

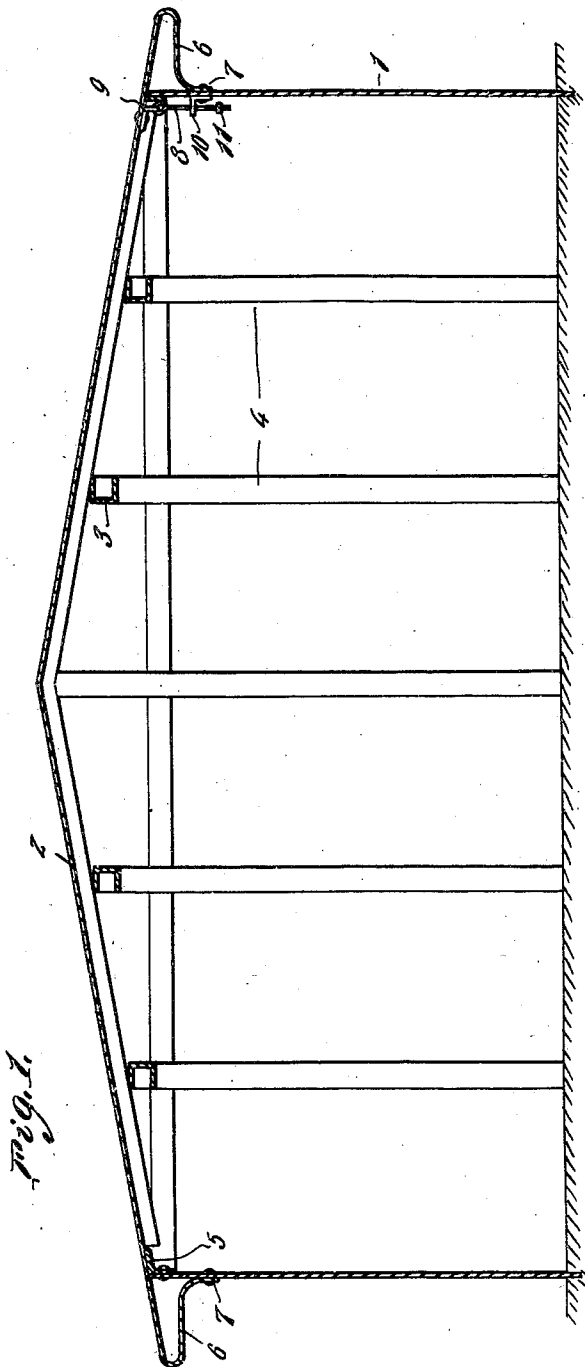
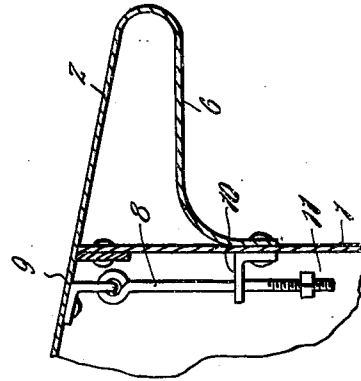
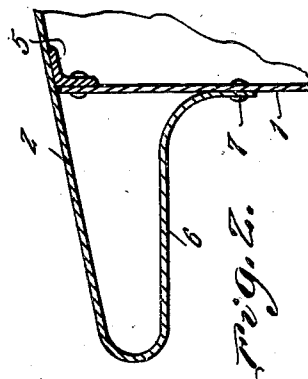
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LIQUID STORAGE TANK

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## UNITED STATES PATENT OFFICE

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## LIQUID-STORAGE TANK

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This invention relates to liquid storage tanks of the type that comprise a roof which is normally supported by the shell of the tank.

5 One object of the invention is to provide a novel means of connecting the roof to the tank shell and permitting vertical movement of that portion of the roof, usually rigidly connected to the tank shell.

10 Another object is to provide a flexible gas-tight connection of the roof to the tank proper, to permit of relative vertical motion of the entire roof.

15 Another object is to provide means of increasing the volume of a tank by vertically raising the roof as a whole by internal pressure.

20 Another object is to provide a roof that will permit of expansion and contraction of gases, from and above the contents of the tank, without any opening to the outside atmosphere or without piping to additional storage space outside of the tank.

25 Another object is to provide a flexible connection between a movable roof and a tank shell by means of an annular spring assisted in operation by internal pressure.

30 Another object is to provide a type of gas-tight construction that will tend to eliminate loss of gaseous vapors by providing additional storage space for their expansion through a vertical movement of the entire roof under low pressure.

