Nov. 28, 1961 G. A. SMITH 3,011,141

THREE-PHASE TRANSFORMER CORE

Filed Dec. 13, 1954

Fig 1

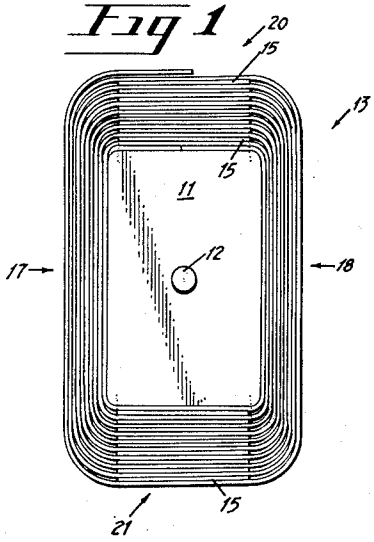


Fig 2

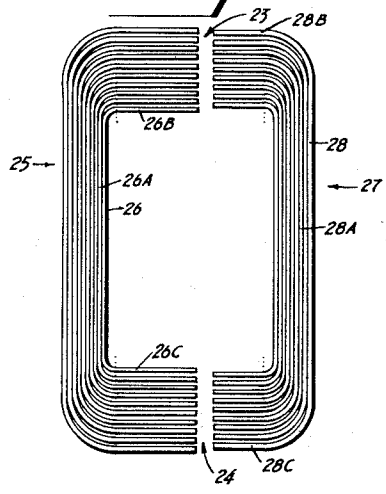


Fig 4

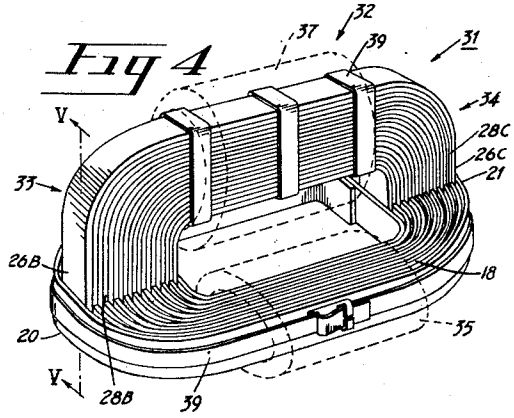
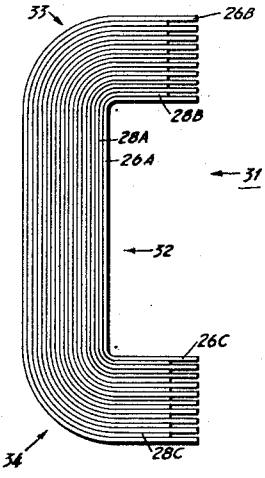


Fig 3



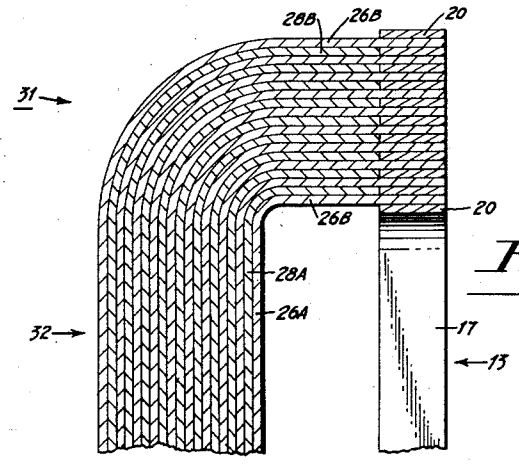


Fig 5

INVENTOR
GEORGE A. SMITH
BY
Wratherford & Wratherford
atty

United States Patent Office 3,011,141
Patented Nov. 28, 1961

3,011,141

THREE-PHASE TRANSFORMER CORE

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

Filed Dec. 13, 1954, Ser. No. 474,645
4 Claims. (Cl. 336—213)

This invention relates to certain new and useful improvements in cores for transformers, and particularly relates to such cores formed from magnetic strip material processed to produce a three-phase transformer core, and more particularly relates to a three-phase T-core for transformers.

Specifically this invention relates to a new and novel three-phase core for transformers comprising three winding legs in parallel relation, interconnected by substantially T-shaped yoke portions in which one of the three legs has a cross sectional dimension equal to substantially twice the cross sectional dimension of each of the other two legs, and this invention further relates to the new and novel method by which such core is produced.

