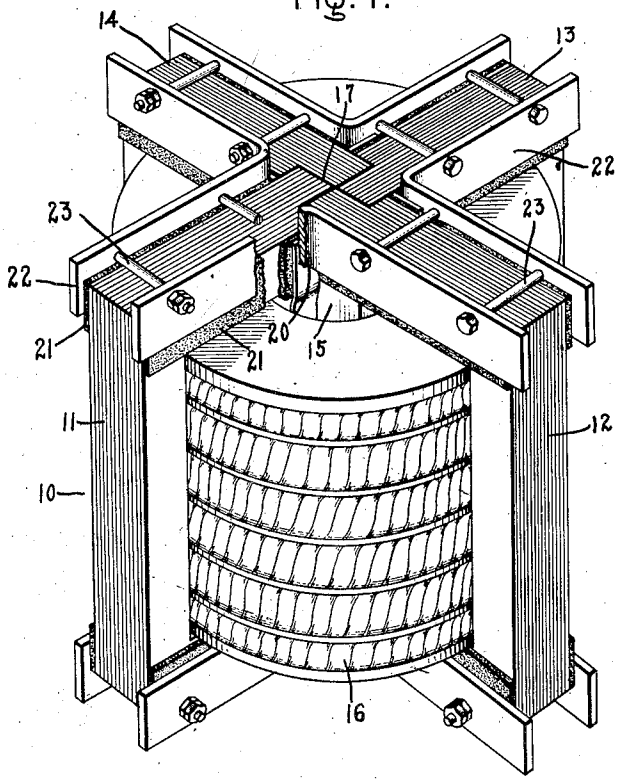
I. H. SCLATER.

ELECTRICAL APPARATUS.

APPLICATION FILED JUNE 12, 1919.

1,394,121. **Patented Oct. 18, 1921.**

Fig. 1.



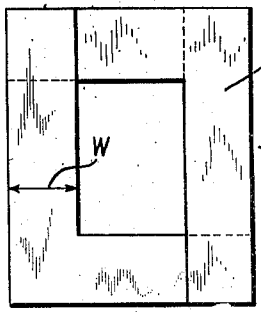


Fig. 3

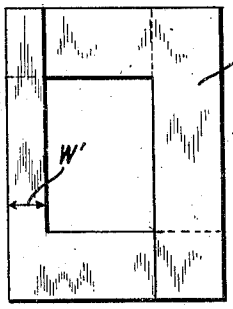


Fig. 4

Fig. 2

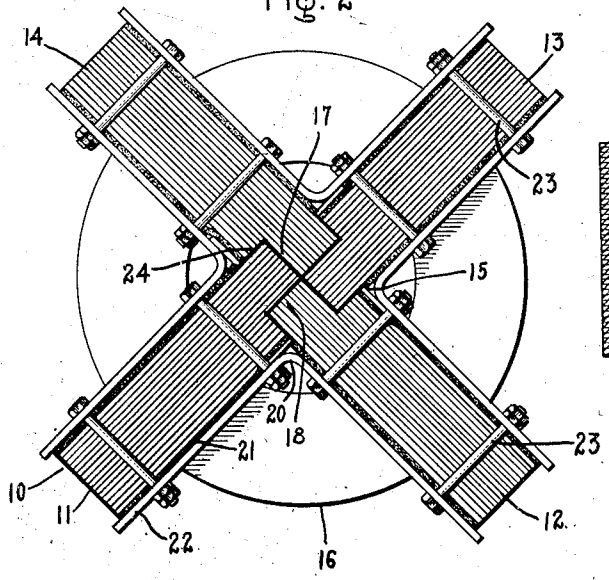
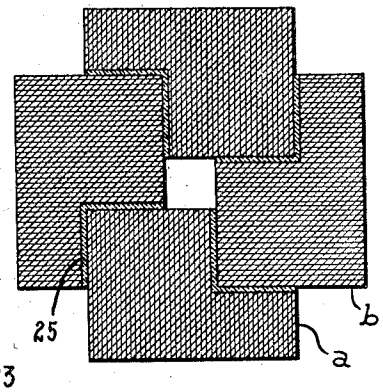


Fig. 5



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UNITED STATES PATENT OFFICE.

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ELECTRICAL APPARATUS.

1,394,121. Specification of Letters Patent. Patented Oct. 18, 1921.

Application filed June 12, 1919. Serial No. 303,617.

To all whom it may concern:

Be it known that I, IVANHOE H. SCLATER, a citizen of the United States, residing at Pittsfield, in the county of Berkshire, State of Massachusetts, have invented certain new and useful Improvements in Electrical Apparatus, of which the following is a specification.

My invention relates to cores for electrical apparatus, such as transformers, some reactors, and the like, and has for its general object an improved construction and method of effecting the same which is economical and lends itself readily to manufacturing processes.

