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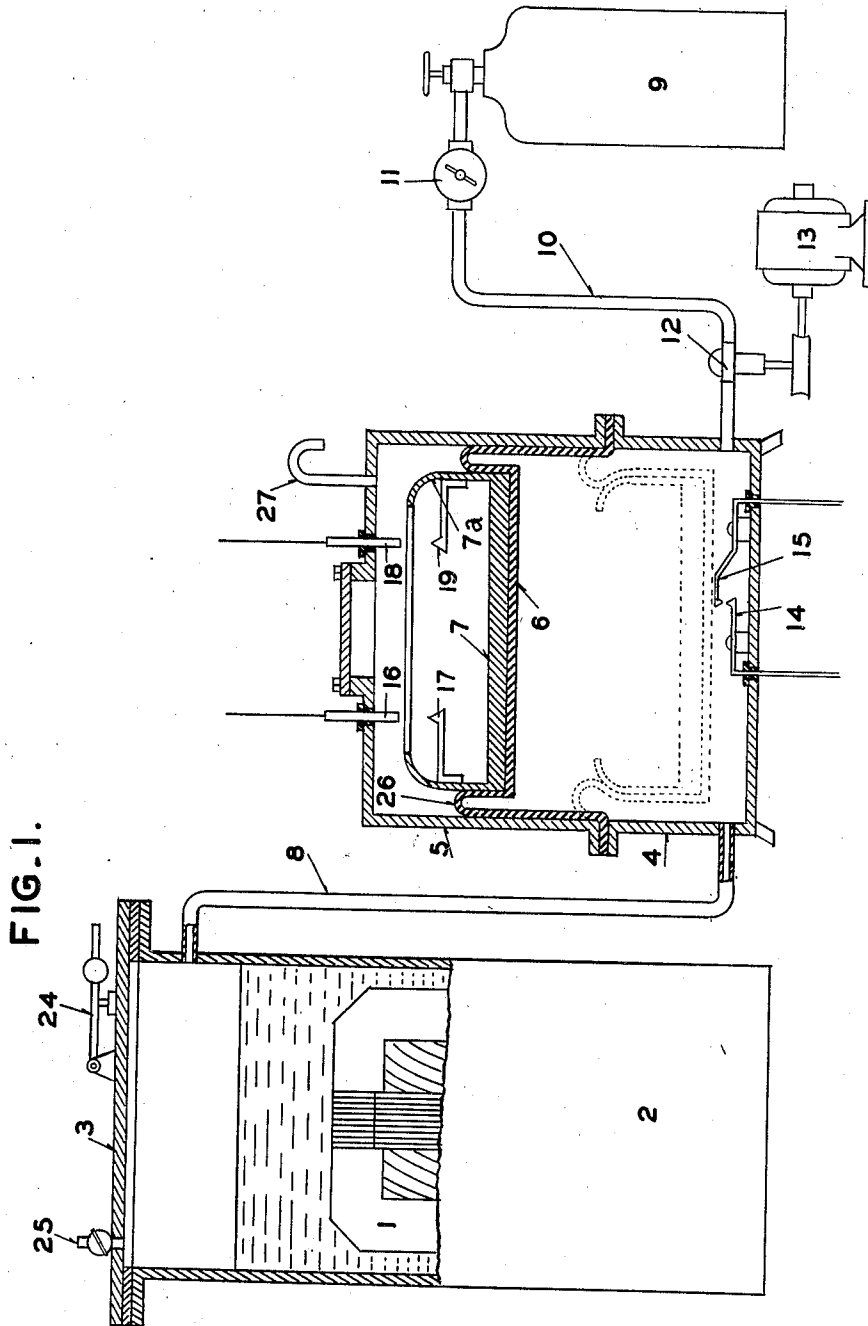
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2,200,610

GAS SUPPLY APPARATUS FOR FLUID TANKS

Filed May 22, 1937

2 Sheets-Sheet 1



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FIG. 2.

