July 5, 1927.

1,635,064

E. A. WAGNER

TRANSFORMER

Filed Dec. 15, 1926

Fig. 1.

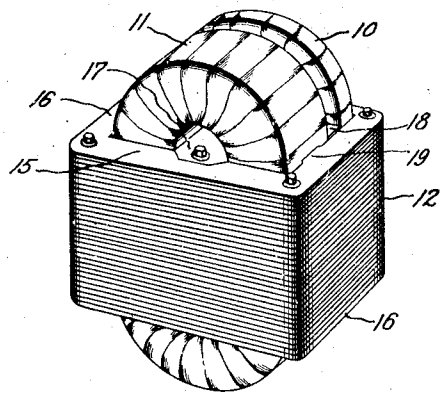


Fig. 2.

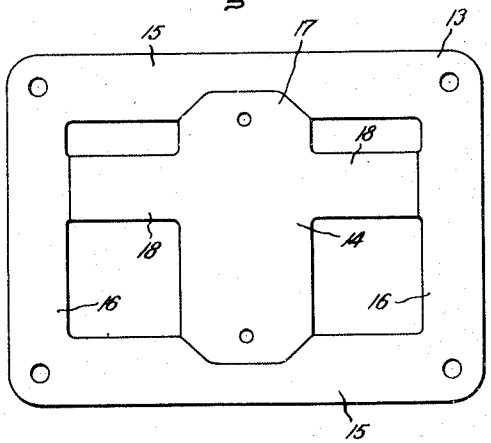
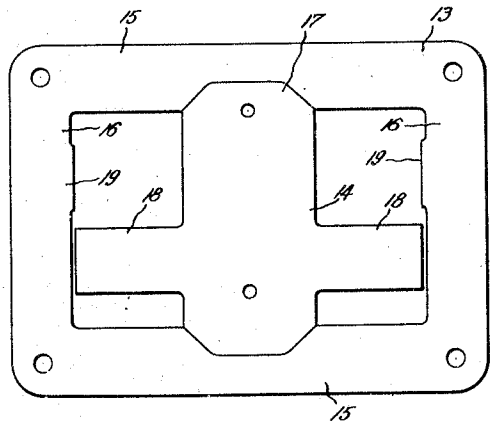


Fig. 3.



Inventor:
Edward A. Wagner,
by Wyman & Lunt.
His Attorney.

Patented July 5, 1927. 1,635,064

UNITED STATES PATENT OFFICE.

EDWARD A. WAGNER, OF PITTSFIELD, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

TRANSFORMER.

Application filed December 15, 1926. Serial No. 155,053.

My invention relates to transformers and more particularly to high reactance transformers. High reactance in a transformer is often desirable or necessary in order to limit the current supplied by the secondary winding of the transformer to a safe value. Such a transformer is useful for operating bells, electric toys, high voltage testing apparatus, spark plugs for igniting the oil vapor in oil burning heating plants, and for various other purposes. The transformer of the present invention is of the general type disclosed in United States Patent No. 1,588,171, issued June 8, 1926, on an application filed by R. H. Chadwick. The general object of the invention is to produce a high reactance transformer of this general type by an improved method. The transformer comprises a rectangular outer section which forms two outer core legs connected by two yokes and an inner section which forms a winding leg having two side extensions. These two side extensions separate the two windings and are just long enough to leave small air gaps between their outer ends and the two outer core legs. It is obvious that the outer and inner sections of the core laminations may be produced from simple rectangular sheets, but if the inner sections are punched from the same positions in the outer sections that they are to occupy when finally assembled to produce the air gaps in the magnetic shunt paths, it is necessary to cut or trim off small portions from the laminations. This not only requires an extra step in the process of producing the laminations, but it is difficult to trim off such small amounts as would be necessary in case the thickness of the air gaps must not be over a few thousandths of an inch. This extra step in the process with its attendant difficulty is avoided by the present invention and at the same time, the inner sections of the core laminations are produced from the material cut or punched out of the outer sections so that as little material as possible is wasted.

The invention will be better understood from the following description taken in connection with the accompanying drawing, in which Fig. 1 shows a transformer constructed in accordance with the present invention, Fig. 2 shows one of the core laminations during an intermediate step of the process by which it is formed and Fig. 3 shows a completed core lamination.

Like reference characters indicate similar parts in the different figures of the drawing.

The transformer shown in Fig. 1 comprises a primary winding 10, a secondary winding 11 and a laminated magnetic core 12. Each lamination of the core 12 comprises an outer element or section 13 and an inner element or section 14. The outer sections 13 are secured together in a hollow rectangular stack to form the yokes 15 and two outer legs 16 of the core. The inner sections 14 are secured together to form the winding leg 17 of the core with integral side extensions 18 nearly reaching the two outer legs 16. The two ends of the winding leg 17 fit tightly into notches in the inner edges or faces of the yokes 15. The length of the winding leg 17 is such that when forced into position between the notches in the yokes 15 it will be retained by friction. An accurate and tight fit between the sections 13 and 14 of the laminations may be assured by punching the inner sections 14 from the same positions in the outer sections 13 that they are to occupy when assembled.

