MAGNETIC CORE MEMBER

Filed April 27, 1950 2 SHEETS—SHEET 1

Fig. 1.

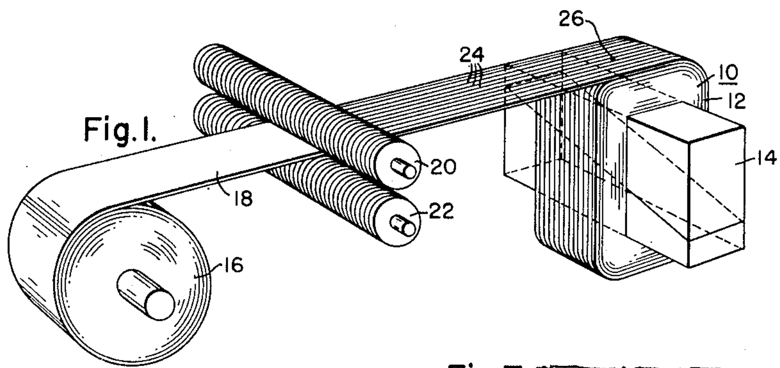


Fig. 7.

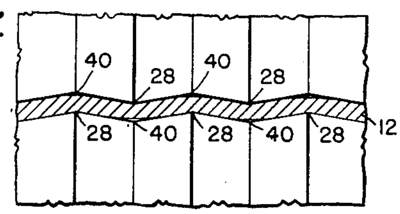


Fig. 2.

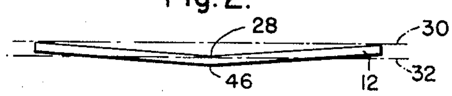


Fig. 3.

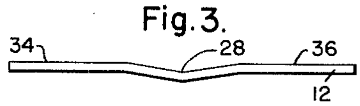


Fig. 8.

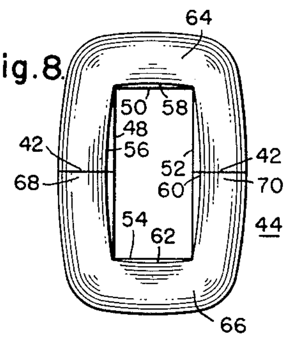


Fig. 4.

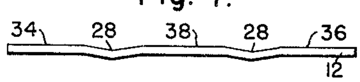


Fig. 5.

Fig. 9.

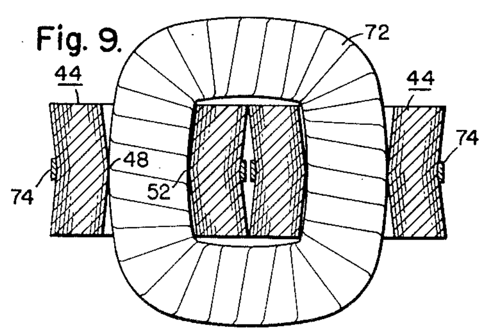
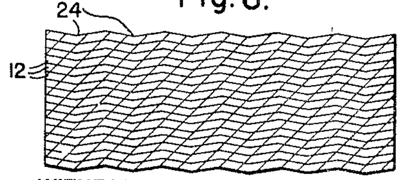


Fig. 6.



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MAGNETIC CORE MEMBER

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Fig. 10.

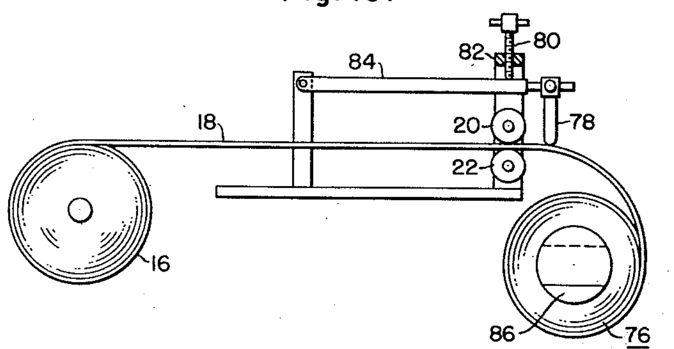


Fig. 11.

