Sept. 6, 1927. 1,641,247

R. V. BINGAY

TRANSFORMER COOLER

Filed March 26, 1921 2 Sheets-Sheet 1

Fig:1.

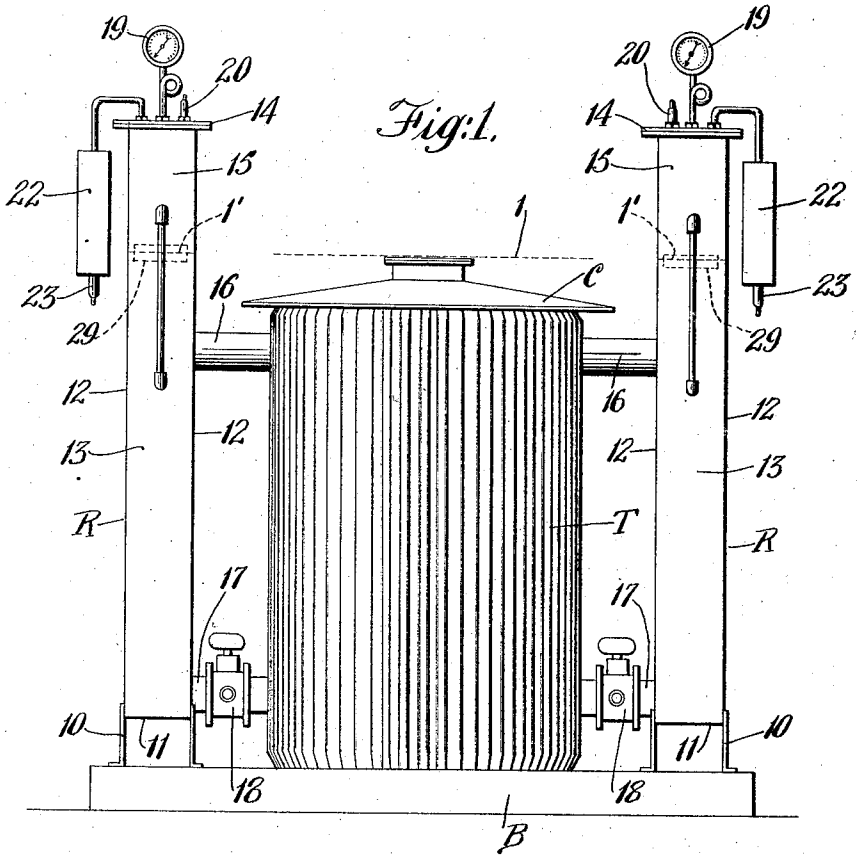
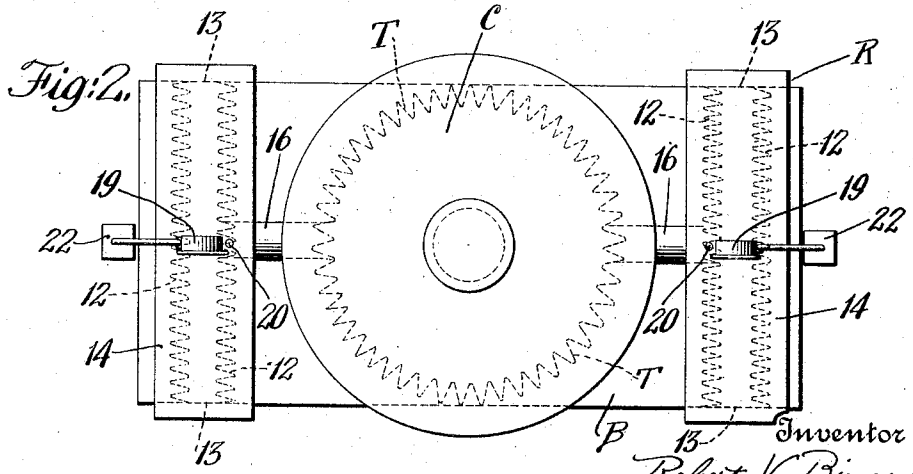


Fig:2.



