

Nov. 8, 1960

W. C. HURT, JR

2,958,931

METHOD OF MAKING MAGNETIC CORES

Filed Feb. 17, 1958

4 Sheets-Sheet 1

Fig. 1.

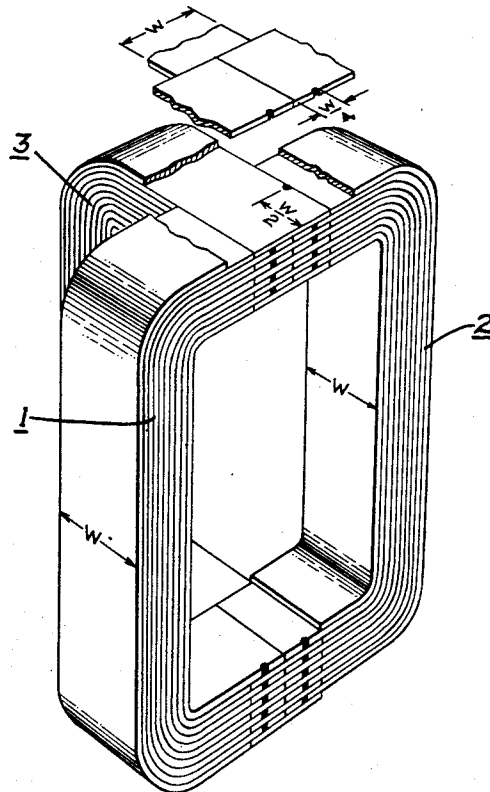
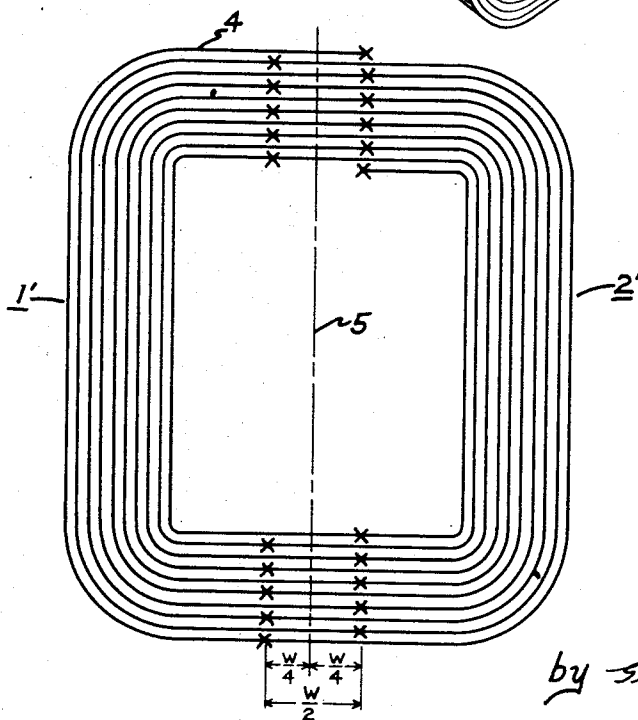


Fig. 2.

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Fig. 3.

