

No. 843,747.

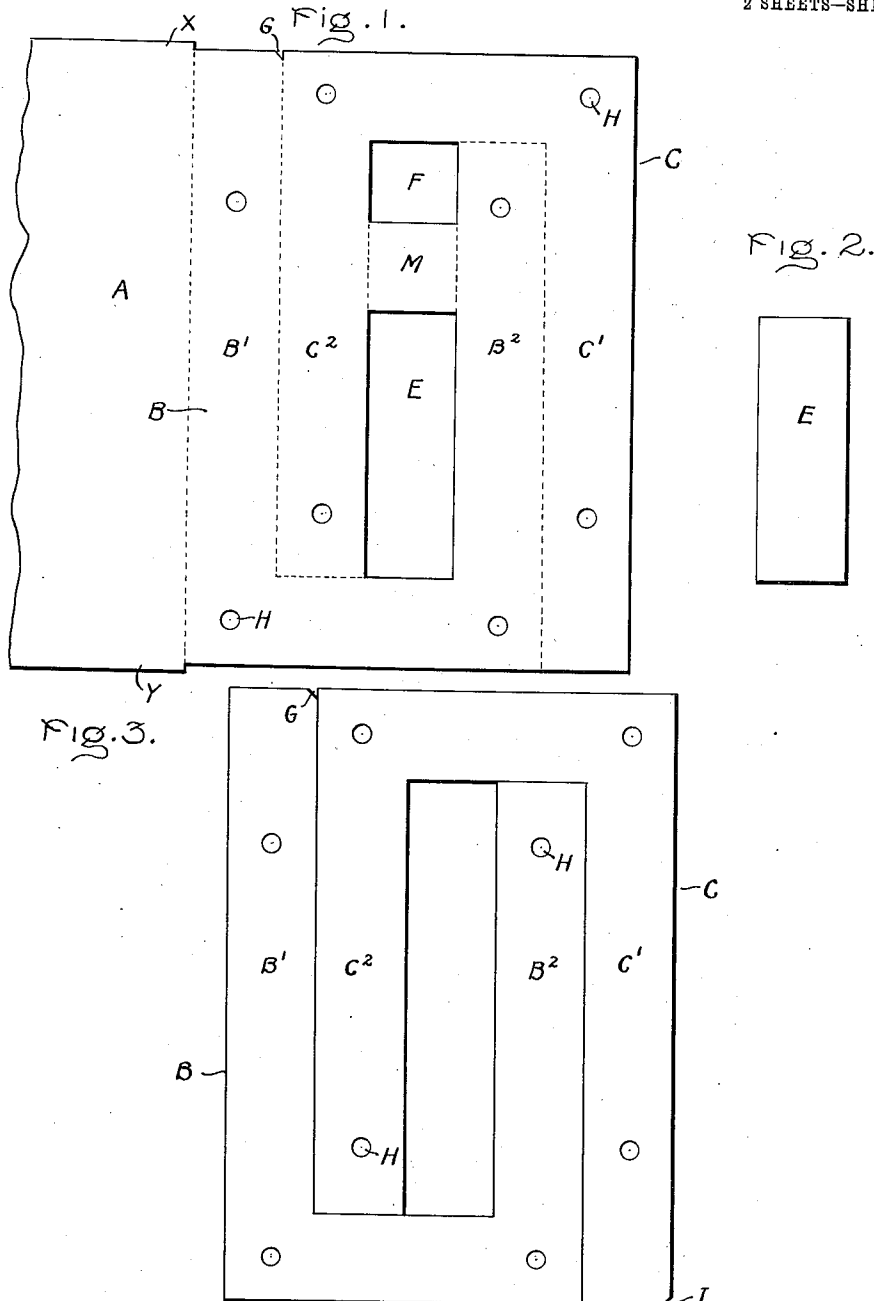
PATENTED FEB. 12, 1907.

W. A. HALL.

METHOD OF PRODUCING LAMINÆ FOR TRANSFORMER CORES.

APPLICATION FILED MAR. 5, 1901.

2 SHEETS—SHEET 1.



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2 SHEETS—SHEET 2.

Fig. 4.

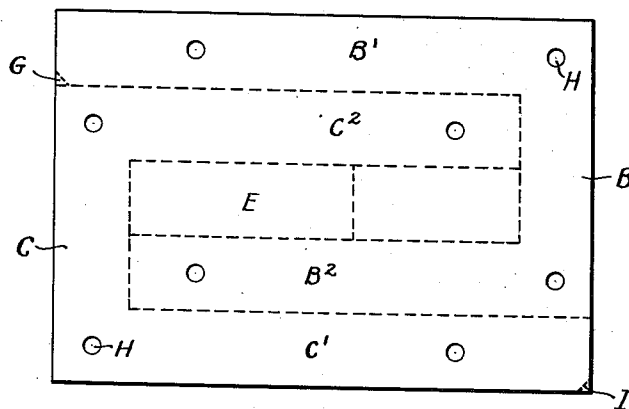


Fig. 5.

