

Dec. 14, 1948.

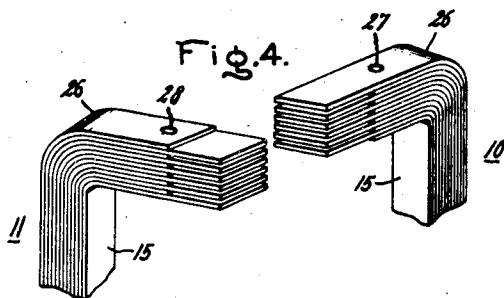
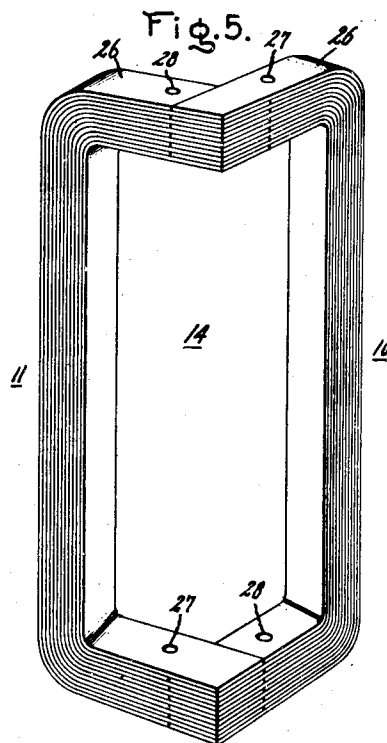
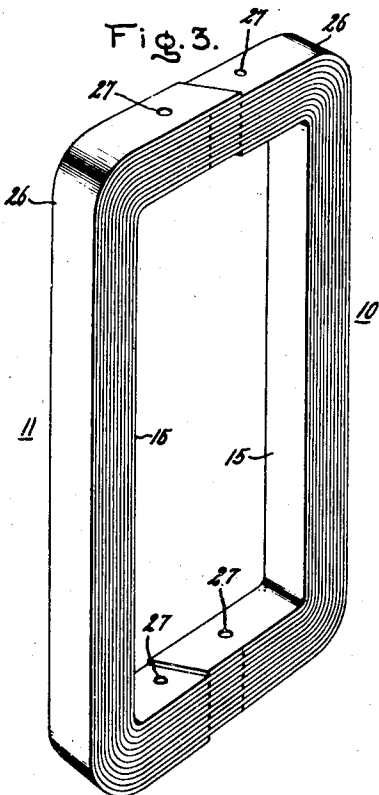
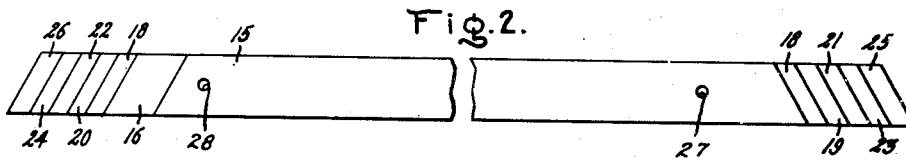
G. G. SOMERVILLE

2,456,459

MAGNETIC CORE

Filed Jan. 18, 1947

2 Sheets-Sheet 1



Inventor:
Gareth G. Somerville,
by *Ernest C. Britton*
His Attorney.

Dec. 14, 1948.