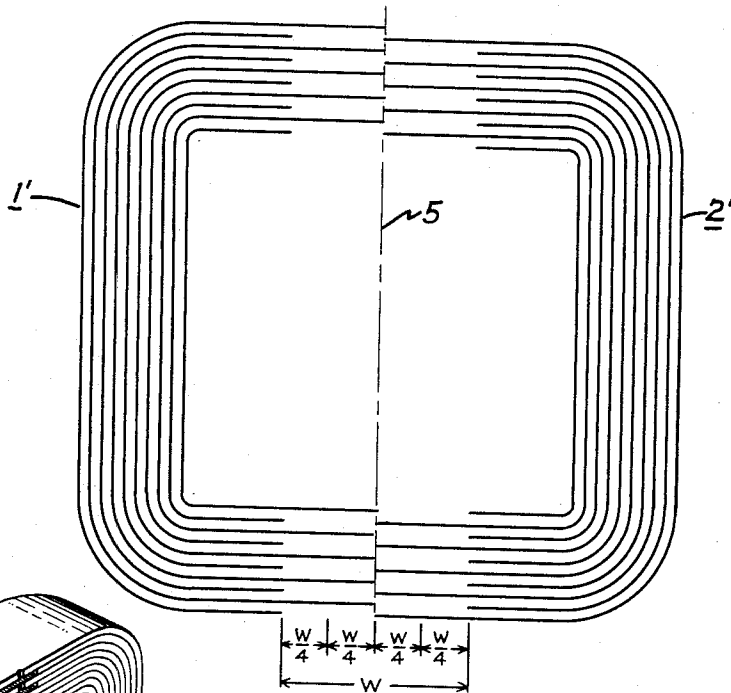
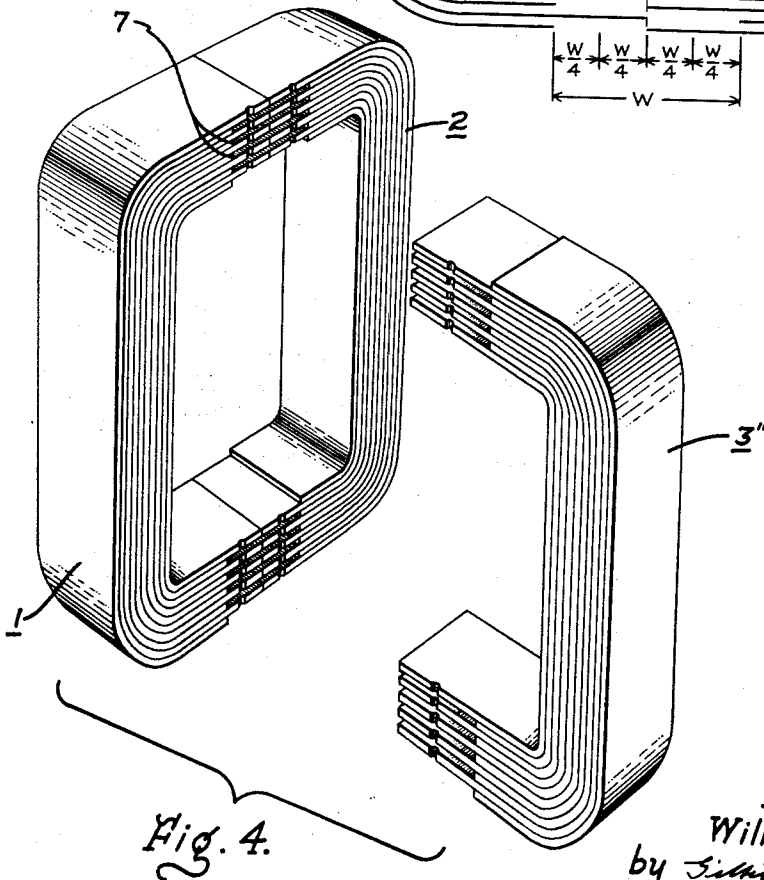


Fig. 4.

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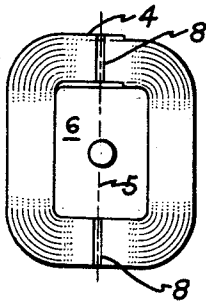
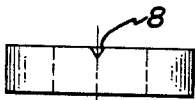
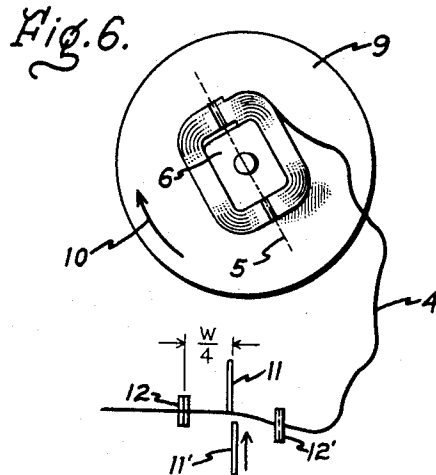
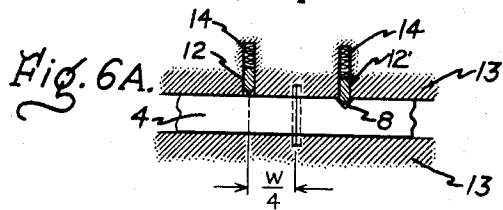
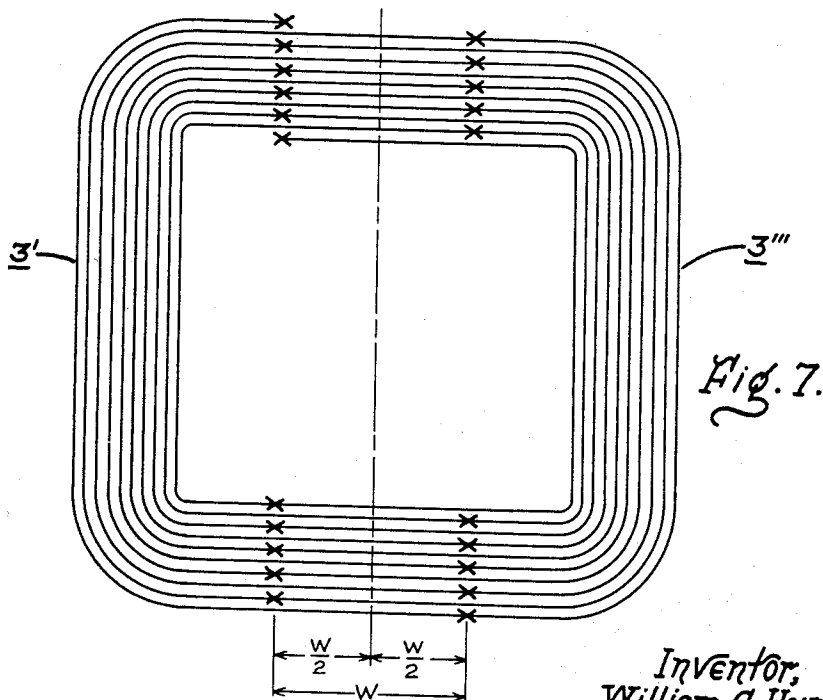
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Fig. 8.