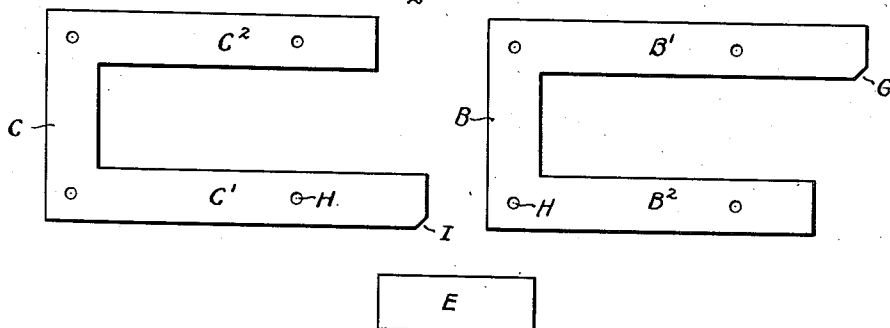
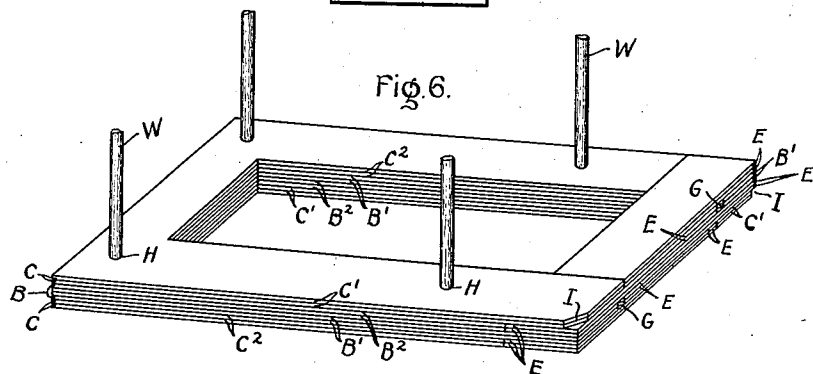


Fig. 6.



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UNITED STATES PATENT OFFICE.

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METHOD OF PRODUCING LAMINÆ FOR TRANSFORMER-CORES.

No. 843,747.

Specification of Letters Patent.

Patented Feb. 12, 1907.

Application filed March 5, 1901. Serial No. 49,694.

To all whom it may concern:

Be it known that I, WALTER ATWOOD HALL, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Methods of Producing Laminæ for Transformer-Cores, of which the following is a specification.

This invention relates in general to new and useful improvements in the construction of laminated transformer-cores of the general type disclosed in the patent to Moody, No. 567,250.

The invention relates specifically to a new and useful method in manufacturing core-laminæ of the special design required for the transformer of Augustine R. Everest, set forth in application for Patent, Serial No. 49,693.

As described in the patent to Moody, the coils were wound on two bundles of straight laminæ having tongue-and-groove ends, which bundles were then placed a suitable distance apart and their ends joined by short bundles of laminæ to complete the magnetic circuit. One end of each short bundle interlocked with the tongue-and-groove end of the long bundle which constituted one leg of the core. The other end of each short bundle abutted against the side of the long bundle which constituted the other leg of the core. This proved a very cheap and convenient mode of constructing a durable and efficient transformer. A very important feature was the economy in producing laminæ. However, there was a not inconsiderable core loss in transformers constructed in the above improvement, which is due to the fact that there were necessarily four joints between the laminæ. With the aid of and in accordance with the invention of Everest transformers have been made which show a reduction in core loss of over five per cent. with respect to transformers constructed as described above. As the core loss of a transformer continues independently of translating devices in the secondary circuit, it is clear that such a reduction is material and important.

My invention relates to improvements in the production of the laminæ required by the Everest transformer, whereby a very considerable saving of material, amounting to at least ten per cent., is effected in their

manufacture without in any wise sacrificing the advantages obtained by the invention of Everest, and whereby a substantial saving in the cost of labor is effected in that an increased number of laminæ are produced by a single operation.

The core made in accordance with this invention is built up of substantially U-shaped laminæ, each of which has a long and short leg, the difference between the lengths of the legs being substantially equal to the width of the bases of the laminæ, as it has been found that laminæ or sheet metal punchings of this shape can be economically produced at a much reduced cost for labor and with very little waste of material while retaining the advantages of the small number of joints and the decreased core loss which were made possible by the U-shaped punching.

