

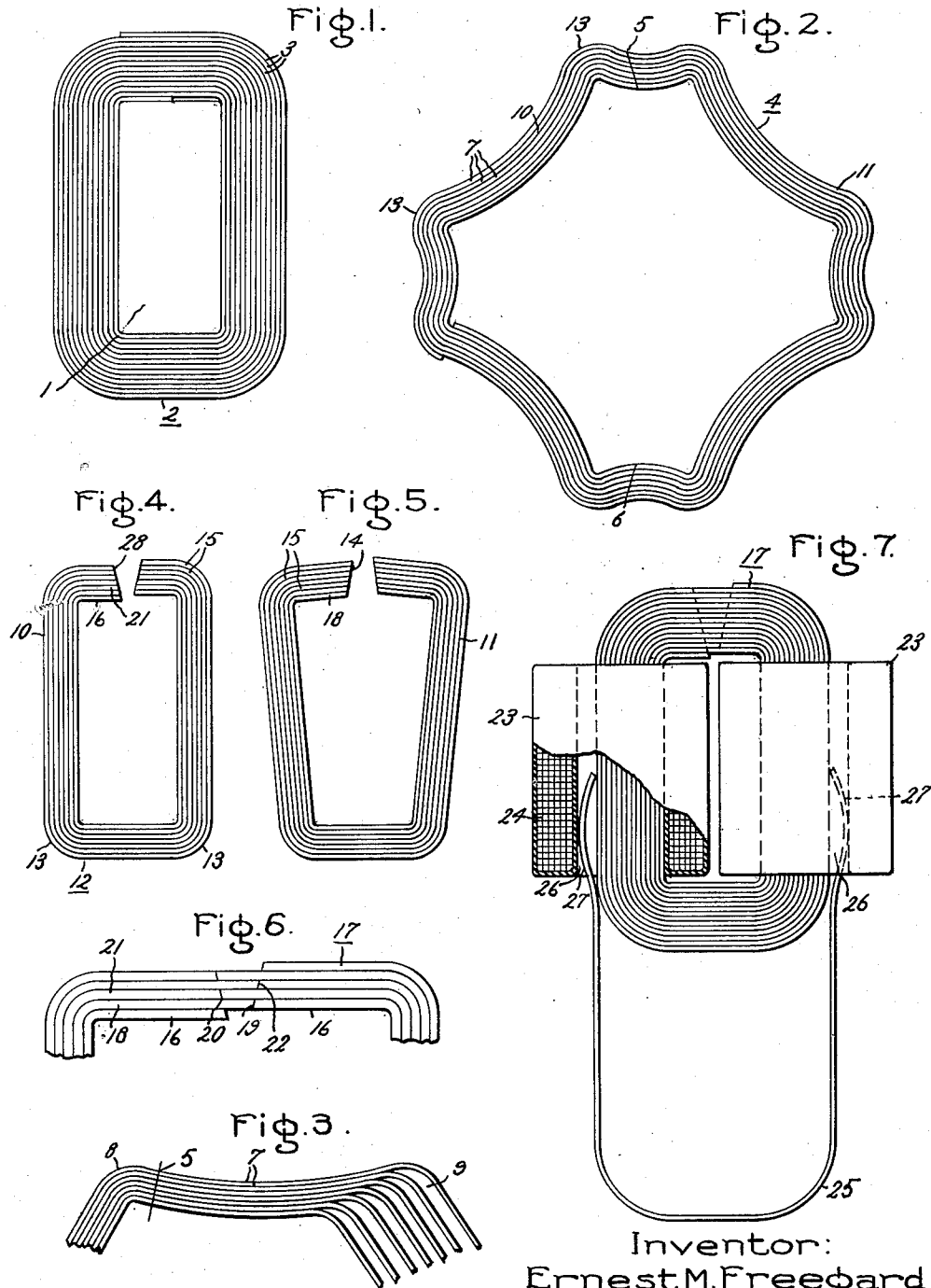
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METHOD OF FORMING WOUND MAGNETIC CORES

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METHOD OF FORMING WOUND MAGNETIC CORES

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6 Claims. (Cl. 29—155.57)

This invention relates to electrical apparatus and more particularly to a method of forming wound magnetic cores for such apparatus.

It has been determined that when magnetic material is rolled in strips, it will exhibit better magnetic properties in the direction of rolling than at right angles thereto. This is referred to as "grain orientation." The flat laminations that have generally been used in the past have had the inherent defect that the flux would have to travel at right angles to the direction of rolling at least part of the time. For this reason, it is desirable to form a transformer core by winding up a strip of magnetic material so that the magnetic flux will always be able to flow in the direction in which the strip is rolled. However, extreme difficulty has been encountered in achieving full utilization of the above mentioned property of magnetic strip material. One important reason for this is that if the strip is merely wound into shape it then becomes necessary to wind the transformer coil around the strip. Experience has shown that for the coil to be wound around the core most efficiently, extreme care must be exercised and an extremely fine copper wire may be necessary. In many applications such requirements would preclude the operation from being economically feasible. If such precautions are not used and a larger size of wire is used the coil cannot be wound as closely around the core as is desirable and, consequently, an air space results and a greater amount of copper is necessary. In view of this it is desirable that a prewound coil be positioned on the core, thereby necessitating some kind of cutting of the spirally wound strip. As soon as the strip is cut, however, the problem of an air gap arises. The magnetizing current is increased and more material is needed for the core to perform the same functions. It is desirable therefore that some method be found of manufacturing a transformer core from spirally wound strip material wherein it will be possible to assemble the prewound coil on the core without objectionable air gaps being present in the core.