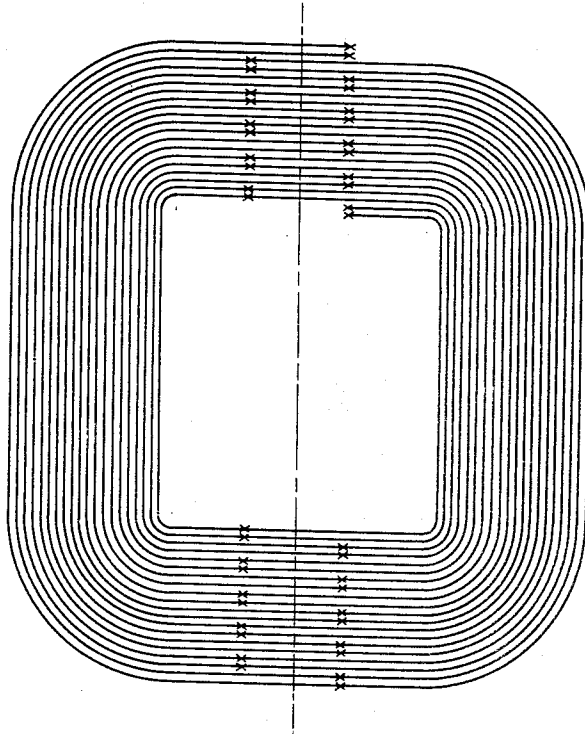
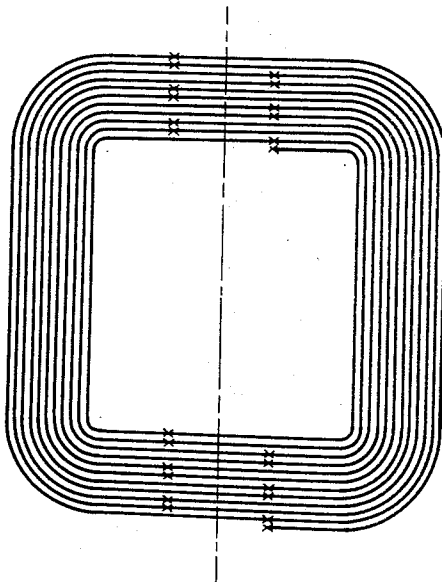


Fig. 9.



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2,958,931

METHOD OF MAKING MAGNETIC CORES

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Filed Feb. 17, 1958, Ser. No. 715,543

9 Claims. (Cl. 29—155.61)

This invention relates to a method of making magnetic cores, and more particularly, to a method of making three-phase magnetic cores of the curved or bent strip type which have three generally C-shaped parts which are joined at their corresponding opposite ends into a T shape.

Heretofore cores of the above mentioned type have been formed by accurately measuring and cutting a continuous strip of magnetic core material into a plurality of strips. The plurality of strips are then formed into a C shape and alternate strips are reversed so that the joints of adjacent laminations of the finished core will be offset with respect to each other. After the plurality of strips have been stacked into a magnetic core they are clamped or banded and annealed.

The above outlined method is high in cost for several reasons. For instance, the labor cost is high inasmuch as the strips have to be handled several times prior to anneal. This includes the steps of measuring and cutting, forming, strip reversal and assembling prior to anneal. This method is also high in manufacturing cost for the reason that generally speaking special procedures and equipment must be adopted for methods which utilize premeasuring and preshaping of strips. Furthermore, frequently joints with special configurations are adopted in order to obtain lapped butt joints, and the special joint configurations are more difficult to form and close. In other instances fairly simple cuts are employed but lapping of the joints is obtained by using inserts in the T joint. This of course raises the number of separate pieces which need to be formed and handled.

Another way of forming this type of core would be to form a closed magnetic core section by winding a continuous strip of magnetic material upon itself in rectangular shape and inserting spacers between adjacent laminations of the yoke sections. After the anneal the spacers could be removed which would leave spaces between adjacent yoke laminations for insertion of the laminations of the remaining core section. However, this method of making this type of core results in a magnetic core which has an increased height and weight over a core made by the previously described method. That is, the most effective utilization of core material is not made, and the thickness of the T joint area may be increased to 1 and 1/2 to 2 times the thickness of the legs of the core.

