Aug. 28, 1956 E. K. KANE 2,761,107

THREE-PHASE TRANSFORMER CORE

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Fig. 1.

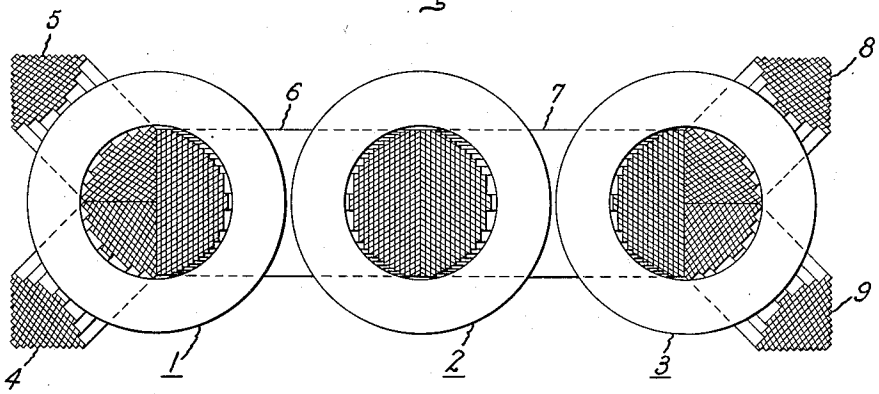

Fig. 2.

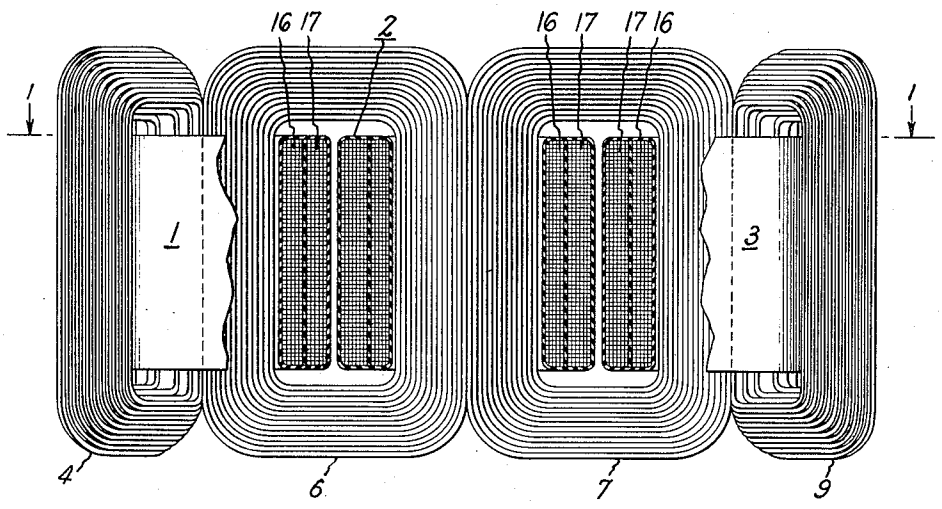

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Fig. 3.

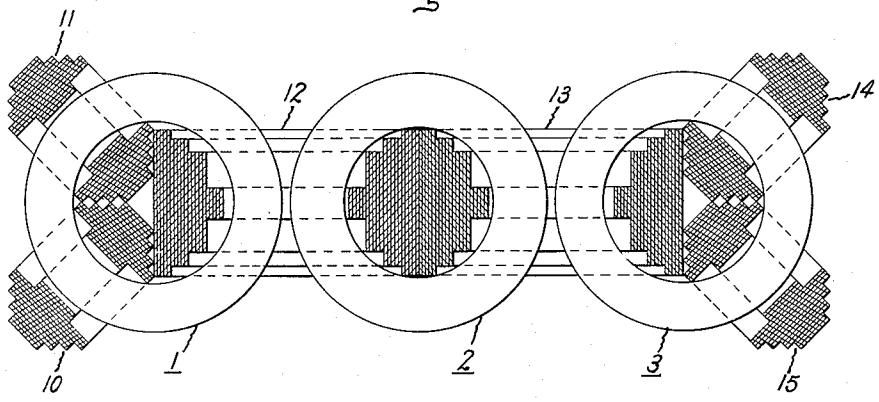
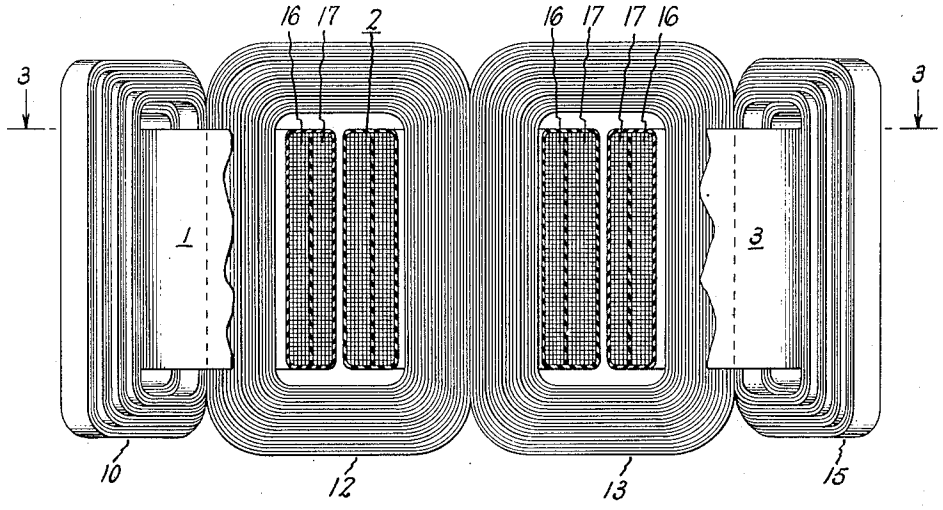