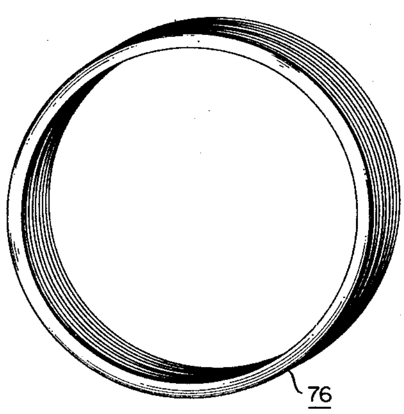
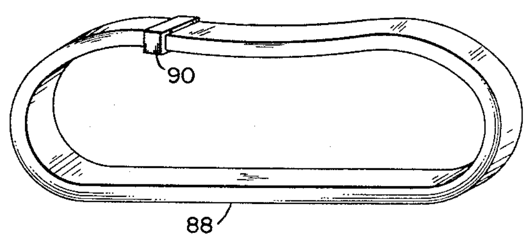


Fig. 12.



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UNITED STATES PATENT OFFICE

2,584,564

MAGNETIC CORE MEMBER

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Application April 27, 1950, Serial No. 158,383

16 Claims. (Cl. 175—356)

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This invention relates to magnetic core structures for use in electrical induction apparatus such as transformers.

In the manufacture of flatwise wound core members, it has been customary to wind magnetic strip material on a suitable mandrel after which the wound structure is annealed to relieve the winding stresses and the mandrel is then removed from the wound core. In practice it is found that the laminated core thus resulting is so weak that the inner turns of the core often collapse upon removal of the mandrel and that the core legs often bulge or curve outwardly. Further, as considerable force is used in forcing the mandrel from the annealed core member, the core member may again have strains introduced therein. In such practice, it is also found that the mandrel must be redressed or resized frequently because the repeated annealing and cooling of such members cause distortion and actual growth of the mandrel with the result that the mandrel loses its accuracy as to size.

In an effort to strengthen the annealed core member so that it may be cut and treated for receiving windings thereon, it has been the practice to impregnate the laminations with a suitable thermosetting or a thermoplastic resinous bonding material and thereafter bake the impregnated core member to effect the curing of the bonding material. Usually, the impregnated core members are stacked one upon another on the flat side of the strips of one of the core legs with spreaders in the winding windows to prevent collapsing of the wound structure and screen separators disposed between the stacked core members. The weight of the core members thus compacts the laminations into a stronger bonded structure, but there is an accumulation of the resin bond in the spaces of the screen where it sticks to the outer lamination in such quantity that the outer laminations must be trimmed off with an accompanying loss of time and material. The introduction of the bond also increases the losses of the core.

The bonded core member thus resulting is then cut through the core legs, the surfaces thereafter being ground and etched to form a good joint surface free from burrs. The core member is then assembled with windings in inductive relation thereto, the sectioned core member being bonded to maintain it in assembled position about the windings.

It is thus seen that because of the inherent weakness of the structure wound from the thin magnetic strip material, extreme care must be exercised in the processing of the wound structure to its assembly with the windings. The steps necessary to safeguard against the collapsing of the wound core member from the time it is first wound on the mandrel until the joints are completed greatly add to the manufacturing cost of the resulting core member and sometimes result in non-uniformity as to structures produced.

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An object of this invention is to provide a strong and substantially rigid flatwise wound core member.

Another object of this invention is to provide a flatwise wound core member in which the laminations are deformed in a predetermined manner lengthwise of the laminations and intermediate the edges thereof to increase the strength and rigidity of the wound core.

A further object of this invention is to provide a laminated flatwise wound rectangular core member having a pair of leg portions and a pair of connecting yoke portions in which the laminations are deformed in a predetermined manner lengthwise thereof to increase the strength and rigidity of the wound core, the deformation of the leg portions and connecting yoke portions of the inner turn of the laminations forming a substantially rectangular winding window in the core member.

Another object of this invention is to provide a toroidal core member of flatwise wound turns of magnetic strip material, the strip material having linear deformations applied thereto to impart strength to the wound core and having a set applied to the turns to maintain the turns tightly wrapped one upon another.

