Jan. 31, 1961 G. A. SMITH 2,969,585

MAGNETIC STRIP MATERIAL FOR CORES OF TRANSFORMERS AND METHOD OF MANUFACTURE OF SUCH STRIP MATERIAL AND CORES

Filed Aug. 9, 1954 3 Sheets-Sheet 1

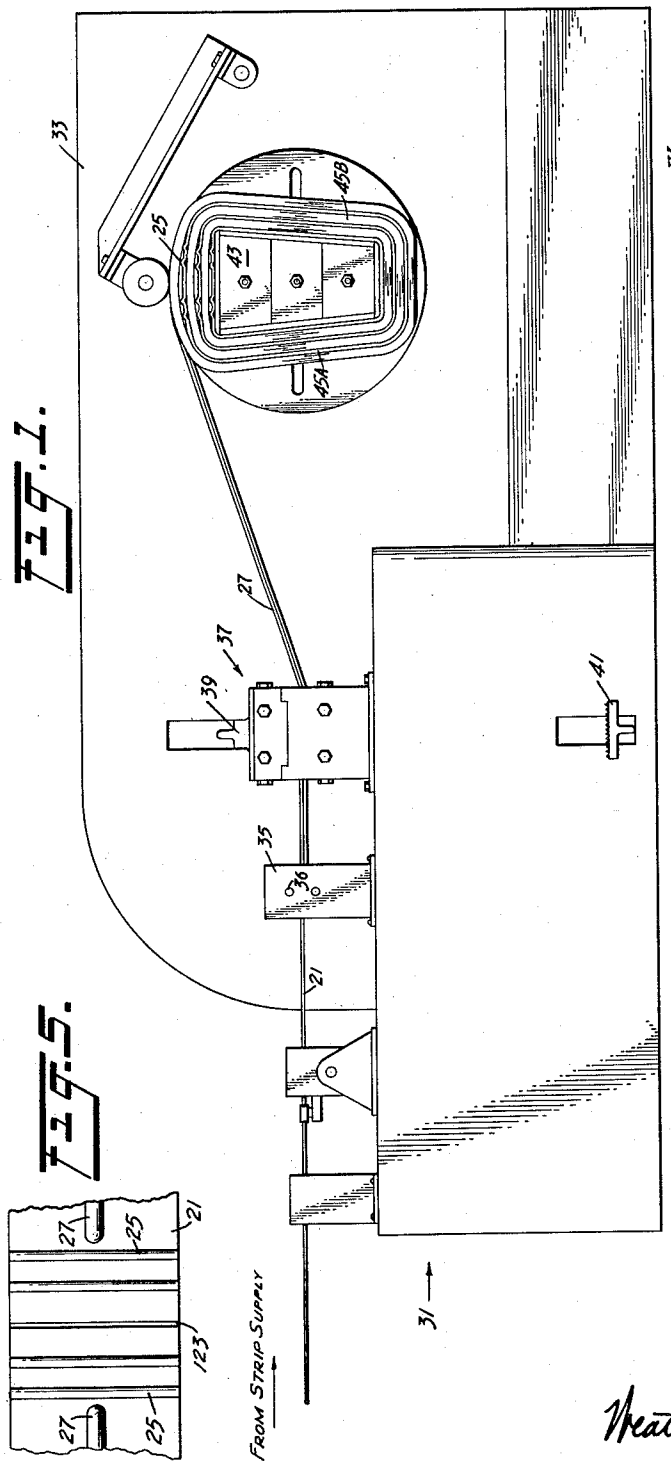


FIG. 1.

FIG. 5.

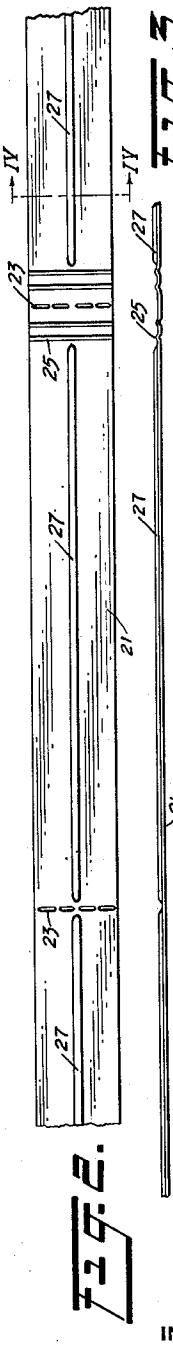


FIG. 2.

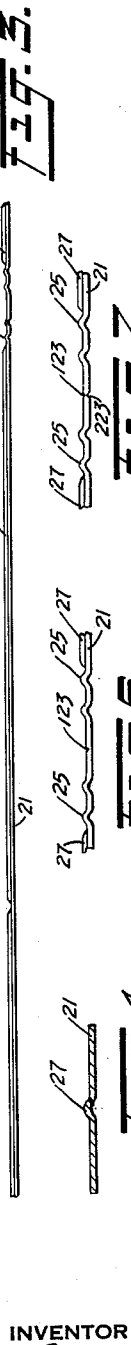


FIG. 3.

FIG. 7.

FIG. 6.

FIG. 4.

