Sept. 28 ,.1926. 1,601,307

L. H. HILL

TRANSFORMER TANK

Original Filed August 30, 1923

Fig. 1.

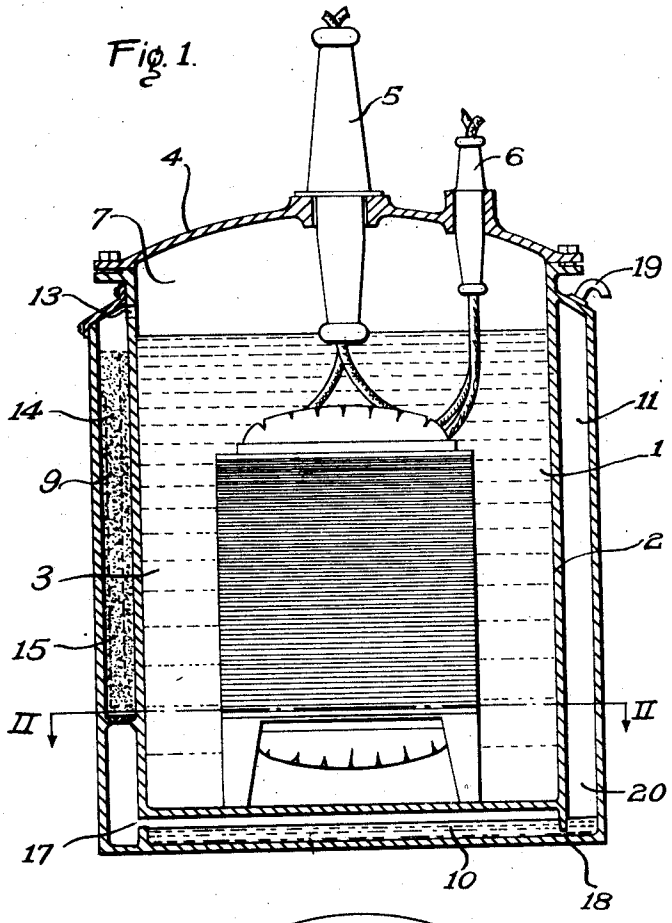
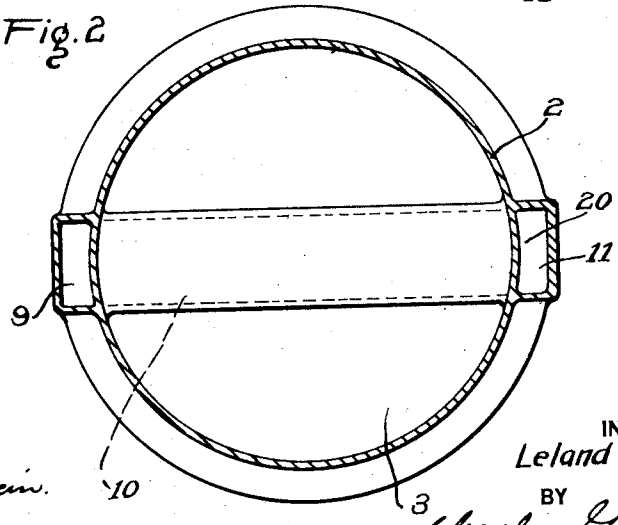


Fig. 2



WITNESSES:

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Patented Sept. 28, 1926. 1,601,307

UNITED STATES PATENT OFFICE.

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TRANSFORMER TANK.

Application filed August 30, 1923, Serial No. 660,116. Renewed February 18, 1926.

My invention relates to transformers, and it has particular relation to such transformers as embody oil for insulating the electrical apparatus from the tank or container.

My invention has, for one of its objects, to provide a liquid seal of simple construction for isolating the space above the insulating oil from the atmosphere.

A second object of my invention is to provide a liquid seal for a transformer, the structure of which is integral with that of the transformer tank.

In constructing a transformer in accordance with my invention, a series of compartments are arranged along the sides and in the base of the transformer tank. The horizontally-extending compartment in the base and one of the vertically-extending compartments contain a quantity of oil or liquid whereby they constitute a liquid seal. The other compartment contains deoxidizing material for rendering inert the air or gas within the transformer.