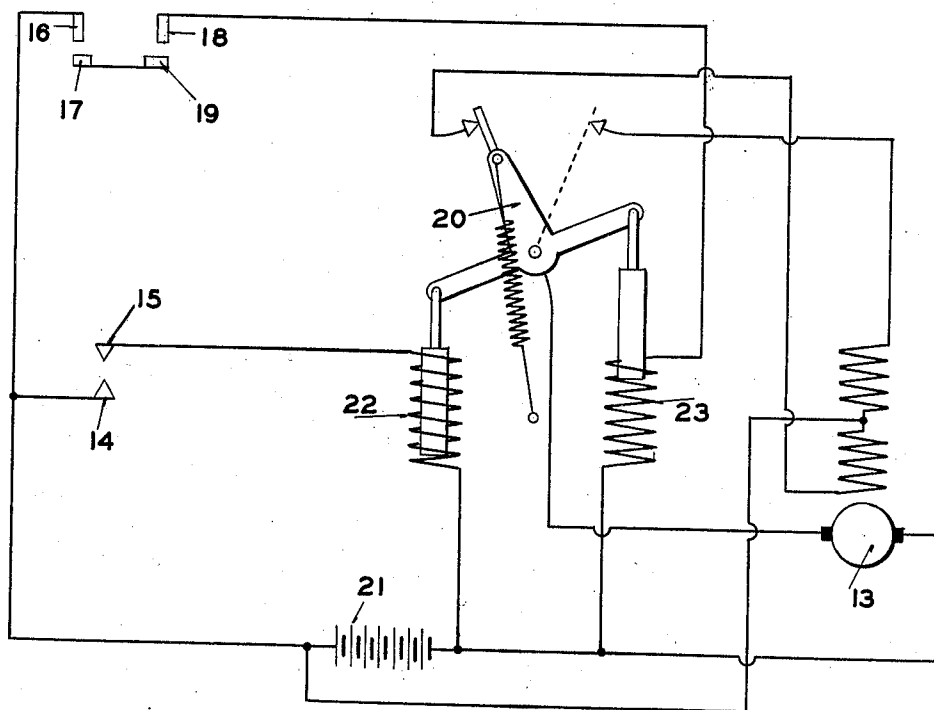
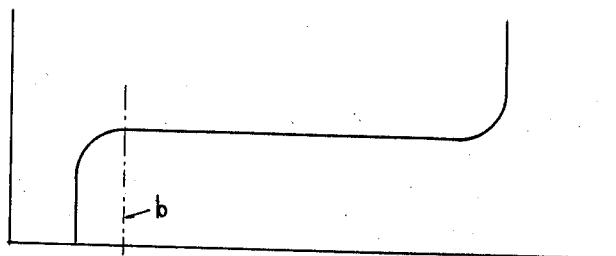


FIG. 3.



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GAS SUPPLY APPARATUS FOR FLUID TANKS

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5 Claims. (Cl. 220—35)

My invention relates to apparatus for supplying inert gas to a space above the fluid level in "oil-filled" transformer tanks and other liquid containing tanks in which it is desirable that the space above the liquid be filled with inert gas (such as nitrogen or carbon dioxide, for example) rather than with air.

The general object of my invention is to provide improved means for the above purpose which will operate automatically and which will reduce the waste of inert gas to a minimum and under some conditions of operation of the transformer and other apparatus will avoid all loss of gas if valves and joints are kept gas-tight.

My invention comprises a gasometer of novel construction by means of which the inert gas will be maintained under constant pressure throughout a considerable range of variation of volume of the gas space to be occupied by it in the fluid containing tank.

In the accompanying drawings Figure 1 illustrates a form of apparatus embodying my invention and shown in association with an oil-filled transformer; Figure 2 is a circuit diagram illustrating the controlling circuits for the motor which operates the gasometer supply valve; and Figure 3 is a diagram showing gas pressure in relation to the position of the weight element of the gasometer.