More specifically my invention relates to cores of the so called "distributed" type, or those in which the laminations are arranged in groups, the groups being disposed in angular relation to one another to form a central leg for windings.

In cores of this type, it is customary to construct the groups of L-punchings which are interleaved in alternate directions so that each group comprises a generally rectangular body of punchings yielding a magnetic circuit having broken joints. In order that the central leg shall have good magnetic properties and at the same time have an external contour yielding a relatively short mean copper turn, it is necessary that the sides of the lamination groups, intended to be associated to form such central leg, should be designed to coact to this end. Heretofore a number of sizes of L-punchings for the core for apparatus having a given rating was needed to effect this coaction in order to produce a group of laminations having a side whose configuration was adapted to be dove-tailed into or interlocked with corresponding sides of the other groups to produce the central leg; each rating having its own set of sizes in L-punchings.

To provide this large variety of L-punchings for an extensive line of distributed core transformer and like electrical apparatus, adapted for varying ratings and duties, entailed a great outlay of money in material, tools and equipment. It is hence one of the specific objects of my invention to provide a core of this type suitable for such series of sizes of transformers, etc., which is assembled from a minimum variety of L-punchings.

To impose a definite potential upon this type of core, its frame, clamps, and its tank or casing which incloses the apparatus embodying the core, it has been customary to ground all these parts; a conductor for this purpose is therefore generally placed in among the core laminations and brought out and connected to the frame and clamps. This mode of making the ground connections, however, is tedious and somewhat expensive. Accordingly it is still another object of my invention to simplify this manner of making the ground connection, which is expeditiously carried out by the arrangement of L-punching employed by me, since I merely bend out a portion of a free end of one of the laminations to engage with the frame and clamps. Preferably, I provide one such ground connection for each group of laminations composing the core, since it is desirable to insulate these groups from one another and from the frame to cut down losses.

Still further objects and advantages of my invention will appear from the following detailed description when taken in connection with the accompanying drawing in which:

Figure 1 shows in perspective a view of a core constructed to embody my invention. Fig. 2 is a top plan view of the core shown in Fig. 1. Figs. 3 and 4 show respectively the type of L-punchings used in my invention; while Fig. 5 shows a cross-section of another form of central leg made from L-punchings in accordance with my invention.

Referring now to the drawings, 10 indicates the assembled core made up by fitting together four groups of laminations 11, 12, 13 and 14 so as to meet each other at right angles and form the central leg 15. The leg 15 carries the windings 16 when assembled.

Each group of laminations is shown as having a stepped formation along its inner side such as shown at 17, where it abuts with the corresponding side of the other groups. Two opposite groups, as 11 and 13, are so disposed that there exists a groove, as at 18, in which the projecting step on an adjacent group 12 may be inserted in interlocking relation. In order to build a group of laminations having a side provided with a stepped formation such as will admit of this construction for the central leg, it is necessary to provide laminations whose vertically

disposed portions or legs, which are to compose such central core leg, shall be of different widths, as indicated at W and W′ in Figs. 3 and 4 respectively where the leg W′ is one half the width of leg W.

The two sizes of L's here illustrated, comprise a set which is sufficient to build up the groups of laminations into the rectangular shapes here shown in coöperation with other similar L's, as shown at M which are placed to abut thereagainst. The horizontal portions or legs of these L's are disposed some in the upper yoke and some in the lower yoke in a predetermined order, thus providing broken joints in the magnetic circuit. A set of more than the two sizes shown, however, will be used where it is desired to construct a core capable of being assembled, or of receiving its windings in a preferred way.

Now in the design of electrical apparatus having magnetic cores, such as the transformer shown in Fig. 1, it is customary to use sufficient iron in the core to bring the magnetic flux density up to a predetermined value. Therefore for a line of transformers similar to that in Fig. 1, each designed for a different rating, (*i. e.*, for a varying number of ampere-turns) the iron content of the core must be correspondingly varied, but instead of having a set of punchings for each rating designed to give the proper iron content to the core, I make the one set of sizes standard for all sizes in the series, and simply change the relative numbers of certain of the laminations entering into each group so that the completed cores for each rating will have the proper magnetic flux density. The manner of effecting this will be more readily comprehended from the following examples:

Suppose the transformer shown in Fig. 1 to have a rating of 150 KVA., a core group would be built up of sufficient punchings having wide legs as shown in Fig. 3 (such punchings generally being .014 inch thick) until a height of 2.25 inches is reached, then punchings which have the narrow legs would be added until a total height of 4.5 inches is reached. Four such groups would then be placed together so that their stepped sides engage. In order that the groups should engage as indicated in Fig. 2 it is obviously necessary that the narrow leg W′ shown in Fig. 4 should be but 2.25 inches in width and that the leg W should be 4.5 inches in width.