The primary and secondary windings 10 and 11 surround opposite ends of the winding leg 17 and are separated by its extensions 18. For many purposes, a very high secondary voltage may be desired and the primary voltage may be comparatively very low. A transformer for use in connection with the ignition circuit of an oil burning heating plant may receive current in its primary winding from the usual one hundred and ten volt house lighting circuit and a secondary voltage of ten thousand volts or more may be required. To produce such a high ratio of voltage transformation, the number of turns in the secondary winding must be much greater than the number of turns in the primary winding. The secondary winding is therefore considerably larger and takes up considerably more space along the winding leg of the core than the primary winding even though the cross section of the secondary conductor may be smaller than that of the primary conductor. The side extensions 18 which form the magnetic shunts between the two windings are therefore offset from the longitudinal center of the winding leg as shown in the drawing.

The core laminations are formed from suitable sheets of magnetic material which may be substantially rectangular in shape.

Four openings are cut or punched in each sheet as shown in Fig. 2 to receive the windings, these four openings defining the three legs, two yokes and two side extensions of the winding leg. The winding leg 17 with its two side extensions 18 is then cut or punched from the outer section 13 of the sheet. The winding leg 17 is punched out in such form that each end projects into a notch in the inner edge of the corresponding yoke. The two ends of the winding leg are also symmetrical in form so that the winding leg may be replaced between the two yokes with its ends reversed in position as shown in Fig. 3, each end fitting accurately into the notch left in the yoke by the removal of the other end. Each side extension 18 is severed along a line adjacent one of its ends so that it is slightly shorter than the width of the openings at its sides and when the winding leg with these extensions is reversed the ends of the extensions are opposite new parts of the outer legs of the core and do not quite reach them, thus leaving the desired air gaps. The thickness of each air gap is determined, of course, by the difference between the length of the side extension 18 and the width of the adjacent openings. In assembling the core, the outer sections of the laminations are secured together in a hollow rectangular stack and the inner sections are secured together in another stack. The two windings are then assembled on their respective ends of the winding leg and the two sections of the core are forced together. The notches in the two yokes hold the winding leg with its extensions in definite and accurate position so that the thickness of the air gaps is also definite and accurate. The process which has been described leaves slight projections 19 on the inner faces of the outer core legs opposite the high tension winding, but this is not objectionable. If similar parts of the different core laminations are made accurately and all just alike in outline, it is obvious that care need not be taken to reassemble each inner section of a lamination in the particular outer section from which it was punched.

A particular transformer and process for producing it have been described, but it will be obvious that modifications may be made within the scope of the invention as defined by the appended claims.

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

1. The process of producing high reactance transformer core laminations, said process comprising the steps of forming four openings in each of a plurality of sheets of magnetic material to define three leg portions connected by two yoke portions and two side extensions offset from the longitudinal center of said center leg portion and extending from the center leg portion to the two outer leg portions, and severing each of said side extensions along a line adjacent one end thereof and cutting said center leg portion along symmetrical lines at its two ends from the two yoke portions, whereby said center leg portion may be reversed in position between said yoke portions to provide a gap at one end of each of said side extensions.

2. The process of producing high reactance transformer core laminations, said process comprising the steps of forming four openings in each of a plurality of sheets of magnetic material to define three leg portions connected by two yoke portions and two side extensions offset from the longitudinal center of said center leg portion and extending from the center leg portion to the two outer leg portions, and severing each of said side extensions along a line adjacent its outer end and cutting said center leg portion along symmetrical lines at its two ends from the two yoke portions, whereby said center leg portions may be reversed in position between said yoke portions to provide a gap at the outer end of each of said side extensions.

3. The process of producing a high reactance transformer having a core comprising a stack of magnetic laminations, said process comprising the steps of forming four openings in each of a plurality of sheets of magnetic material to define three leg portions connected by two yoke portions and two side extensions offset from the longitudinal center of said center leg portion and extending from the center leg portion to the two outer leg portions, severing each of said side extensions along a line adjacent one end thereof and cutting said center leg portion along symmetrical lines at its two ends from the two yoke portions, forming a stack of said yoke and outer leg portions, forming a second stack of said center leg and side extension portions, assembling windings on said center leg portion, and assembling said second stack with said windings between said yoke portions with the positions relative to said yoke portions, whereby a gap is produced at one end of each stack of said side extensions.

4. A high reactance transformer having a laminated core comprising two outer legs connected by two yokes, a center leg having opposite side extensions offset from its longitudinal center, there being a gap between the outer end of each side extension and the adjacent outer core leg, there being symmetrical joints between the two ends of said center core leg and the two yokes, the laminations of said center leg and side extensions being severed from the laminations of said yokes and outer legs and said two sets of laminations being reversed from their original relative positions, and windings surrounding said center leg at opposite sides of

said side extensions, said transformer being characterized by projections on said outer legs from which said side projections were cut, said projections being offset from the outer ends of said side extensions.

5. A high reactance transformer having a laminated core comprising two outer legs connected by two yokes, a center leg, and two side extensions between said center leg and said two outer legs, said side extensions being offset from the longitudinal center of said center leg, there being a gap between one end of each of said side extensions and the adjacent core leg, there being symmetrical joints between the two ends of said center core leg and the two yokes, the laminations of said center leg being cut from the laminations of said yokes and the laminations of each of said side extensions being severed at one end from the adjacent core leg laminations, said center leg laminations being reversed from their original positions relative to said outer leg and yoke laminations, and windings surrounding said center leg at opposite sides of said side extensions, said transformer being characterized by a projection on the core leg adjacent the severed end of each of said side extensions and offset therefrom.

In witness whereof, I have hereunto set my hand this 11th day of December, 1926.

EDWARD A. WAGNER.