Referring to Figure 1, the electrical transformer 1 is shown in an oil containing tank 2 provided with a sealed cover 3, the oil level indicated being that assumed to exist during operating conditions of the transformer in which the oil temperature is less than the maximum that may exist under other operating conditions. The gasometer comprises a cylindrical lower casing part 4 and an upper casing part 5 and between these parts is clamped the periphery of a flexible bag or "balloon" element 6, which element forms with casing part 4 a variable volume of inert gas containing space connected to the upper part of the transformer tank by means of pipe 8. This bag element should be formed of material not reactive to the gas supplied to the transformer nor to such gases as may be evolved from the transformer oil. Synthetic rubber materials such as those on the market under the trade names "duprene" and "thiokol" are suitable for this purpose. The flexible bag carries a weight element 7 on its upper surface which, as shown, is provided with a thin walled cylindrical extension 7a the function of which is to provide bearing for part of the surface of the torus portion 26 of the bag during the rise and fall of the central

portion of the bag in operation of the apparatus. The wall of portion 7a is made thin in comparison with the bottom portion of the weight in order to maintain the center of gravity of the weight as low as possible. The dotted lines in the figure show the position of the weight and bag under condition of such increase in gas containing space in the transformer tank that slight further increase would require the admission of additional gas into the gasometer.

The numeral 9 indicates a supply tank of inert gas in which the gas is under relatively high pressure and from which it may be delivered through pipe 16 to the gasometer. This delivery is controlled by a suitable pressure reducing valve 11 and a gas shut-off valve 12. This shut-off valve is opened and closed by means of a reversible electric motor 13 controlled by the switch contacts 14 and 15 at the bottom of the gasometer, and contacts 16—17 and 18—19 in the top element 5 of the gasometer casing. The control circuits are indicated in Figure 3 wherein is shown solenoid-operated motor switch 20 and a battery 21 for supplying motor operating current. In practice this current would ordinarily be supplied by a small transformer.

Referring now to the operation of the apparatus just described, a reduction in temperature of the oil in the transformer will increase the gas containing space in the transformer with the result that the weight member 6 will descend and reduce the gasometer volume to the extent necessary to transfer additional gas to the transformer tank and the pressure of the gas will remain the same since such pressure depends upon weight 7. If at the time of occurrence of the temperature reduction above assumed, the bag and weight occupy the position shown in dotted lines of the figure, the descent of these parts will close contacts 14—15 whereby the battery current will flow through the solenoid 22 to bring the motor control switch 20 to a position causing the motor to operate in a direction to open valve 12 to permit additional gas to flow into the gasometer through pipe 16. This flow will continue until the bag and weight are lifted to a position where contacts 16—17 and 18—19 are closed, at which time solenoid 22 will bring the motor switch 20 to a position to cause the motor to operate in the opposite direction and close the valve 12. While with the circuits shown the motor is always energized and, therefore, should be of the "stalled" type, known means for opening the circuit of a valve actuating motor when closed or open position of the valve is reached, can be employed.

Should the temperature of the oil in the transformer increase at the time the weight is at its uppermost position in the gasometer, the increased pressure resulting from the rise of the oil level will open the safety valve 24 at the top of the transformer tank to permit reduction of gas pressure to the value determined by the pressure setting of that valve. It is not necessary that the normal pressure on the inert gas be more than slightly above atmospheric pressure and the weight element may be made only sufficiently heavy to increase the inert gas pressure about three or four ounces per square inch above the atmospheric pressure (effective on the outside of the bag by reason of the breather tube 27 in the top of the gasometer casing).

In the initial installation of the apparatus, the air may be eliminated from the transformer by opening purge valve 25 in the lid of the transformer and supplying inert gas through pipe 8 until all the air has been exhausted. Preferably, this initial filling should be under the lowest temperature conditions to which the transformer is subject whereby, unless there is loss of gas due to gas leaks, the apparatus will never require additional gas from the tank if the gasometer is large enough that at maximum operating temperature the gasometer weight does not rise to the limit of its upward movement and, therefore, no condition occurs resulting in escape of gas through safety valve 24. However, under my invention it is permissible to make the gasometer smaller than is necessary to achieve the above end and with the only disadvantage that after the occurrence of a condition that results in the escape of gas through the safety valve, a lower temperature condition might be reached which would result in more gas being admitted to the gasometer. Thus it is possible to compare the cost of gas lost with the factors of original cost of the gasometer and the space available for it, in determining the size of the gasometer to be installed in association with a particular transformer. Ordinarily it would be feasible and desirable to so proportion the gasometer for the load cycle of the transformer and the temperature ranges of the surrounding atmosphere that little or no inert gas will be valved to the atmosphere. Therefore, my invention results in substantial advantage in operating cost over any apparatus for a similar purpose known to me.