Figure 1 is a plan of a sheet-metal blank upon which is performed the first or punching operation. Fig. 2 shows a short end laminæ which is the result of this operation. Fig. 3 is a plan which shows the result of a second or shearing and final operation. Fig. 4 is a reversed plan of the blank shown in Fig. 1 before the punching operation has taken place. Fig. 5 includes views of the three parts which are punched or sheared from the blank shown in Fig. 4, and Fig. 6 is a perspective view showing the core in process of construction from the parts shown in Fig. 5.

With reference to Fig. 1 the first or punching operation, which is accomplished by a suitable die, trims away the edges X Y of the sheet-metal blank A, punches the pin-holes H, and punches the holes E and F, leaving the strip M between them. The sheet of laminæ E (shown in Fig. 2) occupies the space E and is cut out in this operation in order to save a separate operation of cutting it to proper length later, the length shown in Fig. 2 being its final length for adapting it to be used as an end sheet for the core. During the first operation also the guide G is cut in the upper portion of the blank A. The part M is left to hold the parts rigid until the second or shearing operation, when, as is clear, it can also be sheared off. The part F, which is wasted, is punched out in order to permit the second operation to be merely a shearing operation without the punching,

which would be necessary if the corners were not removed before the second operation. The removal of the part E by punching permits the shearing to be accomplished along the dotted line at the lower portion of Fig. 1. In any case there must be a free space at the beginning of the part to be sheared in order to permit the operation of the shear. The second or shearing operation results in the separation of the metal along the dotted lines in Fig. 1, the result of which is seen in Fig. 3, wherein the guide I of the lower right-hand corner is also formed. The punching and shearing operations are conducted substantially simultaneously, and therefore at one complete operation are produced two U-shaped punchings and one end punching, whereas it has hitherto been considered impossible to produce in one operation more than one straight-leg punching and one end punching. As one U-shaped punching is equivalent to two straight legs and one end, it is clear that I produce in one operation four times as many legs and three times as many end pieces than hitherto has been possible. In the case shown the part M is wasted; but this is not always the case. Even when the part M is wasted, this is practically all the waste there is, whereas hitherto it has been considered necessary to waste three-eighths of an inch entirely around each punching. Furthermore, as it has been considered necessary to allow three-eighths of an inch of waste in the width of the center of the blank, by my invention only it is possible to obtain the punching E from the center of the blank. In Fig. 3 it will be seen that two substantially U-shaped laminæ are formed, each having a long and a short leg, the length of the latter of which is equal to the difference between the length of the long leg and the width of the base of the U-shaped laminæ, so that when the parts are arranged, as in Fig. 3, just as they come from the blank A they form a rectangular figure. In addition it will be observed in Fig. 3 that the space between the short inner legs B² and C² is of the same width as the legs or bases of the U-shaped laminæ, or, in other words, the distance between the long leg and the short leg, of one laminæ is twice the width of either leg and therefore equal to the added widths of both legs. From the metal in the space between the short legs B² and C² in Fig. 3 the end sheets of the core are always formed, and according to the dimensions of any given transformer there will be a greater or less waste. In the case illustrated the amount of metal wasted in the construction of this transformer is represented by M and F. If the transformer which is being built is of sufficient size, the material M (the part F being as small as possible) may serve for cores of smaller transformers. On the other hand, the core may be so proportioned that the

metal taken from the entire space E M may be used as the end sheet for that particular transformer. In Fig. 5 the three pieces formed from the blank are shown separately, and it should be particularly noted that the lamina C has the outside corner of its longer leg C' cut away at I, while the lamina B has the inner corner of the end of its long leg B' cut away at G. In Fig. 6 is shown a partial assemblage of these parts, held together by wooden pins W, which fit tightly in the holes H. In assembling, the laminæ are slipped loosely over pointed steel pins. The steel pins are then removed and the wooden pins are driven into the holes. The transformer-coils which have been wound by another operation are then slipped over the legs of the core, and the end sheets E are inserted, as shown in Fig. 6. It will be observed that each end sheet E is inserted between the projecting ends of the longer legs, according to the indication afforded by the guides G and I. The guide I on the right-hand corner of the end of the right-hand long leg and the guide G on the left-hand corner of the end of the long leg behind the first serve to indicate to the operator that the end sheet E is to be placed in the space between them. The other end of the end sheet abuts against the side of the end of the long leg which is contained in the left-hand leg of the core. The end of the next end sheet is inserted between the projecting ends of the long legs of the left-hand core-leg, as indicated to the operator by the guides I and G, and this end sheet abuts against the inner side of the end of the opposite long leg of the right-hand core-leg. The remaining end sheets alternate in the same way until the core is completely assembled.

