Nov. 30, 1965 W. OLSEN ETAL 3,220,239

TRANSFORMER CORE CONSTRUCTION AND METHOD OF PRODUCING SAME

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Fig. 1

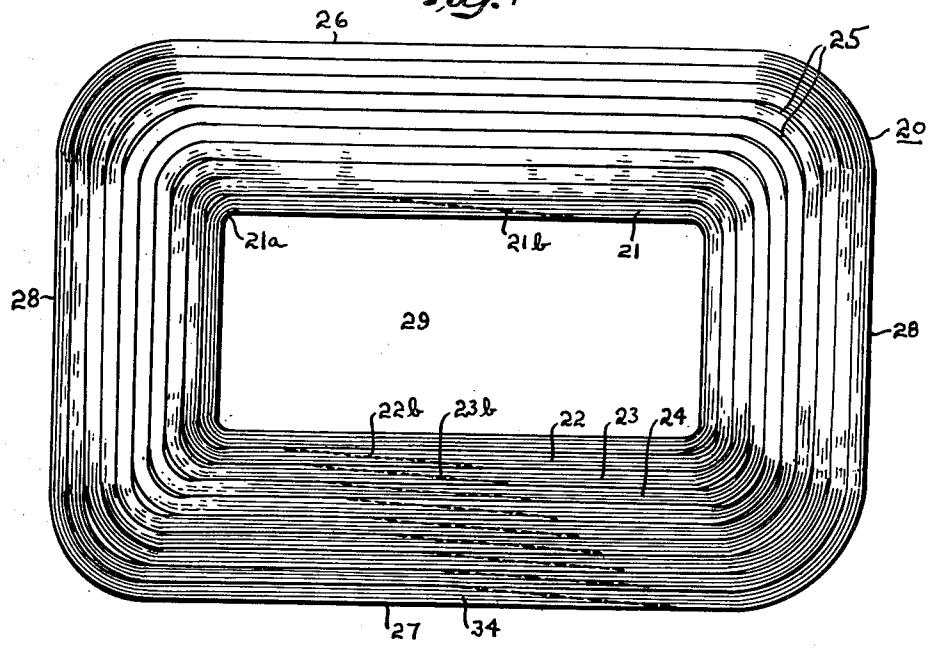


Fig. 2

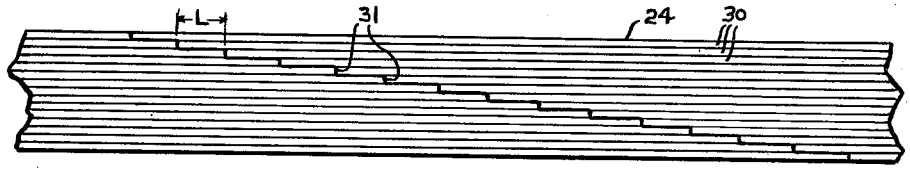
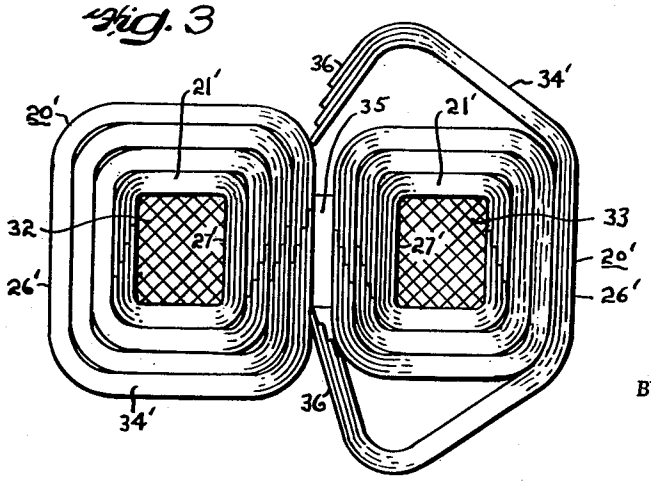


Fig. 3



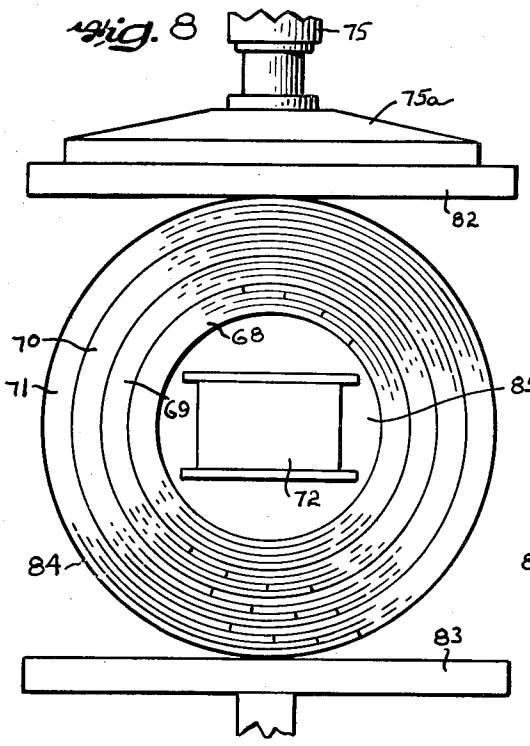
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TRANSFORMER CORE CONSTRUCTION AND METHOD OF PRODUCING SAME

