M. O. TROY.

ELECTROMAGNETIC APPARATUS.

APPLICATION FILED FEB. 3, 1919.

1,365,568. Patented Jan. 11, 1921.

Fig.1.

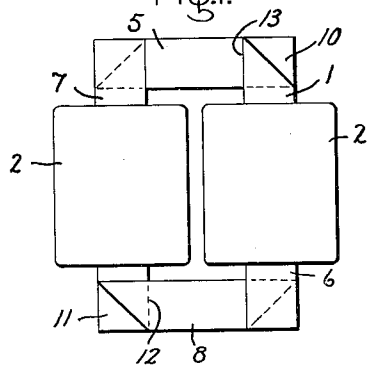


Fig.2.

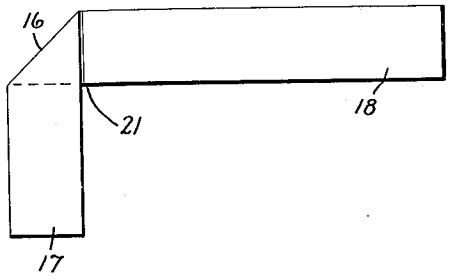


Fig.4.

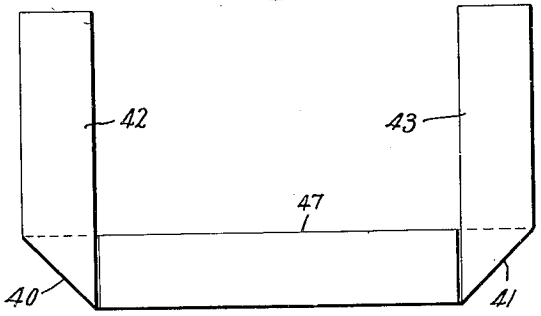


Fig.3.

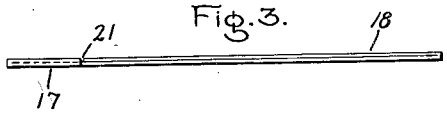


Fig.5.

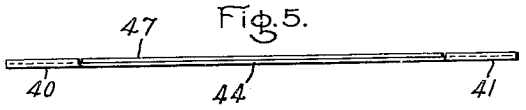
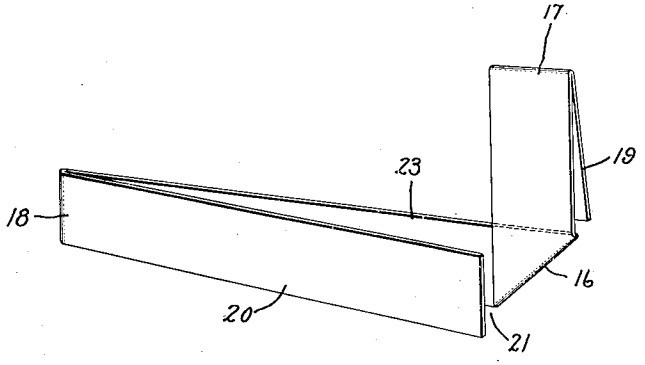


Fig.6.



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UNITED STATES PATENT OFFICE.

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ELECTROMAGNETIC APPARATUS.

1,365,568. Specification of Letters Patent. Patented Jan. 11, 1921.

Application filed February 3, 1919. Serial No. 274,756.

To all whom it may concern:

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

My invention relates to electromagnetic apparatus; more particularly it relates to the cores of electromagnetic apparatus and parts thereof, and methods for making the same.

Cores for electromagnetic apparatus are quite generally made up of laminations, or thin layers, of magnetic material cut from sheets. It is desirable that the laminations be so designed and disposed that the magnetic flux may traverse the laminations in the direction of the grain of the material, for thereby the core entails materially smaller operating losses than when the magnetic flux traverses the material crosswise or at an angle to the grain; the grain of rolled material is usually in the direction of the rolling. Also, for expediting manufacture as well as for other reasons, it is desirable in any instances to employ laminations in the form of L's or U's. As is readily apparent, however, it is impossible to cut L or U shapes from rolled sheets directly in such a way that the magnetic flux may traverse the shape in the direction of the crystalline growth produced in rolling or so-called grain of the metal throughout the whole length of such shape; also it is readily apparent that it is impossible to cut such shapes from such material without considerable waste. Such accompanying disadvantages have been suffered necessarily in the use of L and U shapes prior to my invention.

