Sept. 21, 1954 J. J. VIENNEAU 2,689,396

METHOD OF MAKING MAGNETIC CORES

Filed Aug. 24, 1949

Fig. 1.

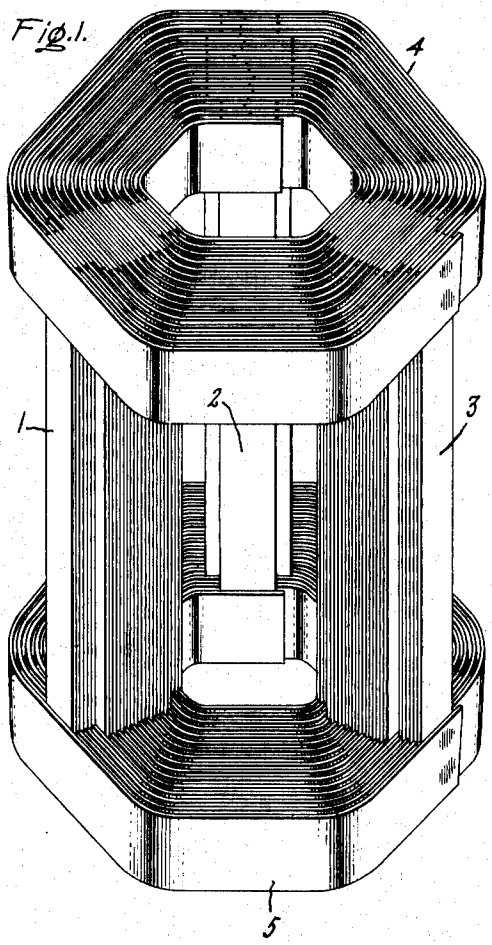


Fig. 3.

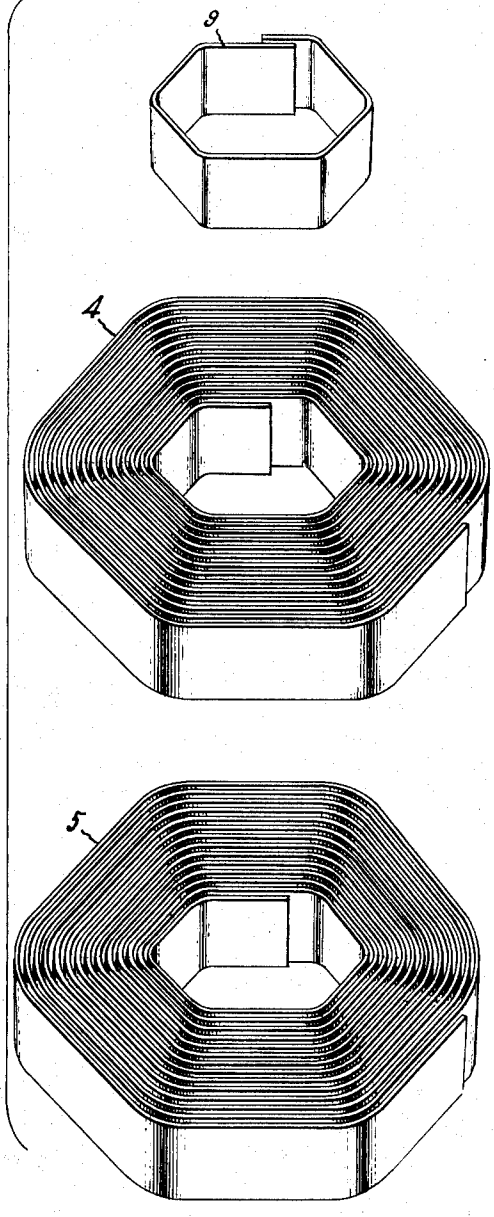
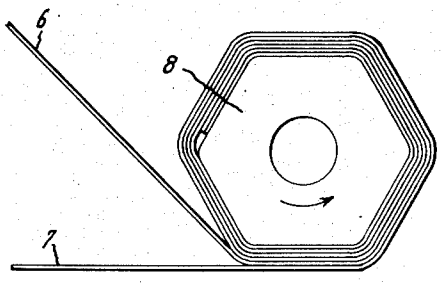


Fig. 2.