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Fig. 8



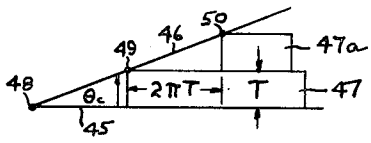


Fig. 5

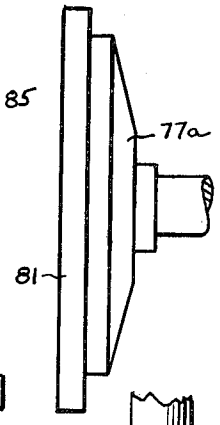


Fig. 9

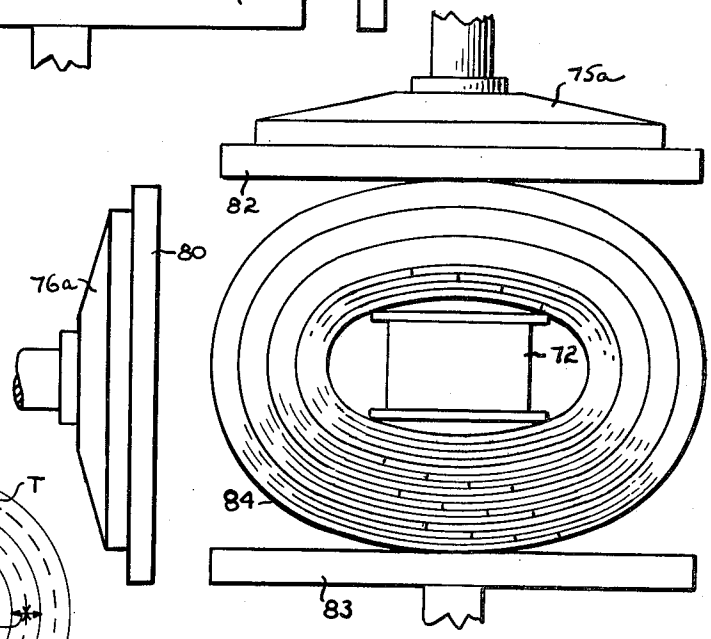
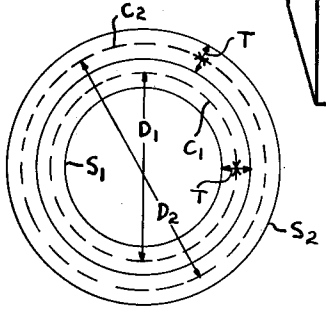


