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J. B. HODTUM

1,706,574

ELECTRIC TRANSFORMER

Filed March 15, 1927

Fig. 1.

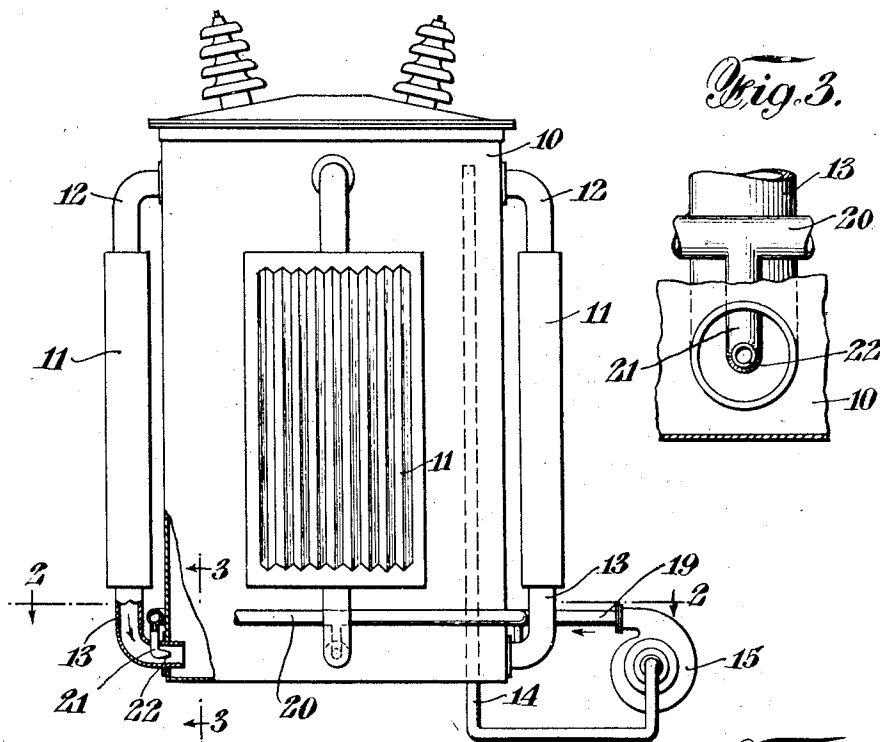


Fig. 3.

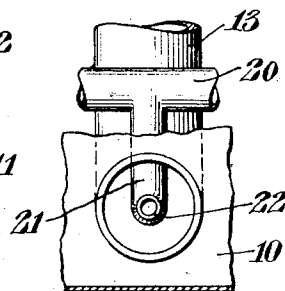


Fig. 2.

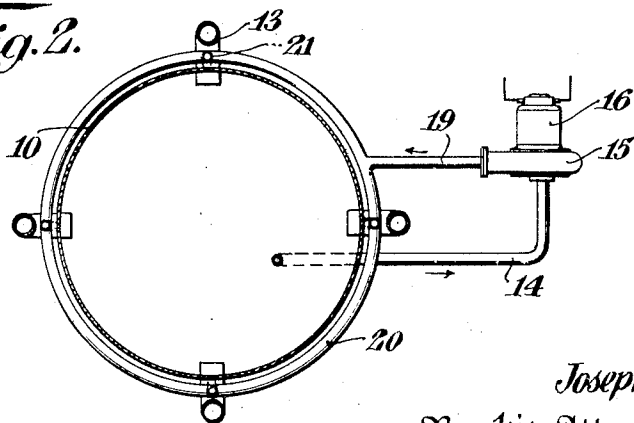
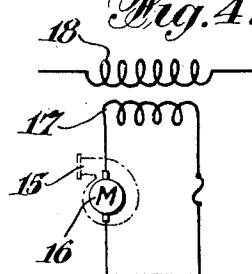


Fig. 4.



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UNITED STATES PATENT OFFICE.

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ELECTRIC TRANSFORMER.

Application filed March 15, 1927. Serial No. 175,457.

This invention relates to electric transformers which are adapted to be immersed in oil contained in a tank or casing and more particularly to means for circulating the oil through the tank.

I have found that it is important to maintain a high rate of circulation of the oil within a transformer tank for the purpose of more rapidly cooling the oil which is heated by the working of the transformer contained in the tank. This increases the rate of radiation of the heat and maintains lower temperature at the transformer.

The object of the present invention is to provide a system for maintaining and increasing the rate of circulation within the transformer tank to effectively and rapidly cool the oil heated by the operation of the transformer immersed in the oil within the tank.

A further object of the invention is to combine the system with the transformer circuits in such a way that the rapidity of the circulation will vary with the load increasing with an increasing load and decreasing with a decreasing load.

Further objects and advantages will be apparent from the following specifications and the accompanying drawings in which

Figure 1 is a side elevation of a transformer tank with portions broken away to more clearly illustrate the invention, and

Figure 2 is a sectional view taken on line 2-2 of Figure 1.

Figure 3 is an enlarged sectional view on line 3-3 of Figure 1, and

Figure 4 is a diagrammatical view of the blower motor connection to the transformer.

In the drawings a tank 10 adapted to contain oil and the electric apparatus immersed therein is provided with a series of radiators 11 communicating with the interior of the tank. The radiators 11 communicate with the interior of the tank 10 by means of oil passages or connections 12 at the top and oil passages or connections 13 at the bottom of the tank. The oil within the tank on being heated by the operation of the electric apparatus therein will expand and rise to the top of the tank, pass out through connection 12 to radiators 11 where it is cooled and returned to the tank through the connections 13 at the bottom, thus completing the cycle of circulation for cooling the oil.