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Fig:3.

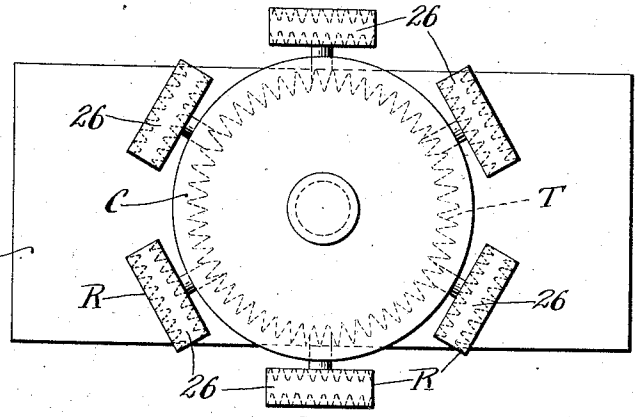


Fig:4.

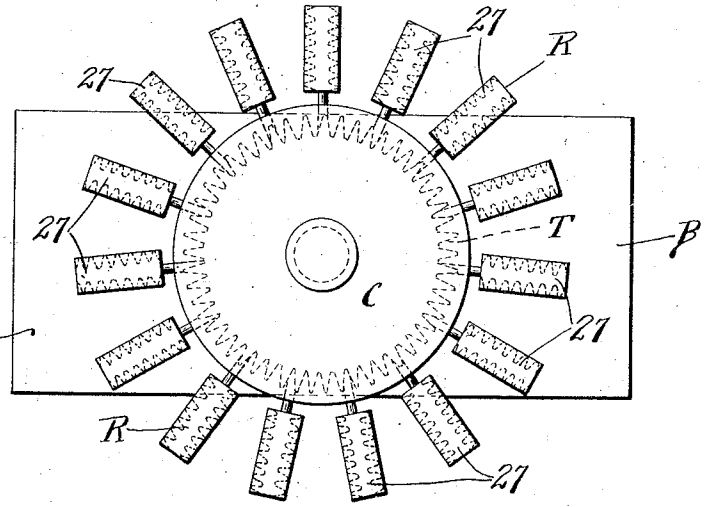
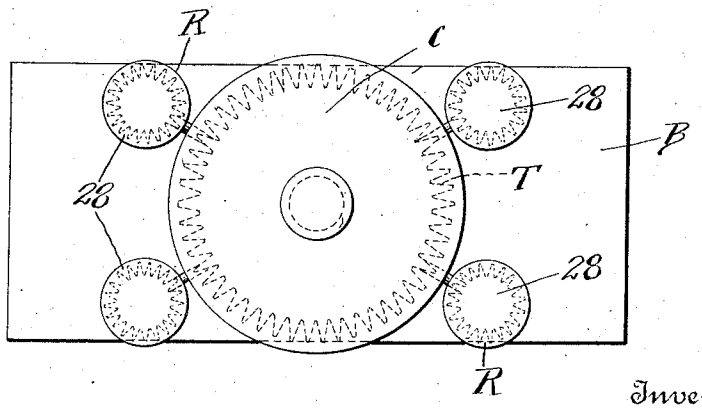


Fig:5.



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UNITED STATES PATENT OFFICE.

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TRANSFORMER COOLER.

Application filed March 26, 1921. Serial No. 456,004.

This invention relates to oil-cooled transformers and particularly to such transformers in which the transformer tank is filled with oil and sealed air tight against the entrance of air or moisture. The object of the invention is to provide means for increasing automatically the radiating surface of the tank as the need for increased radiation arises, and also to provide auxiliary means which will accommodate the expansion of the oil from the main tank when heated, but which will not be open to the danger of freezing the expanded oil in cold climates, or otherwise causing or permitting portions of the oil to lie inert, and thus subject the transformer itself to great danger.

Fig. 1 is an elevational view of a transformer illustrating one embodiment of the invention.

