July 25, 1950 J. J. VIENNEAU 2,516,165

METHOD OF MAKING THREE-PHASE MAGNETIC CORES

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Fig. 1.

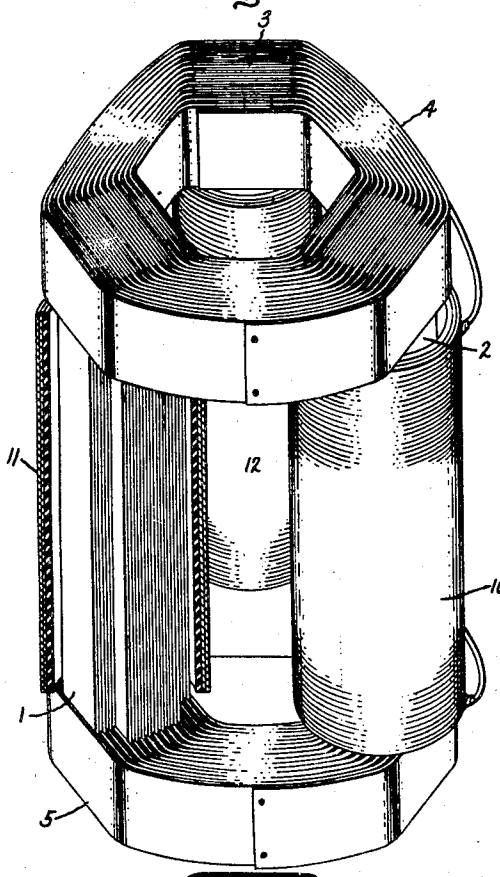
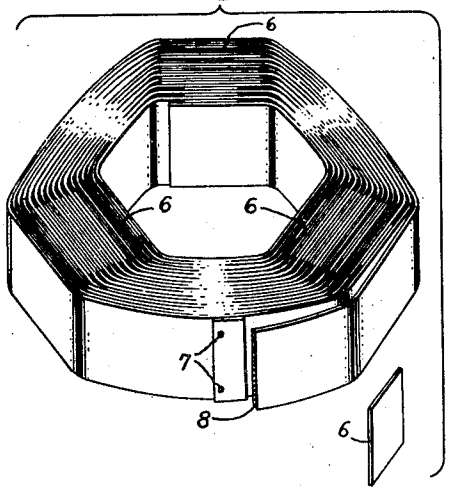


Fig. 2



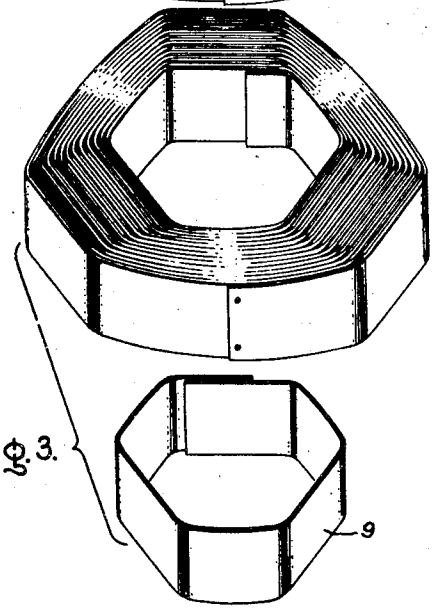
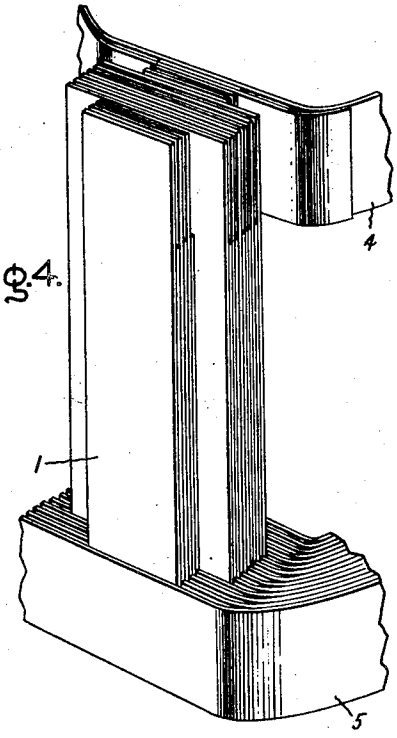


Fig. 3.