INVENTOR
George A. Smith
BY
Wheeler Ford & Wheeler Ford Fatty

Jan. 31, 1961 G. A. SMITH 2,969,585

MAGNETIC STRIP MATERIAL FOR CORES OF TRANSFORMERS AND METHOD OF MANUFACTURE OF SUCH STRIP MATERIAL AND CORES

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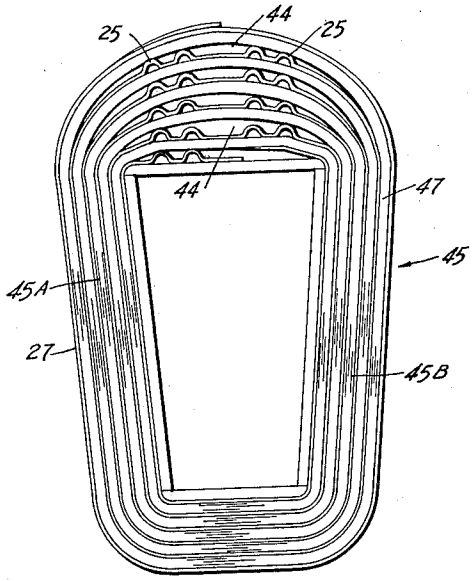


Fig. 8.

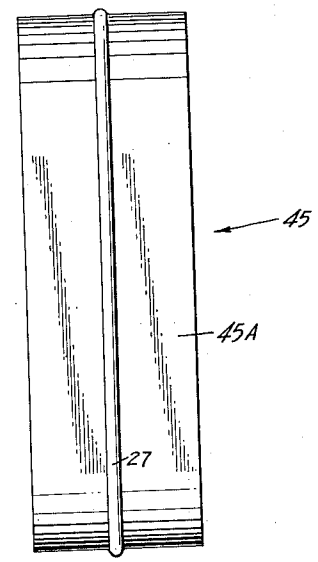


Fig. 9.

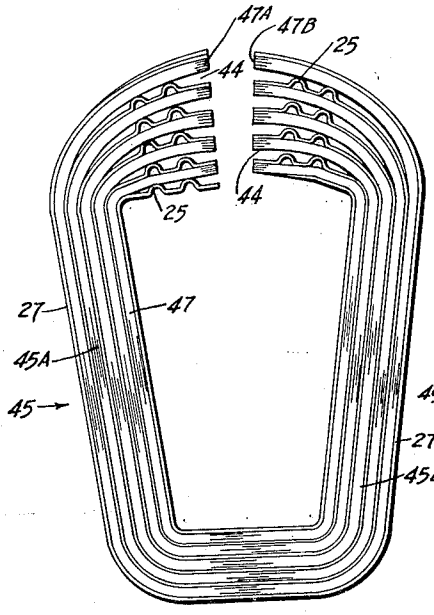


Fig. 10.

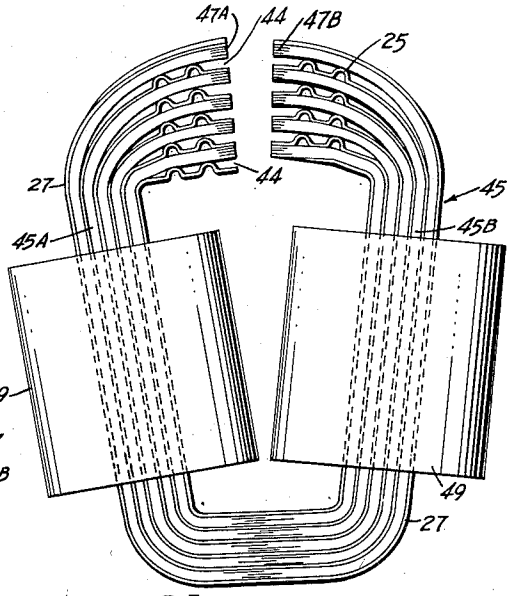


Fig. 11.

INVENTOR
George A. Smith
BY
Heather Ford & Heather Ford Attys

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MAGNETIC STRIP MATERIAL FOR CORES OF TRANSFORMERS AND METHOD OF MANUFACTURE OF SUCH STRIP MATERIAL AND CORES

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Fig. 12

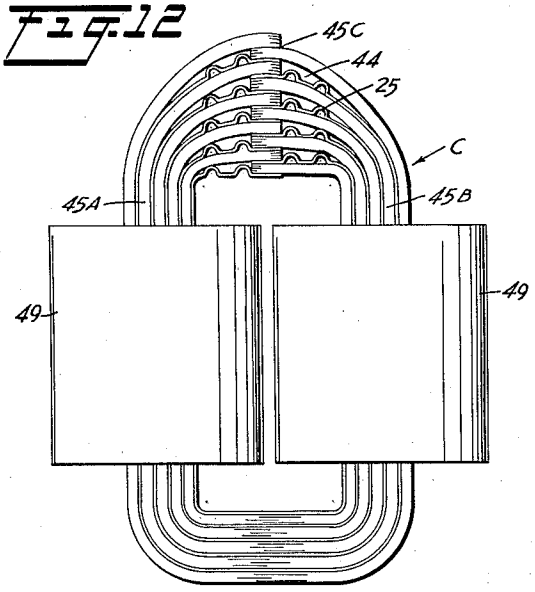


Fig. 14.

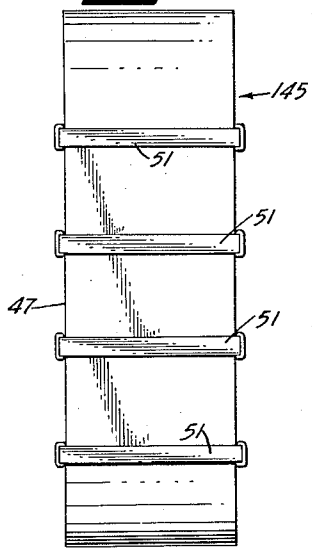


Fig. 13

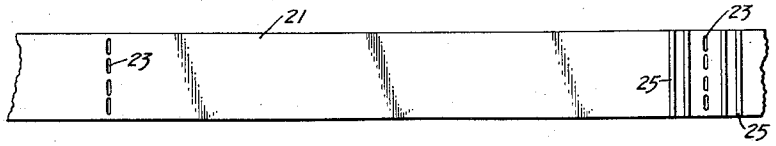


Fig. 15.