Fig. 4



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Fig. 11

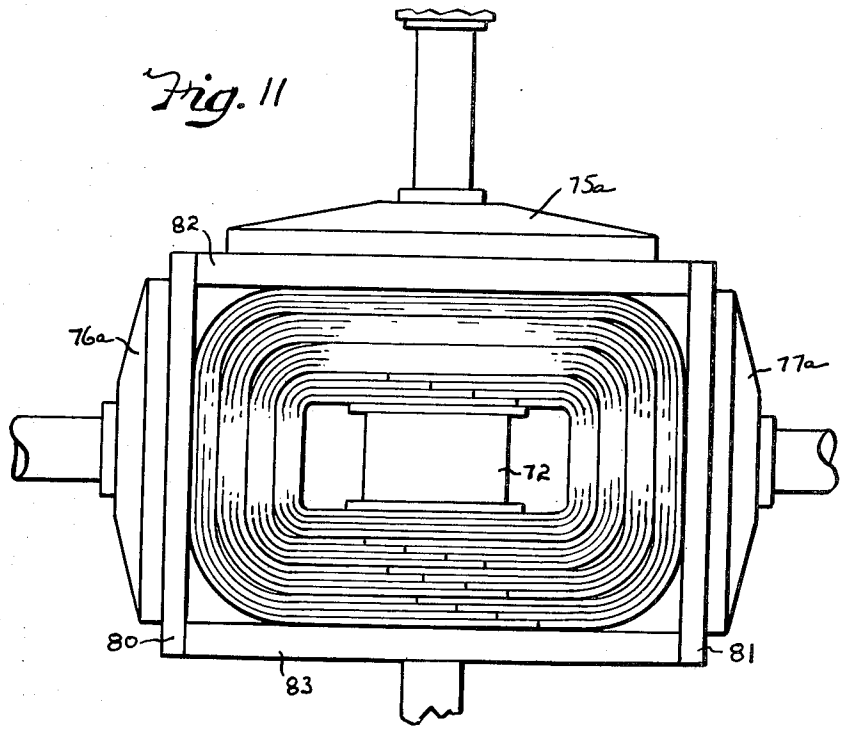


Fig. 6

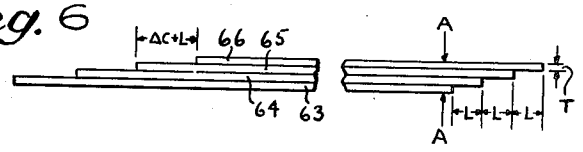
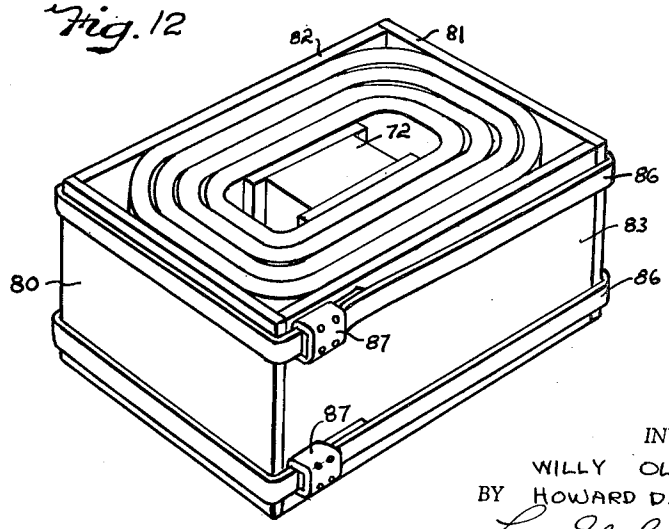


Fig. 12



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Fig. 7

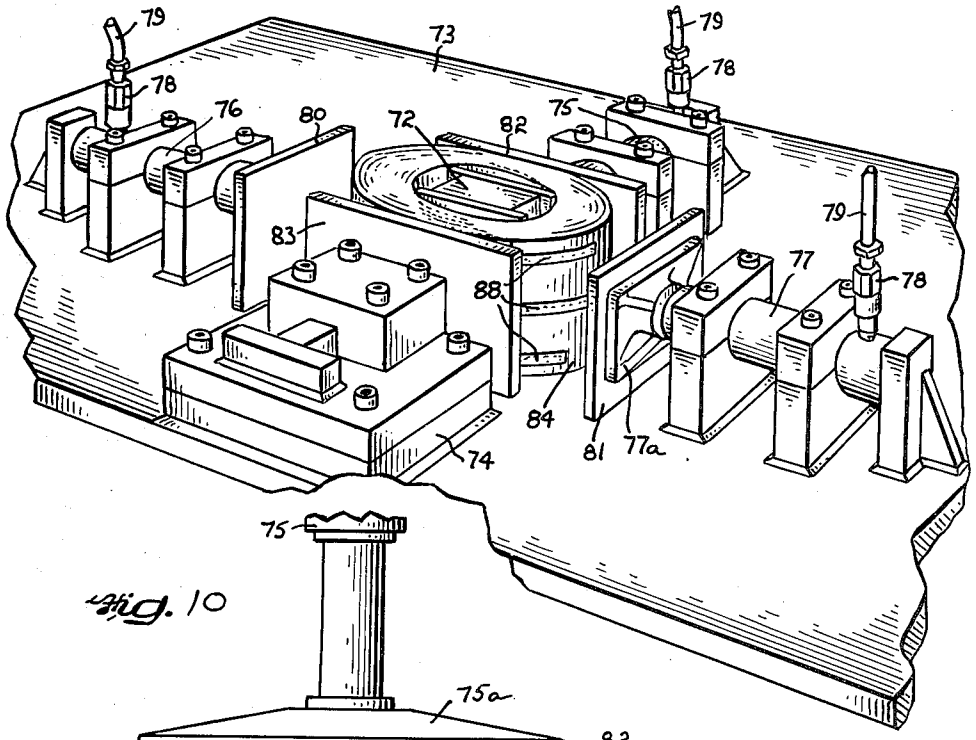
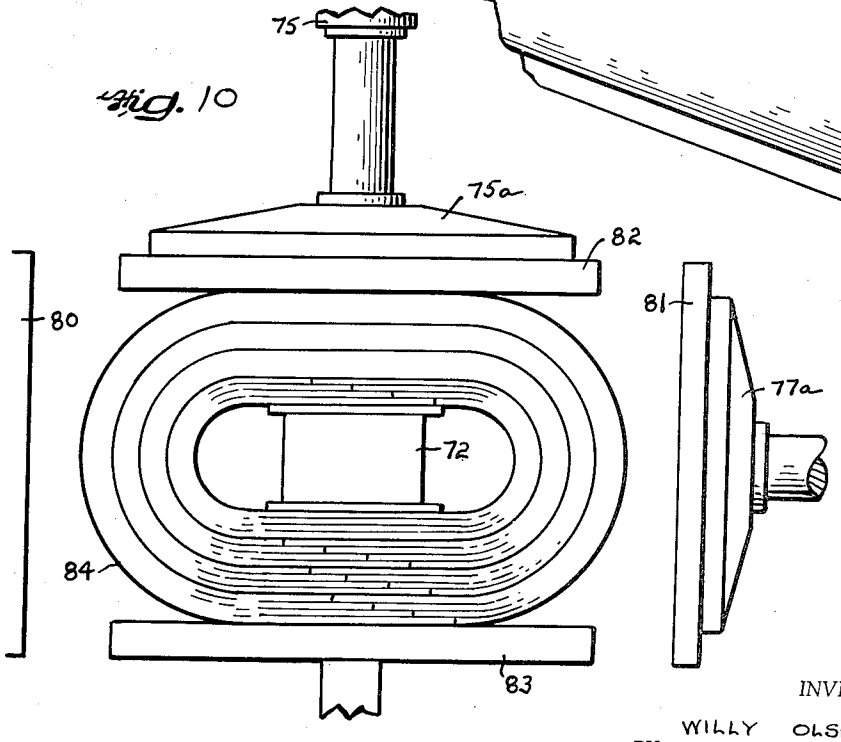


