

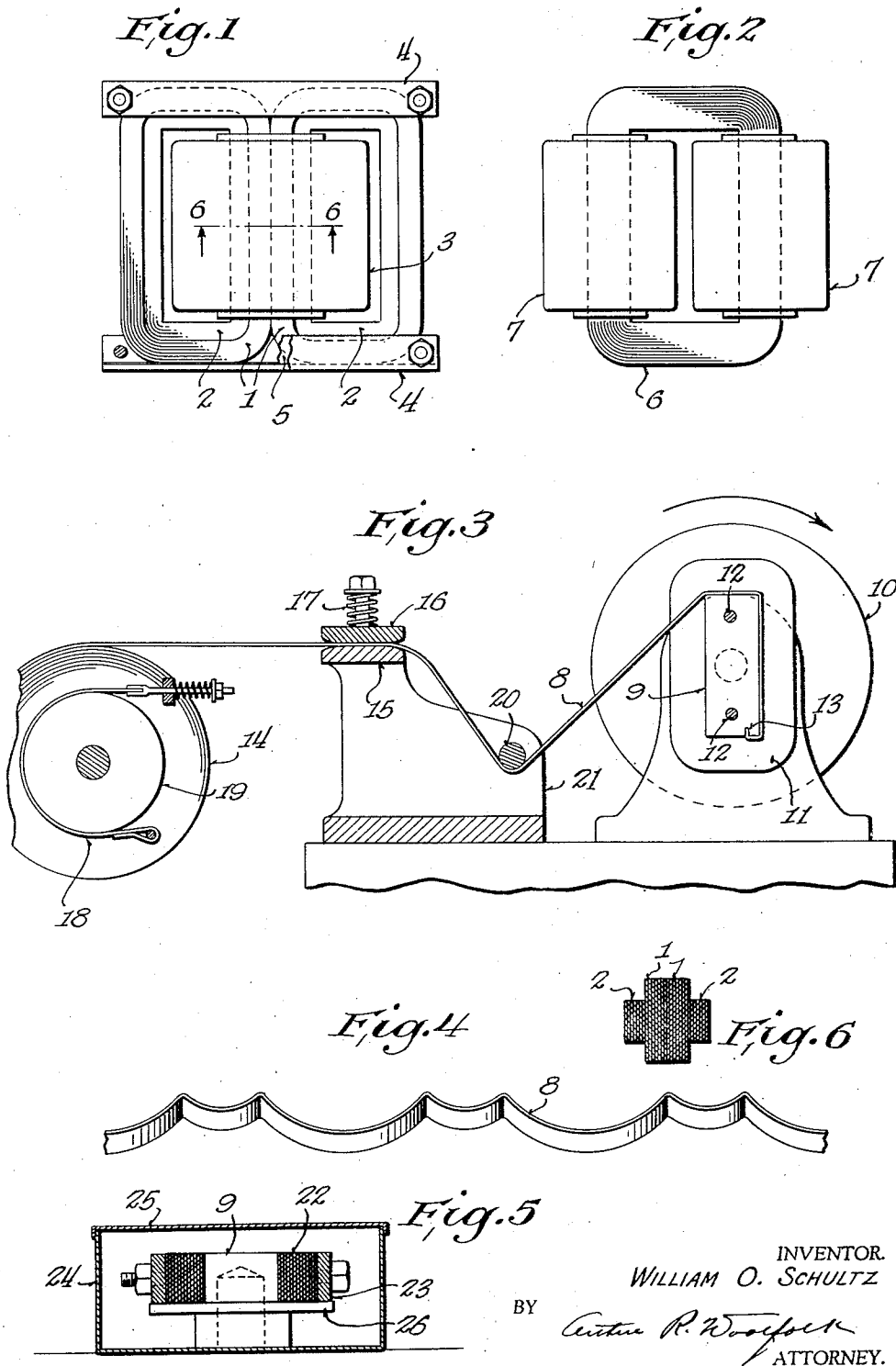
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METHOD OF MAKING CORES FOR TRANSFORMERS OR THE LIKE

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METHOD OF MAKING CORES FOR TRANSFORMERS OR THE LIKE

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3 Claims. (Cl. 148—12)

This invention relates to method of making cores for transformers or the like.

In general this invention is an improvement over that disclosed in the copending application of Alwin G. Steinmayer and William E. Krueger, Serial No. 339,256, filed June 7, 1940, for Method and means for making cores for transformers or the like, which application matured into Patent No. 2,288,855 on July 7, 1942.

Objects of this invention are to provide a method of forming cores for transformers or the like in which an elongated strip or elongated strips of magnetic material are employed which may be of ribbon or other shape, and in which a closed core is wound to shape and is held in the desired shape and annealed to remove internal stresses incident to the winding so that a finished core is provided free from stresses and ready to have a coil structure wound thereon without reworking of the core.

Further objects are to provide a simple and practical method of winding closed cores for transformers or the like from an elongated strip of magnetic material which method may be economically and readily followed to produce a core for a transformer or the like having good electrical characteristics.