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METHOD OF MAKING MAGNETIC CORES

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2 Claims. (Cl. 29—155.57)

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This invention relates to magnetic cores of wound strip oriented magnetic material, particularly three-phase cores for stationary electrical induction apparatus, and more particularly to a method of making such cores and assembling such apparatus.

This invention is particularly applicable to winding delta yoke members for magnetic cores of the delta yoke type, but may be used equally well for simultaneously manufacturing any two magnetic cores of wound strip magnetic material where it is desired that each core have its respective turns spaced apart from each other by an amount equal to the thickness of one turn of the strip magnetic material. By a "delta yoke" magnetic core is meant a three phase magnetic core in which three symmetrically spaced parallel leg members formed of straight strips of magnetic material are joined at opposite ends of the core by a pair of substantially concentric loops of magnetic strip material each defining a plane substantially perpendicular to the respective leg members.

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 material having a most favorable magnetic direction corresponding to the grain direction. An example of such material is high reduction, cold rolled silicon strip steel. Such a magnetic core is disclosed in my copending application, Serial No. 722,849, filed January 18, 1947, now Patent No. 2,516,164 issued July 25, 1950, and assigned to the same assignee as the present application. This invention relates more specifically to an improvement in the method of making the magnetic yoke sections for the core disclosed in the application just mentioned.

An object of this invention is to provide a novel method of making magnetic cores and assembling induction apparatus.

A further object of this invention is to provide a more efficient and economical method of making yokes for magnetic cores of the delta-yoke type.

A still further object of this invention is to provide an improved method of making yokes for the magnetic cores disclosed in my copending application hereinbefore mentioned.

In fulfillment of these objectives, this invention provides a method whereby two spiral magnetic core sections can be wound simultaneously, with each of the respective spirals serving as a spacer for the other spiral, thereby eliminating the use of spacer members which have heretofore been used during the winding of such spiral magnetic core members.

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The features of this invention which I believe to be novel are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and use, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing in which Fig. 1 represents a view in elevation of a three-phase delta-yoke magnetic core constructed in accordance with my invention; Fig. 2 represents a view of the method of winding the spirals which comprise the upper and lower yoke sections of the core shown in Fig. 1; while Fig. 3 represents a detailed view of the unassembled spiral yoke sections which are shown in assembled relation in Fig. 1.

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

The yokes 4 and 5 are wound simultaneously by winding two long strips of suitable material, such as high reduction cold rolled silicon steel, about a suitable mandrel. This is shown in Fig. 2 where strips 6 and 7 are being simultaneously wound on mandrel 8. After strips 6 and 7 have been wound into a sufficient number of turns, they will respectively comprise the two yoke sections shown in Fig. 1.

It can be seen that each of the strips 6 and 7 will respectively serve as a spacer member between the turns of the other strip. This eliminates the need for spacer members between the turns of the respective spirals, as shown in my copending application, Serial No. 722,849, mentioned hereinbefore, where only one spiral yoke is wound at a time, in which case it is necessary to insert spacers between the respective turns of the spiral to provide space for the leg laminations which are subsequently inserted. In the construction method disclosed in the present application, it will be seen that this need for spacers is eliminated since, when two spirals are wound simultaneously in accordance with my invention, each spiral serves as a spacer between the turns of the other spiral.

After the spirals which comprise the upper and lower yokes have been wound in accordance with the method shown in Fig. 2, the two spirals may be strain-relief annealed, after which the spirals may be separated from one another. The separated spirals are shown at 4 and 5 in Fig. 3. Since the two spirals are strain-relief annealed while they are both positioned on the mandrel 8, the turns of each spiral are set and spaced with respect to each other, in accordance with the configuration imparted thereto by the mandrel 8 and

the turns of the other of the two spirals. Accordingly, after the two strain-relief annealed and set spirals are separated the turns of each spiral will retain the configuration and spacing imparted thereto by the mandrel 8 and the turns of the other spiral.

