

July 28, 1925.

1,547,570

L. L. ELDEN

TRANSFORMER

Filed July 21, 1922

Fig. 1.

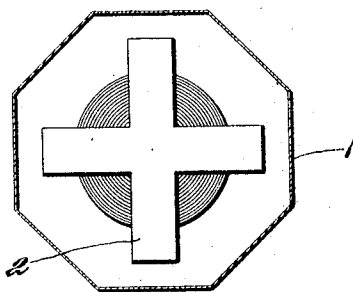
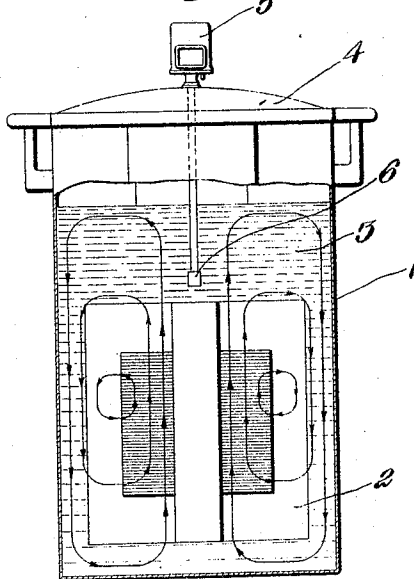


Fig. 2.



Witness:

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by his attorney

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Patented July 28, 1925.

1,547,570

UNITED STATES PATENT OFFICE.

LEONARD L. ELDEN, OF BROOKLINE, MASSACHUSETTS.

TRANSFORMER.

Application filed July 21, 1922. Serial No. 576,486.

To all whom it may concern:

Be it known that I, LEONARD L. ELDEN, a citizen of the United States, residing at Brookline, in the county of Norfolk and State of Massachusetts, have invented certain new and useful Improvements in Transformers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to an improvement in transformers.

One of the most important features in the design and construction of oil cooled transformers is the provision for free circulation of the oil around and through the transformer coils when assembled within the transformer case. This is accomplished by providing suitable passages or spaces between and through the layers of the transformer windings to facilitate the circulation of the cooling oil either horizontally or vertically or in both directions around and through the coils as may be found best adapted to each design. When the coils of the transformer are energized, heat is developed in the coils, and the heat thus developed is transferred to the oil causing the particles of oil thus heated to rise to the surface. The circulation of the oil within the transformer case which is thus created conforms to very precise rules, viz, the oil in direct contact with the transformer coils having become heated by such contact rises vertically to the top of the oil body, flows to the sides of the case and falls as it is cooled by contact with the case due to radiation of the heat from the outside of the case to the surrounding atmosphere. The oil continues to flow to the bottom of the case as it is cooled where it again rises to circulate through and around the transformer coils as heated oil in contact with the coils above is caused to rise and circulate as first described.

The applicant has ascertained that as a consequence of this process the location in which the oil is the hottest is always at a point directly over the coils and in close proximity thereto.

Experience has also shown that while considerable differences in the temperature of the oil may be observed at different locations within transformer cases due to normal conditions of circulation and radiation, the temperature of the oil directly over the coils con-

sistently follows the changes in the temperature of the coils as affected by loading or any other conditions. It has also been found that the temperature of the oil in transformers is markedly affected locally by direct sunlight, winds and deposits of snow. For example differences as great as 15° F. have been noted in the oil adjacent to the windward and leeward sides of the transformer case, due solely to the heating or cooling effect of the wind. Similar results follow from exposure to the sun, the oil in the case on the shady side being materially cooler than the oil adjacent to the side exposed to the sun. Transformers installed in subway manholes are frequently partly immersed in water, this usually reducing the temperature of the oil in the bottom of the case materially below what it would have been under normal conditions of circulation. Retarded circulation due to plugged oil ducts or sludging oil frequently results in local heating in one side of the transformer, with consequent distortion of oil temperatures.

