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2,523,072

MAGNETIC CORE

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Fig. 1.

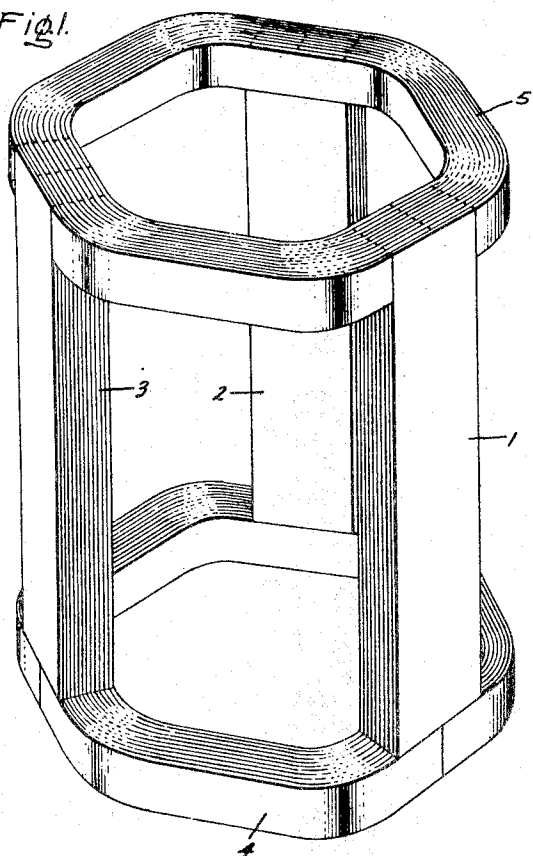


Fig. 2.

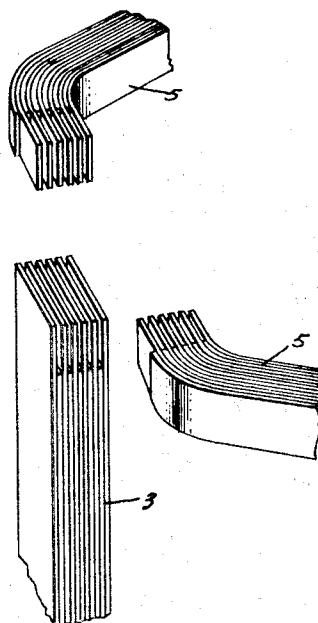


Fig. 3.

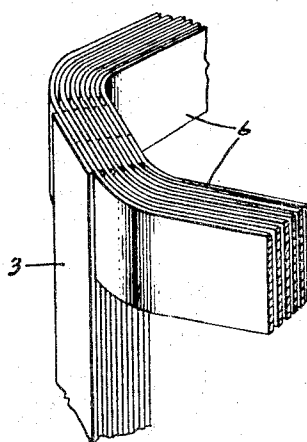
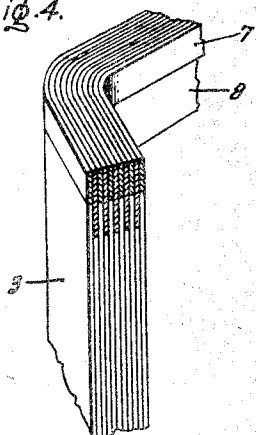


Fig. 4.



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MAGNETIC CORE

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1 Claim. (Cl. 175—356)

1

This invention relates to magnetic cores and more particularly to improvements in unitary three phase magnetic cores for stationary electric induction apparatus, such as transformers and reactors.

An object of the invention is to provide a new and improved magnetic core.

Another object of the invention is to provide a new and improved method of making a magnetic core.

A further object of the invention is to provide a new and improved unitary magnetic core for three phase induction apparatus.

A still further object of the invention is to provide a new and improved method of making a three phase magnetic core.

The invention will be better understood from the following description taken in connection with the accompanying drawings and its scope will be pointed out in the appended claim.

In the drawings, Fig. 1 is a perspective view of an embodiment of the invention; Fig. 2 is a detailed exploded view which illustrates the joints between the leg and yoke portions of the core; Fig. 3 is a modification which illustrates a lower loss type joint between the leg and yoke portions of the core, and Fig. 4 is another modification for accomplishing a purpose similar to that of Fig. 3.

Referring now to the drawings and more particularly to Fig. 1, the core is shown as comprising three straight laminated leg portions 1, 2 and 3. These legs are parallel to each other and their relationship in space may be described by likening them to elements of a right circular cylinder which are equally or symmetrically spaced with respect to each other. The ends of the legs 1, 2 and 3 are joined by closed loop laminated yoke members 4 and 5. The laminations of all the members are preferably made from grain oriented magnetic strip material having a highly favorable magnetic direction along their length. One such material is high reduction, cold rolled silicon strip steel.

