

April 21, 1936.

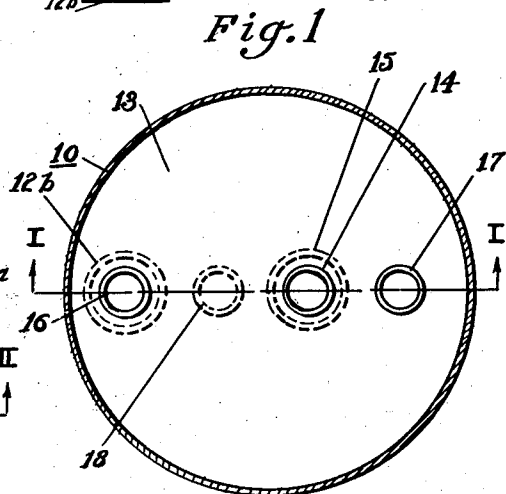
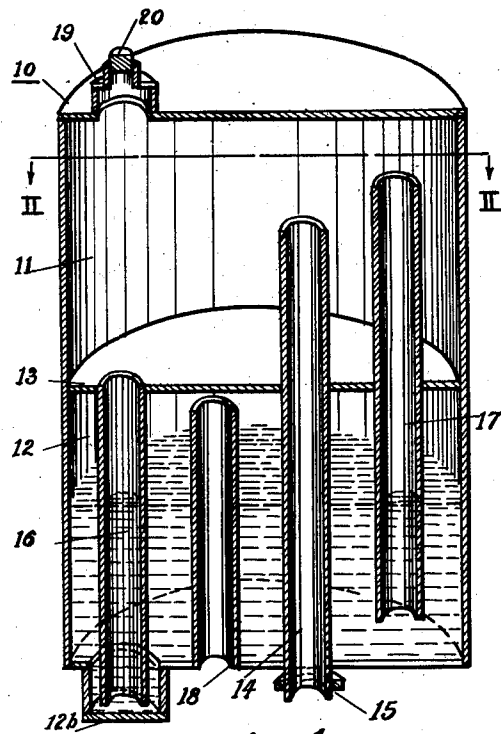
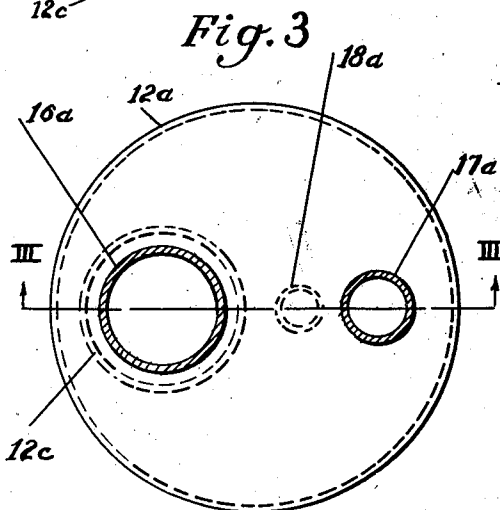
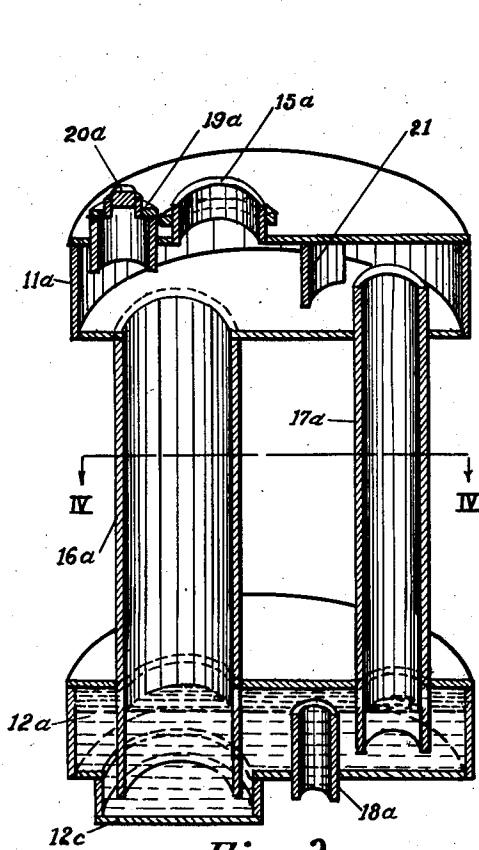
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2,037,731