A further object is to provide a method of winding and shaping a closed core for a transformer or the like so as to provide at least one straight portion of the core on which a coil structure can be wound.

In the practice of this invention, as in the practice of the invention above referred to, a further object is to provide a method of winding cores for transformers or the like in which any desired cross-sectional contour may be given the core so that the core may be formed either with a rectangular section or a cruciform section or section of other desired shape.

More specifically, further objects of this invention are to provide a method of winding closed cores for transformers or the like from an elongated strip of magnetic material in which a back bend is produced in the strip in the opposite direction from that in which the strip is wound so that the successive convolutions along the flat side or flat sides of the form will lie in close contact with each other, the core being preferably subsequently annealed to remove the internal stresses due to back bending and due to winding so that a finished closed core is produced which may have a coil wound thereon without reworking of the core, and in which the successive con-

volutions at the straight portions of the core will lie closely adjacent each other.

An embodiment of the invention is shown in the accompanying drawing, in which:

Figure 1 is a view of the finished transformer with parts broken away, the terminal blocks, casing, etc. being omitted.

Figure 2 is a view of a further type of transformer.

Figure 3 is a fragmentary sectional view showing a form of machine suitable for carrying out the process.

Figure 4 is a view of a portion of a strip unwound from the core illustrating the back bend that is imparted to the strip during winding.

Figure 5 is a sectional view through the core showing it mounted on a support and positioned in a box ready for annealing.

Figure 6 is a sectional view corresponding to a section on the line 6—6 of Figure 1 showing one of the cross-sectional shapes that the core may take.

Referring to Figure 1, it will be seen that a transformer has been illustrated in which there are two core sections which jointly form the central core and which comprise relatively wide portions 1 and relatively narrower portions 2. The transformer is provided with a centrally located coil structure which, of course, includes the primary and secondary and is indicated by the reference character 3. Suitable mounting brackets 4 may be employed and preferably insulating strips 5 are positioned between the supporting brackets and the cores.

Obviously the transformer may take the form shown in Figure 2 and may have either the cruciform shape of core or a rectangular or other shape. In the form shown in Figure 2, a rectangular core has been indicated by the reference character 6.

In this form of transformer, in accordance with the usual practice, the windings are placed on the two main straight legs of the core and are indicated by the reference character 7. These windings, in the case of a transformer of course include a primary and secondary. Obviously the construction is suitable for making chokes or other types of electrical devices as will be apparent as the description proceeds.

In practicing this invention it is contemplated winding a closed core from an elongated strip of magnetic material, such as the magnetic ribbon 8 which is wound on a revolvably mounted suitably shaped form 9. This form is power driven from any source, as by means of the driving wheel 10.

It is preferably composed of the central portion and end flanges 11 which are removably bolted together by means of bolts or other fastening means 12. Preferably the core 9 has a notch formed therein indicated by the reference character 13 within which the end of the ribbon is positioned to thus secure the first convolution of the core to the form.

The ribbon of magnetic material is usually furnished in a coil as indicated by the reference character 14 and is fed through this coil over a guiding and tensioning means consisting of a transverse guide or support 15 towards which a plate 16 is pressed in a graduated manner, as by means of the adjustable springs 17, the ribbon passing between the portions 15 and 16 and having tension applied thereto due to the friction imposed on the ribbon while it is being drawn between the members 15 and 16.

The ribbon may be additionally tensioned, if desired, by providing a brake like member 18 which is adjusted to yieldingly bear against a drum 19 on which the roll of ribbon 14 is wound. Either or both of the tensioning means may be employed.

In winding these cores it is desirable to have the successive convolutions lie in close contact with each other and this is difficult, particularly on the flat elongated sides of a rectangular core. However, the successive convolutions are caused to lie closely adjacent each other by putting a back bend in the ribbon, that is to say, by bending it in a reverse direction to that in which it would be bent during the winding. This is accomplished in any suitable manner, as by means of a transverse bar or member 20 beneath which the ribbon is passed so that when the form 9 is rotated and the ribbon wound to form the closed core, it is bent in a reverse direction by passing around the bar 20. Obviously the bar or member 20 could be revolvably mounted in the standards 21 to reduce friction. However, it is to be noted particularly that the member 20 is offset with reference to a line extending from the guiding or tensioning means 15 to the form 9. In this way the material is bent or stressed in the reverse direction so that if it were unwound from the core, it would have the appearance as shown in Figure 4. It will be seen from this figure that the reverse bend is imparted to the strip between the point of tensioning or guiding and the point at which it is wound on the form and consequently the tendency of the ribbon to bend as shown in Figure 4 causes adjacent convolutions of the elongated flat sides of the form to lie in close contact with each other.

After the core is completely wound, the end may be secured by brazing or welding or in any suitable manner or it may be wired in place, or it may be held in place by a clamping form. At all events it is held in its wound condition on the form and is annealed on the form prior to removal of the form so as to retain the exact shape of the wound core.

