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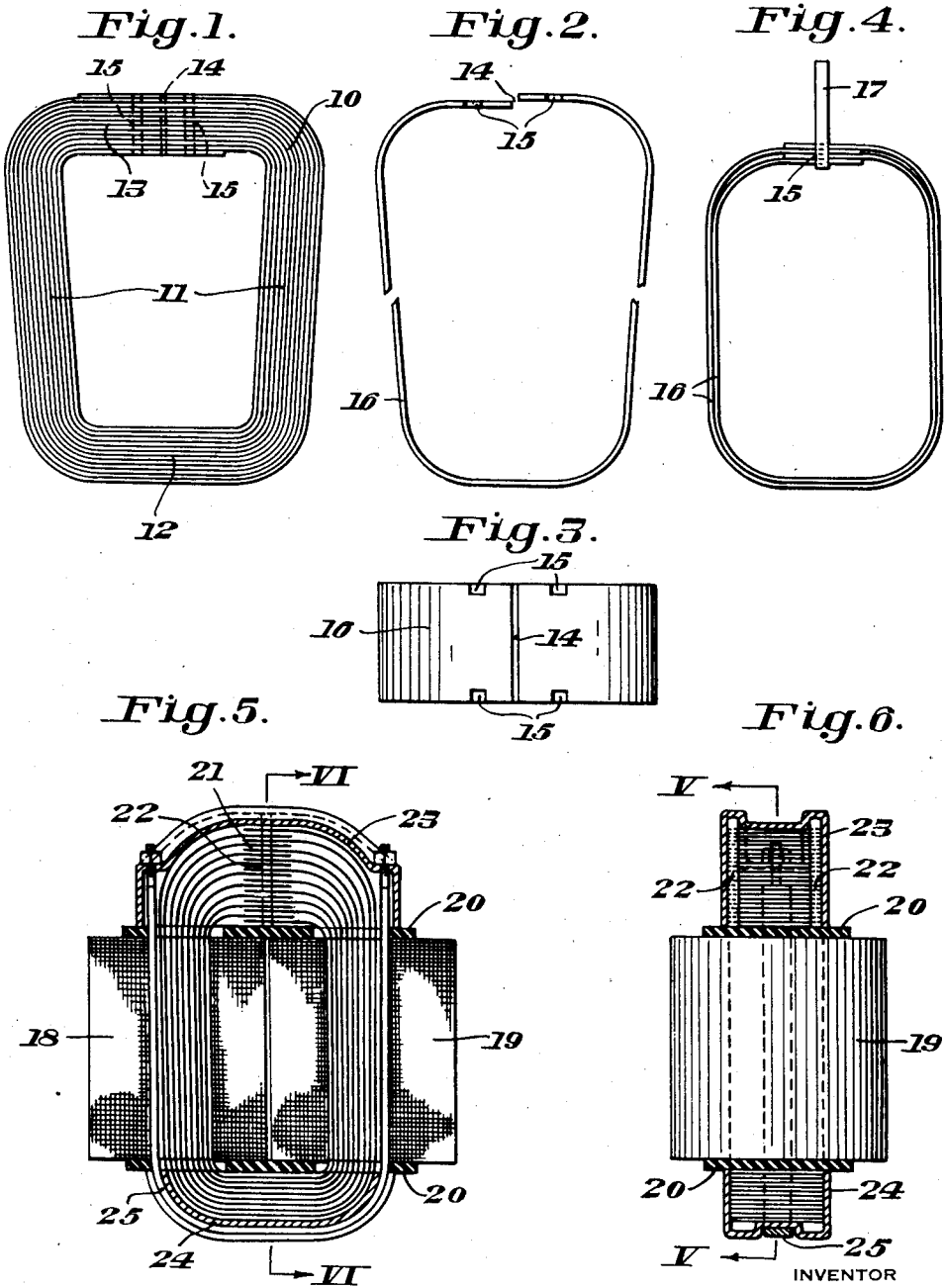
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2,543,089

METHOD OF MAKING TRANSFORMER CORES

Filed Sept. 27, 1947

2 Sheets-Sheet 1



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Fig. 7.