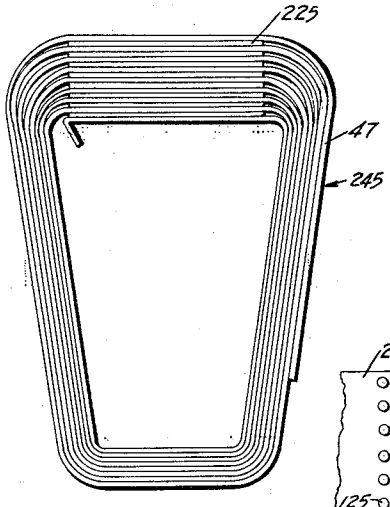
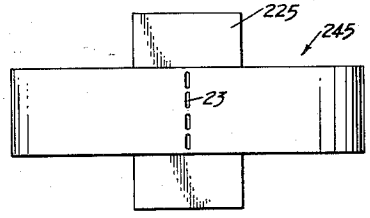


Fig. 16.



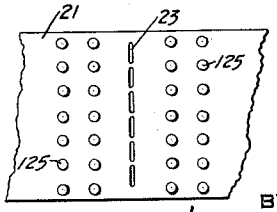


Fig. 17.

INVENTOR
George A. Smith
BY
Weatherford & Weatherford Attys

United States Patent Office 2,969,585 Patented Jan. 31, 1961

2,969,585

MAGNETIC STRIP MATERIAL FOR CORES OF TRANSFORMERS AND METHOD OF MANUFACTURE OF SUCH STRIP MATERIALS AND CORES

George A. Smith, Pine Bluff, Ark., assignor to Central Transformer Corporation, Pine Bluff, Ark., a corporation of Arkansas

Filed Aug. 9, 1954, Ser. No. 448,595

11 Claims. (Cl. 29—155.57)

This invention relates to certain new and useful improvements in the method of manufacture of material for use in transformer cores and of cores for transformers and further relates to the material and to the transformer cores produced by the improved methods.

More particularly the invention relates to certain new and useful improvements in a method of processing magnetic strip material for use in such cores and a method of forming transformer cores from magnetic strip material, and to such strip material and to cores for transformers formed of magnetic strip material which has been wound into a coil and severed or parted to form distinct and separate laminations.

It has heretofore been contemplated that a core for a transformer could be formed from a plurality of minor laminations placed in superposed relationship and folded into core form. Additionally it has heretofore been contemplated that cores may preliminarily be formed by winding lengths of magnetic strip material as upon a suitable mandrel to form a coil of such strip material and either unwinding the wound magnetic strip material and lacing it through pre-formed windings so as to complete the transformer, or by severing the wound coil of strip along one of the short sides thereof so as to form two separated long legs and either inserting the legs through the windows of pre-formed windings or inserting the windings over the elongated legs. In either of the latter instances it has been considered desirable either to perform the severing prior to annealing of the wound magnetic strip material and interleaving the lamination ends to form lapped lamination joints along the severed short side, or, if severing has been made subsequently to annealing, the form the joints in the respective laminations as butt joints, in which the severed ends of each lamination are brought into abutting relationship and there secured in position. These two latter conditions have been considered necessary in order that the final form of the transformer core would not be altered from the form in which the core has been subjected to annealing, so as to eliminate undesired stresses and disturbance of the grain of the annealed strip and thereby to eliminate undesired conditions in current flow through the transformer core and to avoid improper and undesirable operation.

In such prior structures, particularly of the type in which the wound core has been severed and interleaved prior to annealing, it has been considered desirable during the winding of the core to successively interpose spacers or shims between the layers of the winding as it progresses, in order to provide for adequate spacing for the subsequent insertion of the lamination ends in the interleaving formation of the lap joint heretofore mentioned. Such prior practice has proven to be extremely wasteful of time and operational effort in the formation of cores and has required a considerable nicety of skill on the part of the operator forming up the core in the preliminary steps of the formation of same, particularly in the accurate and careful insertion of the spacers or

shims and additionally in the accurate and careful necessity of severing the layers so as to provide for the subsequent interleaving of the same to form lapped joints.

The present invention is specifically directed to the formation of transformer cores from magnetic strip material and contemplates the winding of the strip material into a coil, as upon a suitable mandrel, introducing the wound coil of strip material into annealing means, such as an annealing furnace or the like, effecting severing or separation of the respective laminations along one of the short sides of the wound strip material, preferably effecting the severing or separation during the period of annealing, in which case the annealing is continued after the completion of the severing and results in an annealing of the magnetic strip material in severed condition, thus enhancing the magnetic flow qualities of the material when subsequently jointed into transformer core form, and under such preferred conditions removing the severed core from the annealing means, associating pre-formed transformer windings therewith and subsequently interleaving the severed members of the core to form a lapped joint in one of the short sides of the core. It is found that under this procedure and particularly in the preferred embodiment of same, when the severing occurs during the period of annealing that the subsequent hinged action in moving the core from severed condition to interleaved condition is well within the elastic limits of the material and is far superior to prior practice in which severed cores have been interleaved, annealed in interleaved condition, swung open and separated from interleaved condition for the insertion of pre-formed windings and subsequently return to interleaved condition.

The present method, which preferably includes annealing in severed condition does not require additional separation to any substantial extent for the insertion of preformed windings on the respective legs of the core and accordingly minimizes the hinging action of the members toward interleaving in final assembly, limiting same substantially to movement in the one direction inwardly toward interleaved jointed condition.

Additionally in the present invention it is preferred that, in order to eliminate the skill and time necessary for the insertion of spacers or shims between successive or other layers of the core material as it is being wound upon the mandrel, integral spacing means may be formed in the strip material itself at regulated spaced intervals so that the integral spacing means will eliminate the necessity of separate spacers or shims as well as the positioning of such separate spacers or shims during the winding of the strip material.