It is also important to note that the variations in coil and oil temperatures in transformers due to loading conditions do not follow any exact rule, being affected by factors other than those noted above, for example, size and design of transformer cases with respect to the capacity of transformers and quantity and density of oil within the case. Rapidly fluctuating loads do not produce the same degree of heating as steady loads, in fact the heating effect of fluctuations of short duration extends but a short distance away from the coils into the oil, thus making it impossible to measure the full effects of such loading in any position other than over the coils, a point to which any heated oil naturally flows.

However, regardless of any and all conditions tending to affect or distort the oil temperatures in transformer cases, the hottest spot in the oil will always be found directly over the coils and in close proximity thereto.

In view of all of these conditions, the use of overload indicating apparatus or semaphores designed to exhibit a signal or signals upon the occurrence of a critical temperature, which by experience has been found to be dangerous to the insulation of transformer coils, has been found to be of great value.

Since the temperature of the transformer coils is reflected in the temperature of the

oil, it is therefore important that the heat sensitive element of the semaphore or overload indicating apparatus used in connection with transformers be located where the temperature of the oil is highest at all times and most significant of danger to the insulation of the coils.

This location as previously described, is in a position directly over the coils and in close proximity thereto. It will be obvious that with the heat sensitive element of a semaphore or overload indicator placed in this preferred position, the actual temperature of the oil at its hottest point will be more accurately recorded than can possibly be the case, with the heat sensitive element inserted into the oil within the case in a position adjacent to the side wall of the case, or inserted through the drain plug into the oil in the bottom of the case.

Further, with the heat sensitive element of a semaphore or overload indicator maintained in the preferred position, it will at all times record the highest oil temperature regardless of all external or internal conditions, making it unnecessary to provide for any adjustment of the tripping mechanism of the indicator to compensate for daily or seasonal variations in the outside temperature.

The object of the invention is to produce a construction in which the transformer is so constructed that the indication of overload or excessive heating from any cause will be most accurately indicated under all conditions of use. To the above end the present invention consists of a transformer hereinafter described and particularly defined in the claim.

In the accompanying drawing illustrating the preferred form of the invention, Fig. 1 is a section taken through the transformer case below the leads and above the oil body; Fig. 2 is a vertical sectional elevation of the transformer, showing the upper part of the transformer in side elevation, and the remainder in sectional elevation with the semaphore in position.

The illustrated embodiment of the inven-

tion is described as follows: The transformer casing 1 contains the transformer coils 2, which are immersed in a body of oil 3. The casing is provided with a cover 4, and in the center of the cover is the semaphore or overload indicating apparatus 5, such for example as is shown in the application of T. Donald Adair, Jr., Serial No. 459,574, to which, by permission, reference may be had.

The heat sensitive element 6 of the semaphore is located in the oil body directly over the coils and in close proximity thereto, and therefore in a position where, under all conditions, the temperature of the oil will be hottest. Thus the semaphore or overload indicator will indicate the critical temperature of that part of the oil in the transformer case which will in all cases be the very hottest part of the oil body and will therefore soonest indicate danger to the insulation of the transformer coils.

It will be understood that the heat sensitive element of the semaphore or overload indicating apparatus need not always be inserted through the cover but may be inserted through other portions of the case to reach the preferred position herein described and accomplish the desired results.

In the drawings are shown by arrow lines the circulation of oil within the transformer case. Those rising from the center have been for the longest time in contact with the heated coils of the transformer and will be hottest, while the particles at the bottom of the transformer case will be coolest.

Having thus described the invention, what is claimed is:

A transformer having, in combination, a casing, transformer coils within the casing, a body of oil in which the coils are immersed, and a semaphore supported by the casing, and having its heat sensitive element located so that semaphore indications are substantially unaffected by ambient temperature changes viz: located in the oil body directly over the coils and in close proximity thereto.

LEONARD L. ELDEN.