Two objects of my invention are to provide cores and core parts for electromagnetic apparatus, having or consisting of L or U shapes in which the grain lies substantially in the direction of the magnetic flux throughout substantially the whole length of the shape, and in which the waste or scrap from the rolled sheets is materially reduced. Other objects of my invention are to provide methods of making such cores and core parts.

Another advantage of my invention is that it provides core laminations (and methods of making such core laminations), which are ready for assembly in what is in effect groups of two laminations or layers per group. In order to expedite manufacture and for other reasons, this is desirable.

In the accompanying drawing and the following detailed description, I have illustrated and described in some detail, the best embodiments of my invention of which I am now aware. Figure 1 illustrates very simply in outline a transformer or reactor embodying my invention. Fig. 2 is an elevation of one of the complete L shapes or parts of the core of the device of Fig. 1. Fig. 3 is an edge view of the L shape of Fig. 2. Fig. 4 is an elevation of a U shape embodying my invention. Fig. 5 is an edge view of the U shape of Fig. 4. Fig. 6 is a perspective view of the L shape of Fig. 2 just prior to its completion, or expanded to show the disposition of its parts.

The transformer or reactor of Fig. 1 comprises the rectangular core 1, on the two legs of which are carried the windings 2. This core 1 is made up of L shapes, one of which is illustrated in its complete form in Figs. 2 and 3. These L shapes are so disposed within the core as to form break joints. The upper layer shown in Fig. 1 comprises an L shape which is laid so that its short leg 5 is at the top of the figure, its long leg 6 extending downwardly at the right-hand side of the figure. Against the outer end of the short leg 5 bears one edge of the long leg 7 of the L shape completing the rectangle with the L shape of 5 and 6. The short leg 8 of the same shape or piece as the leg 7, bears at its outer end against the edge of the leg 6. In the next group of L shapes beneath the first two L shapes just mentioned, the short leg immediately under the leg 8 is a component part of the L shape which also comprises the long leg immediately under the leg 6; the left-hand outer end of this lower short leg terminates at the dotted line 12; the long leg beneath 6 is shown in full lines at its upper corner 10 only. Correspondingly the short leg immediately under the short leg 5, is a part of the shape or piece containing the long leg immediately under the long leg 7; and this lower shape appears in full lines at its lower left-hand corner 11 only, this corner being the outer end of the long leg; the outer end of the short leg of this piece termi-

nates beneath the line 13. The remainder of the L shapes of the core 1 are disposed in a similar manner, that is so that immediately under each joint, like that between leg 5 and leg 7, there is found a shape which is continuous across the joint. In general this is a common way of building up cores for electromagnetic apparatus and is well understood by those skilled in the art.

The L shapes used in the core 1 are shown in Figs. 2, 3 and 6. By reference to Fig. 6, it will be seen that each L shape consists solely of a strip or rectangular piece of metal. Preferably this rectangular strip is so produced or so chosen that the grain of the material thereof extends in the direction of the length of the strip. If and when this rectangular strip is produced from sheets of rolled material, it is so cut that the direction of its length is parallel to the direction of the rolling of the sheet from which it is produced, for in rolled sheets of magnetic material the grain extends in the direction of the rolling. From some suitable point 16, one section 17 of the strip is disposed at an angle of 90° from the other section 18 of the strip as appears from Fig. 2 and particularly from Fig. 6. Preferably, and in the instance shown, the sections 17 and 18 are so disposed by folding the strip on the bias at 16. The ends 19 and 20 of the sections are disposed back upon themselves to the juncture of the sections 17 and 18, for example to 21, the end 19 lying in the plane of the part or portion 23 of section 18, which is that part of section 18 adjacent the juncture of the two sections 17 and 18. Figs. 2 and 3 illustrate the completed L shape ready for assembly in the core. It will be observed that the L shape of Figs. 2 and 3 is, in effect, for assembly purposes, two L shapes, and corresponds to the group of two L shapes which has heretofore been used in assembling electromagnetic cores. It will also be observed that this shape is initially a rectangular strip. Rectangular pieces (by reason of their shapes) may be obtained with the least waste from sheets of raw material. It will also be observed that as the magnetic flux traverses the core 1, it traverses each lamination thereof in the direction of the grain of the material throughout substantially the whole of its length.