Fig. 2 is a plan view of Fig. 1 and

Figs. 3, 4 and 5 are plan views of modifications.

In the specific embodiment of the invention shown in Fig. 1 a main transformer tank T containing the transformer is filled with oil and sealed air tight and has a cover C provided with the usual bushings, leads and attachments, not shown. The tank T stands on the base B, and preferably supported on this same base are one or more auxiliary cooling tanks or radiators R which may be spaced from the base for instance by the legs or struts 10. Each radiator R is a tank having a bottom 11, corrugated sides and ends 12 and 13, and a top or cover 14 which is preferably removably clamped in place so that it may be detached for inspection and cleaning of the interior of the radiator.

The radiators R may be mounted as shown and will preferably extend above the top of the main tank T so that in normal unheated condition with the main transformer completely filled with oil to level 1 the corresponding level 1′ in the radiators will leave an air or gas space 15 forming an expansion and compression chamber at the top for expansion of the oil when heated. The radiators are connected to the main tank by upper pipes 16 and lower pipes 17 and suitable valves may be provided in each of these pipes. For instance the valves 18 of the lower pipes 17 may be of the three-way type—one way to close the connection between tank and radiator, another way to act as a separate oil drain for the radiator, and in third position to open connection for circulation from radiator to tank. In operation as the oil in the main tank becomes heated a circulation will be set up out of the main tank through the pipes 16 and downward in the radiators R in contact with the cooling surfaces 12, 13 and back into the main tank through the lower pipes 17. In this way large radiating area for the heated oil is provided making possible larger self cooled transformers.

As the oil in the main tank becomes heated it expands and since the main tank is already completely filled and sealed tight the additional volume of oil due to this expansion must be provided for. In the structure of this invention this expansion simply raises the level 1′ of the oil in the radiators R increasing the area of contact with the cooling walls as the heating is increased so that the hotter the oil the greater will be the cooling effect. The air or gas space 15 above the oil in the radiator may be made so large that the rising level of the oil will only partially fill it and the compression of the air or gas will be small. This expansion and compression space 15 of the radiator may itself be made sufficiently large for this purpose or it may be connected to a separate air tight tank. If the rise in pressure in space 15 is small this space may be sealed air-tight and provided simply with a pressure gage 19 and safety valve 20, and in normal operation there will be no connection between the atmosphere and the space 15, which remains sealed. By initially charging this closed space with helium or other inert gas air will be excluded altogether. Where desired however this space may be connected to the atmosphere through a breather 22 containing moisture absorbing material to dry any air drawn into space 15. An air inlet and exhaust valve 23 may be provided on the breather permitting escape of air in case of an excess of pressure in the compression space 15 and permitting air to be drawn in through the breather 22 when the pressure in space 15 drops below atmospheric. In this way the normal operation of the transformer will simply raise and lower the oil level 1′ and the pressure in chamber 15 without connection with the outside air; but in case of

abnormal rise in pressure a portion of the compressed gas will be permitted to escape from chamber 15 and will be automatically replaced by a subsequent lowering of level 1' which creates a partial vacuum in space 15 and draws air in through the breather 22.

The combined expansion tanks and radiators R of Figs. 1 and 2 are supported from the base B but in many cases it may be desirable to support these radiators from the main tank by a sufficiently rigid connection. The relative arrangement of the radiators may also be widely varied to suit the conditions of particular installations. The radiators may form a circular series facing the tank sidewise as shown at 26 in Fig. 3 or endwise as shown at 27 in Fig. 4. The radiators may also be of circular form as shown at 28 in Fig. 5 or any form best fitting into the space available around the transformer. It is not necessary that the compression space 15 should be an integral extension of the radiator walls as shown but it may be a separately formed tank structure mounted on the radiator or connected therewith in any desired manner.