Fig. 4.



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THREE-PHASE TRANSFORMER CORE

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1 Claim. (Cl. 336—5)

This invention relates to transformer cores, and more particularly, to transformer cores of the three-phase type.

A conventional form of three-phase transformer core, the three-legged construction, consists of a laminated structure built up out of narrow flat plates. The plates comprise the leg and yoke portions and the plates comprising each lamination are arranged in a rectangular-like configuration with two window openings and a plurality of laminations are stacked together. This form of three-phase core construction has a considerable height dimension and in order to reduce the height of three-phase core constructions the five-legged core was developed. A known form of five-legged core consists of four rectangular-like core sections lying in the same plane and abutting each other side by side. This form of three-phase transformer core has a shorter height than the three-legged type. However, the length dimension is increased in order to decrease the height.

An object of this invention is to decrease the length dimension of the conventional five-legged three-phase transformer core.

In a five-legged core consisting of four rectangular-like core sections all lying in the same plane and abutting each other side by side, my invention consists of substituting for each of the endmost core sections two smaller rectangular-like core sections disposed relative to each other in a V-shaped arrangement, lying on opposite sides of said plane, and disposed equidistantly from said plane, the apexes of said V-shaped arrangements pointing towards each other.

The features of my invention which I believe to be novel are set forth with particularity in the appended claim. 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 the drawings, Figure 1 is a sectional view of one form of my invention wherein the rectangular-like core sections are constructed out of tapered magnetic core strip material, the section being taken along the line 1—1 of Figure 2. Figure 2 is a front view of my said one form of invention. Figure 3 is a sectional view of another form of my invention wherein the rectangular-like core sections are constructed out of stepped magnetic core strip material, the section being taken along the line 3—3 of Figure 4. Figure 4 is a front view of said another form of invention.

Referring now to Figures 1 and 2 of the drawings, shown therein are three conventional electrical winding cylinders 1, 2, and 3. Each of the cylinders 1 to 3 comprise primary windings 16 and secondary windings 17. My novel three-phase magnetic core consists of six rectangular-like core sections 4, 5, 6, 7, 8, and 9. Large core sections 6 and 7 abut each other at one of their vertical legs or sides and lie in substantially the same plane. As shown in Figures 1 and 2, core section 6 is looped through cylinders 1 and 2 so that a vertical leg of said

core section is positioned within each of said cylinders, and core section 7 is looped through cylinders 2 and 3 so that a vertical leg of said section 7 is positioned within each of said cylinders 2 and 3.

In a conventional five-legged three-phase transformer core an end core section would be looped through each of the outermost cylinders 1 and 3. That is, there would be four rectangular-like core sections in all, and each endmost core section would have one of its vertical legs positioned within the outermost cylinder through which it is looped. All four core sections would abut each other at a vertical leg or side by side, and all four of the core sections would lie in substantially the same plane. Such an arrangement obviously has a considerable length dimension. In my invention, in order to reduce the length dimension of the conventional five-legged core, I substitute two small end core sections for each of the endmost core sections of the conventional five-legged core, each of said two small core sections being disposed relative to each other at an angle, and lying on opposite sides of said plane and spaced equidistantly therefrom. The apexes of the angles formed by both pairs of small end core sections are directed towards each other.

Thus, as shown clearly in Figure 1, two or a pair of small end core sections are looped through each of the endmost cylinders 1 and 3. End core sections 4 and 5 are identical to end core sections 8 and 9, so a description of one pair of small core end sections will be equally applicable to the other pair. Small core end sections 4 and 5 abut each other at one of their vertical legs and these two vertical abutting legs abut the vertical leg of core section 6 within cylinder 1. The pair of end core sections 4 and 5 are disposed relative to each other in a V-shaped arrangement or at an angle, and lie on opposite sides of the central vertical plane of large or main core sections 6 and 7. The apex of said V-shaped arrangement or angle is pointed towards the transformer core. Also, core sections 4 and 5 are disposed substantially equidistantly from the central vertical plane of core sections 6 and 7. That is, each of the core sections 4 and 5 flare or diverge away from the central vertical plane of the whole core structure at substantially equal angles.