To increase this rate of natural circulation

of the oil a portion of the oil is withdrawn from the tank through pipe connection 14 entering the interior of the tank at the bottom and which extends above the bottom of the tank and terminates adjacent the top of the tank. The pipe connection can be so situated that the oil may be withdrawn from any part of the tank and the position of the pipe connection 14 as shown in the drawings is merely one illustrative position of the same. The pipe connection 14 is attached to the suction or inlet of an oil pump 15 which is operated by an electric motor 16. The motor 16 is connected to the secondary winding 17 of the transformer contained within the tank. The primary winding 18 of the transformer is in series with the load so that the speed of the motor 16 will vary with the load. It will be readily seen that the speed of the motor 16 which drives the circulating oil pump 15 will vary with the load on the transformer and the circulation of the oil varied accordingly. The oil is forced under pressure by the oil pump through a pipe connection 19 connected to the outlet of the pump. The pipe connection 19 merges into and is connected to an annular header 20 encircling the bottom of the tank adjacent to and above the radiator connections 13. The oil is therefore forced through the annular header 20 circulating about the tank. This annular header is provided with downwardly extending injector tubes 21 at each radiator connection 13 which enter the connections through a fluid tight joint and are provided with inwardly directed tips or nozzles 22 located at the centre of the connection 13 where the connections are attached to the transformer casing.

It is apparent that the oil on being forced through the injector tubes 21 under pressure and at a greater velocity than the oil passing through the connections 13 by normal circulation will impart energy to the oil surrounding the tips 22 causing an increase in the velocity of oil passing through the connections 13, consequently causing an increased rate of circulation throughout the entire circulating system, thus providing an increased rate of cooling of the oil and a more efficient operation of the electric apparatus contained within the tank.

In the circulatory system of this invention a single pump is used to draw increased circulation through each of the radiators with-

out in any way impairing or interfering with the natural gravity circulation. Where the pump drive is connected to vary in speed with the load the circulation is also automatically controlled to have a maximum effect when the greatest cooling is required, at the same time saving in current and avoiding excessive cooling at low loads and stopping the power circulation automatically when the transformer load is substantially cut off. In case of failure of the pump or with very low loads or no load the natural gravity circulation through the cooling tanks will come into full effect maintaining a cooling circulation sufficient to avoid dangerous rise in the temperature transformer.

I claim:

1. A transformer tank adapted to contain oil, a transformer in said tank, radiators for said tank having top and bottom connections to the interior of said tank, injector tubes connected to the interior of the bottom connections of said radiators for increasing the circulation of the oil within the tank.

2. A transformer tank adapted to contain oil, a transformer in said tank, radiators for said tank having top and bottom connections to the interior of said tank, injector tubes connected to the interior of the bottom connections of said radiators for increasing the circulation of the oil within the tank and means for forcing the oil through said injector tubes in proportion to the load on the transformer.

3. A transformer tank adapted to contain oil, a transformer in said tank, radiators for said tank having top and bottom connections to the interior of said tank, injector tubes connected to the interior of the bottom connections of said radiators for increasing the circulation of the oil within the tank and an oil pump for forcing oil through said injectors.

4. A transformer tank adapted to contain oil, a transformer in said tank, radiators for said tank having top and bottom connections to the interior of said tank, injector tubes connected to the interior of the bottom connections of said radiators for increasing the circulation of the oil within the tank and an oil pump for forcing the oil through said injector tubes in proportion to the load on the transformer.

5. A transformer tank adapted to contain oil, a transformer in said tank, radiators for said tank having top and bottom connections to the interior of said tank, injector tubes connected to the interior of the bottom connections of said radiators for increasing the circulation of the oil within the tank and means

operated by said transformer for forcing the oil through said injector tubes in proportion to the load on the transformer.

6. A transformer tank adapted to contain oil, a transformer in said tank, radiators for said tank having top and bottom connections to the interior of said tank, injector tubes connected to the interior of the bottom connections of said radiators for increasing the circulation of the oil within the tank and an oil pump connected to said tank for removing oil therefrom and forcing it through said injector.

7. A transformer tank adapted to contain oil, a transformer in said tank, radiators for said tank having top and bottom connections to the interior of said tank, an annular header, injector tubes protruding from said header and extending into the radiator connections adjacent to the bottom of the tank and an oil pump for forcing oil from said tank through said header and injector tubes to increase the rate of circulation of the oil through the interior of the tank.

8. A transformer tank adapted to contain oil, a transformer in said tank, a radiator for said tank having top and bottom connections to the interior of said tank said radiator and tank constituting an oil circuit, means for increasing the flow in said circuit comprising a conduit extending from a point at one level of the oil in said tank to another level, said conduit terminating at said other level in one of said connections and having its discharge opening directed in the normal direction of flow in said circuit, and a pump interposed in said conduit.

9. A transformer tank adapted to contain oil, a transformer in said tank, a radiator for said tank having top and bottom connections to the interior of said tank, said radiator and tank constituting an oil circuit, and an injector tube disposed in one of said connections, said tube being directed in the normal direction of flow in said circuit for increasing said flow.

10. A transformer tank adapted to contain oil, a transformer in said tank, a radiator for said tank having top and bottom connections to the interior of said tank, said radiator and tank constituting an oil circuit, an injector tube disposed in one of said connections, said tube being directed in the normal direction of flow in said circuit for increasing said flow, and an oil pump connected to said tank for removing oil therefrom and forcing it through said injector.

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