VACUUM SEAL

Filed Jan. 15, 1935

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

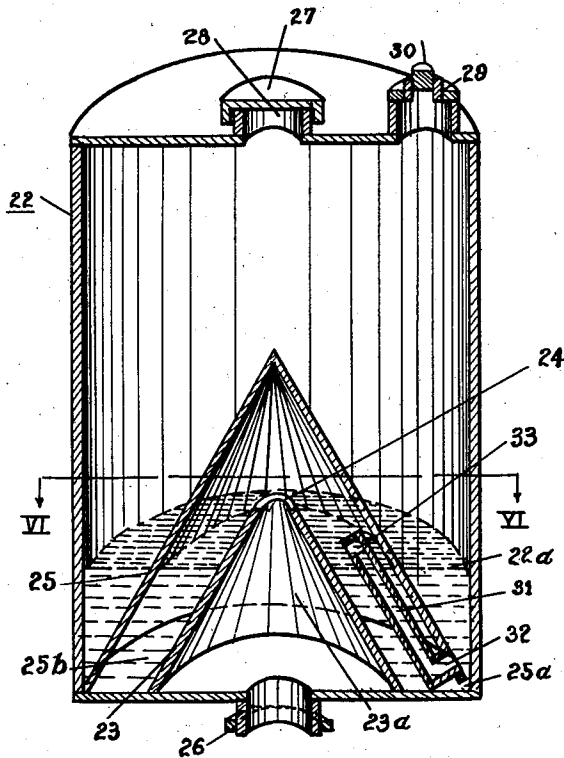


Fig. 5

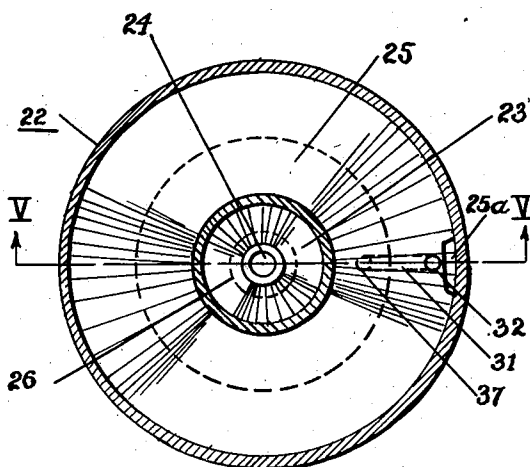


Fig. 6

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2,037,731

VACUUM SEAL

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7 Claims. (Cl. 220—85)

This invention relates to fuel conservation, and more particularly, to a new and improved vacuum seal for storage tanks and the like. Gasoline and similar volatile fluids are commonly stored in large tanks, said tanks often being a hundred feet in diameter, and as the sun beats down upon such during the day, vapors containing valuable fuel elements are given off from the fluid contained therein. Extensive tests have shown that both the quality and the quantity of gasoline stored within a given tank depreciates and decreases from day to day, particularly in the south and southwest where the sun's rays are the hottest; and that at night, when a cooling process has set in, which tends to contract the contents of the tank and condense the vapors therein contained, air is drawn into the tank from the outside, which air is often moisture-laden as when the tanks are situated near water or in a humid atmosphere, with a result that a very considerable quantity of moisture may thus enter a tank in a short time, and mingling with the contents thereof, further lower the quality thereof to a marked degree.

Various devices and expedients have been proposed to remedy the foregoing situation. An obvious means is to tightly seal the storage tank, but this is impracticable because of the pressure built up during the day in such a structure, said pressure being in the form of a highly explosive gas that becomes increasingly dangerous as confined, and which will explode with terrific force if exposed to the smallest spark of fire when so restricted and compressed. Further, such a tank often collapses at night, when the process of condensation of vapors within its interior has reached such a point as to set up a tremendous vacuum on the inside, the force of which caves in the tank, with a resulting loss of structure and contents.