Fig. 4.



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Fig. 5.

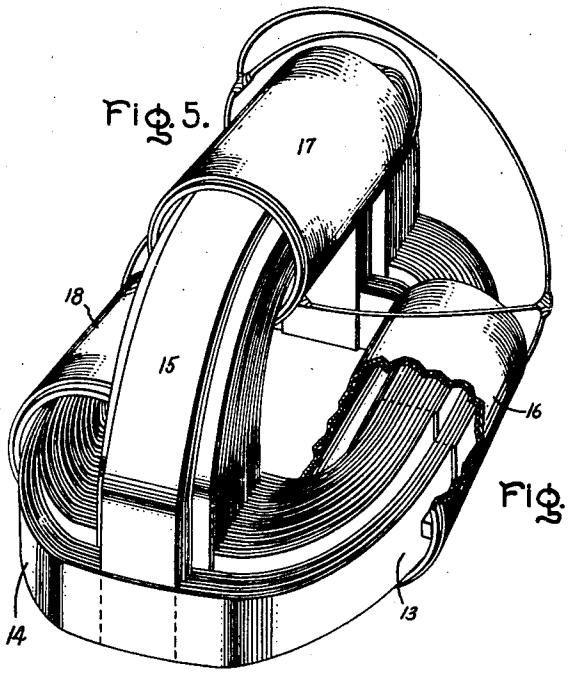


Fig. 7.

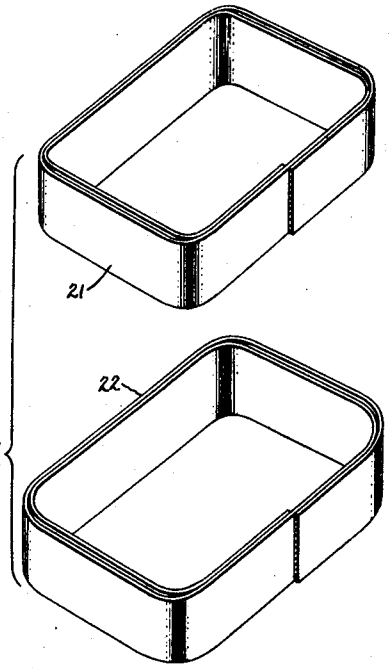


Fig. 6.

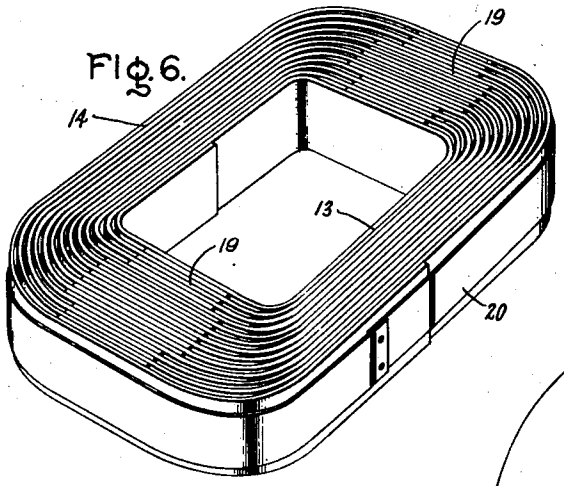
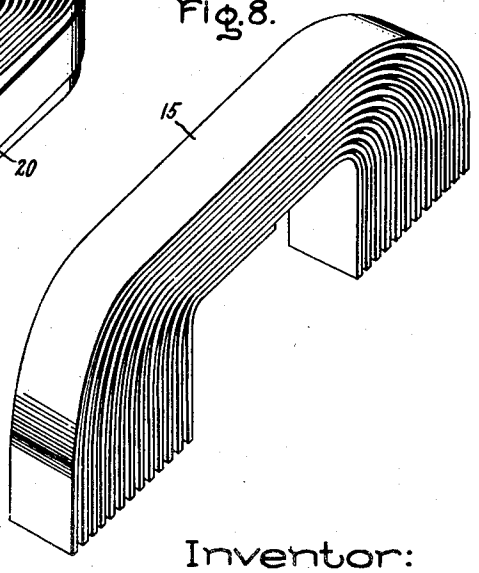


Fig. 8.