It is further found that the magnetic strip material is subjected to a substantial stress when subjected to the heat of annealing which is normally in the nature of one thousand degrees and that such magnetic strip material, preferably formed of a suitable grade as of silicon steel, has the characteristic of parting under the stress of annealing heat when provided with a relief in the form of grooving or perforations laid in a direction transverse to the grain of the strip material. It accordingly is further contemplated by the present invention that the magnetic strip material of which the transformer core is formed should be so handled during its preliminary processing as to partly sever the strip and provide transverse relief zones at longitudinally spaced intervals, which intervals are substantially equal in length to the length of a single lamination or turn of the winding of the strip material, the relief zones being positioned transversely to the strip material, the grain preferably being disposed longitudinally of the strip material and substantially parallel to the direction of winding, the relief zones at spaced intervals being preferably provided by transversely

perforating or transversely grooving the strip material prior to the introduction of the strip material to the winding mandrel.

It has been found that the magnetic strip material, thus provided with spaced transverse relief zones, will, subsequent to winding and after being subjected to the heat of annealing, evenly part under or be severed by the heat of annealing so as to accomplish severing of the strip material along the relief portions. It will be seen that by spacing the relief portions at distances corresponding to the length of the respective turns of the winding, the relief portions are commonly positioned on one side of the wound material, the severing under the heat of annealing occurs along that side and eliminates the necessity of separately severing the wound material either before or after annealing, thus effectively eliminating a labor-consuming and accuracy-requiring step in the preparation of the transformer core.

It is an object of the present invention to provide a new and novel magnetic strip material adapted for use in the formation in wound transformer cores.

It is a further object of the invention to provide a new and novel method of processing strip material for use in the manufacture of transformer cores.

A further object of the invention is to provide magnetic strip material for use in the manufacture of transformer cores in which the magnetic strip material is transversely relieved at spaced intervals to provide parting zones.

A further object of the invention is to provide magnetic strip material for use in transformer cores which is deformed at spaced intervals to provide integral spacer means.

A further object of the invention is to form such integral spacer means as transversely disposed bosses.

A further object of the invention is to provide magnetic strip material for use in the manufacture of transformer cores with longitudinally disposed rib means for retaining the material in wound or bent condition.

A further object of the invention is to provide a new and novel method of manufacturing wound cores for transformers.

A further object of the invention is to provide such a method which includes the steps of winding magnetic strip material to form a wound coil of such strip material, subjecting the wound coil to annealing heat, effecting parting of the layers of the wound coil during the period of annealing, and completing the annealing of the wound coil in parted or severed condition.

A further object of the invention is to provide such a method which additionally includes the step of transversely relieving the strip material as by grooving or perforating prior to winding and effecting the parting by the effect of the heat of annealing upon the transverse relief portions.

A further object of the invention is to provide in a method of manufacturing wound cores for transformers the step of forming integral spacer means in the magnetic strip material prior to winding, whereby upon winding spacing for subsequent interleaving of laminations may be effected without interruption and without the necessity of separate spacer means.

A further object of the invention is to provide a method of manufacturing cores for transformers which includes the steps of parting layers or laminations of a wound coil after the coil has been subjected to the heat of annealing and subsequently interleaving the parted ends of the laminations to form a lapped-joint core for transformers.

The means by which the foregoing and other objects of the present invention are accomplished and the manner of their accomplishment will be readily understood from the following specification upon reference to the accompanying drawings, in which:

Fig. 1 is a somewhat diagrammatic elevational view illustrating the processing of magnetic strip material prior to winding, and further illustrating the winding thereof.

Fig. 2 is a fragmentary face or plan view of a portion of the magnetic strip material after processing and prior to winding.

Fig. 3 is a side or edge view of the material as seen in Fig. 2.

Fig. 4 is a cross-sectional view on an enlarged scale taken as on the line IV—IV of Fig. 2.

Fig. 5 is a fragmentary face or plan view on a similarly enlarged scale illustrating a modification in the transverse relief zone of the strip.

Fig. 6 is a fragmentary edge or side view of the modification of Fig. 5.

Fig. 7 is a view similar to Fig. 6 illustrating a further modification of the strip material.

Fig. 8 is a front view of a coil of magnetic strip material for a transformer core, after winding and prior to annealing.

Fig. 9 is a side view of the wound coil of Fig. 8.

Fig. 10 is a view similar to Fig. 8, but illustrating the core with the laminations parted.

Fig. 11 is a view similar to Fig. 10 with transformer windings in position on the core legs.

Fig. 12 is a view similar to Fig. 11 illustrating the core completed with the lamination ends formed in a lapped joint.

Fig. 13 is a view similar to Fig. 2 illustrating a further modification in the strip material.

Fig. 14 is a view similar to Fig. 9 illusrating a wound coil employing the strip of Fig. 13.

Fig. 15 is a view similar to Fig. 8 and illustrating a coil wound from further modified strip material.

Fig. 16 is a top view of the coil of Fig. 15 more clearly showing the modification of the strip material; and

Fig. 17 is a view similar to Fig. 5 illustrating a further modification in the strip material.

Referring now to the drawings in which the various parts are indicated by numerals, ferrous strip material, preferably of a selected grade of steel and having properties including magnetic properties rendering the material suitable for use in transformer cores, is additionally processed in accordance with the present invention and after such processing is wound into a continuous coil and the wound coil is subsequently subjected to annealing. As illustrated the strip material, indicated at **21**, is drawn from a suitable source of supply, not shown, and in the pre-winding process is primarily provided with longitudinally spaced, transversely disposed, relief zones, in which the strip is partially severed and the cross sectional area of the metal in the strip is thereby ribbed, the zones being longitudinally spaced apart a distance substantially equal to the length of successive turns of the strip material when subsequently wound to form a wound coil. The relief zones may be in the form of perforations **23** (Figs. 2, 13 and 16) which may be stamped out of the strip 21 at the desired spaced intervals or may be formed as substantially V-shaped or angular, transversely extending grooves 123 across the face of the strip material (Figs. 5, 6) or under certain circumstances, an additional similar relief groove **223** may be applied to the opposite face of strip 21 (Fig. 7). Such grooving, either single face or double face, may be formed by a suitable stamping operation.