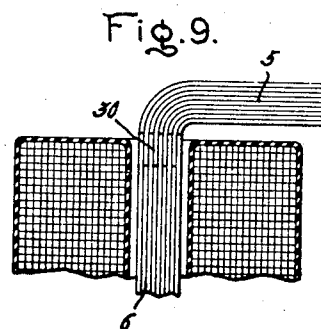
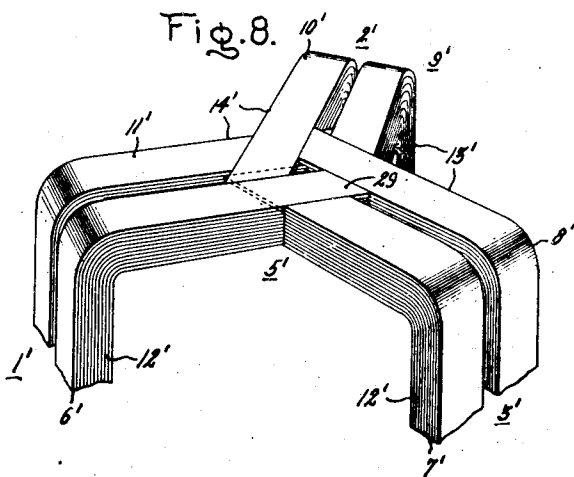
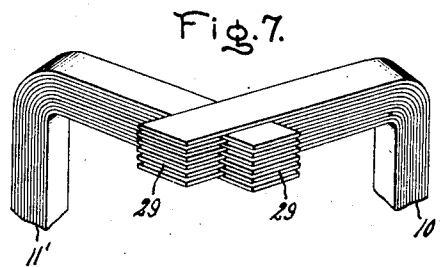
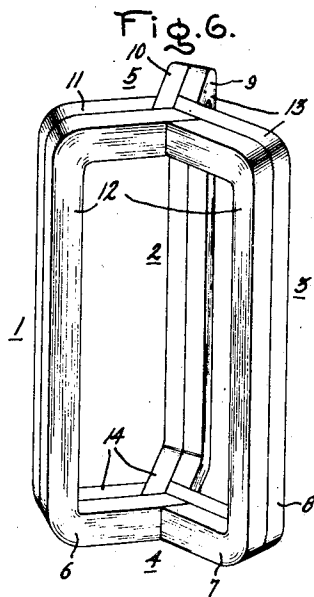
G. G. SOMERVILLE

2,456,459

MAGNETIC CORE

Filed Jan. 18, 1947

2 Sheets-Sheet 2



Inventor:
Gareth G. Somerville,
by *Ernest C. Britton*
His Attorney.

UNITED STATES PATENT OFFICE

2,456,459

MAGNETIC CORE

Gareth G. Somerville, Pittsfield, Mass., assignor
to General Electric Company, a corporation of
New York

Application January 18, 1947, Serial No. 722,838

4 Claims. (Cl. 175—356)

1

This invention relates to magnetic cores, more particularly to three phase cores for electric induction apparatus, and to a method of making such cores.

An object of the invention is to provide a simple and economical three phase magnetic core having low losses.

Another object of the invention is to provide a three phase magnetic core having improved low loss joints in the yoke.

A further object of the invention is to provide a novel method of making three phase cores which enables the parts to be annealed separately with a good space factor in the annealing oven.

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 side elevation view of a packet of laminations which are used to make one of the units which are combined to make my core; Fig. 2 is a plan view of the packet shown in Fig. 1; Fig. 3 is a perspective view showing how two of the unitary packets are formed and inter-fitted for the annealing operation; Fig. 4 shows a detail of the interfitting ends of the units of Fig. 3 after they have been separated and one of them has been reversed preparatory to their recombination for forming a part of the core; Fig. 5 shows how the parts of Fig. 3 are recombined to form a part of the finished core; Fig. 6 is a perspective view of the finished core; Fig. 7 is a detail view of a modification; Fig. 8 is a partial perspective view of the finished modification formed by the parts shown in Fig. 7, and Fig. 9 illustrates another modification in which the core legs may be provided with joints so that the yokes can be separated from the legs for facilitating the mounting of windings on the legs.