Fig. 10



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TRANSFORMER CORE CONSTRUCTION AND METHOD OF PRODUCING SAME

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Original application Nov. 13, 1961, Ser. No. 151,655. Divided and this application Oct. 3, 1963, Ser. No. 318,474

3 Claims. (Cl. 72—394)

This invention relates generally to wound type transformer cores, and more particularly relates to a wound transformer core having superior magnetic characteristics resulting in lower core losses and higher transformer efficiency, this application being a division of application Serial No. 151,655, filed November 13, 1961.

The superiority of a wound transformer core as compared to cores made of solid sections or punched laminations is well-known to workers in the art and need not be detailed herein. Moreover, it is also known that a wound transformer core made from a single continuously wound strip of core material will normally exhibit better magnetic properties than a transformer core fabricated from a plurality of strips which have ends butted or lapped to form the composite core. However, as a practical matter, manufacturing economics dictate that wound cores should be made from a plurality of strips of core material rather than from a single continuous strip even though the joints inherent in such a construction tend to degrade the magnetic efficiency of the core structure. This being the case, a great deal of effort has been concentrated on ways of minimizing the deleterious effects of the joints while maintaining the manufacturing benefits which flow from the jointed type of core construction.

In nearly all instances it is desirable to form the transformer cores so that they are of rectangular or square shape and have a corresponding rectangular or square central opening or window to accommodate the transformer coil structure in order that the overall transformer may be made as compact as possible, the composite transformer usually including at least two cores each of which is disposed about one leg of the coil structure so that one leg of each core is disposed within the coil window in such manner as to cause the coil window to be substantially completely filled. This general type of transformer structure creates problems with regard to the installation of the preformed cores through the coil window since there is very little unoccupied coil window space in the finished assembly and the corners of the core structures must be passed through the window in order to close the core.

The preformed core corners are necessarily deformed by straightening in order to be passed through the window, particularly with regard to the outer laminations of the cores, with the consequent introduction of mechanical stresses and strains into the laminations of the cores. The introduced stresses alter the magnetic properties of the core in an adverse manner and are of course undesirable. This condition is aggravated in most wound core constructions by the fact that the core laminations have a high space factor at the corners and are prevented from readily shifting relative to one another as they are stressed while being passed through the coil window. This increases the strains introduced at the corners and further degrades the core performance. Attempts have been made in the past to reduce the severity of this problem by the use of various forming methods directed toward reducing the space factor at the corners, as for example by the use of insert shims in the corner regions as the core is being wound. Unfortunately, these known methods are either uneconomic or also tend to reduce the space factor in the straight sided legs and yoke regions of the core where a high space factor is desirable. As will be subsequently seen, the physical realizability of the desirable core structure according to the invention is related to the method by which the core is made, and the novel method employed to produce the cores to be hereinafter described is a contributing factor to the superior performance of which these cores are capable. Accordingly, it is a primary object of this invention to provide an apparatus for producing a wound transformer core of rectangular or square form characterized by a high space factor throughout the straight sided regions of the core, and a space factor at the corners of the core which is sufficiently low that it allows for relatively free interlaminar movement during assembly of the core to its coil structure to thereby prevent the creation of mechanical stresses and strains in the core material and preserve the magnetic properties of an unstressed core.

The foregoing and other objects of the invention will become clear from a reading of the following specification in conjunction with an examination of the appended drawings, wherein:

FIGURE 1 illustrates a typical wound core according to the invention showing the high space factor in the straight core portions and the relatively lower space factor at all of the corners, and also illustrating the fact that all of the sections from which the core is built up, excepting the innermost section, are jointed along one of the straight side legs of the core, the innermost section being jointed on the opposite core leg;

FIGURE 2 is an enlarged fragmentary showing of the stepped butt joint construction of a typical core section;

FIGURE 3 illustrates a pair of core sections built through the window of a typical coil structure and illustrating the manner in which the sections are built upon one another to form a complete core;

FIGURE 4 illustrates two strips of material bent into surface engaged concentric circles with their opposite ends respectively abutted, certain geometric relationships being derivable therefrom;

FIGURE 5 illustrates the utilization of the relationships derived from FIGURE 4 for the purpose of constructing a core strip sizing jig;

FIGURE 6 illustrates in side elevation a stack of laminations previously cut to their requisite lengths with their righthand ends displaced from one another preparatory to being bent into a circular loop as one step in the preparation of the core according to the invention;

FIGURE 7 illustrates in perspective an apparatus for forming a rectangular core from a built up core of circular configuration, a circular core being shown in position for forming;

FIGURES 8 through 11 illustrate successive steps in the process of transforming a sectioned wound core of circular form to a core of rectangular form in accordance with the novel method according to the invention; and

FIGURE 12 illustrates the formed rectangular core after removal from the press apparatus shown in FIG. 5 and ready for annealing.