Additionally it is preferred that strip 21 be provided with integral spacer means which are longitudinally spaced apart along strip 21, the spacing being a distance equal to the length of a plurality of coil turns of the wound coil. Preferably the longitudinal spacing of the integral spacer means is a distance equal to the length of five such coil turns, although under varying circumstances the length of the spacing may be varied, as for example to a distance equal to two whole turns or more. Preferably the integral spacing means is in the form of a group of parallel, transversely extending longitudinally rounded ridge-like bosses **25** which are embossed trans-

versely of the strip material as by a suitable forming die. In the embodiments illustrated it will be observed that the transverse ridge-like bosses **25** are formed in spaced pairs and that preferably the spaced pairs embrace a relief zone, either of perforations **23** (Figs. 2 and 13) or the single face groove **123** (Fig. 6) or the double face grooving **123, 223** (Fig. 7), so that the integral spacer means are positioned on opposite sides of selected relief zones. It will be understood that while ridges **25** are shown as formed in spaced pairs, a single ridge may be formed on the opposite sides of the selected relief zones if desired.

In the alternative the integral spacer means may be formed as rounded, dimple-like bosses **125** (Fig. 17) which may be embossed in strip **21** by a suitable die.

Additionally in many instances it is desirable to provide strip **21** with longitudinally extending, transversely rounded, integral binding ribs **27**, which may be interrupted from time to time, as shown for example in Fig. 2. Where strip **21** is relatively narrow longitudinal ribs **27** are preferably disposed substantially along the longitudinal center line of the strip. In instances of the employment of strip material of greater width, additional similar longitudinal ribs **27** may be provided and the longitudinal ribs are preferably arranged symmetrically relative to the longitudinal center line.

It thus will be seen that magnetic strip **21** is subjected to a new and novel pre-winding processing in which a new magnetic strip material is produced, which in the preferred embodiment includes transverse relief zones, either in the form of perforations or of sharp grooving or other suitable reduction of the strip metal, which relief zones are longitudinally spaced apart with the spacing between adjacent relief zones being a distance equal to a turn of the coil subsequently to be wound from the strip material. It further will be seen that there may be provided by the pre-winding processing of the present invention a novel magnetic strip for use in a transformer core in which integral spacer means, either in the form of transverse ridges or dimples or other embossment on the strip material, are formed at intervals longitudinally spaced along the strip material, the successive intervals being of a length equal to the length of a plurality of coil turns, and it further will be seen that the pre-winding processing of the present invention may further provide a new and novel magnetic strip material for use in transformer cores which may include longitudinal binding rib means.

It will be understood that the strip material may include a combination of the features mentioned, relief zones, integral spacer means and longitudinal rib means, or that one or more of these features may be employed. Thus in Figs. 2 and 5 the strip material is illustrated as embodying transverse relief zones, integral spacer means and longitudinal binding rib means, while in Fig. 13 the strip is shown as embodying transverse relief zones and integral spacer means, and in Fig. 16 the strip, there shown in wound condition, embodies transverse relief zones.

After the new and novel magnetic strip of the present invention has been produced it is in condition to be wound into a continuous coil to be additionally processed and formed into a core for transformers, and in such condition if desired it may be stored or otherwise held to await use.

Preferably the pre-winding processing and the coil-winding process are parts of a substantially continuous operation which is somewhat diagrammatically illustrated in Fig. 1 of the drawings. As shown, the strip material is withdrawn from a suitable supply, not shown, and is introduced to a pre-winding processing station **31** which is preferably mounted in adjacency to a winding machine **33**. At the pre-winding processing station are located instrumentalities for processing the strip material, as described hereinabove, these instrumentalities being preferably selectively operable and if desired the operation may be synchronized with the operation of the winding machine.

Thus the processing station may include a housing **35** for suitable rolls, not shown, but which may be connected to the housing as at **36**. The strip material is passed through the housing **35** and the operation of the forming rolls contained therein imparts to the strip material longitudinal ribs **27**. An additional processing device is indicated by the housing **37** within which may be contained a suitable stamping die, not shown, for forming perforations **23**, or, as already pointed out, the stamping operation may be provided to form transverse grooves **123** or the additional transverse grooves **223**. The operation of the stamping die may be automatically controlled, as for example in synchronization with the winding machine, or it may be manually controlled as by a lever **39**. Additionally contained within housing **37** is a suitable embossing or forming die, not shown, for deforming the strip material to provide the integral spacer means, either in the form of transverse ridge-like bosses **25** or the transverse series of dimple-like bosses **125**. Such embossing die may likewise be automatically controlled or it may be manually controlled as by a foot pedal **41**. The pre-winding processing of the strip material thus may be completed at the pre-winding station **31** and may be directly passed from the pre-winding processing station to the winding machine. Upon winding machine **33** a mandrel **43** is of substantially keystone-shape, having two long sides and two short sides, one of which is greater in length, and is driven by the winding machine. The winding operation is substantially continuous and sequentially follows in preferred practice the pre-winding process.