Referring now to the drawings, and more particularly to Fig. 6, the completed core consists of three parallel straight winding legs 1, 2 and 3 whose corresponding ends are joined by Y-shaped yokes 4 and 5. The legs are divided or split along their center planes and their extensions which are bent over to form the three radiating legs of the yokes are similarly split. Actually, the core consists of six generally U-shaped bent lamination type members 6, 7, 8, 9, 10 and 11. These are arranged in pairs with their ends interfitted so as to form three closed loops whose two halves are in planes making 120° with each other. Thus, the parts 6 and 7 form a loop 12, the parts 8 and 9 form a loop 13 and the parts 10 and 11 form a loop 14.

The core shown in Fig. 6 may be constructed as follows. Referring to Figs. 1 and 2, a plurality of lamination layers 15 to 26, inclusive, are arranged as shown. These lamination layers are in the shape of isosceles trapezoids in which the

2

short ends make angles of 60° and 120° respectively with the long parallel sides. The term "lamination layer" is used instead of simply "lamination" because there may be more than one lamination in each lamination layer. However, all the laminations in each lamination layer will be of the same length. The lamination layers, however, are of progressively different lengths. This is to allow for the thickness of the lamination layers as the packet of stacked laminations is bent to shape so that when the longest lamination layer is on the outside and the shortest lamination layer is on the inside, the ends of the laminations will line up with each other. Holes 27 and 28 are punched in the laminations at fixed distances from their ends and the laminations may be aligned and held in proper alignment by means of rods passing through these holes. However, the distance between the hole 27 and its end of each lamination layer is different and, as shown, greater than the distance between the hole 28 and its end of the lamination layer. In stacking the lamination layers to form packets, the lamination layers are reversed end for end so that when the hole 27 of the layer 15 is lined up with hole 28 of the layer 16 and so on throughout the stack, the ends of the lamination layers will be staggered.

In Fig. 3, the parts 10 and 11 of Fig. 6 have been formed from two of the packets or stacks shown in Figs. 1 and 2 by simultaneously bending all of the lamination layers in each packet or stack in a suitable press or jig in which sufficient force is applied to cause the bending. The short lamination layers are on the inside and the long lamination layers are on the inside, as indicated. The details of one suitable method of forming the loop shown in Fig. 3 form the subject matter of my application Serial No. 536,748, filed May 22, 1944, and assigned to the present assignee. It will be observed that the angles of the abutting ends of the laminations complement each other so that the two U-shaped parts 10 and 11 lie in the same plane and the joints between them are beveled butt and lap joints.

The loop shown in Fig. 3 is a strain relief annealed in an oven and by reason of its flat shape, it occupies minimum space in such an oven so that an oven which is loaded with loops of this shape will be operated at good space factor.

The U-shaped members 10 and 11 are next separated by pulling them apart and the member 11 is reversed end for end so that the two ends which are to be fitted together to form the part 14 look as in Fig. 4. When these parts are put together with the member 11 reversed, they will fit snugly with the planes of the parts 10 and 11 making an angle of 120° with each other so as to form the part 14, as shown in Fig. 5.

As has been previously described, the completed core which is shown in Fig. 6 is made by fitting

together three of the 120° angle loops shown in Fig. 5.

In the modification shown in Fig. 7, the difference in length between alternate lamination layers has been increased substantially beyond the width of the lamination layers. Thus, as shown in Fig. 2, the long ends of the lamination layers pass all the way across the interfitted portions of the other core member so as to provide extensions 29. The parts 10' and 11' shown in Fig. 7 are otherwise the same as the parts shown in Fig. 5.

