April 3, 1951 J. B. WADHAMS 2,547,065

FLUID COOLED CORE FOR ELECTROMAGNETIC APPARATUS

Filed Oct. 30, 1947

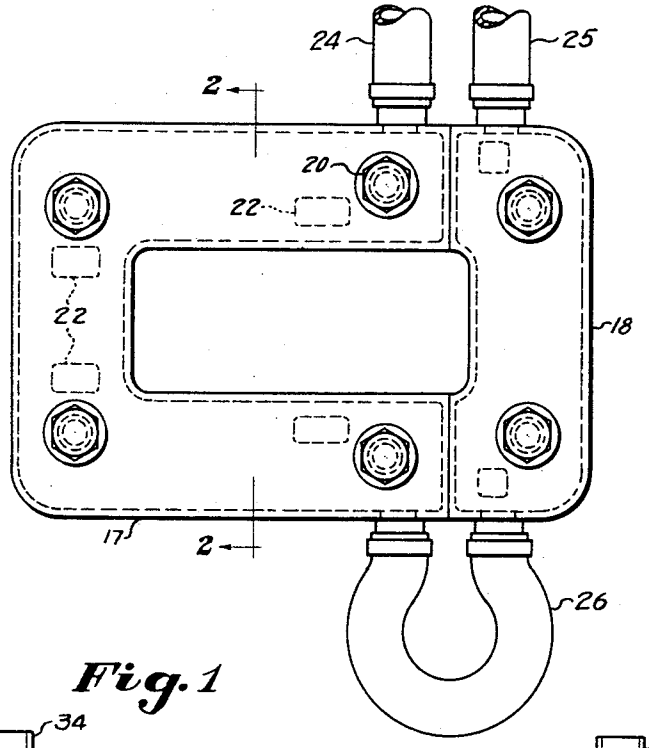

Fig. 1

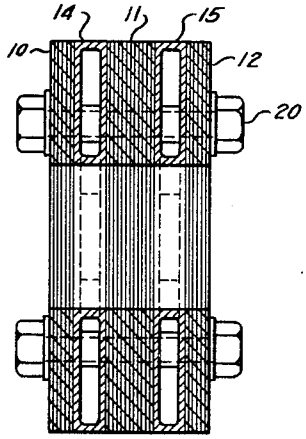

Fig. 2

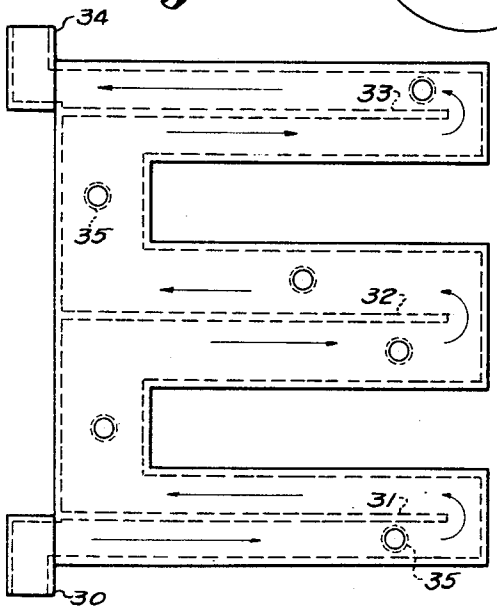

Fig. 3

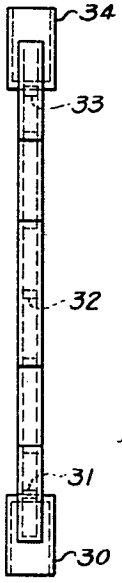

Fig. 4

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Patented Apr. 3, 1951

2,547,065

UNITED STATES PATENT OFFICE

2,547,065

FLUID COOLED CORE FOR ELECTRO-MAGNETIC APPARATUS

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Application October 30, 1947, Serial No. 783,086

3 Claims. (Cl. 175—356)

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The present invention relates, as indicated, to a fluid cooled core for electro-magnetic apparatus and is well adapted to cooling cores of transformers, particularly laminated cores of transformers for high frequency current. It is adaptable to cores of many sizes but primarily to cores of the type known as E-shaped cores.

Maximum loading of a transformer, for instance, is usually limited by the temperature to which its insulation is submitted. When this insulation reaches a certain maximum temperature, application of power must be discontinued to provide a period in which excess heat in the core can be transferred therefrom by conduction or radiation. Such heating is particularly serious at high frequencies and requires that the apparatus be either loaded to only a part of its desired capacity or loaded for only a part of the time. This results in large, costly and cumbersome apparatus for continuous use.

To reduce the size and cost of electro-magnetic apparatus having laminated cores and to increase convenience of use of such apparatus, artificial means for cooling the laminations is extremely desirable. Hollow laminations water filled in which the water is circulated in one end and out the other have heretofore been proposed for this purpose. However, with the E-shaped cores, there is provided a discontinuous path for the flow of water and difficulty has been experienced with the formation of dead pockets in the cooling lamination, particularly at the end of the center leg of the E-shaped core where poor circulation of the water was obtained and steam pockets tended to form. The present invention eliminates dead pockets in the flow of the cooling medium from one end of the laminations to the other and, in particular, forces a flow of water up one side of the center leg of the cooling lamination and down the other side.