As the winding is begun the strip material is introduced to the mandrel, secured to the mandrel in any desired manner, and the mandrel is rotated, in the embodiment illustrated, in a clock-wise direction. The integral spacer means, as for example the transverse ridge-like bosses **25**, are spaced so that upon winding they are positioned along the upper or greater short side of the mandrel. As the strip material is wound upon the mandrel it bends about the corners of the mandrel and in those circumstances in which the longitudinal binding rib means **27** is imparted to the strip material the bending of the longitudinal rib is effective to maintain the wound material in wound condition.

As can be seen, particularly in Figs. 8, 10 and 11, the deformation of the strip material with the spacer means provides spaces **44** between adjacent turns of the coil which are adapted for receiving, upon subsequent processing, the free ends of opposite laminations. It will be seen that the integral spacer means produces a thickening effect of the strip material, establishing spaces **44** between adjacent turns, without increasing the transverse cross sectional area of the strip per se. As already pointed out, the integral spacer means are respectively formed in the strip material at intervals equal to two or more whole turns of the coil upon the mandrel with the result that the spacer means and spaces **44** are positioned commonly along the greater short side of the mandrel and thus provide the desired spacing along one short side of the core when completed.

It has also been pointed out that the relief zones are spaced apart at intervals having a length of the nature of the length of a single turn upon the mandrel, and when the coil is wound upon the mandrel the relief zones are disposed substantially in a common vertical plane which intersects the greater short side of the coil and which lies between and is embraced by the integral spacer means.

When a sufficient length of strip material, determined by the characteristics desired for the transformer core being produced, has been wound upon the mandrel the winding operation is terminated and the wound coil is

removed from the mandrel. A typical wound coil **45**, after removal from the mandrel, is illustrated in Fig. 8. It will be understood that while Fig. 8 is a front elevational view of the wound coil **45**, only certain of the turns, particularly those in which the integral spacer means have been deformed, are shown in full, the remaining turns of which there are a plurality between each such spacer-carrying turn, being indicated by the broken lines, it being understood that while the spacer-carrying turns divide the coil into sections, each of the sections includes a plurality of laminations **47**.

The wound coil **45** may then be removed to a suitable oven or other heating device where the ferrous strip material of the coil wound into the laminations **47** is subjected to the heat of annealing, which is preferably in the nature of 1450° Fahrenheit.

Where the new and novel magnetic strip of the present invention including the transverse, partly severed relief zones has been employed in forming coil **45** as described, the coil, after introduction to the annealing heat and prior to completion thereof, will become severed and parted along the transverse relief zones, producing a parted coil **45**, as shown in Fig. 10, with the laminations **47** being severed into nested discontinuous laminations having free ends **47A**, **47B**, and being stacked for subsequent core use. It is found that this parting of the laminations to form discontinuous laminations occurs after a relatively short period of subjection of the coil **45** to annealing heat and consequently annealing of the severed or parted coil, as shown in Fig. 10, is continued in such severed condition. The binder ribs **27** are effective after parting of laminations **47** to substantially limit unfolding movement of the parted laminations with the severed coil being retained thereby substantially in the position shown in Figs. 10 and 11. Upon completion of the period of time desired for annealing, the annealed severed coil, substantially as shown in Fig. 10, is removed from the annealing means and the coil is permitted to cool for a suitable period.

It will be observed that by the employment of the integral spacer means deformed in the body of the strip material from which the coil is formed, the winding operation previously described does not require interruption for the placing of independent spacer means and the winding may be continued substantially without interruption until the desired length of strip material has been wound upon the mandrel. It further will be seen that the employment of the integral spacer means eliminates additionally the necessity of the separate operation heretofore required of removing independent spacer means, either after annealing or after severing of a wound coil. Additionally it is found that since the integral spacer means form a part of the strip material wound into the coil the heretofore difficult problem of preventing relative sagging of wound coil laminations during annealing is substantially eliminated without the necessity of providing combustible spacers or other similar heat destroyed elements.

After the parted coil has cooled for a desired period transformer windings **49** may be respectively associated with the long legs **45A**, **45B** of the nested laminations of parted coil **45**, either by passing the windows of the transformer windings over the lamination ends **47A**, **47B**, or by threading the lamination ends through the windows of the windings. The association of the transformer windings **49** with the core legs produces the partly completed transformer, as shown in Fig. 11, and thereafter the free lamination ends **47A**, **47B** are interleaved and overlapped, as shown in Fig. 12, along the lapped joint end **45C** of the core, the respective free ends being inserted into the separated spaces **44** formed between adjacent turns or laminations of the core, thus forming the nested laminations into a transformer core C. A plurality of such lamination free ends is preferably inserted in each space **44**.

It will be seen from a reference to Fig. 12, that the extent of the insertion or interleaving of the lamination free ends in forming the lapped joint end **45C** is accurately limited by the integral spacer means, shown as the ridge-like bosses **25**, the free ends of the laminations being moved substantially into abutment with the spacer means and further overtravel beyond the desired extent of interleaving being prevented thereby. In the jointed core condition shown in Fig. 12, under normal circumstances the core C is retained in substantially rectangular condition by the binder rib means **27**, although if desired additional binder straps may be employed.

In some instances it is desirable on account of the characteristics of the transformer core which is to be produced to eliminate the longitudinal binder rib. In such circumstances the strip material after preliminary processing may be in the form fragmentarily illustrated in Fig. 13. It will be understood that while the partly severed transverse relief zones are shown in Fig. 13 as consisting of perforations **23**, transverse grooving **123**, or **123** and **223** may be applied similarly, and additionally while the transverse integral spacer means are there illustrated as comprising spaced pairs of transverse ridge-like bosses **25**, a lesser or greater number of ridge-like bosses may be employed, and if desired dimple-like bosses **125** may be employed in lieu of the ridge-like bosses.