The preferred method of my invention for making the L shape of Figs. 2 and 3, is this: Magnetic material is first rolled into sheets. Then strips are cut from the sheets, the lengths of the strips extending in the direction of the rolling. Thereafter the strips are folded at an angle of 90° and the ends of the strips are folded back on themselves to the angle of the first mentioned fold and until each such back folded part lies in the plane of the unfolded part of the other end or section of the strip. The folding of the strip will be understood from Fig. 6. My preferred method of making an electromagnetic core includes the further step of building up a core from strips so treated by laying the formed strips or shapes so that the sections 17 and 18 extend in the direction of the magnetic flux path.

Figs. 4 and 5 illustrate an embodiment of my invention in U shapes. As before the material is initially a rectangular strip, and preferably the grain of the strip is parallel to the length of the strip. From two suitable points 40 and 41, two sections 42 and 43 of the strip are disposed at right angles to the middle section 44. As with respect to the shape of Fig. 2, the sections are preferably so disposed by folding the strip on the bias at 40 and 41. The end or outer portion of each section 42 and 43 is disposed back against the remainder of the respective section so that the end of the section lies adjacent the juncture at 40 or 41 respectively, and in the plane of the middle section 44. Against one face of the section 44 and in the plane of the portions of sections 42 and 43 joined to section 44, is provided a rectangular strip 47 extending between the two sections 42 and 43. This additional rectangular strip 47 fills out the U shape of Fig. 4 to a uniform thickness throughout its length. Such a U shape may be assembled in electromagnetic cores in numerous ways as will be understood. My method of making such U shapes will be understood from the foregoing description of my method of making L shapes.

While I have illustrated in the accompanying drawings and described above the best embodiments of my invention of which I am now aware, it will be understood that this illustration and description is solely for the purpose of better disclosing my invention and that my invention is not limited to these embodiments, but is set forth in the following claims.

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

1. The method of making a magnetic core for electrical apparatus from rolled sheets of magnetic material, which consists in cutting from the sheets strips extending in the direction of rolling, folding the strips, and building up a core with the sections of the folded strips extending in the direction of the flux path of the core, and at right angles to the paths traversed by the electric current.

2. The method of making a part of an electromagnetic core, which consists in forming a rectangular strip, folding a portion of the same at an angle of 90° to another portion in the plane thereof and folding the ends back upon themselves to the

angle of the first fold, the folded portion of each section lying in the plane of the unfolded portion of the other section.

3. The method of making a part of an electromagnetic core from rolled sheets of magnetic material, which consists in forming from the sheet a rectangular strip extending in the direction of rolling, folding a portion of the strip at an angle of 90° to another portion in the plane thereof and folding the ends back upon themselves to the angle of said fold, the folded portion of one section lying in the plane of the unfolded portion of the other.

4. The method of making a core of magnetic material, which consists in rolling sheets of such material, forming from the sheets strips extending in the direction of rolling, folding portions of the strips at angles of 90° to other portions in the planes thereof, folding the ends back upon themselves to the angle of the first fold so that the folded part of each section lies in the plane of the unfolded part of the other, and building up the core with the sections of the strips extending in the direction of the flux path.

5. A laminar strip of thin magnetic material, one section thereof being disposed at an angle of 90° to an adjacent section in the plane of said strip, having the grain of the material extending longitudinally of the sections of the strip, the piece forming an electromagnetic core part.

6. A laminar strip of thin magnetic material, one section thereof being disposed at an angle of 90° to an adjacent section in the plane of said strip, having the end of one of those sections extending back upon that section to its juncture with the other section, the piece forming an electromagnetic core part.

7. A core of magnetic material formed of laminated parts, each comprising a section disposed at an angle of 90° to another section and in the plane thereof, said parts having the ends of the sections extending back upon the respective sections, the end of each section lying in the plane of that part of the other section which is adjacent the juncture of the sections.

In witness whereof, I have hereunto set my hand this 30th day of January, 1919.

MATTHEW O. TROY.