Accordingly, the chief object of this invention has been to provide improved fluid means for cooling laminations of such apparatus. A further object has been to provide cooling means which can be readily assembled with the laminations when the core is constructed. An additional object has been to provide means for uniformly distributing the cooling effect of the cooling means. Another object has been to provide a laminated core for electromagnetic apparatus which can be constructed inexpensively and which occupies a greatly reduced space.

Another object of the invention is the provision of a cooling lamination for an E-shaped magnetic core which includes a hollow center leg having

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an interior partition extending from the base of the leg up to but spaced from the end of the leg whereby a cooling medium circulated through the cooling lamination must traverse the entire length of the center leg.

With these and other objects in view the said invention then consists of an electro-magnetic core, a preferred embodiment of which is shown in the annexed drawing and hereinafter described.

In said annexed drawing:

Fig. 1 is an elevational view of a transformer core embodying the present invention, the core shown being of the rectangular type.

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1.

Fig. 3 is an elevational view of a modified fluid cooled lamination embodying the present invention for transformer having E-shaped cores.

Fig. 4 is an end plan view of Fig. 3.

Referring now to Fig. 1 and Fig. 2, the core as shown comprises three groups of thin iron laminations 10, 11 and 12 separated by hollow copper plate-like chambers 14 and 15 of limited thickness which replace other groups of iron laminations and which themselves are of the same general form as the iron laminations. The core shown comprises a generally U-shaped member 17 with a straight bar or keeper 18 to complete the magnetic circuit although it may take any conventional shape. The hollow cooling plates are usually constructed of sheet copper having a thickness of the order of one thirty-second of an inch with a space therebetween usually of the order of one-eighth of an inch or less for circulation of the cooling fluid which is usually water, oil, or other liquid or may be a gas. The cooling chambers 14 and 15 are held in firm heat conducting contact with the groups of iron laminations 10, 11 and 12 by bolts such as 20 passing entirely through the stack of laminations. To resist the pressure applied by the bolts and to prevent the chambers from collapsing under this pressure, spacers such as 22 are inserted between the sheets of each chamber, usually near bolts 20. These spacers and the bolts are so located as not to interfere with a free circulation of the cooling fluid in each chamber.

The fluid circuit through each cooling plate comprises an inlet 24, an outlet 25 and a flexible hose 26 connecting the U-shaped member and keeper 18. This construction permits the keeper to be moved out of position so that the core can be readily inserted into the coils or windings with which it cooperates.

Figs. 3 and 4 illustrate a hollow cooling plate or chamber for use in cooling an E-shaped core. As indicated by the arrows, the cooling fluid enters through inlet **30** and by means of baffles **31**, **32** and **33** which lie generally centrally in each leg, is forced to flow through all legs of the E before leaving the plate through outlet **34**. These baffles are usually made of sufficient thickness to serve as spacers between opposite walls of the chamber to resist pressure applied in effecting the assembly of the core by bolts passing through tubular thimbles **35**.

It will be apparent to those skilled in the art that changes can be made in the construction of the apparatus herein disclosed without departing from the scope of the following claims, which claims are for the purpose of defining those parts of the invention which differ from earlier contributions to the art.

What I claim is:

1. A core for electromagnetic apparatus comprised of a plurality of stacked magnetically-permeable laminations each having a base section defined by a first edge and a second edge and three parallel leg sections extending from the first edge in spaced, parallel relationship and having ends remote from said first edge, a cooling lamination identically shaped to said magnetic laminations and interposed therebetween and having corresponding edges, said cooling lamination being comprised of a pair of spaced side members interconnected at their edges by an edge member and together defining a hollow interior, means for circulating cooling fluid through said cooling lamination, and a partition member extending in the hollow interior, from the second edge intermediate the edges of said center leg substantially to but spaced from the end of said center leg section whereby cooling fluid circulated through said cooling lamination must traverse substantially the entire length of said center leg.

2. The combination of claim 1 wherein said other legs have partitions extending from said second edge in the hollow interior substantially to but spaced from the ends thereof, and cooling-water inlet ports located adjacent the ends of said second edge, whereby cooling fluid circulated in all three legs must travel the length of each leg twice and dead pockets are eliminated.

3. A two-piece core for electromagnetic apparatus having a main winding-receiving portion having at least a pair of legs and a keeper portion in abutment with the ends of said legs to provide a flux path therebetween, said portions each comprising in combination a group of magnetic laminations, a heat-conducting member lying in contact with each group of laminations, each of said heat-conducting members comprising a generally hollow metallic member conforming generally with the laminations, and means interconnecting the interior of said conducting member associated with said winding-receiving portion and the interior of said conducting member associated with the keeper portion.

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