With the omission of the longitudinal binder rib means **27**, it is necessary when the strip material has been wound into a coil **145** of desired length that binders, such as the straps **51**, should be applied to retain the strip material in wound condition for annealing and subsequent handling. The wound coil **145** is subjected to annealing, parting of the laminations is effected during annealing by the heat of annealing, the parting occurring along the transverse relief zones, the transverse relief zones being arranged along the greater short side of the wound coil **145**, all in manner substantially identical with that heretofore described in connection with wound coil **45**, and the parted laminations are subsequently interleaved to form a lapped joint core.

It is also desirable under certain circumstances to merely employ the transverse relief zones in order to effect parting of the laminations during annealing, a typical employment of which is illustrated in Figs. 15 and 16, in which a wound coil **245** is provided with transverse relief zones specifically illustrated as consisting of perforations **23**, it being understood that if desired variations in the transverse relief zones may be employed in the strip material if desired. In the absence of the integral spacer means, turns of strip material forming coil **245** are spaced apart in substantially conventional manner, using independent shims or spacers **225**. The annealing and parting of the coil laminations of coil **245** into discontinuous laminations under the effect of the heat of annealing is effective in connection with coil **245** in the manner already described, and after association of transformer windings the lamination ends are interleaved to form a lapped joint core.

It will further be understood that in some instances it may be desirable to merely provide the strip material with integral spacer means and to effect severing as by sawing of the wound coil into a parted coil condition similar to that shown in Fig. 10. Under such circumstances the transverse relief zones are omitted from the strip material and the integral spacer means, either in the form of ridges **25** or dimples **125** may be imparted to the strip material.

I claim:

1. As a new article of manufacture, magnetic strip material adapted for use in wound-type laminated cores for transformers in which laminations are discontinuous and are jointed by overlapping end portions to form lap joints, which comprises elongated ferrous strip, relief zones, in which the cross-sectional area of said strip is reduced, disposed transversely across said strip, said relief zones being longitudinally spaced apart along said strip, the

spacing between adjacent relief zones being a distance substantially equal to the length of a single core turn when wound, integral spacers embossed in said strip at intervals along said strip, each said interval being a distance equal to the length of a plurality of core turns when wound, at least two said spacers being disposed adjacent each said interval and one of said relief zones being interposed between said two spacers adjacent each interval, said two spacers being respectively longitudinally spaced substantially equally and oppositely from the interposed relief zone a distance equal to the length of overlap of said end portions when said laminations are jointed, and longitudinal integral rib means formed in said strip and extending longitudinally thereof.

2. As a new article of manufacture, magnetic strip material adapted for use in wound-type laminated cores for transformers in which laminations are discontinuous and are jointed by overlapping end portions to form lap joints, which comprises elongated ferrous strip, relief zones in which the cross sectional area of said strip is reduced, disposed transversely across said strip, said relief zones being longitudinally spaced apart along said strip, the spacing between adjacent relief zones being a distance substantially equal to the length of a single core turn when wound, integral spacers embossed in said strip at intervals along said strip, each said interval being a distance equal to the length of a plurality of core turns when wound, at least two said spacers being disposed adjacent each said interval and one of said relief zones being interposed between said two spacers adjacent said interval, said two spacers being respectively longitudinally spaced substantially equally and oppositely from the interposed relief zone a distance equal to the length of overlap of said end portions when said laminations are jointed.

3. The method of producing magnetic strip laminations for use in cores for transformers which comprises the steps of partly severing magnetic strip material at spaced intervals to establish relief zones, winding said partly severed magnetic strip material into a coil consisting of a plurality of turns, beginning annealing of said coil, thus expanding said turns with the heat of annealing and thereby effecting parting of said turns along said relief zones during and without interrupting said annealing to establish a parted coil consisting of nested laminations having free ends, and continuing said annealing to anneal said nested laminations while maintaining said laminations in nested condition.

4. Method of manufacture of wound cores for transformers from magnetic strip material, which comprises the pre-winding steps of transversely partly severing said strip material at intervals spaced longitudinally along said strip material to provide transversely extending longitudinally spaced relief zones, subsequently continuously winding said partly severed strip material into a substantially quadrilateral coil of continuous whole turns, thereby positioning said relief zones substantially in alinement at one side of said coil, beginning annealing of said coil, thus expanding said turns with the best of annealing and thereby effecting parting of said turns along said relief zones under the effect of the heat of said annealing and without interrupting said annealing to establish a plurality of discontinuous strip laminations in nested condition and having free ends, completing said annealing with said laminations nested and discontinuous while maintaining said laminations substantially in the shape of said coil and subsequently overlapping said lamination free ends to lap said laminations and complete a laminated, lapped joint core for a transformer.

5. Method of manufacture of wound cores for transformers from magnetic strip material, which comprises the pre-winding steps of transversely partly severing said strip material at intervals spaced longitudinally along said strip material to provide transversely extending longitudinally spaced relief zones, subsequently continuously winding said partly severed strip material into a substantially quadrilateral coil of continuous whole turns, establishing spaces between adjacent of said turns at one side of said coil, said relief zones being positioned during said winding substantially in alinement at said one side of said coil, beginning annealing of said coil, thus expanding said turns with the heat of annealing and thereby effecting parting of said turns along said relief zones under the effect of the heat of said annealing and without interrupting said annealing to establish a plurality of discontinuous strip laminations in nested condition and having free ends, completing said annealing with said laminations nested and discontinuous while maintaining said laminations substantially in the shape of said coil, and subsequently inserting said lamination free ends in said spaces to lap said laminations and complete a laminated, lapped joint core for a transformer.