The three legs which are all the same and whose laminations may all be the same width and length are made by lengthwise staggering or offsetting alternate laminations or groups of laminations. As shown most clearly in Fig. 2, alternate laminations are offset so that when considered from left to right, the odd numbered laminations extend lengthwise beyond the even numbered laminations. At the other end, the reverse will be true and the odd numbered laminations will be the short ones relative to the even numbered laminations. However, as indicated

2

above, it is not essential that the alternate laminations be staggered. For example, the staggering may be made to occur in groups of 2, 3, 4 or any suitable number of laminations.

5 The yokes are preferably made according to the teachings of my prior applications, Serial No. 536,749, filed May 22, 1944, now Patent No. 2,456,458, granted December 14, 1948, and assigned to the present assignee. Briefly, the method comprises cutting the pieces from a long strip of magnetic material in progressively changing lengths and assembling them in a jig in such a way that there are three pieces per layer with the ends of the pieces in each layer making abutting contact and with the abutting contacts of the ends of the pieces in adjacent layers or groups of layers being staggered. By applying pressure to the assembled laminations, the yoke portions 4 and 5 may be formed in the shape shown. Prior to the assembling of the core, the core and yoke portions are strain relief annealed and it will be observed that with the parts illustrated in the drawing, very good space factor in the annealing oven is obtained because the legs 6 are straight and can be packed very completely in the oven. Similarly, the yokes 4 and 5 will also occupy relatively small space and will have a substantially smaller diameter than in the finished core because the ends of the three parts making up each yoke will be fitted together instead of being expanded so as to join the legs as in the finished core.

After the annealing operation, the three equally curved laminated parts which form each yoke and which join each other with butt and lap joints are separated by pulling them apart, as shown most clearly in Fig. 2, and their staggered ends are interleaved with the staggered ends of the leg portions of the core so as to form lap joints as shown at the top of Fig. 1. In performing this latter operation, it will be found that a part of the outer layer of the yokes can be discarded so that, as shown in Fig. 2, the outer layer of the yoke will have two short portions which abut against the sides of the outer layer of the leg whereas the second outermost layer of the yoke will have two long laminations which fit in between the first and third laminations of the leg. These make butt contact at the bottom with the second lamination layer of the leg and make butt contact with each other at their ends, as shown in Fig. 1.

It has been found that the width of the yoke portions need only be about one-half the width of the leg portions for substantially uniform flux

3

density in the various parts of the core. This is because of the vector relation of the leg and yoke fluxes which results in the total value of the yoke flux being substantially less than the value of the flux in its legs.

In the modification shown in Fig. 3, the yoke is made somewhat differently so as to reduce the reluctance and losses in the joints. Thus, it will be observed that in Fig. 1 every other lamination layer in the yoke has two joints where it joins a leg. The number of these joints is reduced in Fig. 3 by utilizing a yoke which is substantially as wide as the legs and having the yoke spongy. That is to say, only one-half as many lamination layers are in the yoke as in the leg portions of the core but because of the width of the yoke, the flux density will be the same as in Fig. 1. The spongy yoke of Fig. 3 is indicated at 6 and with this construction it is unnecessary to have lap joints between the ends of the portions forming the yoke so that these ends may be all butt joints as indicated in Fig. 3 by the fact that the joints are all in line with each other. Yoke 6 may, however, be made in essentially the same way as the yokes 4 and 5. The leg 3 in Fig. 3 is the same as the legs in Fig. 1.

In the modification shown in Fig. 4, the yoke is solid but the alternate lamination layers are of different widths 7 and 8. The sectional part of Fig. 4 is taken on the center line of the leg and the joints in the yoke portions will be in this plane. The staggered ends of the leg 3 fit in between the staggered bottom part of the yoke which results from the alternately different width lamination layers forming it. In this manner, the number of individual joints is reduced below that shown in Fig. 1.

While there have been shown and described particular embodiments of the invention, it will be obvious to those skilled in the art that changes and modifications can be made without departing from the invention and therefore it is aimed in the appended claim to cover all such changes and modifications as fall within the true spirit and scope of the invention.

4

What I claim as new and desire to secure by Letters Patent of the United States is:

A three phase magnetic core comprising, in combination, two similar hexagonally shaped yokes coaxially spaced from each other, each yoke comprising three similar laminated members each having a straight central part between integral straight end portions which make equal angles with the central part, the laminations of the yoke members being radially nested and having alternately extending end portions, and three straight parallel laminated leg members, the laminations of the leg members being flat and being arranged to form alternately extending end portions, the end portions of each leg being interleaved respectively with the end parts of two yoke members, the number of leg laminations being equal to the number of yoke laminations, the width of the leg laminations being substantially twice the width of the yoke laminations.

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