Other objects of this invention will become apparent from the following description when taken in conjunction with the accompanying drawing in which:

Figure 1 is a view in perspective illustrating the winding of a core member in accordance with this invention;

Fig. 2 is an end view of a lamination having a predetermined deformation applied thereto;

Figs. 3, 4, and 5 are views similar to Fig. 2 illustrating other forms of deformation applied to the lamination;

Fig. 6 is a view in section of a core leg constructed from a plurality of laminations having the deformation of the embodiment of Fig. 5 and illustrates the nesting of the laminations as wound one upon another;

Fig. 7 is a partial view in elevation of the rolls of Fig. 1 illustrating the application of the deformations to the magnetic strip material;

Fig. 8 is a view in side elevation of a core member formed in accordance with this invention;

Fig. 9 is a plan view, partly in section, illustrating the assembly of core members embodying this invention with windings;

Fig. 10 is a schematic view, in side elevation, of apparatus for producing a toroidal core member in accordance with this invention;

Fig. 11 is a view in perspective of a toroidal core member embodying the teachings of this invention; and

Fig. 12 is a similar view in perspective of a toroidal core member produced in accordance with the prior art.

Referring to Fig. 1 of the drawing, this invention is illustrated by reference to the forming of a rectangular core member 10. As illustrated the core member 10 comprises a plurality of flatwise wound laminations 12 formed on a collapsible mandrel 14, the laminations being formed from magnetic strip material 18 such as silicon iron having a preferred orientation in the direction of rolling of the strip and of the laminations. As illustrated, the strip material 18 is supplied to the collapsible mandrel 14 from a source of supply represented by the roll 16.

In accordance with this invention, in order to provide rigidity of the core member thus formed and to improve the strength thereof over the strength of core members known heretofore, the strip material 18 passes between a pair of pressure rolls 20 and 22 as it is removed from the roll 16 and wound upon the collapsible mandrel 14.

The rolls 20 and 22 have cooperating complementary surfaces for imparting a predetermined linear deformation to the strip 18 longitudinally of the strip and intermediate the edges thereof, the linear deformation being represented in Fig. 1 by the lines 24. As the strip material 18 having the lines of deformation 24 applied thereto is wound upon the collapsible mandrel 14, it forms a plurality of flatwise wound and nested laminations 12. The laminations 12 are thus flatwise wound upon the mandrel 14 until a predetermined number (depending upon the size of the core member 10) are formed thereon; and when such number are flatwise wound, the last turn is preferably spot welded as at 26 to maintain the laminations 12 in their wound position, and the strip material 18 is severed as close to the core 10 as possible. The collapsible mandrel 14 may then be readily removed from the core member 10 without danger of the laminations thereof collapsing.

The linear deformation applied to the laminations 12 may be of a number of forms, such as represented in Figs. 2, 3, 4, and 5. In Fig. 2 the deformation applied to the lamination 12 is represented as being a somewhat open-faced V-shaped deformation, the apex 28 of the V being centrally located with respect to the edges of the lamination 12. The edges of the lamination are in a plane represented by the dotted line 30 which is spaced from a parallel plane represented by the dotted line 32 passing through the apex 28 of the linear deformation applied to the lamination 12. Reference will be made hereinafter to the space represented between the parallel planes 30 and 32.

In the embodiment of Fig. 3, a single V-shaped deformation is applied centrally of the lamination 12, the outer portions 34 and 36 of the lamination being maintained in a substantially flat condition.

Instead of the single V-shaped deformation having a single apex 28 as represented in Figs. 2 and 3, the deformation applied to the lamination 12 may be in the form of two V-shaped deformations spaced apart as illustrated in Fig. 4, so that the lamination 12 has relatively flat surfaces 34 and 36 at its outer edges and an intermediate flat surface 38 between the V-shaped deformations applied thereto. Where two of the V-shaped deformations are applied to the lamination 12 as in this embodiment, the apex 28 of such deformations need not be as deep as in the embodiment of Fig. 3 in order to obtain the same rigidity of the lamination 12.

On the other hand, where the laminations 12 are formed of exceedingly thin material, such as .002 inch to .006 inch, it is desired to apply the deformations to the lamination 12 in a manner whereby the deformations are disposed adjacent one another substantially across the width of the lamination. Thus, in Fig. 5 there is illustrated a lamination 12 in which the linear deformations applied to the strip 12 are of sufficient number whereby the V-shaped deformations extend substantially across the strip or lamination 12. This, in effect, forms continuous corrugations across the entire width of the strip or lamination 12 to definitely improve the strength of the thin strip material.