In Fig. 8, the parts similar to those in Fig. 6 have been identified by the same reference numerals but these numerals have been provided with primes as the parts are not exactly the same although their relationship is generally the same as in Fig. 6. The extensions 29 interfit with each other as shown in the drawing. This has the advantage over the construction shown in Fig. 6 that there are lapped joints between each half of each leg and at least half of each of the other legs whereas in Fig. 6, there are butt joints between each half of each leg and at least one of the other legs. For example, in Fig. 6, flux in the part 6, which forms one-half of the leg 1, can only get into the leg 2 by way of butt joints as the only connection between three parts 12, 13 and 14 of the core shown in Fig. 6 is by means of butt joints at the sides of the laminations. Furthermore, these butt joints being at the sides of the laminations require such flux to move crosswise of the lengthwise lamination of the lamination layers. As the lamination layers are preferably made of grain oriented material having a highly favorable magnetic direction corresponding to the length of the lamination, such crosswise travel of the flux materially increases the losses. An example of suitable material for this purpose is high reduction cold rolled silicon steel. However, it will be observed that in the modification shown in Fig. 8, the members 6' makes butt and lap joints with the members 7' just as the parts 6 and 7 make lap joints in Fig. 6 while in addition, due to the interlocking of the ends 29, the parts 6' also makes lap joints with the part 9' so that flux over part 6' can readily get into the part 9' which forms one-half of leg 2'.

The U-shaped members which form the core shown in Figs. 6 and 8 may be provided with separate windings by lacing the individual lamination through the window of the windings until all the laminations are in place. This causes some bending of the lamination but the resulting increase in losses is not excessive.

The increased separation between the two halves of core legs in Fig. 8 can be used as a cooling duct and in the case of liquid cooled apparatus, liquid can circulate in this space so as to render more effective the cooling of the apparatus.

In the modification shown in Fig. 9, an additional butt and lap joint 30 is shown at the end of a leg portion such as, for example, 6 or 6' and its corresponding yoke portion 5 or 5'. By having such joints in all of the legs, star or Y-shaped yoke 5 or 5' can be lifted off as a unit so that form wound coils can be slipped into place over the straight winding legs. Such joints 30 can be formed at the same time that the loops shown in Fig. 3 are formed. This merely requires that shorter length lamination members be used and there will be four such members in each lamination layer around the loop shown in Fig. 3.

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 three phase magnetic core comprising, in combination, at least six similar U-shaped magnetic members, said members being joined in pairs at their ends to form three closed loops whose halves are in planes making 120 deg. with each other, the three closed loops being placed side by side around a circle so as to form three parallel split core legs joined at their ends by Y-shaped yokes, the magnetic joints between the U-shaped members forming each of said loops being lapped joints, the joints between adjacent loops being butt joints.

2. A three phase magnetic core comprising, in combination, at least six similar U-shaped magnetic members, said members being joined in pairs at their ends to form three closed loops whose halves are in planes making 120 deg. with each other, three closed loops being placed side by side around a circle so as to form three parallel split core legs joined at their ends by Y-shaped yokes, the magnetic joints between the U-shaped members forming each loop and the magnetic joints between adjacent loops all being lapped joints.

3. A three phase magnetic core comprising in combination at least six similar U-shaped magnetic members of radially nested laminations, said members being joined by pairs at their ends to form three closed loops whose halves are in planes making 120 degrees with each other, the three closed loops being placed side by side around a circle so as to form three parallel split core legs joined at their ends by Y-shaped yokes, the laminations at the ends of the members which form each loop being interleaved.

4. A three phase magnetic core comprising in combination at least six similar U-shaped magnetic members of radially nested laminations, said members being joined by pairs at their ends to form three closed loops whose halves are in planes making 120 degrees with each other, the three closed loops being placed side by side around a circle so as to form three parallel split core legs joined at their ends by Y-shaped yokes, the laminations at the ends of the members which form each loop being interleaved and extending beyond each other, the extending ends of the laminations of the different loops being interleaved so as to form joints between said loops.

GARETH G. SOMERVILLE.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
644,565	Arnold	Mar. 6, 1900
2,367,927	Chubb	Jan. 23, 1945
2,394,648	Woolfolk	Feb. 12, 1946
2,408,212	Hodnette	Sept. 24, 1946

OTHER REFERENCES

Die Wechselstrom Technik (Die Transformator-en) by Arnold und J. L. La Cour Sweiter Band 2 Auflage Berlin 1910, pages 89 to 92.