In the several figures, like elements are denoted by like reference characters.

Turning now to a consideration of the drawings, there will be seen in FIGURE 1 a composite core **20** made up of a plurality of internested individual core sections, the inner and outer sections being designated respectively as **21** and **34** while various of the intermediate sections have been designated as **22**, **23**, and **24**. The core is for purposes of illustration shown as of generally rectangular form having a pair of side legs **26** and **27** and a pair of yoke portions **28**, the straightsided legs and yoke portions of the core being joined by the corner regions which are so formed that gaps **25** are observed to intervene the adjacent core sections. In actuality, there also

exist slight gaps between the individual laminations **30** of each core section in the corner regions thereof although these are not clearly visible because they would tend to confuse rather than clarify the drawing. The inside periphery of inner core section **21** defines a window **29** within which one leg of the transformer coil structure is disposed in a completed transformer unit.

It should be observed that while the corners **21***a* of the innermost lamination of the transformer core are rather sharply defined, all of the remaining laminations of the core are of smoothly curved configuration in the corners thereof, the radii of the corner curvature of the laminations increasing outwardly from the innermost lamination. The curvature of the core section corners combined with the interlaminar gaps in the corner regions allow relative movement between adjacent laminations when the core is being built up section by section upon a coil structure, and prevents mechanical strains from being induced in the laminations and thereby preserves the magnetic characteristics of the core.

By means of a method to be subsequently set forth herein, the looseness in the corners can be controlled to provide a corner space factor in the preferred region of 85% to 95% with an optimum space factor obtaining at about 90%. In contrast to this, wound cores made by the usual methods heretofore known result in core corners having space factors of 96% to 98%, resulting in a corner structure which for all practical purposes is the same as if the corners were rigidly clamped because such high values of space factor prevent corner flexing unless a considerable corner opening force is applied. The necessity for applying such high forces in normal core constructions to effect insertion of the core sections through the window of the coil structure sets up substantial mechanical stress and strain in the corner regions which adversely affect the core magnetic characteristics.

Additionally, it will appreciated that the usual wound core characterized by a high corner space factor is not completely strain relieved by the usual annealing process. This is so because even though it is true that a core during the annealing process may be strain relieved because of longitudinal expansion of the laminations while they are hot, nevertheless, when the annealed core is cooling down, the outer laminations are those which cool first and are attended by contraction of these laminations which exert a compressional force upon the not as yet cooled inwardly lying laminations and cause the latter to buckle so that a wavy condition is produced in the legs and yoke portions of the core. This waviness is of course highly undesirable and tends to reduce the space factor in the legs and yoke portions of the core, which are precisely those portions of the core in which a high space factor is desired. No such undesired condition occurs in wound cores made according to the present invention, the space factor achieved in the legs and yoke portions being very close to 100%.

As best seen in FIGURE 2, the laminations **30** of each of the individual core sections, such as for example core section **24**, close into abutting relationship as at **31**, and the ends of the laminations adjacent to one another are relatively offset a distance designated in FIGURE 2 as the distance L, so that a staircase type of composite joint for the core section is formed. These joints are shown in FIGURE 1 for example as **21***b*, **22***b*, and **23***b* for the respective core sections **21**, **22**, and **23**. Additionally it will be observed that the core section joints **22***b* and **23***b* are longitudinally offset within the core side leg **27** and that this relationship holds for the remainder of the core section joints extending outward through the core side leg **27** to the outer section **34**. Thus, the offset joints of the several internested core sections are distributed lengthwise of the core leg **27** to minimize the magnetic reluctance across a plane extending perpendicularly transversely through the leg **27** with the core overall joint length being greater than the thickness of the core leg **27** in which the joint is located. Significantly, it will be observed that the joint **21***b* for the core section **21** does not lie in the leg **27** but is disposed within the core leg **26**. The significance of this feature is most clearly seen from the showing of FIGURE 3 to which attention should be now directed.

In FIGURE 3 there will be seen a transformer coil structure having a pair of legs **32** and **33**, the leg **32** being disposed within the window of the lefthand core structure **20'** and the leg **33** being disposed within the window of a second righthand core structure **20'** shown in partly assembled condition. It will be observed that the window **35** of the coil structure is substantially filled by the completely assembled side leg **27'** of the lefthand core structure **20'** and the assembled sections of the leg **27'** of the righthand core **20'**, there remaining sufficient space for insertion of the ends **36** of the outer core section **34'** of the righthand core. It will be appreciated that by assembling the individual core sections so that the section gaps are disposed within the window **35** of the coil structure, it is only necessary to feed straight portions of the core section into the window.