In the accompanying drawing,

Figure 1 is a view, partially in elevation and partially in section, of a transformer constructed in accordance with my invention; and

Fig. 2 is a view of the transformer casing in transverse section taken along the line II—II of Fig. 1.

Referring to the drawing, a transformer 1 comprises a tank 2 that is partially filled with insulating oil indicated at 3. The tank is provided with a cover member 4 from which the terminals of the transformer windings are insulated by means of suitable bushings 5 and 6. The space 7 above the insulating oil is initially occupied by ordinary air.

The tank 2 is provided with a series of communicating compartments 9, 10 and 11. The compartments 9 and 11 extend vertically along the sides of the transformer while the compartment 10 extends horizontally in the base of the tank.

The compartment 9, which communicates with the space 7 by means of an opening 13 in the wall of the tank, contains deoxidizing and dehydrating material indicated at 14 that is held within a container 15 of woven material or perforated sheet material, whereby air or gas may readily pass therethrough. The container 15 and the deoxidizing material are so arranged as to divide the compartment 9 into two parts, one of which communicates with the opening 13 and the other of which communicates through an opening 17 with the compartment 10.

The compartment 10, which is relatively shallow but of substantially the same transverse cross-sectional area as that of the compartments 9 and 11, is provided with the opening 17 at its top and with an opening 18 near the bottom thereof for communication with the compartment 11.

The vertically-extending compartment 11 is connected to the atmosphere by a suitably curved, downwardly-projecting pipe 19. The compartments 10 and 11 normally contain a sufficient quantity of oil, indicated at 20, or other suitable liquid, that is substantially equal in volume to that of the compartment 10 for a purpose to be hereinafter described.

When the transformer and its associated parts are assembled, as shown in the drawing and described above, the air within the space 7 is gradually deoxidized by the deoxidizing material in the compartment 9. If the operation has not been completed before the transformer is placed in operation, the removal of oxygen therefrom is hastened by the breathing or exchange of air between the transformer tank and the atmosphere.

It may be assumed that the transformer is being placed in operation. It may be assumed further that the temperature of the transformer is increasing by reason of the heat losses in the windings of the apparatus. The oil expands and causes a corresponding increase in pressure of the air or gas in the space 7. This pressure is transmitted through the opening 13, compartment 9 and opening 17 to the oil 20 within the compartment 10. Oil is accordingly forced from the compartment 10 into the compartment 11 until the head of oil within the latter compartment equals the pressure within the space 7.

In case the pressure rises to such degree that the level of the oil in the compartment 10 is below the upper portion of the opening 18, air or gas escapes throughout opening 18 and through the oil in the compartment 11 to the atmosphere. Upon the relief in pressure caused by the escape of gas, oil will again flow from the compartment 11 into the

compartment 10. These operations will be repeated upon each occurrence of the pressure increasing to the predetermined value at which air may escape through the opening 18.

It will be noted that the pressure required to expel air or gas from the transformer is measured by the head of oil within the compartment 11 since the pressure caused thereby is transmitted through the opening 18 to the oil within the compartment 10.

During normal operation of the transformer, the variations in pressure are comparatively slight and few or no exchanges of gas or air between the transformer and the atmosphere are necessary.

In case the temperature of the transformer falls for any reason, such, for example, as removing the load from the transformer, the volume of oil therein will diminish correspondingly. The pressure within the space 7 decreases and is lower than that of the atmosphere. Accordingly, oil flows from the compartment 11 to the compartment 10 in order to equalize the pressures therein. When the level of the oil in the compartment 11 is below the opening 18, air flows from the compartment 11 to the compartment 10 and through the opening 17 and compartment 9, including the deoxidizing material to the space 7.

The air entering the transformer in the manner just described is completely deoxidized and dehydrated by the material 14, substantially pure nitrogen entering the space 7. Sufficient oil flows from the compartment 10 to the compartment 11 to equalize the pressures after the admission of air. This process is repeated in case the fall in temperature continues.