The angle at which the end core sections are disposed relative to each other is shown in Figure 1 as being approximately 90 degrees. However, this angle need not necessarily be 90 degrees but can obviously be varied. In my preferred embodiments this angle is 90 degrees because then the length dimension of the conventional five-legged three phase transformer core is substantially decreased without a concomitant substantial increase in the width dimension of transformer apparatus embodying my invention. The transformer apparatus comprising the core and electrical windings is housed in a tank. Transformer apparatus embodying my invention can be housed in a tank having about the same width as a tank housing conventional three-phase transformer apparatus having a five-legged core. This is so because the electrical winding cylinders, bushings, electrical leads, and other transformer parts demand that the housing tank have a certain width. The diverging end core sections permit conventional tanks to be shortened and the diverging end core sections now merely occupy space along the side walls of the tank that heretofore went unused. Thus, my three-phase transformer core retains the decreased height of the conventional five-legged core over the conventional three-legged core, and the length dimension of the conventional five-legged core is substantially decreased without requiring an increase in tank width.

The legs of all six core sections 4 to 9 have equal lengths and the yokes of the small core sections 4, 5, 8 and 9 have a length less than that of the yokes of the

large core sections 6 and 7. The cross sectional area of the legs of the small core sections is about one-half the cross sectional area of the legs of the large core sections. Also, the window openings of the small core sections is about one-half the size of the window openings of the large core sections. That is the outer legs of the small core sections 4 and 5 and 8 and 9 are disposed closely along the outer circumference of the cylinders 1 and 3 respectively.

It will be noted that the core material positioned within each of the winding cylinders 1, 2, and 3 has a circular outline. That is, the proportion of core metal within the cylinders as compared to the cylindrical tubular space within the cylinders is very high. This high space factor is attained by constructing the various core sections from a core strip material that is tapered. The core sections 6 and 7 are each constructed from a tapered strip that is narrowest at one end and widest at the other end. After core sections 6 and 7 are assembled the narrower portions of the core material are located at the inner circumference of the rectangular-like core sections, and the widest portions are located at the outer circumference thereof. The small core sections 4, 5, 8, and 9 are also constructed out of a tapered strip. This tapered strip is widest at a point in between its ends and tapers towards its narrow ends. The strip of material comprising each core section can be continuous or cut up into several segments to facilitate the assembly of each core section.

In Figures 3 and 4 is shown another form of my invention. This form of invention is identical to the first embodiment in that large core sections 12 and 13 are looped through conventional winding cylinders 1, 2, and 3, and these large core sections abut each other at a leg thereof and lie in substantially the same plane. A pair of small end core sections 10, 11 or 14, 15 abut each other and also the non-abutting legs of large core sections 12 and 13 by looping a pair of end core sections through each of the endmost cylinders 1 and 3. Each pair of end core sections located at opposite ends of the core structure are disposed relative to each other at an angle, are positioned on opposite sides of the central vertical plane of large core sections 12, and 13, and are spaced equidistantly from said plane. Also, the apex of the angle formed by each pair of end core sections points towards the whole core structure.

The Figures 3 and 4 form of invention differs from the Figures 1 and 2 form of invention in that instead of using tapered core strip material several strips of uniform but different widths are used to construct each core section. Such a stepped form of core construction will not give as high a space factor as when tapered strip material is used. However, since it may be difficult to accurately cut tapered strip material, a stepped core construction may present a manufacturing advantage.

While there have been shown and described two 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 claim to cover all such changes and modifications as fall 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:

A three phase transformer core comprising two relatively large substantially equal dimensioned rectangular-like core sections, each of said core sections having two vertical legs and two horizontal yokes which define a window opening, said core sections being butted up against each other along only one of the legs thereof and being disposed in substantially the same vertical plane, and two pairs of relatively small substantially equal dimensioned rectangular-like core sections, each of said small core sections having two vertical legs and two horizontal yokes which define a window opening, only one of the legs of each core section of one of said pairs being butted up against each other and against one of the outer legs of said two large core sections, and only one of the legs of each core section of the other one of said pairs being butted up against each other and against the other one of the outer legs of said two large core sections, each of said pairs having their core sections disposed with respect to each other at an angle of substantially 90 degrees and substantially equidistantly along opposite sides of said plane, the apexes of said angles being directed toward each other, all the legs of all six of said core sections having substantially equal lengths, each yoke of said four small core sections having a length which is less than the length of each yoke of said large core sections, and the cross sectional area of each leg of said four small core sections being substantially one-half the cross sectional area of each leg of said large core sections, and each window opening of said large core sections being substantially twice the size of each window opening of said four small core sections.

References Cited in the file of this patent

UNITED STATES PATENTS

1,933,140	Gakle	Oct. 31, 1933
2,199,116	Sanders	Apr. 30, 1940
2,483,159	Somerville	Sept. 27, 1949
2,561,250	Treanor	July 17, 1951
2,595,753	Beardsley	May 6, 1952