In my patent application Serial No. 601,550, filed March 28, 1932, which is expected to issue into Patent No. 1,988,325, on January 15, 1935, I disclose a vent seal for storage tanks which provides for a breathing action, said seal allowing for a normal expansion within the tank without permitting the loss of vapors therefrom, said vapors containing valuable fuel elements; and further allowing for a contraction within the tank at night without the entrance of outside air thereinto, the head pressure developed by a body of liquid contained within the seal making possible this action, the seal, however, temporarily breaking when any unusual expansion or contraction takes place within the tank, and

thus eliminating the dangers and undesirable features of a tightly sealed tank, as aforesaid. It has been found, though, that when a tank equipped with such a seal is partially emptied, as it may be frequently in the case of a small tank such as those used by dry cleaners, garages, filling stations, et cetera, for the purpose of storing volatile fluids, an amount of air approximately equal to the number of cubic feet of liquid contents withdrawn from the tank, will be admitted into the interior thereof. This is because the seal automatically "breaks" during filling or emptying of the tank, and during such times, is, to all practical purposes, out of the way. While said seal has been found very satisfactory, and as a matter of fact is considered revolutionary in the art, the objection of admitting air to storage tanks in the manner described, is a serious one, and it is with this problem that the instant invention is primarily concerned.

An object of my invention is to provide a seal which, when attached to an air-tight tank, makes possible the admission of a lesser number of cubic feet of air into said storage tank than the number of cubic feet of the contents of said tank withdrawn.

A further object is to provide a vacuum seal of the foregoing type that is economical in its operation, requiring no means of motivation outside of the forces automatically set in movement within the tank during the emptying operation.

Another object is to provide a seal of the foregoing type that requires re-filling only at infrequent intervals.

Another object is to provide cheapness of construction in a device of this type.

A still further object is to provide a vacuum seal that will permit discharge of vapor when the tank is being filled, but which will retain vapors generated as by evaporation within the tank once it is filled, said seal providing for a breathing action within the tank, thus conserving valuable fuel elements contained in said vapors.

These and other objects made apparent throughout the further progress of this specification are accomplished by means of my vacuum seal, the full and complete understanding of which is made possible by reference to the drawings herein, in which:

Fig. 1 is a side view, partially in vertical cross-section and partially in perspective, of a seal embodying my invention, said view being taken along the line I—I of Fig. 2.

Fig. 2 is, a top plan view of the device illustrated

in Fig. 1, said view being taken along the line II—II of Fig. 1.

Fig. 3 is a side view, likewise partially in vertical cross-section, of a modification of the device illustrated in Figs. 1 and 2, said view being taken substantially along the line III—III of Fig. 4, looking in the direction of the arrows.

Fig. 4 is a top plan view of the seal illustrated in Fig. 3, said view being taken along the line III—III of Fig. 3.

Fig. 5 is a side view likewise partially in vertical cross-section and partially in perspective, of another modification of the instant invention, said view being taken along the line V—V of Fig. 6, looking in the direction of the arrows.

Fig. 6 is a top plan view of the structure illustrated in Fig. 5, said view being taken along the line VI—VI of Fig. 5.

Like numerals indicate corresponding parts throughout the figures of the drawings.

Referring now to the drawings, Fig. 1, my device comprises a container 10, preferably of metal, divided into upper and lower chambers 11 and 12 respectively by a partition or baffle 13. Communicating with the upper part of chamber 11, and terminating therein at one end, and communicating with the exterior of the container at its other end, is a tubular conduit 14, provided with a connecting means such as 15 whereby it may be connected to the vent line of a storage tank (not shown). Communicating with the lower interior of the upper chamber 11, and terminating in the lower interior of chamber 12, is a second tubular conduit 16; and communicating with the upper interior of chamber 11 and the lower interior of chamber 12 and terminating at a point above the lower end of conduit 16, is a conduit 17. An air conduit 18 terminated in the upper interior of lower chamber 12 at one end, and with the atmosphere at its other end, is likewise provided. A suitable liquid such as glycerine, for instance, or even water, is admitted to the container, filling such to a point indicated by the dotted lines in the drawings, through a filler cup 19 having a plug 20, located in or near the top of container 10.