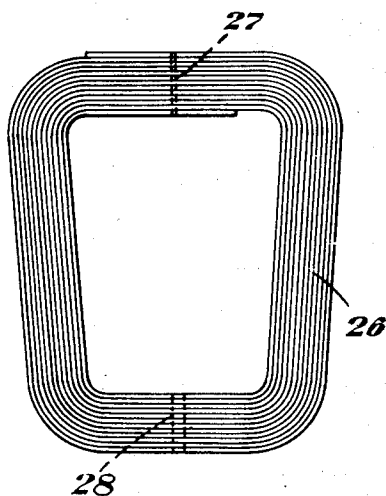


Fig. 8.

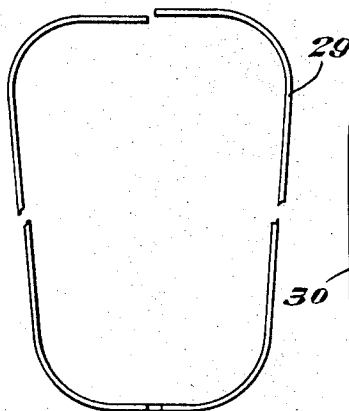


Fig. 10.

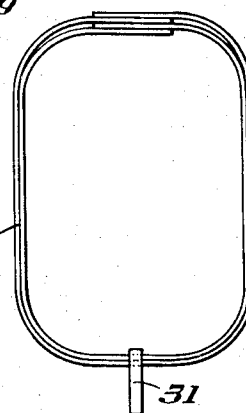
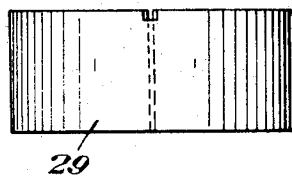


Fig. 9.



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METHOD OF MAKING TRANSFORMER
CORESJohn J. Zimsky, Pittsburgh, Pa., assignor to Penn-
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Application September 27, 1947, Serial No. 776,580

1 Claim. (Cl. 29—155.57)

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This invention relates to electrical transformers and, in particular, to a novel form of wound core therefor and the method of making it.

Wound cores are now extensively used in making transformers. The copending application of Robert C. Sefton et al. Serial No. 665,045 discloses and claims a transformer including a core of this type and its method of manufacture. In making this core, a strip of magnetic metal is wound into a coil, the coil is cut through and the resulting separate laminations are stacked with their ends successively overlapped. After annealing, the laminations are inserted through preformed windings, and the ends of the laminations are then again successively overlapped to form a closed magnetic path. The amount of the overlap has heretofore been left to the judgment of the workman. This requires considerable skill on the part of the workman and increases the time required for assembling the core for annealing as well as permitting variations from the exact amount of overlap desired. There is no assurance, furthermore, that the laminations will be assembled with the windings after annealing in the same relative positions they occupied during annealing. If this is not done, the core loss increases considerably.

I have invented an improved form of wound core and a method for the manufacture thereof whereby the foregoing objections are overcome. In a preferred embodiment and practice, I slot the side edges of the core laminations adjacent their ends or adjacent their mid-point. The ends are then lapped sufficiently to bring the slots into alinement and the slots are fitted on keys to hold the laminations assembled during annealing. After annealing, the keys are removed and the laminations are opened up and inserted through preformed windings. Their ends are then successively overlapped again and non-magnetic keys may be placed in the slots. Core clamps are then applied to hold the keys in place and bind the transformer as a whole.

A complete understanding of the invention may be obtained from the following detailed description and explanation which refer to the accompanying drawings illustrating diagrammatically the several steps of the method and the transformer produced thereby. In the drawings,

Figure 1 is an elevation of a coil of metal strip wound up in a shape suitable for making a transformer core;

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Figure 2 is an elevation of one turn thereof after cutting and slotting;

Figure 3 is a plan view thereof;

Figure 4 is an elevation showing the building up of a stack of laminations and the use of keys for determining the overlap of the ends thereof and securing them in proper relative positions;

Figure 5 is a central section through a completed transformer taken in the plane of the core;

Figure 6 is a sectional view taken along the plane of line VI—VI of Figure 5; line V—V of Figure 6 indicates the plane on which the section of Figure 5 is taken.

Figure 7 is a view similar to Figure 1 showing a modified core winding slotted on one side only at a point opposite that at which the cut through the turn is made; and

Figures 8, 9 and 10 are views similar to Figures 2, 3 and 4, illustrating the assembly of the modified form of core.