It will be noted that the difference in pressure between the interior of the tank and the atmosphere before air is admitted to the tank is that measured by the head of oil within the compartment 10. It will be noted further that this pressure is materially less than that required before gas may be expelled from the tank. The relation of the respective pressures may be arranged as desired by suitably proportioning the horizontal cross-sectional areas of the compartments 10 and 11 in order to determine the rates at which the levels therein vary during an exchange of oil therebetween.

The provision of a liquid seal of the character described above operates automatically to control the pressures at which air or gas may be expelled from, or admitted into, a transformer tank. The limiting of exchanges of air or breathing to the occurrence of predetermined differences in pressure materially reduces the breathing during normal operation of the transformer and serves to economize in the consumption of deoxidizing material. The arrangement of the compartments along the sides and in the base of the tank economizes space and provides a simple and convenient construction.

While I have shown my invention as applied to transformers, it is equally applicable to circuit breakers and electrical apparatus of a similar nature. Various modifications will occur to those skilled in the art to which my invention appertains and it is understood that my invention is not limited except as indicated by the appended claims.

I claim as my invention:

1. The combination with a tank, of a liquid seal therefor comprising two communicating compartments and a quantity of liquid therein, said compartments being so disposed and arranged that the level of liquid therein varies at different rates upon an exchange of liquid therebetween.

2. The combination with a tank of a liquid seal therefor comprising two communicating compartments of unequal horizontal cross-sectional area and a quantity of liquid therein whereby said seal opens at different pressures in the respective directions.

3. The combination with a tank and a relatively shallow compartment having an upper opening communicating with said tank, of a relatively deep compartment connected to a lower opening in the shallow compartment and a quantity of liquid in said compartments whereby air or gas traverses said compartments at predetermined pressures in the respective directions.

4. The combination with a tank and a compartment, of means for supplying liquid to said compartment, said compartment having an upper opening communicating with the upper portion of said tank and a lower opening connected to the liquid-supplying means whereby said compartment constitutes a liquid seal that permits gas to escape from said tank at a relatively high pressure and permits air or gas to be admitted to said tank at a relatively low pressure.

5. The combination with a tank partially filled with insulating fluid, of a compartment communicating with the space above said fluid, said compartment having openings at different levels and means for supplying liquid to one of said openings whereby said compartment constitutes a liquid seal for permitting air or gas to traverse said compartment at pressures applied thereto which differ in value according to their direction.

6. The combination with a tank, of means for controlling the connection of said tank to the atmosphere, said means comprising a horizontally-extending compartment connected at its upper portion to said tank, a vertically-extending compartment connected to the lower portion of the first-named compartment, and a quantity of liquid in said compartments, whereby air or gas is ex-

pelled from said tank against the head of liquid in the vertically-extending compartment and is admitted to said tank against the head of the liquid in the horizontally-extending compartment.

7. The combination with a tank, of a liquid seal therefor comprising a compartment extending beneath the base of said tank, a second compartment extending along the side of said tank and communicating with the other compartment and a quantity of liquid in said compartments.

8. The combination with a tank, of a liquid seal therefor comprising a compartment extending beneath the base of said tank, a second compartment extending along the side of said tank and communicating with the other compartment and a quantity of liquid in said compartments, and deoxidizing apparatus connected between said tank and the first-named compartment.

9. The combination with a tank partially filled with insulating oil and deoxidizing apparatus communicating with the space above the oil, of a liquid seal for controlling the connection of said apparatus to the atmosphere, said seal comprising communicating compartments respectively in the base and on the side of the tank.

10. The combination with a tank partially filled with insulating oil, of a series of compartments along the sides and base of said tank, deoxidizing means in one compartment which communicates with the space above the oil, an intermediate compartment communicating at its upper portion to said one compartment and at its lower portion to a third compartment, said third compartment communicating with the atmosphere and a quantity of liquid in the intermediate and the third compartments.

In testimony whereof, I have hereunto subscribed my name this 23rd day of August 1923.

LELAND H. HILL.