An object of this invention is, therefore, to provide an improved method of manufacturing a wound core transformer from strip magnetic material which will have the desirable features discussed above.

Further objects and advantages of this invention will become apparent and the invention will be better understood by reference to the following description and the accompanying drawing; and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

This invention in its broadest aspects provides a method of manufacturing transformer cores wherein a strip of magnetic material is first wound in a spiral. A plurality of cuts are made through the wound strips, preferably on a slant, and each of the two or more groups of strips are then separated. The core is then formed by taking strips in sequence from each of the

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groups and assembling them into a core of the desired shape. The number and the direction of cuts made will give a predetermined offset between the air gaps in each layer of the core so that at no one point will there be an unduly large air gap without some means for the flux to avoid such an air gap.

In the drawing, Figure 1 is a front view of a spirally wound strip of magnetic material illustrating the first step in my improved method of manufacture;

Figure 2 is a front view of the same strip after the second step;

Figure 3 is a fragmentary front view of the strip of Figure 2 when placed under stress and showing the third step;

Figure 4 is a front view of a group of strips resulting from the fourth step;

Figure 5 is a front view of another group of strips resulting from the same step;

Figure 6 is a fragmentary front view of the strips during assembly into a finished core; and

Figure 7 is a front view, partly in cross section, of the assembly of a core about a pair of coils.

Referring now to Figure 1 of the drawing, there is shown an arbor 1 about which a strip of magnetic material 2 is spirally wound into a number of turns 3. The finished coil while still on the arbor is preferably annealed, for example in an inert gas at temperatures from 900° C. to 1200° C.

Turns 3 are then removed from arbor 1 and unwound so that every two turns 3, as shown in Figure 1, will become one turn 7 of the polygonal configuration 4 shown in Figure 2, which in the present instance is an octagon. The turns of the configuration 4 are then cut through in two places as shown at 5 and 6. It will be seen that these cuts do not extend straight down through the turns of the configuration 4, but are along lines slanting through the turns at less than a right angle to the longitudinal axis of the turns. Such a cut may be achieved simply as will be seen by now referring to Figure 3 of the drawing. The turns 7 of configuration 4 are not tight; therefore it is possible to compress the turns as shown at 8, thereby causing them to spread farther apart as at 9. If a cut is now taken straight down through the turns 7 it will fall along the line 5 which, while slanted when the turns 7 are unstressed, is straight down when they are stressed as shown in Figure 3.

Returning now to Figure 2, it will be seen that cuts 5 and 6 will separate the configuration 4 into two unequal parts 10 and 11. Part 10 will be slightly less than half of configuration 4 while part 11 will be slightly more than half. Because of the slant of cutting lines 5 and 6 the size of the strips in group 11 will increase, with respect to those in group 10, in relation to the closeness of the strips to the outer perimeter of the configuration 4.

Referring now to Figures 4 and 5 it may be seen that group 10 can now be formed into a substantially rectangular form without, however, being quite long enough complete the rectangle. This rectangular shape 12 will come about naturally as a result of the bends 13 already present in configuration 4 and which were inherited from the original spiral as shown in Figure 1. Group 11 will tend to fall into a shape similar to rectangle 12 formed by group 10. However, whereas group 10 was not long enough to form a complete rectangle, group 11 will have a length in excess of a complete rectangle which is equal to the deficit of group 10. Because of the slant of cuts 5 and 6 in Figure 2, the deficit of rectangle 12 will increase at as 28 toward the outer turns. The excess of group 11 over the length necessary for a rectangle

such as 12 will increase, as at 14, to the same extent as the deficiency shown at 28. The individual turns 15 of the two groups 11 and 12 are then separated from each other.

Referring now to Figure 6, the final assembly of the core is effected using alternately a turn from group 10 and a turn from group 11. The innermost turn 16 of group 10 is used as the innermost turn of the finished core assembly 17. The innermost turn 18 of group 11 is placed against end 19 of turn 16. Turn 18 continues around to point 20, at which point the next innermost turn 21 of group 10 is used and placed in abutting relationship against turn 18. It will be seen that the air gaps, represented by the joints 19 and 20 of the different turns, are always separated and, further, that air gaps along the same line, such as 19 and 22, will always have a solid strip of magnetic material between them. Because of this, the problem brought about by air gaps is kept to a minimum and the flux will always have a metal path by means of which it can avoid any air gaps caused by an abutting relationship of two individual turns.