Whether the strip or lamination 12 be deformed in accordance with the embodiment of Fig. 2 or any of the embodiments of Figs. 3 through 5, it is found that the linear deformation applied to the strip aids in the flatwise winding of the laminations 12 upon the collapsible mandrel 14, for the deformations aid in positioning or nesting each succeeding turn wound upon the previously applied turns. The nesting of the laminations 12 and the accurate aligning of the edges of the turns by reason of the deformations 24 are clearly illustrated in Fig. 6 which represents a section through any one of the winding legs and connecting yoke portions of the core member 10.

While Fig. 6 illustrates the nesting of the flatwise wound laminations 12 as having sharp apexes at the points of the deformation, in practice it is found that where the deformations are applied across the width of the lamination 12 as illustrated in Fig. 1, the upper roll 20 will not apply a sharp ridge to the lamination 12 at the high point between the adjacent deformations 24. This is illustrated in Fig. 7 in which it is clearly shown that the apexes 28 of adjacent V-shaped deformations are substantially sharp, whereas the intermediate ridge 40 formed between the apexes 28 is not a sharp point but tends to be slightly curved. The same condition is found on the underside of the lamination 12 wherein the apexes 28 are sharp and the ridges 40 are curved. Such formation aids in the nesting of the laminations as they are wound on the mandrel, permitting slight adjustments of the laminations relative one to the other.

After the rectangular core member 10 is wound in the manner described hereinbefore, the collapsible mandrel 14 is removed therefrom, and the core member 10 is annealed to relieve the winding stresses therefrom. The resulting core member may then be impregnated with a thermoplastic resin as in prior art practice and baked to cure or set the resin which functions as a bond between the laminations 12. In practice it is found that where the core member 10 is formed in accordance with this invention it may be desirable to employ the core member without the resinous bond, or where the resin bond is employed, less of the bonding material is required as the core member formed in accordance with this invention is quite strong even without the bond. By using less of the bond, the losses of the resulting structure are held to a minimum. Whether the core member is or is not impregnated with the resinous bonding material, it is preferably cut through the leg members as at the lines **42** shown in Fig. 8 of the drawing to facilitate the assembly of windings on the core member. It will, of course, be understood that where a bond is employed, the cutting of the core legs will not be effected until after the bond has been cured or set.

Referring to Fig. 8, there is illustrated a substantially rectangular core member **44** formed of the flatwise wound laminations deformed longitudinally of the strip or lamination intermediate the edges thereof in accordance with this invention. The embodiment of Fig. 8 has the deformation of Fig. 2 applied thereto. As clearly shown in Fig. 8, the relatively sharp edge **46** of the linear deformation illustrated in Fig. 2 is illustrated in Fig. 8 as forming a rectangular window opening represented by the lines **48**, **50**, **52** and **54**. In winding such a core member, it is found that while the edge **46** of the deformation forms the straight line rectangular window, the outer edges of the lamination **12** take a curvature as represented by lines **56**, **58**, **60** and **62** when wound to form the core member **44** of Fig. 8. It is to be noted that in winding the turns of laminations the deformation tends to flatten at the four corners of the core member **44** to maintain the line rectangular window opening in the core member. On the other hand, the outer perimeter of the core member **44** assumes the shape of the curved edges represented by the lines **56**, **58**, **60**, and **62** and the yoke portion ends **64** and **66** of the core member **44** are shorter than the leg portions **68** and **70**.

With the core member **44** formed as described and cut as at the lines **42** and with the faces formed on the resulting joints ground and etched as in accordance with prior art practice, the core members thus formed may be assembled with respect to a winding **72** as illustrated in Fig. 9 of the drawing. In this embodiment, two similar core members **44** are utilized, the winding legs of the two core members being positioned in back-to-back relation with the winding **72** passing through the winding windows of the core members. As in usual practice, a signode strap or band **74** is applied about the periphery of the core members **44** to maintain the two halves of the cut core member in operative position about the winding **72** with their joint faces seating tightly against one another.

As illustrated, the signode straps **74** are positioned in the V-shaped deformation of the outer turn of the core members, the V-shaped deformation aiding in maintaining the straps **74** in the applied central position to the assembled core member. Where the core member **44** is formed as illustrated and embodies the V-shaped deformation of the lamination of Fig. 2, it is apparent from Fig. 9 that the strap **74** readily accommodates itself within the space formed between the two parallel planes represented by the dotted lines **30** and **32** of the embodiment of Fig. 2. As it is impossible to wind a coil **72** with a perfectly square window therein, it is seen from the illustration of Fig. 9 that the embodiment of the core member **44** represented therein readily accommodates itself to the shape of the winding **72**. Thus, the lines **48** and **52** of the leg portions **68** and **70**, respectively, define the window opening for receiving the winding **72**, these lines being tightly against the winding **72**. Because of the sloped surfaces of the internal turn of the laminations, it is seen that the internal turn accommodates itself to the shape of the winding passing through the winding window of the core. Further, since the signode strap **74** is in the space between the apex **28** of the deformation and the plane of the outer edges of the lamination, it is not necessary to provide extra space for the accommodation of the signode strap, the straps of the two core members being within the confines of the outer edges of the core members.