In order to provide core conditions in which the flux flow qualities of one of the winding legs of a transformer, as in a three-phase transformer, may be enhanced, it has become apparent that it is desirable to substantially increase the mass of magnetic material incorporated in one such leg and thereby to enhance the desirable magnetic flow qualities resulting therefrom in a transformer construction.

It has heretofore been contemplated that three-phase cores for transformers may be fabricated employing substantially T-shaped yokes. It has, however, been considered undesirable to attempt to increase the mass of material in any of the winding legs of such construction because of the bulkiness of the resultant product.

The present invention is particularly directed to the production and formation of such T-cores for transformers in which one of the legs is of substantially twice the cross sectional area of the other two legs and is so related to the remaining two legs as to minimize the heretofore undesirable bulkiness.

The principal object of the present invention is to provide a T-core for transformers including three substantially parallel winding legs in which the cross sectional area of one of the winding legs is substantially twice the cross sectional area of the other winding legs.

A further object of the invention is to provide a new and novel means of associating a third transformer leg in parallel relation with a pair of transformer legs.

A further object of the invention is to provide a T-core for transformers comprising a substantially continuous coil of a plurality of turns of magnetic strip material providing a pair of winding legs and connecting yoke portions and to associate therewith a substantially U-shaped bundle of U-shaped lamination layers comprising in number substantially twice said plurality in which substantially half of the U-shaped lamination layers are interleaved between adjacent turns of the continuous coil and the remainder of said U-shaped laminations are abutted against edge portions of the continuous coil.

A further object of the invention is to provide a new and novel method of fabricating a three-phase core for transformers.

A further object of the invention is to provide a method of fabricating a three-phase core for transformers which includes the steps of associating with a substantially continuous coil of magnetic strip material, a bundle of U-shaped laminations, interleaving alternate said U-shaped layers with turns of said coil, and butting the interposed U-shaped laminations against edge portions of the coil.

A further object of the invention is to provide a new and novel method of fabricating three-phase cores for transformers which comprises forming a three-phase core having T-shaped yoke portions, in which one of the winding legs is of a cross sectional area equal to substantially twice the cross sectional area of the remaining legs.

A further object of the invention is to improve the design, construction and efficiency of three-phase transformers; and

A further object of the invention is to generally improve the efficiency and facility in methods of fabricating three-phase cores for transformers.

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

FIG. 1 is a face view of a substantially rectangular continuous coil of magnetic strip material as employed in the present invention.

FIG. 2 is a face view of a coil similar to the coil of FIG. 1, in which the short sides of the coil have been severed along a line parallel to and offset from the longitudinal center line of the coil to produce two U-shaped bundles of lamination layers.

FIG. 3 is a face view of a composite U-shaped bundle of lamination layers formed from the two bundles of FIG. 2.

FIG. 4 is a perspective view of a transformer core formed in accordance with the present invention; and

FIG. 5 is a fragmentary sectional view through one of the yoke portions of the core of FIG. 4, as on the line V—V.

Referring now to the drawings in which the various parts are indicated by numerals, the present invention relates to a new and novel method of fabricating three-phase cores for transformers and to the new and novel core produced thereby.

In the preferred practice of the invention magnetic strip material is withdrawn from a suitable source of supply, not shown, and is introduced to a suitable winding mechanism, preferably in the form of a substantially rectangular mandrel **11**, which is preferably rotatably supported as by a shaft **12**. Rotation of the mandrel, with the magnetic strip material engaged therewith, is undertaken to bend the strip material flatwise and produce a substantially rectangular coil **13** of a plurality of lamination layers. During the formation of coil **13** suitable spacers **15** are interposed between the successive layers along the short sides thereof providing upon completion of formation of the coil spaces between adjacent layers.

The rectangular coil **13** thus produced includes a pair of winding leg portions **17, 18** formed by the long sides of the coil and connecting yoke portions **20, 21** formed by the short sides of the coil. Preferably a second coil, like the coil **13** and having an equivalent number of whole turns and lamination layers, is formed upon a mandrel **11** and is severed, as best shown in FIG. 2, as at **23, 24**, along a line parallel to but laterally offset from the longitudinal center line of the coil to divide second coil **13** into a substantially U-shaped bundle **25** of major lamination layers **26** and a minor U-shaped bundle **27** of minor lamination layers **28**. The major lamination layers **26** each includes a winding leg portion **26A** and opposite yoke portions **26B, 26C**, bent substantially at right angles to the leg portions **26A**. Minor lamination layers **28** include winding leg portions **28A** and opposite yoke portions **28B, 28C**. The yoke portions **26B, 26C** exceed the length of the yoke portions **28B, 28C** by an amount of the nature of the width of the strip material from which the coils and lamination layers are formed.