In practice, as shown in the drawings, the units of assemblage comprise two or more single laminæ.

Further reference to Fig. 6 is necessary in order to explain how from the two different kinds of U-shaped laminæ shown in Fig. 5 the result shown in Fig. 6 is accomplished by means of the alternating guides I and G. Beginning at the bottom of Fig. 6 a group of two laminæ C is laid with its short leg C² in the foreground and its long leg C', with the outer cut-away corner I, in the background. Upon this group is laid a group of two laminæ B, with their long legs B' and inner cut-away corner G in the foreground and their shorter legs B² in the background. The third layer is a group of two of the same laminæ B which constitute the second layer, but turned upside down, so that their short legs B² are in the foreground and their long legs B' and inner cut-away corner G are in the background. The fourth layer consists of a group of two of the laminæ C which form the first layer, but turned upside down, so that their long legs C' and outer cut-away corner

I are in the foreground and their short legs C^2 are in the background. This series of four layers is continued until the core is completely assembled. From this description it follows that the successive projecting long legs have their cut-away portions located alternately on the inside and outside of the core-leg, so that the operator can quickly and accurately insert the ends E in the proper position after the coils have been slipped over the core-legs.

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

1. The method of producing from sheet metal, U-shaped laminæ having the space between their legs equal to twice the width of one leg, the difference between the lengths of the legs being equal to one-half the distance between them, which consists in punching a portion out of the sheet to provide a free space in front of a portion to be sheared, and then in conducting the shearing operation, beginning at the edge of the free space prepared by the punching operation, whereby the extra strip remaining is of the same width as the legs of the U-shaped laminæ.

2. The method of preparing transformer core-pieces consisting of U-shaped portions and straight portions from strips of sheet metal which consists in punching a straight portion from between the interleaved legs of a pair of U-shaped portions and adjacent the end piece of one of the U-shaped portions, and punching a waste portion from the material between the interleaved legs of the U-shaped portions adjacent the end piece of the other U-shaped portion and then separating the U-shaped portions by shearing.

3. The method of preparing transformer core-pieces consisting of U-shaped portions from plates of sheet metal, which consists in punching out of the plate, a portion of the material between the interleaved legs of the U-shaped portions adjacent the end piece of each U-shaped portion and then separating the U-shaped portions by shearing cuts.

4. The method of preparing from strips of sheet metal transformer-laminæ composed of U-shaped portions and straight end-closed portions, the legs of each U-shaped portion being separated by a space double the width of a leg, which consists in punching out the material from between the interlocked legs of a pair of U-shaped portions, one of said U-shaped portions being reversed with respect to the other, and then separating the U-shaped portions by shearing, the portion punched out being of length to form the end-

closing piece and its removal leaving a free space from which a shearing cut may start.

5. The method of simultaneously producing a pair of U-shaped laminæ from a plate of sheet metal which consists in punching out of the plate a portion of material to form a space between the interlocked legs of the laminæ, then completing the shaping of the laminæ by shearing cuts, some of which start from the space left by the punching.

6. The method of preparing transformer core-pieces consisting of U-shaped portions, one leg of which is longer than the other by the width of the yoke or base connecting the legs, and straight end-closing portions, which consists in punching a straight portion from a strip of sheet metal of a width equal to the length of a long leg of a U-shaped portion plus the width of the connecting base portion thereof, so that the hole formed which extends transversely to the length of the strip is separated from one side of the strip by a distance equal to its width and from the end of the strip by a distance equal to twice its width, punching another portion of material from the strip so that the hole left is in line with the first-mentioned hole and of the same width and is separated from the opposite side of the strip by a distance equal to the width of said base and then separating from the strip by shearing cuts two U-shaped laminæ of the form described, the outer edge of the base of one of which is one side edge of the strip and the outer edge of the base of the other is the other side edge of the strip, the inner edges of the interlocked inner legs of the U-shaped punchings being in line with the edges of and separated by said holes.

7. The method of preparing from a strip of sheet metal transformer core parts consisting of U-shaped portions and straight end-closing portions, each of which is of a width equal to the width of each leg of the U-shaped portions, the legs of each U-shaped portion being separated by a space double the width of a leg, which consists in punching out of the strip an end-closing portion and a waste portion in line therewith, and then shearing from the strip two U-shaped portions, parts of the inner edge surface of one leg of each of said U-shaped portions being formed by said punching-out operation.

In witness whereof I have hereunto set my hand this 23d day of February, 1901.

WALTER ATWOOD HALL.

Witnesses:

DUGALD McK. McKILLOP,
HENRY O. WESTENDARP.