By practicing this invention, it is possible to produce a much stronger core member of the flatwise wound type than has ever been produced heretofore. The strength and rigidity imparted to the core legs and to the connecting yoke portions of the core member are so great that the mandrel may be removed therefrom prior to the anneal without danger of collapsing of the core legs. Since the resulting core is so much stronger than the known cores, where a resinous bond is employed between the laminations it is not now necessary to utilize spreaders within the winding window of the core member during the baking operation, nor is it necessary to stack the cores flatwise of the laminations forming the core legs during the baking operation. Instead, the cores may be stacked edgewise with the result that the outer lamination thereof will not have the external mass of resinous bond adhering thereto nor will it entail the necessity for removing the outer lamination of the core member, thus resulting in a saving of time and material.

This invention may be applied to a range of core members for distribution transformers of from 1½ to 10 kv.-a. in size, or to thin gauge core members for radio and other electronic applications as well as to power and network transformers of the wound core type. The core members can be readily produced from strip material, such as silicon iron, having a thickness ranging from .001 to .020 inch thickness. The depth of the linear deformation applied to the strip material will, of course, depend upon the thickness of the material and the strength which it is desired to impart to the core member. Preferably, the deformation should not be greater than ⅛ inch where a single V is employed as in Figs. 2 and 3 of the drawing.

Where a compound deformation, such as illustrated in Fig. 5, is employed, the depth of the deformation applied to strip material having a thickness of 0.010 inch and the deformations extending over a distance of about ½ inch from peak to peak is preferably not over .08 inch maximum as the strip may crack. In the embodiment of Fig. 5, the depth of the deformation represented by the letter V is preferably of the order of .04 inch, where the lamination **12** is of .010 inch thick, the deformation extending over a distance of about ½ inch from peak to peak between the adjacent deformations. The stiffness factor applied to such deformed material can be readily approximated from the formula

$$\left(\frac{V}{d}\right)^2$$

where V is the depth of the deformation and d is the thickness of the material. The increase in stiffness thus can be readily calculated in a material having a thickness of .010 inch where the depth of the deformation is .040 inch to be about 16 times the stiffness of the flat lamination.

In another embodiment of this invention as applied to toroidal core members **76**, as described in my copending application Serial No. 158,384, filed simultaneously herewith and now abandoned, the core member is formed in accordance with Fig. 10 of the drawing. In this embodiment, the strip material **18** is passed between a pair of rolls **20** and **22** having complementary surfaces thereon for applying a predetermined deformation to the strip **18** longitudinally throughout the length of the strip and intermediate the edges thereof as described with reference to Figs. 1, 2, 3, 4 and 5.

However, in this embodiment, after the strip **18** passes between the rolls **20** and **22**, it passes under an adjustable bias or set member **78** to bend the strip **18** and set it in the curvature of the toroidal core member **76**. The set imparted to the strip **18** having the longitudinal deformation or deformations is determined by the adjustment of a set screw **80** carried by a cross bar member **82** and disposed to limit the upward movement of a pivoted lever **84** which carries the set member **78**. Thus as the strip **18** emerges from the complementary deforming rolls **20** and **22**, pressure is applied by the set member **78** directly to the strip **18** to so bend the strip as to impart thereto the required set.

In practice, the set is sufficient to develop a curvature in the strip material **18** substantially equal to the curvature of the collapsible mandrel **86** so that as successive turns are wound on the mandrel **86**, the successive turns are biased to tightly engage the preceding turns. The linear deformation of the strip **18** having the set imparted thereto aids in nesting and aligning the successive turns as the strip **18** is flatwise wound on the mandrel **86**. When the required number of nested turns are wound for a given toroidal core member, the strip **18** is cut across the width thereof, the outer turn being so biased as by reason of the set imparted thereto as to tightly adhere in wound relation to the preceding turn without the necessity of clamping or otherwise securing the cut end of the last turn to the wound core. The bias thus developed in the successive turns prevents the unwinding of the core member unless sufficient force is applied to overcome at least a part of the set of the strip material.