Figs. 3 and 4, illustrate a modification of my invention, in which upper chamber 11a amounts to a separate container, communicating with a second container 12a by means of a conduit 16a terminating in said chamber at a point somewhat below the point of termination of a second and smaller conduit 17a, which, however, terminates in chamber 11a at a point above the corresponding portion of 16a. A baffle 21 is situated in upper chamber 11a; and a conduit 18a, terminating in the upper-interior of chamber 12a at one end, and communicating with the atmosphere at its opposite end, is likewise provided. A filler cup 19a having a plug 20a may be located at any suitable point on either chamber, while a connecting means such as 15a is provided for the purpose of attaching the device to the vent line of a storage tank, as by means of an elbow joint, (not shown).

It will be noted that the structure illustrated in Fig. 3, dispenses with conduit 14 and partition 13; and that the lower chambers of the seal in both the forms illustrated in Figs. 1, and 3, are provided with an off-set or well 12b and 12c, the object and purpose of which is made clear elsewhere herein.

In Figs. 5 and 6, I have shown another modification of my device, comprising a container 22, securely attached to the lower inside wall of which

is a cone-shaped member 23 having an opening 24 at the top thereof. A second cone-shaped member 25 is positioned within container 22, 25 being of less diameter at its bottom than said container, and having an opening 25a in its bottom wall so that liquid may pass freely under it. While members 23 and 25 are described as cone-shaped herein, it is apparent that said elements may be any one of several other shapes, as for instance, cylindrical, or in the shape of a hemisphere. A connecting means 26 is provided at the bottom of container 22, and within the circle formed by 23, for the purpose of attaching said device to the vent line of a storage tank; while the top of 22 may be provided with a lid 27 covering an opening 28 in said top, which opening may be flanged upwardly to seat with a downward flange on 27, said lid being held closed by gravity, or by a spring (not shown) so as to open with pressure from the inside, as when the tank is being filled. The flanges above described are for the purpose of keeping water from entering the seal; but such structure may be dispensed with, if desired, and holes simply provided in the top of said container to permit the discharge of air therefrom. A filling opening 29 and plug 30 for the filling of the seal with a liquid to a desired point, as indicated by the dotted line in the drawings, may be positioned in the top of container 22. A hollow tube 31 is positioned within container 22 in relation to cone 25 in such a manner that one end 32 thereof communicates with chamber 22a at a point slightly above 25a, and the other end 33 of said tube opens into chamber 25b at a point somewhat above the normal level of the liquid therein.

In operation, my device works as follows: Referring to the drawings, Fig. 1, and assuming that the storage tank connected to conduit 14 has begun to be emptied (said tank being air-tight except for discharge port and my seal), it is apparent that a suction or reduced pressure will have been set up in the upper chamber of said seal such as to tend to draw the fluid thereof upwardly in conduits 16 and 17, the air freely entering chamber 12 through pipe 18 compensating at once for the space vacated in said chamber by said fluid. This action will proceed until the level of said liquid recedes to the lower end of conduit 17, after which the seal in effect "breaks" temporarily and the liquid in said conduit together with a quantity of air is shot or ejected into upper chamber 11, this action relieving the pressure within the seal for the time being, and the liquid thus ejected into the upper chamber draining down and passing through conduit 16 and hence into the lower chamber, this action raising the level of the liquid in said chamber to a point considerably above the lower edge of 17, the level of said liquid, in view of the relieved pressure, now approximating normal. However, the suction caused by the removal of fluid from the storage tank continues, and the foregoing action is repeated, there being a continuous circulation of liquid and air within the seal. Thus it is apparent that a greater number of cubic feet of the contents of the storage tank will be removed than the number of cubic feet of air admitted into said tank, the result being that a partial vacuum is built up therein, a minimum of fresh or new air being allowed to enter the interior of the tank and tend to reduce the quality and quantity of the fluid contents thereof by absorbing part of the volatile contents of said tank,