The transformer of this invention combines together a radiator and expansion space simplifying and cheapening the construction. The varying level of oil in the radiator thus automatically supplies more radiating surface when needed and reduces the radiating surface as the oil becomes cooler. The radiator and the circulation of the oil through it maintain a permanently open connection between the main tank and the expansion space. The oil is kept hot and fluid, so that it will not thicken in cold weather and obstruct the free flow necessary to permit expansion and contraction. Any such obstruction causes serious over-pressure during expansion and during contraction forms a partial vacuum in the main tank drawing in air and moisture through any weak points in the sealing means and forming a mixture of air and oil vapor in very dangerous manner. The expansion means of this invention permanently maintains the main tank free from air and oil vapor so that there is no opportunity for any short circuit flash to cause an explosion. The area of oil surface exposed to air is small and, as indicated in dotted lines in Fig. 1 may be further reduced by a float 29 on the oil. Where there are a number of radiators for instance as in Figs. 3–5 it is not necessary to provide an expansion chamber 15 in each radiator but only in a sufficient number of them to give the desired space. In normal operation the system is completely sealed against the admission of air thus avoiding oxidation and the opportunity for the entrance of moisture. The separate radiators spaced from the tank leave the main tank cover free and unencumbered so that clear space is afforded for the bushings and leads and for access to and removal of this cover and its parts.

I claim:—

1. The combination with a tank adapted to contain a transformer core and coils immersed in oil, an auxiliary radiator at the side of said tank, a connection from said tank to the top of said radiator and a connection from the bottom of said radiator to said tank, of a cover tightly fitting said tank and an auxiliary expansion chamber connected to said tank below said cover and adapted to permit an overflow of oil from said tank.

2. The combination with a transformer tank adapted to contain a transformer immersed in oil, of a radiator at the side of said tank, a connection from said tank to the upper portion of said radiator and a connection from said radiator to the lower portion of said tank for circulating and cooling said oil, said radiator having its top extended above the level of the oil in said tank to form an expansion chamber permitting an overflow of oil from said tank.

3. The combination with a tank adapted to contain a transformer core and coils immersed in oil, of a cover tightly fitting said tank and an auxiliary expansion chamber having its upper portion connected to said tank below said cover and adapted to permit an overflow from said tank, and means whereby heat in the main tank maintains circulation in said auxiliary tank comprising a connection from said auxiliary tank to the lower portion of said main tank.

4. The combination with a transformer tank adapted to contain a transformer immersed in oil, and having a fluid tight cover adapted to contact with and retain said oil when said tank is full, of a separate expansion tank adapted to receive the overflow of oil due to the expansion of the oil when heated and located at the side of said main tank with an upper supply connection and a lower return connection thereto, connecting means from the interior of said expansion tank to the air adapted to normally maintain nearly atmospheric pressure on the surface of said oil in said expansion tank, and a protective float member freely floating on the surface of the oil in said expansion tank so as to reduce the contact of said oil with the air.

5. The combination with a transformer tank adapted to contain a transformer immersed in oil, and having a fluid tight cover adapted to contact with and retain said oil when said tank is full, of a separate expansion tank adapted to receive the overflow of oil due to the expansion of the oil when heated and located at the side of said main tank with an upper supply connection and a lower return connection thereto, and con-

necting means from the interior of said expansion tank to the air adapted to normally maintain nearly atmospheric pressure on the surface of said oil in said expansion tank.

6. The combination with a main tank adapted to contain a transformer core and coils immersed in oil, of an auxiliary radiator tank having its lower portion connected to the lower portion of the main tank to return cooled oil thereto, and its upper portion connected to the upper portion of the main tank and having an upward extension above said upper connection so that there is an upper space for inflowing hot oil to the radiator to flow first upwardly above said upper connection and then downwardly to said lower connection.

7. The combination with a main tank adapted to contain a transformer core and coils immersed in oil, of an auxiliary cooling and expansion means comprising a radiator having its upper portion connected to the upper portion of the main tank to receive hot oil therefrom, an expansion space at the top of said radiator permitting the level of the oil to rise therein, and a return connection from the lower portion of said radiator to the lower portion of said main tank, said return connection being above the bottom of said radiator, so that any moisture collecting in said expansion space and passing down through said radiator will be trapped at the bottom thereof.

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