The core is preferably assembled by placing one of the yokes on a flat surface and inserting the leg laminations in the spaces provided therefor in the yoke. Alternate leg laminations extend into the spaces between the yoke laminations and the intermediate leg laminations butt up against the edge of the corresponding yoke laminations. The legs are shown by way of example as having a step or cruciform cross section. After the straight leg laminations are assembled with one of the yokes, windings may then be slid onto the respective legs 1, 2 and 3. The second yoke is then put into place, and, in doing this, it is preferable that the second yoke be cut into relatively short length pieces of at least one turn, such as the one shown at 9 in Fig. 3, by making a transverse cut across the cross section of the wound spiral. This makes it much easier to insert the yoke laminations of the second yoke between the end of the leg laminations, and has little or no effect on the magnetic characteristics of the yoke. However, it is not essential that the second yoke be cut into short length pieces as just described, and it can with sufficient care be fitted into place with the ends of the leg laminations inserted in the proper spaces.

As will be seen in Fig. 1, a given leg lamination which fits between adjacent turns of one yoke member abuts against the edge of a laminar turn in the opposite yoke member. Due to the method of simultaneously winding the yoke members hereinbefore described, the spaces between turns of one yoke member are offset from the spaces of the other yoke member in a manner which automatically provides for interleaving of leg laminations, the amount of offset being equal to the thickness of one laminar layer.

Thus, in a given laminar layer one yoke member will have a space into which a leg lamination may be interleaved, while the opposite end of the same leg lamination will abut against the edge of a laminar turn of the opposite yoke member. Thus, it can be seen that yoke members which are simultaneously wound in the manner hereinbefore described are automatically spaced properly for interleaving with leg laminations.

In conclusion, it will be seen that simultaneously winding two spiral strips in accordance with my invention greatly simplifies the process of manufacturing three-phase delta-yoke cores, by eliminating the necessity for placing spacer strips between succeeding turns of the spiral, since when two spirals are wound together each serves as a spacer for the other. Furthermore, yoke members spirally wound as hereinbefore described are automatically properly spaced for interleaving with leg laminations.

When my invention is applied to the manufacture of delta yoke members, I prefer to position the two simultaneously-wound delta yoke members at opposite ends of the same core, as just described. However, the two simultaneously-wound yoke members need not necessarily be placed on the same core.

While there have been shown and described particular embodiments of my 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. In a method of making a three phase delta yoke type magnetic core having two parallel spaced spirally wound delta yoke members interconnected by each of three laminated spaced parallel leg portions having alternate laminations thereof at opposite ends thereof interleaved with the turns of each of said two yoke members, and wherein each of said turns and laminations have an equal thickness, said method comprising simultaneously forming said two yoke members by simultaneously spirally winding two flat continuous strips of magnetic core material in radially superposed relationship about a mandrel, strain-relief annealing said two strips while they are still in said superposed relationship whereby the turns of each of said two strips are set and spaced with respect to each other in accordance with the configuration and spacing imparted thereto by said mandrel and the turns of the other of said two strips, separating said two annealed strips whereby the turns of each of said two separated spirally wound strips are spaced from each other by a distance equal to said thickness, and interleaving alternate laminations of said three leg portions at opposite ends thereof with the spaced turns of each of said two annealed separated spirally wound strips.

2. A method of manufacturing a three phase delta yoke type magnetic core having two parallel spaced spirally wound delta yoke members interconnected by each of three laminated spaced parallel leg portions having the laminations thereof at opposite ends thereof interleaved with the turns of each of said two yoke members, and wherein each of said turns and laminations have an equal thickness, said method comprising simultaneously forming said two yoke members by simultaneously spirally winding two flat continuous strips of magnetic core material in radially superposed relationship about a mandrel, strain-relief annealing said two strips while they are still in said superposed relationship whereby the turns of each of said two strips are set and spaced with respect to each other in accordance with the configuration and spacing imparted thereto by said mandrel and the turns of the other of said two strips, separating said two annealed strips whereby the turns of each of said two separated spirally wound strips are spaced from each other by a distance equal to said thickness, interleaving odd numbered laminations of said three leg portions at one end thereof with the spaced turns of one of said two separated strips, cutting the other of said two separated strips into segments having a length of at least one complete turn, and interleaving said segments with the even numbered laminations of said three leg portions at another end thereof.

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