Referring now in detail to the drawings, Figure 1 shows a coil 10 wound of strip of a suitable metal such as silicon steel, on a form (not shown) of keystone shape dimensioned to mold a core of the desired size as to the length of its side legs 11, bottom leg 12 and top leg 13. The winding of the strip on the form is continued until a core of the desired thickness is produced. The strip being wound is then cut off and the ends of the coil are temporarily secured as by clamps or the like. The turns of the core are then severed as by making a saw cut 14 therethrough and the side edges of the severed ends of the turns are slotted as at 15.

As a result of the operations described above, I provide a plurality of shaped, nested laminations such as that indicated at 16 in Figures 2 and 3, in the form of loops of strip having their two ends disposed adjacent each other and having slots 15 in their side edges adjacent the ends. I then place the core in condition for annealing by lapping the ends of each turn 16 successively, as shown in Figure 4, until the slots 15 in the two ends are in alinement, and I fit these slots onto keys 17. The keys 17 coacting with the slots 15 fulfill two functions. First, they determine the exact amount of overlapping of the ends of the turns, thus making it unnecessary for the workman to use any judgment in respect to the amount of overlap; and, second, they hold the turns in properly assembled relation. When the core has been completely assembled with the keys 17, it is subjected to the usual annealing treatment. The keys 17 are preferably metal

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to withstand the temperatures involved in this treatment. The turns of the core may be secured together by supplemental bindings of wire or strap (not shown) during annealing.

When the completed core has been annealed, the keys 17 are removed and the laminations are opened up sufficiently to permit them to enter the openings through preformed windings 18 and 19 as shown in Figure 5. Insulating blocks 20 are disposed above and below the windings and the usual padding of insulation (not shown) is disposed between the windings and the core proper. When the core laminations have been inserted through the windings, their ends are again overlapped successively as indicated generally at 21 and are fitted on keys 22 of fiber or other non-magnetic material. In Figure 5, each lamination is represented by a single line since the illustration is only diagrammatic, instead of attempting to show the thickness of each lamination by double lines.

When the core has been assembled with the windings and the ends of the laminations lapped and fitted onto the keys 22 as described, core clamps 23 and 24 pressed from sheet steel are disposed on the upper and lower ends of the core and are secured together by a tie rod 25. The rod extends around the clamp 24 and its ends protrude through the clamp 23, being threaded to receive securing nuts bearing thereon. As clearly shown in Figure 6, the clamp 23 confines the keys 22 and holds them firmly seated in the slots 15 in the ends of the laminations. The ends of the laminations themselves are thus permanently held in proper relative positions.

Figures 7 through 9 show the manufacture of a modified core with only one slot located opposite the cut made through the several turns. A coil 26 wound from magnetic strip is cut through at 27 and is slotted on one side opposite the cut as indicated at 28. The severed turns of the coil, one of which is shown at 29, are assembled as shown in Figure 10 to form a core 30. In assembling the core the coil turns have their slots fitted on a metal key 31. This serves to keep the turns in their proper positions relative to each other. After annealing, the core turns are opened up as already described and linked with preformed electrical windings after which the core turns are again closed and their ends successively lapped. The turns may be fitted on a fiber key as they are assembled with the windings but this is not essential. After completion of the assembly the fiber key, if used, may be left in place or removed.

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It will be apparent from the foregoing that the invention is characterized by numerous advantages. In the first place, it relieves the workman from the exercise of any judgment or skill in determining the amount of overlapping of the ends of successive laminations. This makes it possible to assemble the core in about half the time required without the use of the slots and keys. The keys also serve to lock the individual laminations into proper position. By this means it is unnecessary to take any special precautions to insure that the ends of the laminations in the completed transformer have the same relative positions as they occupied during annealing. There is a further advantage in that a transformer according to my invention may be easily disassembled without skilled labor, in case it is desired to repair the windings or substitute others.

Although I have illustrated and described but a preferred practice and embodiment of the invention, it will be recognized that changes in the procedure and structural details may be made without departing from the spirit of the invention or the scope of the appended claim.

I claim:

In a method of making a transformer core, the steps including winding metal strip in a coil, cutting through the coil thereby severing the turns into separate laminations, slotting the edges of the laminations, lapping the ends of the laminations successively and fitting the slots thereof on a metal key to hold the laminations in assembled relation during annealing of the core, and thereafter replacing said metal key with a non-metallic key.

JOHN J. ZIMSKY.

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