Referring now to Figure 7, there is shown a core assembly 17 being assembled in coils 23 which are normally formed of copper wire 24. Each individual turn from the two groups 10 and 11, such as turn 25, is slipped up through the spaces 26 formed in coils 23. The bent parts 27 of turn 25, due to their elasticity, will resume the shape shown by the remainder of the turns of strip magnetic material. Once turn 25 is completely in position this operation is continued until spaces 26 are substantially filled by the strips of core 17.

It will be seen from the above description that this invention provides a core which is easily assembled and wherein a predetermined symmetrical separation of air gaps between abutting turns is ensured.

It will be understood that countless modifications of this method of coil forming exist; for instance, the configuration 4 shown in Figure 2 could be made with six sides, or any other desired number of cuts could be made in any desired number of places. A greater number of cuts may obviate the necessity of having the cuts slanted. Another advantage which would be obtained by a greater number of cuts would be the avoidance of the necessity of bending parts 27 of Figure 7 out of shape in order to pass them through the coil. For instance, four cuts in configuration 4 would permit the individual turns to be slipped through the coil openings without the necessity of partly deforming the bends in the strips. Also, the separation of the air gaps could be predetermined to occur anywhere in any desired sequence by modification of the shape shown in Figure 2 and by proper selection and location of the number of cuts made.

While this invention has been explained by describing a particular embodiment thereof, it will be apparent that improvements and modifications may be made without departing from the scope of the invention as defined in the appended claims.

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

1. A method of making wound transformer cores from strip magnetic material comprising the steps of winding said strip about an arbor to form a plurality of continuous superimposed turns, unwinding said turns so as to form therewith a polygon having a smaller number of turns, cutting through said turns of said polygon in a plurality of locations to form a plurality of groups of strips, at least one of said groups having a length different from the length of another of said groups, and successively superimposing strips from each of said groups one on the other to form a core, each of said successively superimposed strips having an end abutting against an end of the previously superimposed strip.

2. A method of making a wound transformer core from a strip of magnetic material comprising the steps of winding said strip into a polygon having a plurality of

continuous superimposed turns, said polygon having a smaller number of turns than the completed core, cutting through said turns in two locations so as to form two groups of strips, one of said groups having a length different from the length of the other of said groups, and successively superimposing strips from each of said groups one on the other to form a core, each of said successively superimposed strips having an end abutting against an end of the previously imposed strip, said cuts being made at an angle less than a right angle to the longitudinal axis of the turns at the said locations whereby said abutments are prevented from occurring along lines at right angles to the longitudinal axis of the strip at the locations of said abutments.

3. A method of making wound transformer cores from strip magnetic material comprising the steps of winding said strip about an arbor to form a plurality of continuous superimposed turns, annealing said superimposed turns unwinding said turns so as to form therewith a polygon having a smaller number of turns, cutting through said turns of said polygon in two locations so as to form two groups of strips, said cuts being made at an angle less than a right angle to the longitudinal axis of the turns at the said locations, one of said groups having a length greater than the length of the other of said groups, and successively superimposing strips from each of said groups one on the other to form a core, each of said successively superimposed strips having an end abutting against an end of the previously imposed strip.

4. A method of making wound transformer cores from strip magnetic material comprising the steps of winding said strip about a substantially rectangular arbor to form a plurality of continuous superimposed turns, annealing said superimposed turns, unwinding said turns so as to form therewith an octagon having approximately half the previous number of turns, cutting through said octagon turns in two locations so as to form two groups of strips, one of said groups having a length greater than the length of the other of said groups, and successively superimposing strips from each of said groups one on the other to form a core, each of said successively superimposed strips having an end abutting against an end of the previously imposed strip.

5. A method of making wound transformer cores from strip magnetic material comprising the steps of winding said strip about a substantially rectangular arbor to form a plurality of continuous superimposed turns, annealing said superimposed turns, unwinding said turns so as to form therewith an octagon having approximately half the previous number of turns, cutting through said octagon turns in two locations so as to form two groups of strips, each of said groups having a shape approaching a rectangle, one of said groups having strips whose length is in excess of the rectangle it approaches, the other of said groups having strips shorter than the rectangle it approaches by an amount equal to the excess of length of the first of said groups, and successively superimposing strips from each of said groups one on the other through a preformed coil to form a core, each of said successively superimposed strips having an end abutting against an end of the previously imposed strip.

6. A method of making transformer cores from strip magnetic material comprising the steps of winding said strip about a substantially rectangular arbor to form a plurality of continuous superimposed turns, annealing said superimposed turns, unwinding said turns so as to form therewith an octagon having approximately half the previous number of turns, cutting through said octagon turns in two locations so as to form two groups of strips, each having a shape approaching a rectangle, one of said groups having strips whose length is in excess of the rectangle it approaches, the other of said groups having strips shorter than the rectangle it approaches by an amount equal to the excess of length of the first of said groups, and successively superimposing strips from each of said

groups one on the other through a preformed coil to form a core, each of said successively superimposed strips having an end abutting against an end of the previously imposed strip, said cuts being made at an angle less than a right angle to the longitudinal axis of the turns of the said locations whereby the abutments of superimposed strips are prevented from occurring along lines at right angles to the longitudinal axis of the strips at the locations of said abutments.

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