Vertically-disposed slots 13 (see Figure 6) are formed in the lower edge portion of the shell C, so as to form clearance spaces for the laterally-projecting brackets 3 on the shell C' when the shell C moves downwardly into telescoped or nested relationship with the shell C'. In order that the shell C will constitute a substantially continuous backing for the sealing element C^2 when the storage chamber is full of gases, cover plates 14 are provided for the clearance slots 13, said cover plates 14 being slidingly mounted in guideways 15 on the exterior of the shell C, as illustrated in Figures 6 and 7, and made of such weight that gravity tends to hold them in their closed position, said cover plates being moved automatically into their open position when they engage or come into contact with the brackets 3 on the shell C' during the downward movement of the shell C relatively to the shell C'.

In principle of operation the device above described acts in substantially the same manner as the device described in my prior Patent No. 1,930,495, i. e., the flexible peripheral portion B' of the bottom of the gas chamber flexes upwardly and downwardly to vary the distance between the top wall and the stationary central portion B of the bottom of the gas chamber, and the counterweighting mechanism assists the vertical movement of the peripheral portion of the structure. However, in my present device the top wall A of the gas chamber can rise an extra distance, which is substantially twice the vertical depth or height of the sealing element C^2. By attaching said sealing element in the manner herein illustrated and combining it with the telescoped shells C and C', said sealing element really does double duty for vertical movement, since it reaches clear down its vertical length and clear up its vertical length. The down reaching effect is taken care of by part of the shell C attached to the top diaphragm A. Now it will be observed that an internal pressure in the gas chamber will force the sealing element C^2 inwardly against the outer surface of the shell C' in the event a positive pressure is created in the storage chamber when the top diaphragm A is in its extreme lower position. Accordingly, as the shell C' backs up the sealing element and prevents it from being strained, no tension, or at least, no abnormal tension, can be set up in the sealing element. The only place that there can be any tension at all is at the bottom curve of the sealing element when the top diaphragm is in its extreme lower position, which tension will be very slight, due to the small area affected and the shortness of the curve or loop in the fabric or the like from which the element C^2 is constructed. When the top diaphragm A is in its extreme upper position, as shown in Figure 3, the internal pressure of the storage chamber causes the sealing element to be forced outwardly against the shell C and all tension that would naturally be set up in the sealing element is effectively absorbed by the lower portion of the shell C that backs up the sealing element. The sealing element C^2 is so proportioned or designed that when it is not forced outwardly into tight engagement with the shell C, said sealing element has a circumference as great, or slightly greater, than the shell C, so that no tension can ever be set up in the sealing element. As previously explained, the chains or cables 10 eliminate the possibility of tension being set up in the sealing element C^2 when the shell C moves upwardly relatively to the shell C'. Also, as previously explained, the springs 9 maintain the top diaphragm A in a substantially level plane when said top diaphragm moves upwardly.

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

1. A device of the kind described having a storage space or chamber that comprises opposed top and bottom metal walls, said top wall being of the breather type and said bottom wall having a peripheral portion that is capable of flexing upwardly and downwardly as described, and an extensible or collapsible side wall for said chamber joined to said flexible peripheral portion and to the peripheral edge of said top wall.

2. A device of the kind described in claim 1, in which the extensible or collapsible side wall is provided with a gas-tight sealing element of fabric or the like.

3. A device of the kind described in claim 1, in which the extensible or collapsible side wall comprises a gas-tight sealing element of fabric or the like and means for protecting said sealing element against forces which tend to strain or disrupt the same.

4. A device of the kind described in claim 1, in which the extensible or collapsible side wall comprises a plurality of telescopically arranged shells and a sealing element of fabric or the like, so constructed and arranged that said shells constitute backing members for the sealing element which protect it against forces tending to strain or disrupt said sealing element.

5. A device of the kind described having a storage space or chamber that comprises a bottom having a flexible peripheral portion whose shape is adapted to change so as to provide for bodily vertical movement of the top wall of said chamber, relatively to a stationary portion of the bottom of said chamber, and a side wall for said chamber that comprises gas-tight fabric or the like combined with telescopically arranged metal members that absorb forces or pressures exerted on said fabric in a way tending to strain or disrupt the same when a positive pressure or a minus pressure is created in said chamber.

6. A device of the kind described having a storage space or chamber that comprises a metal top wall of the breather type, a bottom for said chamber having a flexible peripheral portion that is adapted to rise and fall to provide for bodily vertical movement of said top wall relatively to a stationary portion of the bottom of said storage space, an extensible or collapsible side wall structure for said storage space, and means for assisting in the upward movement of the flexible

peripheral portion of said bottom and the parts joined to same.