Stated somewhat differently, excepting for the innermost section, it is not necessary to pass any of the core section corners through the coil structure window. Obviously, in the illustrated case of FIGURE 3 no core section corner could pass through the window without being practically completely straightened out, the necessity of doing which would cause the severe mechanical strains and stresses in the core material corners previously discussed. Nevertheless, this is exactly what is done in the assembling of most known types of core structures because these cores are almost always constructed so as to be openable through the core yoke region or through the core leg corresponding to those designated as **26'**. The difficulty of passing a core section corner through the coil window becomes increasingly more acute as the window size is reduced due to the buildup of the core structure.

It will be observed however in both the showings of FIGURE 1 and FIGURE 3 that the innermost core sections **21** and **21'** respectively each has a gap region disposed in the leg opposite to that in which the gap regions of the other core sections are placed. The reason for this is that since the inner core section is in effect the form on which the remainder of the core sections are placed and determines the initial size of the core window, it is almost essential that there should be a guarantee that the gap of the inner core section be completely and properly closed. By placing the gap of the inner section on the outside of the coil leg, and not in the window, such proper closing of the gap can be assured since the joint is clearly visible and easily manipulable when placed in this location. Further, this orientation of the inner core section joint does not pose a real problem with regard to the installation of the inner core section about the coil form because the coil structure window is completely open at this time and the coil section corners may be rather easily passed therethrough without any material flexing or straightening thereof, so that the mechanical stress situation, which becomes progressively worse as the cores are built up, does not really exist for the innermost core section.

While FIGURE 3 shows the typical core sections as being each composed of four laminations, this is by no means a necessary condition or limitation and the individual core sections may be formed with as many laminations as are deemed desirable. In this regard, FIGURE 2 illustrates the core section **24** as being built up of 15 laminations. Moreover, it is not necessary that all of the core sections of any given composite core should contain the same number of laminations.

Understanding now the novel structure of the wound transformer core according to the invention, the method of assembling such a core into an associated coil struc-

ture and the improved performance of which the core is capable, attention should now be directed to the remainder of the figures for an understanding of the method of making the novel core structure and the apparatus employed for carrying out the method.

Each of the rectangular core sections which together make up the composite core shown in FIGURE 1 is made from a plurality of pre-cut straight strips of core material of graduated length produced by any desired suitable means. The strips are stacked and bent into a circle with the shortest strip occupying the inside position in the loop and with the longest strip occupying the outside position in the closed loop. The loop sections are then placed in a press and the circular cross-section of the core is then formed into a rectangular section. The formed core is then annealed and disassembled section by section for subsequent installation onto a coil structure.

Referring to FIGURE 11 there will be seen a pair of strips S_1 and S_2 each of thickness T and folded into internested circular form with the ends of each strip brought into abutment. The strip S_1 has a mean diameter D_1 and a mean circumference C_1 while the strip S_2 has a mean diameter D_2 and mean circumference C_2. The strips S_1 and S_2 of course correspond to any two adjacent laminations of the core to be constructed, these laminations being in circular form in the configuration assumed prior to rectangular forming. It is apparent that the strip S_2 must be longer than the strip S_1 in order that its ends shall be able to close, and it is necessary to determine what the difference in strip length should be so that successive strips of properly increasing length may be cut to form the core. The difference in length between the strips S_1 and S_2 is the difference between their mean circumferences C_2 and C_1. The mean circumference of S_1 is,

$$C_1=\pi D_1$$

whereas the mean circumference is S_2 is,

$$C_2=\pi D_1+2\pi T$$

Therefore,

$$C_2-C_1=\Delta C=2\pi T$$

From this last relationship it is observed that the difference in length ΔC between any two laminations is a function of the lamination thickness T.

In FIGURE 5 it will be observed that the horizontal line **45** and the upwardly inclined line **46** define therebetween an acute angle θ_c. Also shown are a pair of rectangles **47** and **47***a* each of which is of a height designated as T. The lefthand end of the rectangle **47***a* is positioned to the right of the lefthand end of the rectangle **47** by an amount equal to 2πT or 2π times the height of either of the rectangles. The inclined line **46** is pivoted about the apex **48** of the angle θ_c until it is tangent to the upper lefthand corners of the rectangles **47** and **47***a*, as illustrated at **49** and **50**. Thus,

$$\tan\theta_c=\frac{T}{2\pi T}=\frac{1}{2\pi}$$

and

$$\theta_c=9°2.6'$$

It should be noted that the tangent function of θ_c is a constant, and hence the angle θ_c is completely independent of the height T of the rectangles **47** and **47***a*. By considering the rectangles **47** and **47***a* of FIGURE 12 to be the ends of any two core lamination strips each of thickness T, it will be noted from the relationship developed from FIGURE 4 that the difference in length between successively cut strips should be 2πT to obtain a proper closure of the joints. However, since the critical angle θ_c defines the angle which theoretically results in exact abutment of opposite ends of each lamination of a stack bent into circular form together with the maintenance of complete surface to surface contact between adjacent laminations, it will be appreciated that when the circular stack is rectangularly formed there would exist a 100% space factor at all points of the core cross-section. Since the novel core construction according to the invention is characterized by looseness in the corners, it is necessary that the difference in length between successively cut strips should be slightly longer than that which would result from the utilization of the critical angle θ_c. This is achieved by reducing the actual angle below the critical angle, an actual angle of approximately $8\frac{1}{2}°$ having been found to be satisfactory.