35 Still another object is to provide a movable roof that is, from its form, naturally self-draining, in all positions.

40 This invention also consists in certain other features of construction and in the combination and arrangement of the several parts, to be hereinafter fully described, illustrated in the accompanying drawings and specifically pointed out in the appended claims.

45 In describing our invention in detail, reference will be had to the accompanying drawings wherein like characters denote like or corresponding parts throughout the several views, and in which:

50 Figure 1 is a vertical sectional view

through a tank constructed in accordance with this invention.

Figure 2 is an enlarged detail sectional view showing the details of the invention.

Figure 3 is a view similar to Figure 2, but showing the means for limiting the upward movement of the roof. 55

When a tank contains a volatile liquid (such as oil) the air between the surface of the liquid and the roof combines with the vapor from the liquid. Temperature changes cause expansion and contraction of this confined gas, requiring additional space for the expansion, otherwise producing undesirable internal pressure or requiring a decreased space in the case of contraction otherwise producing a tendency toward a partial vacuum. This expanding and contracting action is generally known as "breathing" of the tank. 60 65 70 75

It is the general practice to take care of this change of volume of the gases by passing the same through a pipe leading from the roof of the tank to a point some distance outside of and away from the tank. The gases passing out through this pipe into the outside atmosphere are lost. This loss consists of the most volatile part of the liquid contents and may be considerable. It is this loss that we propose to eliminate by the use of our invention. 80

In the drawing 1 indicates the tank and 2 indicates the roof thereof, said roof normally resting upon the cross beams 3 which are supported on the uprights 4 which are arranged within the tank at the sides thereof. An angle iron 5 is fastened to the upper edge of the shell and a part of the roof normally rests upon this angle iron, it being understood that the roof is not attached to either the angle iron or to the cross pieces. A flexible member 6 of loop shape is formed with or suitably connected to the periphery of the roof and the opposite edge of the member is riveted or otherwise fastened in a gas-tight manner to the shell a distance from the upper edge thereof, as shown at 7. The member 6 may be connected to the top angle strip, if desired. 85 90 95

Thus when the mixture of gas and air in 100

the top of the tank expands, the roof will be lifted and the flexible member 6 will act as a spring and permit this movement and at the same time prevent the gas escaping from between the roof and the shell. When the pressure lowers the roof will move back upon its supports.

A plurality of rods 8 is connected with the roof by the brackets 9 and the threaded lower ends of these rods pass through openings formed in the brackets 10 which are attached to the shell a distance from the upper edge thereof. A nut 11 is placed on the threaded end of each rod and when the roof is raised to a certain extent, the ends will engage the brackets 10 and thus prevent further movement of the roof.

From the foregoing, it will be seen that we have provided simple means for permitting vertical movement of the roof of a tank without causing leakage of the gases accumulating in the top of the tank unless the roof reaches the limit of its movement due to excessive pressure in the tank. When this occurs, the valve will be opened and the excessive pressure exhausted from the tank so as to prevent damage to the tank.

If desired, a release and vacuum valve can be used with the tank for preventing a vacuum or excessive pressure occurring in the top thereof, but as such valves are well known, it is not thought necessary to show them in the drawing.

It is thought from the foregoing description that the advantages and novel features of our invention will be readily apparent.

We desire it to be understood that we may make changes in the construction and in the combination and arrangement of the several parts, provided that such changes fall within the scope of the appended claims.

What we claim is:—

1. A storage tank for volatile liquids comprising a shell, a roof with its peripheral marginal portion normally resting on and contacting with the top of said shell, and means for movably connecting said roof to said shell, said connecting means comprising an annular spring loop constituting a peripheral extension of the roof beyond its point of contact with the shell and having sufficient flexibility to allow vertical movement of the roof upon expansion of gases within the tank.

2. A storage tank for volatile liquids comprising a shell, a roof with its peripheral marginal portion normally resting on and contacting with the top of said shell, and means forming a flexible gas tight connection between said roof and shell, said connecting means comprising an annular spring loop forming a peripheral extension of the roof projecting beyond the periphery of the shell and adapted to open to allow vertical

movement of the roof upon expansion of gases within the tank.

3. Means for forming a flexible gas tight connection between a tank shell and a movable roof comprising an annular spring steel loop connecting the periphery of the roof to the tank shell, the body of said loop projecting beyond the outer periphery of the tank shell to permit the roof to rise vertically and return to its normal position of rest with its peripheral marginal portion upon the top of and contacting with the tank shell.

In testimony whereof we affix our signatures.

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