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UNITED STATES PATENT OFFICE

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METHOD OF MAKING THREE-PHASE MAGNETIC CORES

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Original application January 18, 1947, Serial No. 722,849. Divided and this application May 13, 1949, Serial No. 93,072

4 Claims. (Cl. 29—155.61)

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This is a division of my application for Three Phase Magnetic Core, Serial Number 722,849, filed January 18, 1947, and assigned to the same assignee.

The invention relates to magnetic cores, particularly three phase cores for induction apparatus and more particularly to methods of making such cores and assembling such apparatus.

These cores are characterized by a compact design which is suitable for economical use in circular cross section transformer tanks and they also utilize to good advantage the grain direction of magnetic materials having a most favorable magnetic direction corresponding to the grain direction. An example of such material is high reduction, cold rolled silicon strip steel.

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

Another object of the invention is to provide a novel and compact three phase magnetic core for stationary induction apparatus.

A further object of the invention is to provide a novel method of making magnetic cores and assembling induction apparatus.

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 claims.

In the drawings, Fig. 1 is a perspective view of an embodiment of the invention; Fig. 2 is perspective view, during an intermediate stage of construction, of one of the yoke members used in Fig. 1; Fig. 3 is a perspective view of a yoke member in another stage of its manufacture; Fig. 4 is a detail view showing the method of assembling the core shown in Fig. 1; Fig. 5 is a perspective view of a modified core construction; Fig. 6 is a view of one of the parts of the modification shown in Fig. 5 during an intermediate stage of the construction; Fig. 7 is a detail view showing how the part of Fig. 6 is cut into generally two-turn length pieces; and Fig. 8 is a perspective view of another part of the core shown in Fig. 5.

Referring now to the drawing and more particularly to Fig. 1, the core comprises three straight legs 1, 2 and 3 whose corresponding ends are joined by generally circular yokes 4 and 5.

The yokes are formed by winding a long strip of suitable material, such as high reduction cold rolled silicon steel, into a multi-turn spiral. As shown in Fig. 2, comparatively short spacers 6

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are placed between the turns at three symmetrically spaced locations which are separated by 120°. The outer end of the strip which forms the yoke is fastened in any suitable manner such as by tack welds which are indicated at 7. The portions of the yoke spiral which contain the spacers are clamped tightly so as to make three flat or straight portions on the yoke while the yoke is being strain relief annealed. After the yoke has been annealed, the strip may be cut as at 8 in Fig. 2 so as to loosen the turns and permit easy removal of the inserted spacers 6. The yoke with the spacers removed looks like the upper part of Fig. 3 in which it will be seen that spaces between the laminations are provided for receiving straight leg laminations. However, for facilitating assembly of the second yoke (it may be either the upper or lower yoke) with the leg laminations it is preferable to unwind it and cut it into convenient lengths of one or two turns. One of these cut portions is indicated at 9 in Fig. 3.

The core is preferably assembled by placing an uncut yoke with the spacers removed on a flat surface and inserting the leg laminations in the spaces provided therefor in the yoke. As will be seen in Fig. 4, alternate leg laminations extend into the spaces between the yoke laminations and the intermediate leg laminations butt up against the edge of the intermediate yoke laminations. The legs are shown by way of example as having a stepped or cruciform cross section. After the straight leg laminations are assembled with one of the yokes, windings such as are indicated by 10, 11 and 12 in Fig. 1 are slid onto the respective legs. The second yoke is then put into place preferably by building it up from the relatively short length pieces which have been cut from the wound yoke. This makes it much easier to insert the yoke laminations between the ends of the leg laminations. However, it is not essential that the second yoke be cut into short length pieces and it can with sufficient care be fitted into place with the ends of the leg laminations inserted in the proper spaces.