When sufficient turns have been wound to form a given toroidal core member **76** as just described, the collapsible mandrel **86** is removed from the wound toroidal core member with the result that a toroidal core member **76** as illustrated in Fig. 11 is produced. This core member has sufficient strength by reason of the linear deformations applied thereto to be self-supporting during later applied annealing treatments and assembly in induction apparatus and because of the set imparted to the turns will not unwind even though clamping means are not used to secure the ends of the turns.

In order to demonstrate the improvement in strength of the toroidal core members produced in accordance with this invention over the toroidal core members of the prior art, reference may be had to Figs. 11 and 12. Fig. 11 clearly illustrates the self-supporting characteristic of the unclamped core member **76** of this invention, whereas Fig. 12 illustrates the collapse of an unsupported toroidal core member **88** of the prior art wound from flat strip material and with the ends of the turns clamped or taped as at **90** to prevent the turns from unwinding. As a specific example of the improved stiffness in a toroidal core member embodying the teachings of this invention, and having twenty-four laminations and of original diameter of $16\frac{9}{16}$ths inches when stood in the position of the core member of Fig. 11, the core member of this invention deflected only $\frac{3}{16}$th inch, whereas a toroidal core member of twenty-six laminations and a diameter of $16\frac{11}{16}$th inches which was produced and clamped in accordance with prior art practice deflected or collapsed in the manner shown in Fig. 12 to a diameter of $13\frac{7}{8}$th inches. On larger sized core members of the same number of laminations, the improvement is more pronounced as for example the core member of Fig. 11 having a diameter of $24\frac{7}{8}$th inches sags only $1\frac{3}{16}$th inches when in the position shown, whereas the prior art core member of Fig. 12 collapses from a wound diameter of $24\frac{7}{8}$th inches to a diameter of only $12\frac{1}{8}$th inches.

Because of the improvement in strength and rigidity, the toroidal core members of this invention are easier to handle, test, store and assemble with the other elements of the electrical induction members than the toroidal core members of the prior art. The end turns need not be secured as the nested turns are biased one upon the other. Further, because of the rigidity of the toroidal core, it is not necessary to utilize a resinous bond which increases the losses to improve the strength and because of the nesting of the turns, they will not readily "telescope" while being handled. It is also to be noted that in the prior art toroidal core structures, it has been necessary to utilize a supporting tube or ring consolidated under heat and pressure from laminated sheets of fibrous material impregnated with a resinous binder about the core. Where the toroidal core is formed in accordance with this invention, such supporting structures can be dispensed with as the core has adequate strength and rigidity. As the cores are rigid, they can be annealed in the shape required for service.

Where the core members are produced in accordance with this invention, considerable savings are effected in the handling of the core members as well as in overcoming prior art practice damage to the mandrels by repeated anneals. Further, less bond is required where a bond is employed, effecting a savings in material as well as producing a core member having lower losses. It is believed that the core members of this invention can be readily reproduced by anyone skilled in the art.

I claim as my invention:

1. A core member for electrical induction apparatus comprising, in combination, a plurality of turns of magnetic strip material having a thickness of not more than about .020 inch wound flatwise one upon another to provide a substantially rectangular member of predetermined shape and size, the strip material having a predetermined linear deformation applied thereto longitudinally throughout the length of the wound strip and intermediate the edges thereof, the linear deformation in one turn nesting in the linear deformation of the next turn to prevent lateral relative movement of the turns after

they are wound and increase the strength and rigidity of the substantially rectangular member.

2. A core member for electrical induction apparatus comprising, in combination, a plurality of turns of magnetic strip material having a thickness of not more than about .020 inch wound flatwise one upon another to provide a substantially rectangular member of predetermined shape and size, the strip material having a plurality of spaced linear deformations applied thereto longitudinally throughout the length of the wound strip and intermediate the edges thereof, the spaced linear deformations in one turn nesting in the corresponding spaced linear deformations of the next turn to prevent lateral relative movement of the turns after they are wound and increase the strength and rigidity of the substantially rectangular member.