It is an object of this invention to provide an improved method of making the above type of magnetic core which will overcome the disadvantages of the above discussed prior art methods.

In my invention no measuring, cutting, shaping, strip reversal and assembling of individual strips is required prior to annealing of the core. That is, there is no handling of individual strips prior to annealing of the core parts. Instead, in my invention the first step of the method comprises continuously winding a strip of magnetic core material into a closed core loop having a plurality of turns. The core loop can be wound on a rec-

tangular shaped mandrel to give a rectangular shape to the core loop, or the strip can be wound into a circular or other curved form and then formed into a rectangular shape. Thereafter the closed and continuously wound core loop is annealed to give a permanent set to the turns and to relieve the strains set up in the core strip during the winding and forming operation. Then the annealed core loop is cut into two parts along its yoke portions by a special cutting procedure which will be described in greater detail hereinafter. In the finished core the two core parts will be spread apart slightly and shifted slightly in a lengthwise direction with respect to each other so that the alternate laminations of both core parts are butt jointed to each other whereas the remaining laminations of both core parts are spaced with respect to each other, and a third core part will be interleaved with the first two core parts. The third core part is formed from a continuously wound core loop in a manner similar to that employed in forming the first two core parts. In the third core part the alternate laminations at each end of the core part overhang the remaining laminations. After the third core part has been assembled with the first two core parts these remaining laminations will be butt jointed to the butt jointed ends of the first two core parts and the overhanging laminations of the third core part will fit into the spaces provided between the butt jointed laminations of the first two core parts. The remaining core part of the second core loop is not wasted but is utilized with another two core parts which will be formed from a third core loop similar to the first mentioned two core parts. The resulting three-phase core will have the butt joints of each layer offset with respect to the butt joints of adjacent layers, and this is accomplished without any complicated cuts in the lamination ends, strip reversal or inserts. Additionally there is no waste core material and the thickness of the T joint area will be equal to the thickness of the leg and yoke portions of the core.

The features of my invention which I believe to be novel are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a perspective view of a magnetic core constructed with one form of my invention;

Fig. 2 is a diagrammatic illustration of one form of cutting procedure of my invention;

Fig. 3 is an illustration of the two core parts of Fig. 2 pulled apart slightly;

Fig. 4 is an exploded perspective view of a magnetic core constructed in accordance with my invention;

Fig. 5 is a top view of an annealed magnetic core loop after it has been marked off preparatory to the cutting operation;

Fig. 5A is an end view of the core of Fig. 5;

Fig. 6 is a diagrammatic illustration of one form of apparatus which can be utilized in practicing the methods of my invention;

Fig. 6A is a side view of the cutting mechanism of Fig. 6;

Fig. 7 is a diagrammatic illustration of the cutting procedure to be employed in forming the third core parts of the magnetic cores illustrated in Figs. 1 and 4;

Fig. 8 is a diagrammatic illustration of another form of my invention wherein the core parts are constructed from two simultaneously wound core strips; and

Fig. 9 is a diagrammatic illustration of another form of my invention in which a single strip of core material is wound but the cutting procedure is modified to give

a magnetic core which will be equivalent to the double strip wound magnetic core of Fig. 8.

Like reference numerals will be used throughout the various figures to indicate identical parts.

Referring now particularly to Fig. 1, illustrated therein is a three-phase magnetic core of the curved or bent strip type which has three core parts 1 to 3 which are connected to each other at their corresponding opposite ends in the form of a T. As will be obvious to those skilled in the art the longer sides of the core parts will have electrical winding cylinders disposed thereabout, but these winding cylinders have been omitted from the drawings for the purpose of simplicity. The method of forming the main core loop which comprises the two core parts 1 and 2 will be described first although the third core part 3 is formed in a very much similar manner except as to minor differences in the cutting procedure. The width W of the laminar strips for the three core parts is illustrated as being identical for purposes of simplicity in describing the invention. However, as will be more obvious hereinafter this is not absolutely necessary. For instance, the width of the laminar strips for the third core part 3 can be different from the width of the laminar strips of the main core loop which comprises the two core parts 1 and 2. Additionally although in Fig. 1 the third core part 3 is illustrated as being symmetrical with the main core loop this is not absolutely necessary. For instance, the third core part 3 could be disposed slightly to the left or right from its illustrated position in Fig. 1. However, a symmetrical disposition has been illustrated in order to simplify the explanation of the invention.

Referring to Fig. 2, the method of forming the two core parts 1 and 2 of Fig. 1 will now be described. Illustrated in Fig. 2 is a closed magnetic core loop which has been formed by continuously spirally winding a magnetic core strip 4 into a plurality of superposed turns. The left-hand core part 1' corresponds to the left-hand core part 1 of Fig. 1, and the right-hand core part 2' corresponds to the right-hand core part 2 of Fig. 1. The strip 4 can be directly wound into the illustrated rectangular shape by winding the strip on a rectangular shaped mandrel, or it can be initially wound into a circular, oval or other curved form and then shaped into a rectangular form in a manner well known to those skilled in the art. After the strip is wound and the rectangular shape has been obtained the closed core loop is annealed to give a permanent set to the curvature of the turns and to relieve the stresses built up in the core material due to the winding and shaping operation. Preferably the strip is grain oriented material in which the grains are oriented lengthwise of the strip.