7. A device of the kind described in claim 6, in which said side wall comprises a plurality of telescopically arranged shells combined with a sealing element of fabric or the like, disposed in such relationship with said shells that the shells back up the sealing element and restrict movement of same when said sealing element is flexed laterally by a force created in said chamber.

8. A device of the kind described having a storage space or chamber that comprises a bottom having a flexible peripheral portion that is normally inclined downwardly but which is adapted to flex upwardly so as to permit the top wall of said chamber to move bodily and thus increase the volume of said chamber, and an extensible or flexible side wall for said chamber, formed by telescopically arranged metal parts and gas-tight, flexible or pliable, non-metallic material, disposed so as to be protected against strains by said metal parts.

9. A device of the kind described in claim 8, provided with a counterweighting mechanism attached to the flexible peripheral portion of the bottom of said chamber.

10. A device of the kind described having a storage space or chamber of the breather type which comprises a flexible metal top wall, a bottom having a stationary central portion and a flexible peripheral portion that is pitched downwardly relatively to said central portion when the storage space is empty, a cylindrical shell attached to the peripheral edge of said top wall, a second cylindrical shell attached to the flexible peripheral portion of said bottom and being of less height than the shell first mentioned, said shells being telescopically arranged, and a sealing element of fabric or the like for producing a gas-tight joint between said shells, disposed so that a force exerted on said sealing element by a positive or minus pressure in said space will be absorbed by one or the other of said shells.

11. A device of the kind described having a storage space or chamber provided with a breather type top wall, a bottom for said chamber provided with a flexible peripheral portion, a side wall for said chamber, composed of telescopically arranged shells, one of which is rigidly attached to said top wall and the other to said flexible peripheral portion, a sealing element of fabric or the like for producing a gas-tight joint or connection between said shells, disposed so that one of said shells surrounds said sealing element and limits the outward flexing or movement of same when the medium confined in the storage space exerts an outward force or pressure on said sealing element, and means for restricting the vertical movement of one shell relatively to the other so as to protect said sealing element against strains tending to tear it away from said shells.

12. A device of the kind described having a storage space or chamber that comprises a breather type metal top wall, a bottom for said chamber having a flexible peripheral portion that is adapted to flex in one direction so as to permit said top wall to be supported by the stationary portion of the bottom of said chamber and adapted to flex in the opposite direction so as to provide for the bodily upward movement of said top wall relatively to said stationary bottom portion, a gas-tight, collapsible or extensible side wall for said chamber, and a counterweighting mechanism attached to the flexible peripheral portion of the bottom of said chamber.

13. A device of the kind described having a storage space or chamber provided with a top wall of the breather type that is adapted to rise and fall and thus vary the volume of said chamber, a collapsible or extensible structure for joining said top wall to the bottom of said chamber, said collapsible or extensible structure comprising a gas-tight sealing element of fabric or the like, combined with a substantially rigid or inflexible backing means, and a means which tends to balance said top wall and hold it in a substantially horizontal plane when said top wall rises and falls.

14. A device of the kind described having a storage space or chamber that comprises a breather type top wall that is adapted to move bodily in a vertical direction, a bottom for said chamber having a flexible peripheral portion, side wall members rigidly attached to said flexible peripheral portion and to the peripheral edge of said top wall and arranged in telescopic relation, a flexible or pliable, non-metallic, gas-tight sealing element for producing a gas-tight joint or connection between said side wall members, means for assisting the upward movement of the flexible peripheral portion of said bottom, and means which tends to hold said top wall in a substantially level position when said top wall moves vertically.

15. A device of the kind described having a storage space or chamber which comprises a breather type metal top wall that is adapted to move bodily in a vertical direction relatively to a stationary portion of the bottom of said chamber, said bottom having a flexible peripheral portion, side wall shells connected to said peripheral portion and to the peripheral edge of said top wall and arranged in telescopic relation, and a sealing element of gas-tight fabric or the like joined to said side wall shells in such a manner that when said top wall is in its extreme upper position, said sealing element is surrounded and backed up by one of said shells and when said top wall is in its extreme lower position, said sealing element is interposed between said shells.

16. A device of the kind described in claim 15, provided with a guideway for said vertically-movable top wall, and a counterweighting mechanism attached to the flexible peripheral portion of the bottom of said chamber.

17. A device of the kind described in claim 15, in which the side wall shell attached to the flexible peripheral portion of the bottom of said chamber is provided with laterally-projecting brackets, counterweights attached to said brackets, the other side wall shell having slots in its lower edge for receiving said brackets when the shells are in telescoped relationship, and shiftable closures for said slots.

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