3. A core member for electrical induction apparatus comprising, in combination, a plurality of turns of magnetic strip material having a thickness of not more than about .020 inch wound flatwise upon one another to provide a substantially rectangular member of predetermined shape and size, the strip material having a substantially V-shaped deformation applied thereto longitudinally throughout the length of the wound strip and intermediate the edges thereof, the V-shaped deformation in one turn nesting in the V-shaped deformation of the next turn to prevent lateral relative movement of the turns after they are wound and increase the strength and rigidity of the substantially rectangular member.

4. A core member for electrical induction apparatus comprising, in combination, a plurality of turns of magnetic strip material having a thickness of not more than about .020 inch wound flatwise one upon another to provide a substantially rectangular member of predetermined shape and size, the strip material having a substantially V-shaped deformation applied thereto longitudinally throughout the length of the wound strip, the apex of the V-shaped deformation being disposed substantially centrally of the strip intermediate the edges thereof, the deformation of one turn nesting in the deformation of the next turn to prevent lateral relative movement of the turns after they are wound and increase the strength and rigidity of the substantially rectangular member.

5. A core member for electrical induction apparatus comprising, in combination, a plurality of turns of magnetic strip material having a thickness of not more than about .020 inch wound flatwise one upon another to form a substantially rectangular core member of predetermined size having a pair of leg portions and a pair of connecting yoke portions, the strip material having a V-shaped deformation applied thereto longitudinally throughout the length of the wound strip, the apex of the V-shaped deformation being disposed substantially centrally of the strip width, the apex of the longitudinal deformation of the first turn of the leg and yoke portions extending inwardly in the wound core to provide a substantially rectangular outline defining a winding window in the core member, the deformation in one turn nesting in the deformation of the next turn to prevent lateral relative movement of the turns after they are wound and increase the strength and rigidity of the wound core.

6. A core member for electrical induction apparatus comprising, in combination, a plurality of turns of magnetic strip material having a thickness of not more than about .020 inch wound flatwise one upon another to provide a substantially rectangular member of predetermined shape and size, the strip material having a plurality of V-shaped deformations applied thereto longitudinally throughout the length of the wound strip and intermediate the edges thereof, the deformations in one turn nesting in the corresponding deformations of the next turn to prevent lateral relative movement of the turns after they are wound and increase the strength and rigidity of the substantially rectangular member.

7. A core member for electrical induction apparatus comprising, in combination, a plurality of turns of magnetic strip material having a thickness of not more than about .020 inch wound flatwise one upon another to provide a substantially rectangular member of predetermined shape and size, the strip material having a plurality of V-shaped deformations applied thereto longitudinally throughout the length of the wound strip, the V-shaped deformations being disposed adjacent one another substantially across the width of the strip, the deformations in one turn nesting in the corresponding deformations of the next turn to prevent lateral relative movement of the turns after they are wound and increase the strength and rigidity of the substantially rectangular member.

8. A core member for electrical induction apparatus comprising, in combination, a plurality of turns of magnetic strip material having a thickness of not more than about .020 inch wound flatwise one upon another to form a substantially rectangular laminated core member of predetermined size having a pair of leg portions and a pair of connecting yoke portions, the strip material having a predetermined linear deformation applied thereto longitudinally throughout the length of the wound strip and intermediate the edges thereof, the linear deformation in one turn nesting in the linear deformation of the next turn to prevent lateral relative movement of the wound turns and increase the strength and rigidity of the wound core, and banding means applied to the external turn of the wound core to seat in the linear deformation of the leg and yoke portions of said external turn to maintain the turns in their wound laminated relation.

9. A core member for electrical induction apparatus comprising, in combination, a plurality of turns of magnetic strip material having a thickness of not more than about .020 inch wound flatwise one upon another to form a substantially rectangular laminated core member of predetermined size having a pair of leg portions and a pair of connecting yoke portions, the strip material having a predetermined linear deformation applied thereto longitudinally throughout the length of the wound strip and intermediate the edges thereof, the linear deformation in one turn nesting in the linear deformation of the next turn to prevent lateral relative movement of the wound turns and increase the strength and rigidity of the wound core, the edges of any one of the turns in the leg or yoke portions of the core member being in a plane spaced from a parallel plane through the linear deformation of said leg or yoke portions of the turn, and banding means applied to the external turn of the wound core to seat in the space of the linear deformation between said parallel planes of the

leg and yoke portions of said external turn to maintain the turns in their wound relation.