After the anneal the core loop is cut into strips of approximately one-half turn lengths by making the cuts indicated by the "X" marks. For purposes of simplicity in illustrating and practicing the invention the lengthwise axis 5 of the core loop is selected as the reference line or plane for making the various cuts. However, other places of reference can be selected as long as the reference crosses the straight part of the yokes perpendicularly. The reason for this will become apparent after the manufacturing apparatus is explained hereinafter in connection with Figs. 6 and 6A.

The core is cut into two parts by cutting each end or yoke of the core. In cutting the core alternate laminations at each end or yoke are cut on one side of the reference line 5, and the remaining laminations are cut on the other side of the reference line 5. The strip 4 can be cut as it is gradually unwound from the core loop. As it is progressively unwound from the core loop the manner of cutting follows a certain pattern. That is to say, first a pair of cuts are made in the strip on one side of the reference line 5 and then a pair of cuts are made on the other side of the reference line 5 and this procedure is employed until the strip has been cut into the

required number of half turns. Looking at it in another way, if the reference line 5 were marked off on the edges of the strip then as the strip is being unwound two cuts would be made in front of the marks and then two cuts would be made behind the marks and this procedure would be followed until the required number of half turns were obtained.

The cuts on one side of the core are aligned with each other, and the same is true of the cuts on the opposite side of the core. The cuts on opposite sides of the core are spaced from each other by a distance of $W/2$ where W is the width of the laminar strips of the third core part 3 of Fig. 1. The cuts on opposite sides of the core are equidistantly spaced from the reference line 5 by a distance of $W/4$ where W is equal to the width of the laminar strips of the third core part which is to be joined with the two core parts 1' and 2'.

As the strip 4 is being cut into half turns they can be stacked into two packets in which they occupy their original positions with respect to each other. That is, the half turns do not have to be reversed in order to obtain lapped butt joints in the final core. After these two packets have been incorporated into the final cores illustrated in Fig. 1 or 4 the two core parts 1' and 2' will be spaced with respect to each other by a distance of $W/2$ from their Fig. 2 position. This is illustrated in Fig. 3. As shown therein, alternate laminations at each end of both core parts overhang, extend or protrude beyond adjacent laminations by a distance of $W/2$. Therefore, if the overhanging laminations at corresponding ends of the two core parts are butt jointed to each other there will be spaces left at each end of the core between adjacent butt jointed laminations having a width of W where W corresponds to the width of the laminar strips of the third core part which will be joined with the core parts 1' and 2'. When the overhanging laminations are butt jointed to each other the spaces between adjacent butt jointed laminations will be automatically aligned with respect to each other.

In the finished core the overhanging laminations are butt jointed to each other by in effect shifting the two core parts 1' and 2' in a lengthwise direction with respect to each other for a distance equal to the thickness of a single lamination. The relative positions of the laminations of the two core parts 1' and 2' after they have been shifted with respect to each other in a lengthwise direction will correspond to that illustrated in the core loop shown in Fig. 4. The core loop of Fig. 4 is identical to the core loop illustrated in Fig. 1. From Fig. 4 it will be seen that at each end of the core loop adjacent butt jointed laminations have spaces 7 therebetween. Therefore, a third core part such as 3 shown in Fig. 1 or 3' shown in Fig. 4 can be readily interleaved with the two parts of the main core loop.

One form of manufacturing apparatus which may be used in practicing my invention will now be described in connection with Figs. 5, 5A, 6 and 6A.

In Fig. 5 the heretoforementioned strip 4 is illustrated as having been continuously wound about a rectangular shape mandrel 6. The core has been annealed to give the rectangular shaped turns a permanent set and strain relief the strip. In order to accurately cut the strip 4 the line 5 is marked off on the core. I prefer to do this by milling a notch 8 on one side of the core at both yoke portions. However, other marking means could be employed such as paint or the like or aligned index holes in the center of the laminations. After the notches 8 are formed in the edges of all of the turns on one side of the core the core and its mandrel is placed on a turntable 9 which will rotate in the direction indicated by the arrow 10. As the strip 4 is being unwound it is brought through a strip cutting mechanism which comprises a pair of shear blades 11 and 11' and a pair of movable blocks 12 and 12'. The notches and lower edges of the

blocks are given a V shape but other shapes could be used.