The stresses which are imparted to the ribbon during winding are removed by annealing. During the annealing process the closed core, which is indicated in section by the reference character 22 in Figure 5, is held clamped to the form 9 by any suitable means, as by the clamping frame 23. It is placed in a box 24 provided with a cover 25 or else packed in flaked mica and is carried by a suitable supporting member 26 so that it will not sag during annealing. The purpose of the box or of covering the core with flaked

mica is to prevent direct contact of the flame with the core. Also it is preferable to use a reducing atmosphere in the tempering furnace to prevent oxidation of the core.

It is to be understood that the core can take other cross-sectional shapes than rectangular. For instance as shown in Figures 1 and 6, the core may be of cruciform shape, the wider portions 1 being formed of wider ribbon and the narrower portions 2 being formed of narrower ribbon.

Either cold rolled or hot rolled magnetic ribbon may be used. Also it is to be distinctly understood that although a continuous length of ribbon has been shown, that the core can be wound from separate strips of ribbon.

It will also be seen that by following the method disclosed that a core for a transformer or other similar device has been disclosed in which straight side portions are provided in the core structure itself, thus enabling the conductive coil to be wound as a circular coil with all of the inherent advantages of strength and freedom from the likelihood of breaking the insulation due to the sharp bending which does result when a preformed rectangular coil is employed. In addition to these features, the use of the straight-sided core produced by this invention enables a coil to be wound thereon which has a relatively small depth as compared with its length, thus materially reducing the reactance of the resulting transformer.

This invention produces a transformer core in which the air gap is reduced to a minimum as there is in effect only one air gap which has a very small effect as compared with the multiplicity of air gaps in the ordinary transformers where individual sections are assembled. In addition to this, following the method of this invention the successive layers are held very closely compacted and the air gap therefore is reduced to a minimum. Also by having the core clamped during annealing, it is apparent that no chance for the separation of the successive layers is afforded.

Additionally, the straight side portions of the core have been caused to lie in close contact with each other during the winding thereof and inasmuch as they are held during annealing in this closely compacted condition, it is obvious that a very compacted resulting annealed structure is produced. Also after annealing it is apparent that the successive layers hold their shape and remain in their close compacted relation.

In addition to this, by forming the core in the manner herein disclosed it is possible to efficiently use a high grade steel and have a higher flux density therein as the reluctance of the magnetic path has been greatly reduced by the reduction in air gaps. If, on the other hand, it were attempted to have a high flux density in the magnet core and yet have a number of air gaps, it is obvious that the high flux density would also exist at the air gaps and consequently a very inefficient transformer would result as the exciting current would be very high.

Also by using a high grade steel and substantially eliminating the majority of air gaps, it is possible to effect a real economy in the production of cores for transformers or the like. The form on which the core is wound has been shown as provided with end flanges. It is to be understood that the invention is not limited to the

use of end flanges as the form may be made without them.

After the core has been annealed, the clamping frame 23, Figure 5, is removed and thereafter the core may have the coil wound thereon, for example in accordance with the method disclosed in the copending application of Alwin G. Steinmayer and William E. Krueger, Serial No. 342,524, filed June 26, 1940, and now Patent No. 2,305,999, for Method and machine for winding coils.

It will be seen that a novel method of winding closed cores for transformers and the like has been shown, and it will be seen further that the closed cores may be rapidly and expeditiously formed and that when finished they are substantially free from internal stresses and are not reworked after winding of the core.

Although this invention has been described in considerable detail, it is to be understood that such description is intended as illustrative rather than limiting, as the invention may be variously embodied and is to be interpreted as claimed.

I claim:

1. The method of making permanently shaped, closed, wound magnetic cores for transformers or the like free from any working after annealing, said method comprising forming a reverse bend in a flat ribbon of magnetic material, the reverse bend being in the opposite direction from that in which the ribbon is wound in forming the permanently shaped core, winding the reversely bent flat ribbon upon a form in a direction opposite that in which the reverse bend is formed thereby causing successive convolutions to lie tightly against each other, annealing the core

while it is on the form to remove all strains including that of the reverse bend, and subsequently removing the core from the form to provide a permanently shaped, unstressed, closed core.

2. The method of making a permanently shaped, closed, wound magnetic core for transformers or the like free from any working after annealing, said method comprising forming a reverse bend in a flat ribbon of magnetic material and simultaneously winding the ribbon on a core in a direction opposite that of the reverse bend and applying a tension to the ribbon while it is being wound whereby successive convolutions are caused to lie tightly against each other, and annealing the wound core to remove all strains including that of the reverse bend to provide a permanently shaped, unstressed, closed core.

3. The method of making permanently shaped, closed, wound magnetic cores for transformers or the like free from any working after annealing, said method comprising forming a reverse bend in a flat ribbon of magnetic material with the reverse bend in opposite direction from that in which the ribbon is wound, winding the ribbon on a core having at least one flat side and applying a tension to the ribbon while it is being wound to cause successive convolutions to lie tightly against each other on at least the flat side of said core, annealing the core while it is on the form to remove all strains including that of the reverse bend, and subsequently removing the core from the form to provide a permanently shaped, unstressed, closed core.

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