as would be the case if ordinary air in proportionate quantities to the amount of fluid withdrawn were to be admitted. The foregoing action is explained by the simple fact that for every cubic foot of contents withdrawn from the tank, a certain amount of air, and a certain amount of fluid in the seal is admitted, the two equalling in volume the withdrawal, but the fluid of the seal does not enter the tank, merely chasing itself around in the seal as described herein, which means that the amount of air admitted is less than the amount of liquid withdrawn from the tank, this action creating a partial vacuum with attendant beneficial and desirable results as set forth.

The modification disclosed in Figs. 3 and 4, operates in a similar manner, suction created through the withdrawal of the contents of the storage tank (not shown) with which 15a is connected, tending to draw up the fluid in chamber 12a, into conduits 16a and 17a, this continuing until the level of said fluid contents reaches a point below the lower end of 17a, upon which a quantity of liquid and air is ejected through the top of said tube into upper chamber 11a, said liquid then returning to the lower chamber by way of conduit 16a, and thus again raising the level of the liquid in such chamber to a point above the termination of 17a, upon which, the suction continuing, the foregoing process is repeated, the circulation of the liquid within the seal, however, making for the admission of a smaller number of cubic feet of air into the storage tank than the number of cubic feet of contents withdrawn therefrom, and thus building up a partial vacuum therein, with advantages as described heretofore.

It is to be noted that the embodiment illustrated in Fig. 1, and also in Fig. 3, is provided with an off-set or well 12b and 12c, respectively, into which conduits 16 and 16a terminate as indicated, the purpose of such construction being to provide a maximum depth of penetration of said conduits into the liquid of the seal, with the use of a minimum quantity of said fluid, the saving made possible thereby being considerable, particularly when a relatively expensive fluid such as glycerine is used in the seal.

In the modification illustrated in Figs. 5 and 6, a suction is created within chamber 24a by the emptying of the contents of the storage tank (not shown) the vent line of which is attached to 26, said suction or low pressure being communicated to chamber 25b in view of opening 24 in 23, with a result that the liquid in said chamber 25b tends to be drawn upwardly therein, with a corresponding decrease in the level of said fluid in 22a, which action continues until said level reaches the opening 32 of pipe 31, said opening being just above the lower edge 25a of 25, at which time liquid in said pipe, and a quantity of air, is forced therethrough and out 33 into chamber 25b, the relieving of pressure in this manner tending to restore the liquid in the seal to its normal level, upon which the process is again repeated, it being apparent that during the entire complete operation, a lesser quantity of air is admitted into the storage tank than is withdrawn cubic feet of contents thereof.

From the foregoing it is apparent that I have disclosed a new and useful vacuum vent seal for storage tanks and the like, whereby during the emptying of said tanks a smaller quantity of air is admitted thereto than the number of cubic feet of contents withdrawn, with advantages in

maintaining the quality and quantity of the contents of the tank as aforesaid. Further, that when the tank is filled, the seal interferes in no way with such operation; and that while it lies dormant during normal storage use, the escape of valuable gases and vapors containing vital fuel elements is precluded by the head pressure developed by the column or columns of liquid within the seal; the basic principle upon which this feature of the device operates being fully disclosed in my prior patent application referred to herein. Finally, it is apparent that the present invention by admitting a minimum of outside air to the interior of a storage tank as it is partially emptied, provides for the further conservation of said fluid contents thereof by permitting a minimum contamination from outside sources; and as such, represents a valuable improvement in the art.

While I have described at length a preferred form and several modifications of my invention herein, I do not intend to in any way limit myself thereby, but on the contrary intend that I shall be accorded a range of equivalents in keeping with a broad interpretation of the appended claims.

