Feb. 7, 1956 H. R. GOULD ET AL 2,734,176

MAGNETIC CORE

Filed July 30, 1951

Fig. 1.

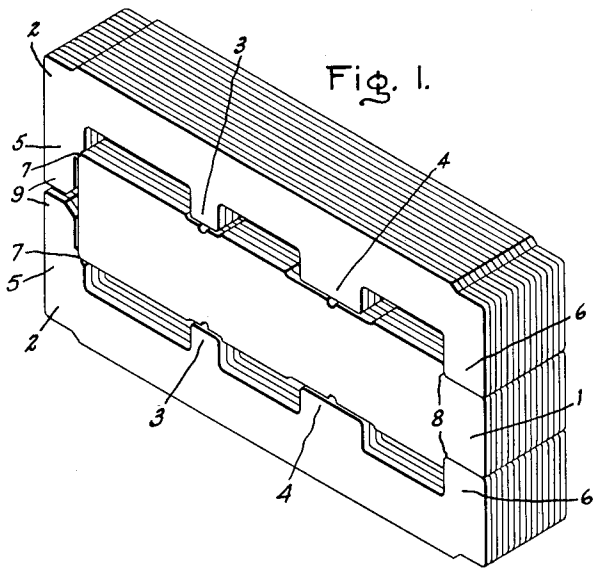


Fig. 2.

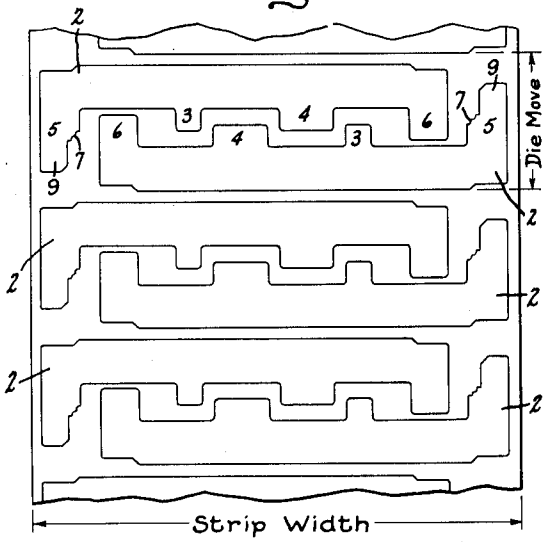
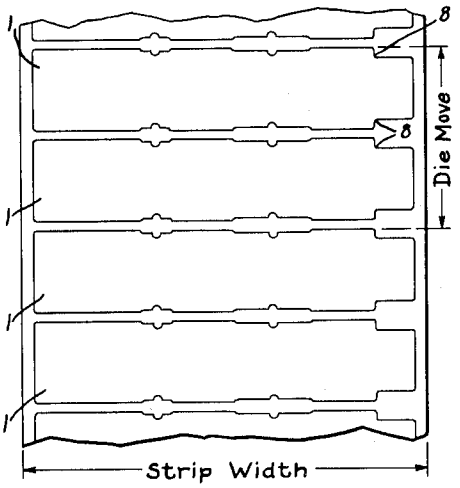


Fig. 3.



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MAGNETIC CORE

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3 Claims. (Cl. 336—165)

This invention relates to magnetic cores and more particularly to improvements in magnetic cores for shell type high reactance transformers used as ballasts for electric discharge devices such as fluorescent lamps.

The invention is an improvement on the core shown in Fig. 6 of an application, Serial No. 68,546, filed December 31, 1948 in the name of Wesley W. Brooks (now Patent No. 2,562,693) which is assigned to the same assignee. However, the present core is characterized by and differs from the Brooks core in a number of structural features which for a given electrical size or rating of the transformer permits a substantial reduction in gross area of magnetic material from which the core lamination punchings are made, while at the same time permitting a material increase in net area of magnetic material constituting the actual punchings, so that the percentage of scrap or loss represented by the difference between the gross and net areas is reduced from 44% in the case of the Brooks core to 37% in the case of the present core. When it is realized that cores of this type are made by the hundreds of thousands, it will be appreciated that such savings are highly important.