The conventional practice is to make one of the shear blades, as 11, stationary and the other, as 11', movable. The two blocks can be spring loaded or otherwise activated for movement into and out of the notches 8, and the blocks are disposed on opposite sides of the shear blades. When the core halves 1' and 2' of Fig. 2 are being cut the blocks are spaced from the shear blades by a distance of $W/4$ where W is equal to the width of the laminar strips of the third core part.

As will be seen from Fig. 6A, the shear blades can be mounted in bottom and top frame members 13 and 13', and the V blocks 12 and 12' can be mounted in the upper frame 13'. The blocks are retractable but are biased downwardly by springs 14 for entry into the V notches 8 as the strip 4 is brought through the cutter mechanism between the two frame members 13 and 13'. Assuming that a cut is to be made in the strip 4 ahead of a V notch, then the strip 4 will be pulled through the cutter until the V block 12' enters the V notch. This is the relative position of the parts illustrated in Fig. 6A. If the cut is to be made behind a V notch as the strip is being unwound and pulled through the cutter mechanism then the strip is pulled through the cutter mechanism until the V block 12 enters the V notch. In this manner very rapid and accurate cutting of the core strips can be readily obtained.

The V blocks will not interfere with pulling of the strip 4 through the cutter mechanism or aligning of one V block in a V notch in preference to the other V block inasmuch as they can be lightly spring loaded so they are readily retractable with a moderate application of force on the strip 4. Alternately the mechanism can be made automatically operable. For instance, it was previously described in connection with Fig. 2 that the cutting pattern is such that first two cuts are made in front of the V notches as the strip is unwound and then two cuts are made behind the V notches and that this pattern is repeated throughout. Therefore, it will be readily apparent that the cutting mechanism can be automated by having a machine pull the strip through the cutter and utilizing a counting mechanism and electrical controls whereby each time the cutter blade operates twice one V block is automatically raised and the other released in alternating fashion. The strip pulling mechanism would stop each time a V block entered a notch. Another arrangement which will suggest itself is to employ two cutters in combination with a single V block. The cutters would be disposed on opposite sides of the single V block by the distance of $W/4$. The single V block would enter all of the notches but only one of the cutters would operate at a time depending upon whether a cut was to be made before or after a V notch.

It was stated heretofore that the reference line for making the cuts should cross the straight parts of the yokes perpendicularly. It will now be apparent that if this is not done then the distance between the cutter and blocks will need to be changed as each turn is cut since the turns get progressively shorter from the outside to the inside of the core loop. This distance would not change but the core would be non-symmetrical if the reference line crossed the yokes at an angle.

The method of making the third core parts illustrated in the magnetic cores of Figs. 1 and 4 will now be described in connection with Fig. 7. A comparison of Fig. 7 with Fig. 2 will disclose that the method of making the third core parts is identical to the method already described except as to the spacing of the cuts. In Fig. 7 the cuts on opposite sides of the lengthwise axis of the core are spaced from each other by the distance W , and they are equidistantly spaced from the center line of the core by the distance of $W/2$ where W is equal to the width of the laminar strips employed in making the core halves 1 and 2. The left-hand core half 3' of Fig. 7

corresponds to the core part 3 of Fig. 1, and the right-hand core half 3''' of Fig. 7 corresponds to the core part 3'' of Fig. 4. Obviously if the amount of overhang at the ends of the core halves of Fig. 7 in alternate laminations is made greater than the distance W the ends of the third core parts will protrude through the opposite side of the main core loops of the finished magnetic cores which would make for waste material. If the amount of overhang were less than the distance W then the butt joints of the main core loops of the finished core would not be fully lapped. For this reason in constructing the third core parts of the finished cores the distance W in Fig. 7 is selected to be equal to the width of the turns of the main core loop of the finished core. Also, if the final core is to be symmetrical the total transverse dimension of the core loop of Fig. 7 should be greater than that of Fig. 2 by the distance of $W/2$.

Due to the cutting procedure employed the core part 3' of Fig. 7 is not exactly identical to the core part 3''' . For instance, in part 3' the yoke portion of each half turn is longer at one end than at the other whereas in part 3''' in each turn the yoke portions have equal lengths. However, the two parts 3' and 3''' are magnetic equivalents, and the same is true of the core parts 1' and 2' of Fig. 2. That is, either the left-hand or right-hand part of Fig. 7 can be used equally well with the main core loop of the finished magnetic core as illustrated by Figs. 1 and 4.

The apparatus illustrated in Figs. 6 and 6A can be used for cutting the core loop shown in Fig. 7. The only change which needs to be made in the apparatus is in the spacing of the cutting blades and the blocks. In cutting the core loop indicated in Fig. 2 the cutting blades and blocks were spaced with respect to each other by a distance of $W/4$. In cutting the core loop illustrated in Fig. 7 this distance will be increased to $W/2$.