In the modification shown in Fig. 5, there is a wound magnetic loop having opposite leg portions 13 and 14 combined with a U-shaped member 15. The leg portions 13 and 14 carry windings 16 and 18 and the central portion of the U-shaped member 15 constitutes a leg portion on which is mounted winding 17. The loop having the legs 13 and 14 is formed by winding a sufficiently long strip of magnetic material on

a suitably shaped mandrel to form the rectangular laminated structure shown in Fig. 6. Spacers 19 are inserted between the turns at opposite ends. The finished loop may be held together by retaining band 20 and the loop is then given a strain relief anneal at the proper temperature and under the proper atmospheric conditions.

After it has been annealed, the loop shown in Fig. 6 is unwound and cut into lengths of any suitable number of turns such as two turns. Two of these two-turn cut loops are shown at 21 and 22 in Fig. 7.

The member 15 is made by cutting a loop of the type shown in Fig. 6 in half through the center of the inserts 19 after the loop has been annealed. This will result in two members each of which looks like the part shown in Fig. 8 because after the loop has been cut in half, the half spacers between the ends will drop out.

The core shown in Fig. 5 is assembled by lacing or threading the cut pieces which form the loop having legs 13 and 14 through the coils 16 and 18. The parts are threaded through one at a time with their ends brought into contact so that they occupy the same relative positions they did before they were cut. In this manner, the loop has its legs 13 and 14 provided with windings 16 and 18.

The member 15 is inserted in the winding 17 by lacing or threading its individual laminations through the window of the winding 17, one piece at a time, until the member 15 is built up to the proper height. The pieces are put through in the same order and occupy the same relative positions that they did when the member 15 was formed originally. The spaced ends of the member 15 are then fitted into the spaces which had previously been occupied by the spacers 19 so as to provide a low reluctance magnetic joint.

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 claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

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

1. A method of making a three phase magnetic core which includes, winding magnetic strip material into two multi-turn spirals, inserting relatively short spacers between the turns at three symmetrically located places during the winding operation, annealing said spirals, removing said spacers, and interconnecting said spirals with three straight laminated leg members alternate laminations of which extend into said spirals between the turns thereof in the places previously occupied by said spacers, the intermediate laminations of said members making butt contact with the edges of the turns of said spirals.

2. A method of making a three phase core which includes, winding magnetic strip material into two multi-turn spirals, inserting relatively short spacers between the turns at symmetrically separated locations during the winding operation, said spacers being of different length in order to form a cruciform cross section pattern in said spirals, annealing said spirals, removing said spacers, and interconnecting said spirals with three straight cruciform cross section laminated leg members alternate laminations of which extend into said spirals between the turns thereof in the places previously occupied by said spacers, the intermediate laminations of said leg members making butt contact with the edges of the turns of said spirals.

3. A method of making a magnetic core which includes, winding magnetic strip material into two multi-turn spirals, inserting relatively short spacers between the turns at three symmetrically located places during the winding operations, annealing said spirals, removing said spacers, inserting straight parallel laminations in the places previously occupied by the spacers of one of said spirals, inserting shorter straight parellel laminations between the first-mentioned straight laminations so that their ends make butt contact with the edges of the turns of said spiral, cutting the other spiral into a plurality of relatively short spirals, and individually interleaving said short spirals with the opposite ends of the straight parallel laminations so as to rebuild the second spiral in lapped joint relation with the straight parallel laminations.

4. A method of assembling induction apparatus which includes, winding magnetic strip material into two multi-turn spirals, inserting relatively short spacers between the turns at three symmetrically located places during the winding operations, annealing said spirals, removing said spacers, providing a plurality of straight laminated leg members having staggered ends, interleaving one staggered end of each leg member with the turns of one of the spirals at the places previously occupied by said spacers, fitting conductive coils over said straight leg members, cutting the other spiral into relatively short length pieces, individually interleaving said short length pieces with the opposite ends of said leg members so as to rebuild the second spiral in interleaved relation with the other ends of said leg members.

JACOB J. VIENNEAU.

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The following references are of record in the file of this patent:

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