An object of the invention is to provide a new and improved magnetic core.

Another object of the invention is to reduce the gross area of flat magnetic materials from which fluorescent ballast core punchings are made, while at the same time increasing the net area of the punchings themselves so as to provide a substantial reduction in percentage scrap or wasted material created during the punching operation.

The invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the drawing, Fig. 1 is a perspective view of a preferred embodiment of the invention, Fig. 2 is a view illustrating how one shape of punching used in the core shown in Fig. 1 is made, and Fig.3 is a view showing how the other shaped punching used in the core illustrated in Fig. 1 is made.

Referring now to the drawing, and more particularly to Fig. 1, the core comprises a plurality of congruent lamination layers of flat magnetic material with each layer comprising a generally I-shaped center punching 1 and two similar four-legged E-shaped outer punchings 2. The center legs 3 and 4 of the outer punchings have their centerlines (not shown) spaced approximately the same distance from the inner sides of the respectively adjacent end legs 5 and 6 of the outer puchings; and those centerlines are spaced approximately the same distance from each other. The center leg 4 is generally about twice as wide as the center leg 3. The center legs 3 and 4 are also preferably of equal length. The end legs 6 of the outer punchings which are adjacent the wider center legs 4 are longer than the center legs 3 and 4 but are shorter than twice the length of the center legs 3 and 4.

The other end legs 5 of the outer punchings are longer than the end legs 6 and they are provided with shoulders 7 on their inner sides.

The end of the center punchings 1 which is adjacent the shorter end legs 6 of the outer punchings is provided with open ended notches 8 into which the ends of the shorter end legs 6 fit, while at the same time the shoulders 7 on the longer end legs 5 engage corners on the other end of the center punching 1. The depth of the notches 8 and the location of the shoulders 7 is such as to provide non-magnetic gaps or spaces between the ends of the center legs 3 and 4 and the sides of the center punching 1.

In some cases the sides of the center punching 1 opposite the ends of the center legs 3 and 4 may be notched for providing additional control of the non-magnetic gaps, and these notches may also be more deeply notched at the center for providing header passageways into which non-magnetic cement may be forced.

Non-magnetic gaps or spaces also exist between the inner sides of the extremities 9 of the longer end legs 5 of the outer punchings and the adjacent end surface of the center punching 1 so that these gaps in combination with the bridging portions where the shoulders 7 engage the corners of the center punching 1 provide so-called bridged gaps at this end of the core.

The core illustrated in Fig. 1 is suitable for use with a number of different ballast circuits, for example, it can be used with a conventional so-called two-lamp lead-lag circuit in which case the primary winding could be mounted on the center punchings between the legs 3 and 4 with a lagging current secondary winding mounted on the center punchings between the legs 4 and 6 and a lead secondary winding mounted on the center punchings between the legs 3 and 5 of the outer punchings. In other words, the lead secondary winding would have a capacitor connected in series with it and the lamp which it energizes, and by reason of the resulting leading current it is unnecessary to have a large cross section for the legs 3 which in such an arrangement would act as magnetic shunts between the primary winding and the lead secondary winding. However, the lag secondary winding on the other end of the core, being in effect a demagnetizing winding on the core when it is carrying lagging load current, will require the large width magnetic shunts provided by the legs 4 so that these legs can accommodate a greater amount of leakage flux than is required to be accommodated by the shunts 3. In such a circuit the function of the bridge gaps comprising the portions 7 and 9 is to increase the reluctance of the main part of the magnetic circuit associated with the lead secondary winding so as to prevent magnetic saturation of the main body of the magnetic circuit due to the magnetizing effect of the leading current secondary winding. Another type of ballast circuit with which the core shown in Fig. 1 can be used is a series circuit for two lamps of the type in which there is a primary winding, a main secondary winding and a high reactance starting winding. In such a circuit, examples of which are shown in Feinberg Patent 2,558,293, granted June 26, 1951, on an application filed December 29, 1949, the primary winding can be mounted on the center punchings between the shunt legs 3 and 4 of the outer punchings, the main or operating secondary winding which is fairly loosely coupled to the primary winding, may be mounted on the center punchings between the legs 3 and 5 of the outer punchings, while a very loose coupled high reactance starting winding may be mounted on the core between the legs 4 and 6 of the outer punchings.