In Fig. 8 is illustrated another form of my invention wherein two strips are simultaneously spirally wound into a closed magnetic core loop. The method of cutting is identical to that employed in Figs. 2 and 7 except that the two strips of the turns are simultaneously cut. In the finished core the core halves will be shifted lengthwise with respect to each other by a distance equal to the thickness of a core turn or twice the thickness of a strip assuming that both strips have an equal thickness. That is to say, in the final core instead of single laminations being butt jointed and lapped, the core resulting from the procedure outlined in Fig. 8 will have double laminations which are butt jointed and lapped.

Referring now to Fig. 9, illustrated therein is another form of my invention which employs a single strip but which employs a cutting procedure which will result in a finished core having double butt jointed and double lapped half strips similar to that resulting from Fig. 8. The cutting procedure of Fig. 9 is similar to that of Fig. 8 in the sense that each yoke portion of the core loop is cut first twice on one side of the center line and then twice on the other side of the center line. However, the cutting procedure of Fig. 9 is different from that of Fig. 8 in that as the turns of Fig. 9 are unwound and cut first four cuts are made behind the notches or marks on the turns and then four cuts are made ahead of the notches or marks on the turns, whereas in Fig. 8 as a two strip turn is unwound first two cuts are made ahead of the notches or marks and then two cuts are made behind the marks or notches and so on. This is also a point of difference between the cutting procedure of Fig. 2 and Fig. 9. However, all the cutting procedures of Figs. 2, 8 and 9 are identical in that when the turns are being unwound, viewing a turn as comprising either a single strip or two strips, the cuts are made in the sequence of first an even number of cuts ahead of the notches or marks and then an equal even number of cuts behind the notches or marks and so on. Therefore, by the term superposed spiral turns of continuous laminar magnetic

core material is meant a magnetic core loop which is made by winding a single strip of magnetic core material or winding two or more strips of magnetic core material simultaneously. That is, a turn of continuous laminar core material may have one or more laminations. Of course in Figs. 2 and 8 the even number of cuts in the turns consists of two cuts, whereas in Fig. 9 the even number of cuts in the turns consists of four cuts.

After two annealed core loops have been unwound, cut, and stacked into four half core loops the half turns will occupy the same positions they had with respect to each other as before unwinding and cutting. Three of the half core loops can then be assembled into a finished core in several ways.

The preferred way is to work with a single half turn at a time since if preformed electrical winding cylinders are used the half turns will have to be laced through the winding cylinders in order to link the core with the electrical coils. For instance, there will be an electrical winding cylinder for each leg of the finished core. Therefore, the three cylinders can be first properly positioned with respect to each other and each innermost half turn of the three half core loops can then be laced and butted together at their corresponding ends. Then the same will be done with each of the next innermost half turns, and so on, until all of the half turns are laced and bolted together.

Another way is to work with several half turns at a time from each half core loop. However, this will be a little more difficult due to the increased number of pieces being simultaneously handled. Simultaneously working with all the half turns will be still more difficult due to the still larger number of pieces and the necessity for bending the yokes so as to get them through the winding cylinders. However, working with several or all of the half turns at a time may be practical when they are not going to be laced through preformed electrical winding cylinders but the electrical coils are going to be wound on the core legs after the core is finally assembled and banded or otherwise clamped. In fact, where the coils are to be wound on the core it may be practical to assemble the core by for instance moving the core part 3" of Fig. 4 into the main core loop 1, 2.

While there have been shown and described particular embodiments of the invention, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention, and therefore, it is intended by the appended claims to cover all such changes and modifications as well within the true spirit and scope of the invention.

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

1. A method of manufacturing a three phase magnetic core which has three generally C-shaped laminated core parts which are connected together at their corresponding opposite ends in the form of a T, said method comprising forming two generally rectangular-shaped and similar core loops which have a plurality of superposed spiral turns of continuous laminar magnetic core material, annealing both core loops, cutting the core material of both core loops into generally half turns by progressively making an even number of cuts in said core material along the length thereof alternately ahead and behind of the parts of said core material which are aligned with the lengthwise axis of their respective core loops, said cuts being made transverse to the length of said core material, said cuts being made at a distance of $W/4$ from said aligned parts in one of said core loops where W is equal to the width of the other core loop and in the other core loop said distance being $w/2$ where w is equal to the width of said one core loop, and alternately butting and lapping the opposite ends of the half turns of either half of said other core loop with the opposite ends of the half turns of both halves of said one core loop to form a butt lapped T-shaped joint between the

corresponding opposite ends of said either and both core loop halves which will have a thickness equal to the thickness of said core loops.