10. A core structure for electrical induction apparatus comprising, in combination, a plurality of turns of a corrugated strip having a thickness of not more than about .020 inch wound flatwise in superimposed nesting relation to provide a hollow member substantially rectangular in shape, the corrugation extending lengthwise for the entire length of the wound strip, the corrugation in one turn nesting in the corrugation of the next turn to prevent lateral relative movement of the wound turns and resinous bonding material applied intermediate the adjacent turns to bond the superimposed turns into a unit resistant to distortion by pressure in any direction.

11. A core member for electrical induction apparatus comprising, in combination, a plurality of turns of magnetic strip material having a thickness of not more than about .020 inch wound flatwise one upon another to provide a substantially rectangular member of predetermined size having a pair of leg portions and a pair of connecting yoke portions, the strip material being corrugated, the corrugation running lengthwise for the entire length of the wound strip, the corrugation in one turn nesting in the corrugation of the next turn to prevent lateral relative movement of the turns after they are wound and to strengthen the turns against collapse, the leg and yoke portions defining a winding window in the member.

12. A core member for electrical induction apparatus comprising, in combination, a substantially rectangular core loop formed from a strip of magnetic sheet steel having a thickness of not more than about .020 inch and a preferred orientation lengthwise of the strip and wound flatwise layer upon layer, the strip material having a predetermined linear deformation applied thereto longitudinally throughout the length of the wound strip and intermediate the edges thereof, the linear deformation in one turn nesting in the linear deformation of the next turn to impart strength and rigidity to the substantially rectangular wound core and prevent collapse of the inner layers thereof.

13. A core member for electrical induction apparatus comprising, in combination, a substantially rectangular core loop formed from a strip of magnetic sheet steel having a thickness of not more than about .020 inch and a preferred orientation lengthwise of the strip and wound flatwise layer upon layer, the strip material having a predetermined linear deformation applied thereto longitudinally throughout the length of the wound strip and intermediate the edges thereof, the linear deformation in one turn nesting in the linear deformation of the next turn to impart strength and rigidity to the substantially rectangular wound core and prevent collapse of the inner layers thereof, and resinous bonding material applied intermediate the adjacent turns to bond them into a unit resistant to distortion by pressure in any direction.

14. A core member for electrical induction apparatus comprising, in combination, a plurality of turns of magnetic strip material having a thickness of not more than about .020 inch wound flatwise one upon another to provide a substantially rectangular member of predetermined size having a pair of leg portions and a pair of connecting yoke portions, the strip material having a plurality of substantially V-shaped deformations applied thereto, the V-shaped deformations running lengthwise for the entire length of the wound strip and intermediate the edges thereof, the deformations in one turn nesting in the deformations of the next turn to prevent lateral relative movement of the turns after they are wound and to strengthen the turns against collapse, the leg and yoke portions of the inner turn of the wound member defining a winding window.

15. A toroidal core member for electrical induction apparatus comprising, in combination, a plurality of turns of magnetic strip material having a thickness of not more than .020 inch wound flatwise one upon another to provide a toroidal core member of predetermined size, the strip material having a predetermined linear deformation applied thereto longitudinally throughout the length of the wound strip and intermediate the edges thereof to increase the strength and rigidity of the wound member, the linear deformation in one turn nesting in the linear deformation of the next turn to prevent lateral relative movement of the wound turns, the strip also having a set applied thereto to develop a curvature therein substantially equal to that required of the inner turn of the wound toroidal core member whereby the succeeding turns are biased to tightly wrap themselves on the preceding turns, the set applied to the strip preventing the unwinding of the turns of the core member without the application of force.

16. A toroidal core member for electrical induction apparatus comprising, in combination, a plurality of turns of magnetic strip material having a thickness of not more than about .020 inch wound flatwise one upon another to provide a toroidal core member of predetermined size, the strip material having a plurality of V-shaped deformations applied longitudinally throughout the length of the wound strip, the V-shaped deformations being disposed adjacent one another substantially across the width of the strip, the longitudinal deformations in one turn nesting in the corresponding longitudinal deformations of the adjacent turn and cooperating to increase the strength and rigidity of the wound member, the strip also having a set applied thereto to impart a curvature flatwise of the strip substantially equal to that required of the inner turn of the wound toroidal core member whereby the succeeding turns are biased to tightly wrap themselves on the preceding turns, the set applied to the strip preventing the unwinding of the turns of the core member without the application of force.

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