The respective lamination layers 26, 28 of the bundles 25, 27 are unstacked and are alternately nested together to form a composite U-shaped bundle 31, best shown in FIG. 3. Bundle 31 comprises a winding leg 32 composed of the alternate winding leg portions 26A, 28A and comprises a plurality of lamination layers substantially equal in number to twice the number of lamination layers comprising the layers of which the winding legs 17, 18 are formed. At its opposite ends the composite bundle 31 includes yoke portions 33, 34 respectively composed of yoke portions 26B, 28B and 26C, 28C. Like the winding leg 32, the yoke portions 33, 34 are each composed of a plurality of layers substantially equal in number to twice the layers comprising the yoke portions 20, 21, and in addition each of the yoke portions 33, 34 includes projecting portions formed of the end sections of the yoke portions 26B, 26C, substantially equal in number to the layers comprising the yoke portions 20, 21.

In the assembly of the core of the present invention, a coil 13 is formed as described and preferably threaded through the windows of phase windings 35, the spacers 15 being preferably removed during the association of the coil 13 with phase windings 35. The composite bundle 31 is formed up as described and the successive lamination layers 26, 28, of which bundle 31 is formed, are laced through the window of a third phase winding 37, positioning the winding leg 32 within phase winding 37 with composite yoke portions 33, 34 projecting substantially at right angles at the opposite ends of winding leg 32.

The extending end portions of yoke portions 26B, 26C are then successively interleaved into the spaces between the lamination layers of the yoke portions 20, 21 of coil 13 and the assembled devices may be bound together with suitable binders 39.

It will be observed that the end portions of yoke portions 26B, 26C fully overlap the width of the layers comprising yoke portions 20, 21 and that the square ends of yoke portions 28B, 28C are respectively abutted against the edges of the layers in yoke portions 20, 21.

It will be seen that the cross sectional area of winding leg 32 is substantially twice the cross sectional area of winding legs 17 and 18 and that the winding legs are interconnected in substantially parallel relation by substantially T-shaped yoke portions.

It further will be observed by virtue of the present constructions that the joints between the coil yoke portions 20, 21 and bundle yoke portions 33, 34 are maintained without excessive bulkiness and do not exceed in cross sectional dimension the cross sectional area of major winding leg 32. By virtue of the full lap joints between yoke portions 26B, 26C, and coil yoke portions 20, 21 supplemented by the butt joints between yoke portions 28B, 28C and the edges of coil yoke portions 20, 21, a superior jointing arrangement is produced, greatly enhancing the magnetic flow qualities of the transformer core thus produced and enabling the production of the T-core in which one of the legs is of substantially increased cross sectional area relative to the two remaining three legs.

The term "lamination layer" has been used herein since there may be more than one lamination in each layer.

I claim:

1. In a three-phase core structure for electrical apparatus having three winding legs arranged in parallel relation, in combination, a substantially rectangular uninterrupted core coil formed of a plurality of superimposed wound layers of magnetic strip material bent flatwise to conform to the shape of the coil, two opposite sides of the coil comprising diametrically opposed winding legs having a plurality of lamination layers and the remaining two sides comprising coil yokes connecting the ends of the winding legs together in the coil, a like plurality of major U-shaped lamination layers of magnetic strip material, a like plurality of minor U-shaped lamination layers of magnetic strip material, each said U-shaped lamination layer having a substantially straight leg portion and opposite yoke portions bent substantially at right angles to said leg portion, said major and minor lamination layers being nested into a single substantially U-shaped bundle comprising a winding leg having substantially twice the lamination layers and substantially twice the cross sectional area comprising each of said coil winding legs, said major U-shaped layers and said minor U-shaped layers being alternated in said bundle, the yoke portions of said major U-shaped layers being longer than and projecting beyond the yoke portions of said minor U-shaped layers, said bundle yoke portions being joined with said coil yokes with said major U-shaped lamination layer yoke portions being respectively interleaved between adjacent coil yoke layers to form lapped joints and said minor U-shaped lamination layer yoke portions being abutted against coil yoke layers to form butt joints, said bundle leg being bowed away from said core coil intermediate said coil winding legs, the junction part of the structure being thereby in the form of a T comprising lapped and butt joints and being of a cross sectional area substantially equal to the said cross sectional area of said bundle winding leg.