The clearance between the wall 7a of the weight element and the wall of the gasometer should be relatively small because the smaller this clearance the less the strain on the bag material, such strain being proportional to the area of the surface of the bag which is not in contact with either the weight member or the wall of the gasometer. Another reason for employing a small clearance is that the smaller this clearance is the less wrinkling occurs in the bag material as the center of the bag rises and falls. The clearance of about one inch at the point referred to, has been found satisfactory for gasometers of diameter of from 40 to 60 inches.

In order to hold the center of gravity of the weight as low as possible, it is advisable, in addition to making the wall 7a thin, that its height be less than that of the bag in full inflated condition, but the height should be sufficiently great that the surface area of the portion of the bag that contacts with neither the weight element nor the wall of the casing at the lowest position of the weight (see dotted lines in the figure) is

not sufficiently great to result in undue strain on the bag material.

Referring to the curve shown in Figure 3, this illustrates the relation between the gas pressure and the position of the gasometer weight (extent of bag inflation). The apparatus should be so proportioned that the valve 25 will be opened at the point on the curve indicated by dotted line b. Under such condition, of course, the valve will close before the pressure has risen substantially above this point. How high the pressure may rise after closing of the gas supply valve, is determined, as heretofore indicated, by the setting of safety valve 24 on the transformer tank.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. The combination of a sealed gas container having a variable volume gas space, variable volume means connected thereto to maintain constant gas pressure in said space over a predetermined range, said last named means comprising a container having a weighted flexible wall, and means controlled by the position of said wall for automatically supplying a predetermined volume of additional gas to said container, said means comprising an electrically-operated valve and two control circuits therefor, one of said circuits being controlled by a switch actuated when the flexible wall approaches the upper limit of its travel and the other circuit by a switch actuated when the flexible wall approaches the lower limit of its travel.

2. The combination of a sealed gas container having a variable volume gas space, means forming a variable volume gas chamber connected thereto for supplying gas to said space and receiving gas therefrom said chamber having a weighted flexible wall, a source of inert gas under high pressure connected to said gas chamber, a gas shut-off valve in said connection, a pressure reducing valve between the gas shut-off valve and said high pressure gas container, and means for opening and closing said shut-off valve, said means being responsive to predetermined changes in volume of the gas chamber.

3. A gasometer apparatus for the purpose described comprising a gas-tight container having a portion of its wall formed of flexible material, and a weight element supported by said wall and provided with an upward cylindrical extension forming a bearing surface for portions of the flexible material, the weight of said extension being small in proportion to that of the portion of the weight element engaging the upper surface of the flexible wall.

4. A gasometer apparatus for the purpose described comprising a gas-tight container having a portion of its wall formed of flexible material, a weight element supported by said wall and provided with an upward cylindrical extension forming a bearing surface for portions of the flexible material, the weight of said extension being small in proportion to that of the portion of the weight element engaging the upper surface of the flexible wall, and a casing element embracing said weight element and forming therewith an annular space for receiving the exterior portions of the flexible material during rise and fall of the weight.

5. A gasometer apparatus for the purpose described comprising a gas-tight container having a portion of its wall formed of flexible material, a weight element supported by said wall and provided with a cylindrical extension, and a casing element embracing said weight element and ex-

tension in the positions of the latter under which the container capacity is either at maximum or more than half maximum and forming with the extension a narrow annular space for receiving
5 portions of the flexible wall, said casing, weight extension, and flexible wall being so related that

under said last mentioned conditions as to container capacity all of the flexible wall other than the torus portion bears either on the casing or on the weight element.

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