Fig. 2 illustrates how the outer punchings 2 may be punched from a strip of magnetic material with very

little waste or scrap by having alternate ones reversed end for end and nested closely together. Thus, for example, the minimum separation between the two uppermost punchings 2 in Fig. 2 is determined by the minimum amount of scrap material which can exist between the ends of the shorter end legs 6 and the main body of the punchings 2. If this is too small, the filamentary pieces of scrap material break or bend and unsatisfactory punching results. However, because the end legs 6 are shorter than the end legs 5, the center legs 3 and 4 can be nested or interfitted together, and this action is further facilitated by the spacing between the centerlines of the various legs on the E-shaped punchings 2. Thus, the gross area of the strip involved in any one punching operation is the "die move" indicated in Fig. 2 multiplied by the "strip width" which is also indicated in Fig. 2. The net area of the actual punchings included in such gross area is, of course, the sum of the areas of the two nested punchings 2.

Fig. 3 shows how the center punchings 1 can be made from a strip of magnetic material of the width indicated. In this case the punching operation is straightforward and the transverse spacing between adjacent punchings is the minimum permitted by the strength of the filamentary portions of the scrap which connect its side pieces when the punchings are removed from the punched strip.

It has been found that the increase in gross area of the center punchings 1 occupied by the material between their end notches 8 is materially less than the decrease in gross area of the E-shaped punchings which is permitted by the shortening of the legs 6 and the closer spacing of adjacent nested E-shaped punchings occasioned thereby and by the orientation of the center legs 3 and 4 which permit their being interfitted or nested together.

While there has been shown and described a particular embodiment of the invention, it will be obvious to those skilled in the art that changes and modifications can be made without departing from the invention, and therefore it is aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

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

1. A magnetic core for a shell type transformer comprising a plurality of congruent lamination layers of flat magnetic material with each layer comprising a generally I-shaped rectangular center punching and two similar multi-legged E-shaped outer punchings, one end leg of each outer punching being longer than the other end leg and having an integral shoulder on its inner side, one end of each center punching having open ended notches on opposite sides which receive in interfitting relation the ends of the shorter end legs of the outer punchings, the shoulders on the longer end legs of the outer punchings being in engagement with corners on the other end of the center punching and supporting the center punching with said other end in closely spaced relation to the inner sides of the extremities of the longer-end legs of the outer punchings thereby to provide non-magnetic gaps therebetween, the depth of said open ended notches and the location of said shoulders being such as to provide non-magnetic gaps between the ends of the center legs of said outer punchings and the sides of said center punchings.

2. A magnetic core for a shell type transformer comprising a plurality of congruent lamination layers of flat magnetic material with each layer comprising a generally I-shaped rectangular center punching and two similar multi-legged E-shaped outer punchings, the two center legs of each outer punching being of the same length, the spacing between the center line of each center leg and the inner side of its adjacent end leg being substantially the same as the spacing between said center lines, one of said center legs being substantially twice as wide as the other one, the end leg of each outer punching which is adjacent to the wider center leg being longer than said center legs and shorter than twice the length of said center legs, the other end leg of each outer punching being longer than the first-mentioned end leg and having an integral shoulder on its inner side, one end of each center punching having open ended notches on opposite sides which receive in interfitting relation the ends of the shorter end legs of the outer punchings, the shoulders on the other end legs of the outer punchings being in engagement with corners on the other end of the center punching and supporting the center punching with said other end in closely spaced relation to the inner sides of the extremities of the longer-end legs of the outer punchings thereby to provide non-magnetic gaps therebetween, the depth of said open ended notches and the location of said shoulders being such as to provide non-magnetic gaps between the ends of said center legs and the sides of the said center punchings.

3. The magnetic core of claim 1 wherein the length of the extremity of the longer-end leg of each outer punching from its shoulder to its end is less than one half the width of the center punching to provide a non-magnetic gap between adjacent sides of the longer-end legs of the core.

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