2. In a three-phase core structure for electrical apparatus having three winding legs arranged in parallel relation, in combination, a substantially rectangular uninterrupted core coil formed of a plurality of superimposed wound layers of magnetic strip material bent flatwise to conform to the shape of the coil, two opposite sides of the coil comprising diametrically opposed coplanar winding legs having a plurality of lamination layers and the remaining two sides comprising coil yokes connecting the ends of the winding legs together in the coil, a single substantially U-shaped bundle of lamination layers comprising a winding leg having substantially twice the lamination layers and substantially twice the cross sectional area comprising each of said coil winding legs, and connecting yoke portions bent substantially at right angles to said bundle winding leg, said bundle being disposed in a plane perpendicular to the plane of said coil legs, said bundle yoke portions being joined with said coil yoke portions, said bundle leg being bowed away from said core coil intermediate said coil winding legs, the junction part of the structure being in the form of a T and being of a cross sectional area substantially equal to the said cross sectional area of said bundle winding leg.

3. In a three-phase core structure for electrical apparatus having three winding legs arranged in parallel relation, in combination, a substantially rectangular uninterrupted core formed of a plurality of superimposed layers of magnetic strip material bent flatwise to conform to the shape of the core, two opposite sides of the core comprising diametrically opposed winding legs having a plurality of lamination layers and the remaining two sides comprising core yokes connecting the ends of the winding legs together in the core, a like plurality of U-shaped lamination layers of magnetic strip material, a plurality of minor lamination layers of magnetic sheet material, each said U-shaped lamination layer having a substantially straight leg portion and opposite yoke portions bent substantially at right angles to said leg portion, said U-shaped and minor lamination layers being nested into a single substantially U-shaped bundle with said minor lamination layers interleaved between said U-shaped lamination layers, said bundle comprising a winding leg having substantially twice the lamination layers and substantially twice the cross sectional area comprising each of said coil winding legs, and connecting yoke portions including said U-shaped layer yoke portions, the yoke portions of said U-shaped layers projecting beyond the ends of said minor layers, said bundle yoke portions being joined with said core yokes with said U-shaped lamination layer yoke portions being respectively interleaved between adjacent core yoke layers to form lapped

joints, said bundle leg being bowed away from said core intermediate said coil winding legs, the junction part of the structure being in the form of a T and being of a cross sectional area substantially equal to the said cross sectional area of said bundle winding leg.

4. In a three-phase core structure for electrical apparatus having three winding legs arranged in parallel relation, in combination, a substantially rectangular uninterrupted core coil formed of a plurality of superimposed wound layers of magnetic strip material bent flatwise to conform to the shape of the coil, two opposite sides of the coil comprising diametrically opposed winding legs having a plurality of lamination layers and the remaining two sides comprising coil yokes connecting the ends of the winding legs together in the coil, a single substantially U-shaped bundle of lamination layers of magnetic strip material, comprising a winding leg having substantially twice the lamination layers and substantially twice the cross sectional area comprising each of said coil winding legs, end portions of the layers in said U-shaped bundle being bent substantially at right angles to said bundle winding leg to provide bundle yoke portions, said bundle yoke portions being joined with said coil

yoke portions with at least part of said layer end portions being interleaved between adjacent coil yoke layers to form lapped joints, said bundle leg being bowed away from said core coil intermediate said coil winding legs, the junction part of the structure being thereby in the form of a T and being of a cross sectional area substantially equal to the said cross sectional area of said bundle winding leg.

References Cited in the file of this patent

UNITED STATES PATENTS

2,456,458	Somerville	Dec. 14, 1948
2,456,461	Dunn	Dec. 14, 1948
2,467,868	Somerville	Apr. 19, 1949
2,516,164	Vienneau	July 25, 1950
2,542,806	Ford et al.	Feb. 20, 1951
2,579,578	Horstman et al.	Dec. 25, 1951
2,634,321	Larkin	Apr. 7, 1953
2,889,525	Smith	June 2, 1959

FOREIGN PATENTS

1,038,604	France	Sept. 30, 1953