I claim:

1. In a vacuum seal for storage tanks, a container having side and end walls, a partition dividing said container into separate chambers, a tubular conduit communicating with the upper of said chambers, said conduit being adapted to connect to the vent line of a storage tank, a tubular conduit communicating with the lower interior of said lower chamber and the lower interior of said upper chamber, a tubular conduit communicating with the lower interior of said lower chamber at a point somewhat above the point of termination of said second-mentioned tubular conduit and with the said upper chamber at a point in the upper interior thereof; a tubular conduit communicating with the upper interior of said lower chamber at one end and with the atmosphere at the other end; said lower chamber being adapted to retain a body of liquid, said liquid being circulated from said lower chamber to said upper chamber by the action of air admitted to said upper chamber and said tank by the low pressure created therein when the contents of said tank are being withdrawn.

2. In a vacuum seal for storage tanks, a container having side and end walls, a partition dividing said container into upper and lower chambers, an opening communicating with the upper of said chambers in the form of a conduit adapted to communicate with the vent line of a storage tank, a second conduit communicating with the lower interior of said lower chamber and the lower interior of said upper chamber, a tubular conduit communicating with the lower interior of said lower chamber at a point somewhat above the point of termination of said second conduit, and with the interior of said upper chamber at a point above said dividing partition; and a conduit communicating with the upper interior of the lower chamber at one end and with the atmosphere at its opposite end, said lower chamber being adapted to retain a liquid for the purpose specified.

3. In a vacuum seal for storage tanks and the like, a container having side and end walls, a partition dividing said container into separate chambers, a conduit communicating with one of said chambers at one end and with the vent line of a storage tank at its opposite end, a conduit communicating with the interior of the other of said chambers at one end and with the

atmosphere with the other, and tubular means within said chambers providing for the circulation of a body of liquid from one chamber to the other through low pressure created when the contents of said storage tank are being withdrawn.

4. In the vacuum seal for storage tanks, upper and lower chambers and conduits communicating therewith, one of said conduits terminating in the lower surface of said upper chamber and in the lower interior of said lower chamber, and the other of said conduits terminating in said chambers at points above the respective points of termination of said first-mentioned conduit; a conduit communicating with the upper interior of said lower chamber at one end and with the atmosphere at its opposite end, and means for connecting the upper chamber to the vent line of a storage tank, said lower chamber being adapted to retain a body of liquid therein.
5. In a vacuum seal for storage tanks, upper and lower chambers and conduits communicating therewith, one of said conduits terminating in the lower interior of said upper chamber and in the lower interior of said lower chamber, said conduit being of greater diameter than a second conduit, said second conduit communicating with the interiors of said chambers at points above corresponding points of termination of said first-mentioned conduit; a conduit communicating with the upper interior of said lower chamber at one end and with the atmosphere at its opposite end, a body of liquid retained in said lower chamber, means for connecting said upper chamber to the vent line of a storage tank, means for filling said seal, and a baffle disposed in said upper chamber at a point opposite the end of said second conduit.

6. In a vacuum seal for storage tanks, a container having side and end walls, a cone-shaped

member having an opening in the small end thereof disposed within said container, a second cone-shaped member concentric with and surrounding said first member at a spaced interval, likewise disposed within said container, said second member having an opening along a portion of the bottom edge thereof, a body of liquid retained in the lower portion of said container, and a tubular conduit positioned in said second cone-shaped member in such a manner that one end thereof communicates with the interior of said container at a point below the normal level of liquid therein and above the lower edge of said cone-shaped member, and the opposite end with the interior of said member at a point above the normal level of liquid therein.

7. In a vacuum seal for storage tanks and the like, a container having side and end walls, a cone-shaped member having an opening in the small end thereof disposed within said container, a second cone-shaped member concentric with and surrounding said first member, likewise disposed within said container, said second member having an opening in the bottom edge thereof, a body of liquid retained in the lower portion of said container, and a conduit positioned in said second cone-shaped member in such a manner that one end thereof communicates with the interior of said container at a point below the normal level of liquid therein, and the opposite end with the interior of said member at a point above the normal level of liquid within the chamber formed by said cone-shaped members; means whereby said first cone-shaped member communicates with the vent line of a storage tank, means for filling said seal, and an air vent in the top of said container.

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