By so reducing the angle θ_c to below its critical value, there is obtained a degree of looseness between successive strips in the laminated core structure sufficient to render differences in length of the successive strips inconsequential due to variations in thickness thereof. As will be apparent, the essential requirement is that each lamination strip forming a turn of the core be properly butt-jointed and by providing sufficient looseness between successive turns, minor variations in the lengths of the strips due to thickness variations will not prevent proper butt-jointing of their ends but instead will result only in varying in minor degree the looseness between certain successive turns of the core structure.

When the strips for a given core section or core have been cut to requisite length in accordance with the foregoing principles, they are flat stacked in the manner shown in FIGURE 6. This particular arrangement of stacking is effected by end shifting the strips relative to one another so that the ends of the adjacent strips are offset by an amount designated as L in FIGURE 6. This of course causes the opposite ends of these strips to be relatively offset by an amount equal to $\Delta C+L$. The end offset distance L is a function of the thickness T of the core strip and is chosen to be large relative to the strip thickness in order to minimize the reluctance introduced by the joint created by abutment of opposite ends of each strip of core material. The L/T ratio is normally chosen to fall between a lower limit of 6 to 1 and an upper limit of 10 to 1, a ratio of 8 to 1 being completely satisfactory for most purposes.

With the stack of strip material positioned as illustrated in FIGURE 6, clamping pressure is applied transversely, as for example at the points indicated by the arrows A—A, to hold the stack together while it is bent into circular form to thereby form a circular section, as for example designated by any one of the sections **68** through **71** shown in FIGURE 8. As shown in FIGURE 8 it is also to be understood that a plurality of sections may be stacked and simultaneously circularly formed as for example the sections **69**, **70** and **71**, or alternatively the sections may be individually formed and then internested to provide the composite array shown in FIGURE 8 and including the section **68**. It should be noted that the joints of the sections **69**, **70** and **71** are located in a manner shown for the joint of the side leg **27** of the core shown in FIGURE 1, and that the joint of the section **68** lies in the opposite leg. Further, the orientation of the central forming mandrel **72** relative to the joints of the core sections **68** through **71** should be noted. The significance of this orientation will appear shortly hereinafter when the operation of the forming apparatus shown in FIGURE 7 is understood.

The forming apparatus of FIGURE 7 includes a flat bed or table **73** upon which are fixedly mounted a stop block **74** and three hydraulically actuated piston cylinders **75**, **76** and **77**. The cylinders **76** and **77** are spaced apart with their longitudinal axes in alignment, and the cylinder **75** and stop block structure **74** are similarly aligned along an axis perpendicular to the alignment axis of the cylinders **76** and **77**. The piston of each of the cylinders is actuated by a hydraulic pressure system (not shown) coupled thereto through the fittings **78** and hoses **79**. The actuatable pistons which are reciprocable within the cyl-

inders 75, 76 and 77 have affixed to their outer ends rams 75*a*, 76*a* and 77*a* respectively, only the ram 77*a* being visible in the showing of FIGURE 7. Disposed flatwise against each of the rams is a forming plate 80, 81 or 82, a similar forming plate 83 being held fixed position by the stop block 74. The forming plates 82 and 83 are employed to elongate the circular core structure with the length of these plates defining the ultimate overall length of the rectangular core to be formed. The forming plates 80 and 81 are the end forming plates and transform the core from an elongated oval into the final rectangular form. The core shape transformation is effected by the apparatus in FIGURE 7 in the following manner.

A circular core stack 84, such as the one shown in plan view in FIGURE 8 is placed on the table 73 between the forming plates, and a central forming mandrel 72 is placed in the window 85 of the core stack, as also shown in FIGURE 8. The core stack is prevented from spontaneously unwinding by means of the tape strips 88. With the core stack 84 so disposed, the piston of the cylinder 75 is actuated to drive the ram 75*a* toward the stop block 74 and thus to move the forming plate 82 toward the forming plate 83. As the ram 75 moves the forming plate 82 toward the forming plate 83, the core stack 84 begins to elongate in the manner shown in FIGURE 9. It should be noted that the corners of the central forming mandrel 72 do not impose any stresses or strains upon those portions of the laminations which form the corners of the core or core sections. The movement of the ram 75*a* continues until the conditions of FIGURE 10 obtain wherein it will be seen that the core stack 84 is now tightly compressed between the forming plates 82 and 83 on the outside and the central forming mandrel 72 in the window region. The significance of the orientation of the central mandrel 72 is now observed to reside in the fact that all of the joints of the core stack 84 are clamped and there exists no possibility of overriding of the ends of adjacent laminations or the opening of the joints when the forming plates 80 ind 81 begin to move inward.