2. A method of manufacturing three phase magnetic cores which have three generally C-shaped laminated core parts which are connected together at their corresponding opposite ends by a T-shaped butt lapped joint which has a thickness equal to the thickness of said C-shaped core parts, said method comprising forming three generally rectangular-shaped and similar core loops which have a plurality of superposed spiral turns of continuous laminar magnetic core material which has a width of W , annealing all the core loops, dividing all the core loops into halves by cutting the core material thereof into generally half turns by progressively making an even number of cuts in said core material along the length thereof alternately ahead and behind of the parts of said core material which are aligned with the lengthwise axis of their respective core loops, said cuts being made transverse to the length of said core material, said cuts being made at a distance of $W/4$ from said aligned parts in two of said core loops and $W/2$ in the remaining core loop, and alternately butting and lapping the opposite ends of the half turns of different halves of said remaining core loop with the opposite ends of the half turns of both halves of a different one of said two core loops.

3. The method of claim 2, wherein said continuous laminar magnetic core material consists of a single strip of magnetic core material and said even number of cuts is equal to two.

4. The method of claim 2, wherein said continuous laminar magnetic core material consists of at least two superposed strips of magnetic core material.

5. The method of claim 2, wherein said continuous laminar magnetic core material consists of a single strip of magnetic material and said even number of cuts is equal to at least four.

6. A method of manufacturing a three phase magnetic core which has three generally C-shaped laminated core parts which are connected together at their corresponding opposite ends in the form of a T, said method comprising forming two of said core parts by forming continuous laminar magnetic core material into a generally rectangular-shaped core loop having a plurality of superposed spiral turns, annealing the core loop, cutting said core material into generally half turns of said core loop by progressively making an even number of cuts in said core material along the length thereof alternately ahead and behind of the parts of said core material which are aligned with the lengthwise axis of said core loop, said cuts being made transverse to the length of said core material, said cuts being made at a distance of $W/4$ from said aligned parts where W is equal to the width of the third of said three core parts, forming the third core part by repeating said cutting procedure with a second annealed core loop which is similar to the first core loop but with the cuts being made at a distance of $w/2$ from the lengthwise axis of said second core loop where w is equal to the width of the first core loop, and alternately butting and lapping the opposite ends of the half turns of either half of the second core loop with the opposite ends of the half turns of both halves of the first core loop to form a butt lapped T-shaped joint between the corresponding opposite ends of said either and both core loop halves.

7. A method of manufacturing a three phase magnetic core which has three generally C-shaped laminated core parts which are connected together at their corresponding opposite ends in the form of a T, said method comprising forming two of said core parts by forming continuous laminar magnetic core material into a generally rectangular-shaped core loop having a plurality of superposed spiral turns, annealing the core loop, progressively unwinding and cutting said core material into generally half turns of said core loop by progressively making an

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even number of cuts in said core material along the length thereof alternately ahead and behind of the parts of said core material which were aligned with the lengthwise axis of said core loop prior to said unwinding, said cuts being made transverse to the length of said core material, said cuts being made at a distance of $W/4$ from said aligned parts where W is equal to the width of the third of said three core parts, reassembling said half turns into their original positions, spacing the resultant two halves of said core loop from their original position with respect to each other by a transverse distance of $W/2$ and a lengthwise distance which is equal to the thickness of a turn of said core loop, forming the third core part by repeating said unwinding and cutting procedure with a second annealed core loop which is similar to the first core loop but with the cuts being made at a distance of $w/2$ from the lengthwise axis of said second core loop where w is equal to the width of the first core loop, alternately butting and lapping the opposite ends of the half turns of either one of the resultant halves of the second core loop with the opposite ends of the half turns of the spaced halves of the first core loop to form a butt lapped T-shaped joint between the corresponding opposite ends of said two and one resultant core loop halves.

8. A method of manufacturing a three phase magnetic core which has three generally C-shaped laminated core parts which are connected together at their corresponding opposite ends in the form of a T, said method comprising forming two generally rectangular-shaped and similar core loops which have a plurality of superposed spiral turns of continuous laminar magnetic core material, annealing both core loops, making marks which are

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aligned with the lengthwise axis of the core loops on their respective turns of core material on both yokes of the core loops, cutting the core material of both core loops into generally half turns by progressively making an even number of cuts in said core material along the length thereof alternately ahead and behind successive marks on said core material, said cuts being made transverse to the length of said core material, said cuts being made at a distance of $W/4$ from the marks in one of the core loops where W is equal to the width of the other core loop and in the other core loop said distance being $w/2$ where w is equal to the width of said one core loop, and alternately butting and lapping the opposite ends of the half turns of either half of said other core loop with the opposite ends of the half turns of both halves of said one core loop to form a butt lapped T-shaped joint between the corresponding opposite ends of said either and both core loop halves which will have a thickness equal to the thickness of said core loops.

9. The method of claim 8, wherein said aligned marks are made by forming a continuous groove on one side of the core loops along both yokes.

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UNITED STATES PATENT OFFICE
CERTIFICATION OF CORRECTION

Patent No. 2,958,931

November 8, 1960

William C. Hurt, Jr.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, lines 33 and 51, for "joined", each occurrence, read -- jointed --; column 7, line 49, for "wall" read -- fall --.

Signed and sealed this 9th day of May 1961.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

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