6. Method of manufacture of wound cores for transformers from magnetic strip material, which comprises the pre-winding steps of transversely partly severing said strip material at intervals spaced longitudinally along said strip material to provide transversely extending longitudinally spaced relief zones, transversely embossing said strip material at intervals spaced along said strip material which latter intervals are greater than the intervals between said relief zones, to form integral transversely extending embossed spacer means spaced longitudinally of said strip material, subsequently continuously winding said partly severed, embossed strip material into a substantially quadrilateral coil of continuous whole turns, the embossings on said strip establishing spaces at one side of said coil between adjacent said turns during said winding, said relief zones being positioned during said winding substantially in alinement at said one side of said coil, beginning annealing of said coil, thus expanding said turns with the heat of annealing and thereby effecting parting of said turns along said relief zones under the effect of the heat of said annealing and without interrupting said annealing to establish a plurality of discontinuous strip laminations in nested condition and having free ends, completing said annealing with said laminations nested and discontinuous while maintaining said laminations substantially in the shape of said coil, and subsequently inserting said lamination free ends in said spaces to lap said laminations and complete a laminated, lapped joint core for a transformer.

7. Method of manufacture of wound cores for transformers from magnetic strip material, which comprises the pre-winding steps of transversely partly severing said strip material at intervals spaced longitudinally along said strip material to provide transversely extending longitudinally spaced relief zones, transversely embossing said strip material at intervals spaced along said strip material, which latter intervals are greater than the intervals between said relief zones, to form integral transversely extending embossed spacer means spaced longitudinally of said strip material, longitudinally ribbing said strip material to form binder means, subsequently continuously winding said partly severed, embossed and ribbed strip material into a substantially quadrilateral coil of continuous whole turns, the embossings on said strip establishing spaces at one side of said coil between adjacent said turns during said winding, said relief zones being positioned during said winding; substantially in alinement at said one side of said coil, and said ribbing being bent by said winding to bind said coil, beginning annealing of said coil, thus expanding said turns with the heat of annealing and thereby effecting parting of said turns along said relief zones under the effect of the heat of said annealing and without interrupting said annealing to establish a plurality of discontinuous strip laminations in nested condition and having free ends, completing said annealing with said laminations nested and dis-

continuous while maintaining said laminations substantially in the shape of said coil, and subsequently inserting said lamination free ends in said spaces to lap said laminations and complete a laminated, lapped joint core for a transformer.

8. The method of manufacture of wound cores for transformers from magnetic strip material, which comprises the pre-winding steps of transversely partly severing said strip material at intervals spaced longitudinally along said strip material to provide transversely extending longitudinally spaced relief zones, subsequently continuously winding said partly severed strip material into a substantially quadrilateral coil of continuous whole turns, beginning annealing of said coil, thus expanding said turns with the heat of annealing and thereby effecting parting of said strip material along said relief zones under the effect of the heat of said annealing and without interrupting said annealing to render said coil discontinuous, said strip where parted having free ends, completing annealing of said discontinuous coil, while maintaining said coil in substantially quadrilateral shape and subsequently lap jointing said free ends to complete a laminated core for a transformer.

9. The method of manufacture of wound cores for transformers from magnetic strip material, which comprises the pre-winding steps of transversely partly severing said strip material at intervals spaced longitudinally along said strip material to provide transversely extending longitudinally spaced relief zones, subsequently continuously winding said partly severed strip material into a substantially quadrilateral coil of continuous whole turns, said relief zones being positioned during winding substantially in alinement at one side of said coil, beginning annealing of said coil, thus expanding said turns with the heat of annealing and thereby effecting parting of said strip material along said relief zones under the effect of the heat of said annealing and without interrupting said annealing to render said coil discontinuous and provide subsequent access to said coil for the association therewith of a transformer winding, said strip where parted having free ends, completing annealing of said discontinuous coil while maintaining said coil in substantially quadrilateral shape and associating a transformer winding with said coil and jointing said free ends to complete a laminated core for a transformer.

10. Method of processing magnetic strip material for subsequent use in the manufacture of wound cores for transformers, which comprises the prewinding steps of transversely perforating said strip material intermediate the edges thereof at intervals spaced longitudinally along said strip material to form series of perforations, thereby partly severing said strip material and providing transversely extending longitudinally spaced perforated relief zones, transversely embossing said strip material at intervals spaced along said strip material, which latter intervals are greater than the intervals between said relief zones, to form integral transversely extending embossed spacers spaced longitudinally of said strip material, at least two of said spacers being formed in spaced apart relation at each embossing of the strip material, one of said series of perforations being interposed between and substantially equidistant from said two spacers, and longitudinally ribbing said strip material to provide binder means.

11. Method of processing magnetic strip material for subsequent use in the manufacture of wound cores for transformers, which comprises the prewinding steps of transversely perforating said strip material intermediate the edges thereof at intervals spaced longitudinally along said strip material to form series of perforations, thereby partly severing said strip material and providing transversely extending longitudinally spaced perforated relief zones, transversely embossing said strip material at intervals spaced along said strip material, which latter intervals are greater than the intervals between said relief zones, to form integral transversely extending embossed spacers spaced longitudinally of said strip material, at least two of said spacers being formed in spaced apart relation at each embossing of the strip material, one of said series of perforations being interposed between and substantially equidistant from said two spacers.

References Cited in the file of this patent

UNITED STATES PATENTS

685,758	Griffith	Nov. 5, 1901
2,305,650	Vienneau	Dec. 22, 1942
2,311,995	Parker	Feb. 23, 1943
2,423,810	Goulding	July 8, 1947
2,489,625	Dornbush	Nov. 29, 1949
2,552,109	Nahman	May 8, 1951
2,574,417	Rowe	Nov. 6, 1951
2,579,560	Ford	Dec. 25, 1951
2,584,564	Ellis	Feb. 5, 1952
2,588,173	Somerville	Mar. 4, 1952
2,602,988	Klym	July 15, 1952
2,657,456	Moody	Nov. 3, 1953
2,700,207	Zimsky	Jan. 25, 1955
2,748,452	Pierce	June 5, 1956