The tight clamping effected by the forming plates 82 and 83 together with the forming mandrel 72 causes all of the excess length of material in each of the core strips to run outward toward the ends, and when the forming plates 80 and 81 are moved inward as shown in FIGURE 11, the clamping pressure exerted on the now defined yoke portions, or short legs, of the formed core causes the excess material to be forced out into the corner regions to thereby lower the space factor at the corners. It now merely remains to apply the securing bands 86 and clamps 87 to the outer periphery of the forming plates, retract the rams 75*a*, 76*a* and 77*a* and remove the banded formed transformer structure from the forming apparatus. After annealing, the banding clamps 87 are removed and the annealed core may be released from the forming plates and the central mandrel 72 removed to reveal a finished core structure as illustrated in the showing of FIGURE 1.

While the present invention has been described in connection with the production of cores formed of a plurality of internested single turn laminations, it is to be understood that the forming apparatus shown in FIGURE 7 and the forming method as carried out in FIGURES 8 through 11 may be utilized in the making of complete cores or core sections wound from a single continuous strip of core material or from a plurality of strips of core material each of which is formed into as many turns as the strip length will permit. Further, it will be understood that the term "wound" as employed in the foregoing specification and in the appended claims is intended to cover cores and/or core sections in which the laminations thereof are formed of separate lengths of strip material successively arranged in concentric relation or of a continuous length thereof and wherein the strip material is bent lengthwise so that the plane of its surface is always parallel to the axis of the core.

Having now described our invention in connection with a particularly illustrated embodiment of a core structure and the method and apparatus utilized in producing the same, it will be appreciated that modifications of our invention may now occur from time to time to those persons normally skilled in the art without departing from the essential scope or spirit of the invention, and accordingly it is intended to claim the same broadly as well as specifically as indicated by the appended claims.

What is claimed as new and useful is:

1. Apparatus for forming a substantially rectangular transformer core having a substantially rectangular central window from a non-rectangular wound transformer core built up of layers of magnetic core strip material and having a non-rectangular central window, comprising in combination, a forming mandrel having a pair of parallel faces positioned in fixed relation to one another and being spaced apart a distance equal to the shorter dimension of the rectangular window to be formed, each of the parallel faces of said forming mandrel being of a length shorter than the longer dimension of the rectangular window to be formed and sufficiently short so that the mandrel may be disposed within the non-rectangular window of the non-rectangular core without materially distorting the latter, a first pair of spaced apart forming platens having parallel faces presenting toward one another and each being of a length equal to the longer dimension of the rectangular core to be formed, said forming mandrel being disposable between said first pair of platens so that one of the parallel faces of the mandrel presents toward and is parallel to the face of one of the forming platens and the other parallel face of the mandrel presents toward and is parallel to the face of the other forming platen, a second pair of spaced apart forming platens having parallel faces presenting toward one another and each being of a length greater than the shorter dimension of the rectangular core to be formed, the parallel faces of said second pair of platens being oriented perpendicularly to the parallel faces of said first pair of platens and being disposed respectively laterally outward beyond the opposite ends of said first pair of platens, first means for relatively moving said first pair of platens toward one another while maintaining the parallel relationship of the platen faces, and second means for relatively moving said second pair of platens toward one another while maintaining the parallel relationship of the platen faces to cause the faces of the second pair of platens to eventually abut the opposite ends of said first pair of platens, the face of one of the second pair of platens abutting one end of each of said first pair of platens and the face of the other one of the second pair of platens abutting the opposite end of each of said first pair of platens, whereby, when a core to be formed is placed between said first and second pairs of platens and said mandrel is disposed within the window thereof and oriented with respect to the faces of said first pair of platens as aforesaid, said first pair of platens may be relatively moved toward one another by said first means to compress the core material between the faces of said first pair of platens and the parallel faces of said forming mandrel to tightly compact the layers of material which form the longer legs of the rectangular core, and said second pair of platens may be relatively moved toward one another by said second means until the faces thereof abut the ends of said first pair of platens as aforesaid to compress and substantially square off the core material at the ends to form the shorter legs of the rectangular core.

2. The apparatus according to claim 1 wherein the length of each of said second pair of forming platens is not only greater than the shorter dimension of the rectangular core to be formed but additionally does not extend laterally outwardly beyond the ends of the said first pair of platens when the latter have been moved toward one another to their limit when compressing a core disposed therebetween with the said forming mandrel in the core window, whereby, after core forming has been com-

pleted, said platens form a four-sided closed rectangular box which may be peripherally secured by means of banding straps.

3. The apparatus according to claim 1 wherein said first and second means for relatively moving said first and second pairs of platens respectively toward one another comprise reciprocable rams which engage the non-forming rear sides of at least one of the platens of each pair.

References Cited by the Examiner

UNITED STATES PATENTS

1,237,015	8/1917	Brinton	153—2
1,495,959	5/1924	Mavity	153—16
2,468,223	4/1949	Mueller	153—48
2,982,330	5/1961	Roberts	153—2

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