To build a transformer for a rating of 200 KVA., sufficient wide-legged punchings would be used to build the group up to a height of 2.75 inches, narrow-legged punchings being added until the total height is 5.0 inches. When four such groups are assembled to form the core, the central leg would have a vertical ventilating duct passing axially through it about 0.5 inch wide, as indicated in the section of such central leg as shown in Fig. 5, but the addition of this half inch of wide-legged punchings does not change the widths of the sides *a* and *b* of the corner notches formed by two groups in the central leg. Consequently the winding supporting edges of the central leg are still equally spaced from the center thereof and lie on the arc of a circle. To build a transformer for a rating of 250 KVA., the group would be increased in thickness another half inch by adding more wide-legged punchings. Other transformers in this series would be continued, in this manner; the sides *a* and *b* of the corner notches being kept with the same dimensions throughout.

To reduce eddy current losses in the central leg, I preferably insert folded strips of insulation between the groups, which strips are bent over the edges of the laminations which are fitted together to form the central leg. These folded strips of insulation are inserted as indicated by the black lines 24 in Fig. 2 and as indicated at 25 in Fig. 5.

As hereinbefore indicated, a core of this type constructed as above described, lends itself well to a construction affording a readily made ground connection; the ground connection preventing the accumulation of "static" or induced charges on the core. In my improved construction the core laminations are electrically connected to the frame and the clamps, which are insulated from the core in order to increase the magnetic reluctance of this path to the leakage flux and thereby reduce eddy current losses. In Figs. 1 and 2, the free end of each narrow leg W′ adjacent the central core leg is shown as bent out at 20 and the strip of insulation 21 for insulating the core from the clamps, inserted behind it. These strips of insulation 21 are customarily laid along the yoke portions of each group of laminations and held in place by the clamping angles 22. The clamps are held together for clamping the core members in place by means of bolts 23, the insulating qualities of the paint or varnish applied to the bolts and clamps being sufficient to keep the local circulating current, induced therein, down to a negligible value.

Having now described what is at present the best means known to me for carrying out an embodiment of my invention, I would have it understood that such means are merely illustrative and that I do not mean to be limited thereby to the exact details shown nor in the choice of recognized equivalents except as defined in my claims hereunto appended.

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

1. The method of constructing distributed cores with four outer legs for a line of electrical apparatus rated for varying duties and having interlocking groups of laminations arranged to have their coil supporting

edges lying on a circle, which consists in making a few standard sizes of L-punchings, assembling said different sized punchings in groups adapted to be dovetailed at right angles with other groups, and building each group out of some of each sized punching, one portion of such group being varied in dimensions to correspond with the ratings desired.

2. The method of constructing distributed cores with four outer legs for a line of electrical apparatus rated for varying duties and having interlocking groups of laminations arranged to have their coil supporting edges lying on a circle, which consists in making a few standard sizes of L-punchings, assembling some of each sized punchings in groups a portion of such groups being varied in thickness to correspond with ratings to be given, arranging the punchings in said groups to form a complete magnetic circuit having broken joints, and fitting each group with another group at one edge and at angles of 90° to each other.

3. The method of constructing distributed cores with four outer legs for a line of electrical apparatus rated for varying duties and having interlocked groups of laminations arranged to have their coil supporting edges lying on a circle, which consists in making a few standard sizes of L-punchings, assembling some of each sized punching into stepped groups adapted for dovetailed engagement with other groups disposed at right angles therewith, and varying the number of punchings composing a predetermined step of each group in amounts varying with the rating desired whereby the distances from the corners of the central leg where said groups meet to their winding supporting edges are maintained mutually equal.

4. In electrical apparatus, the combination with a winding, of a core made from angularly disposed groups of laminations composed of L-punchings, clamping members embracing the yokes of the assembled core, and strips of insulation inserted between said members and the core; the free end of a lamination of a group being bent out from under said insulation and placed in conducting relation with one of said clamping members.

5. In electrical apparatus, the combination with a winding, of a core made from angularly disposed groups of laminations composed of L-punchings, strips of insulation laid over the abutting edges of said groups, clamping members embracing the yokes of the assembled core, and other strips of insulation inserted between said members and the core; the free end of an external lamination of the core being bent out from under the last named insulation and placed in conducting relation with one of said clamping members.

6. In electrical apparatus, the combination with a winding, of a core composed of laminated punchings, a clamp for holding the core in assembled relation, and insulating material inserted between said core and said clamp; a portion of one of the laminations being bent out from under the insulating material and placed in conducting relation with said clamp.

In witness whereof, I have hereunto set my hand this 9th day of June, 1919.

IVANHOE H. SCLATER.