Dec. 6, 1955 H. EPSTEIN 2,725,616

METHOD OF FORMING AIR GAPS IN A TRANSFORMER

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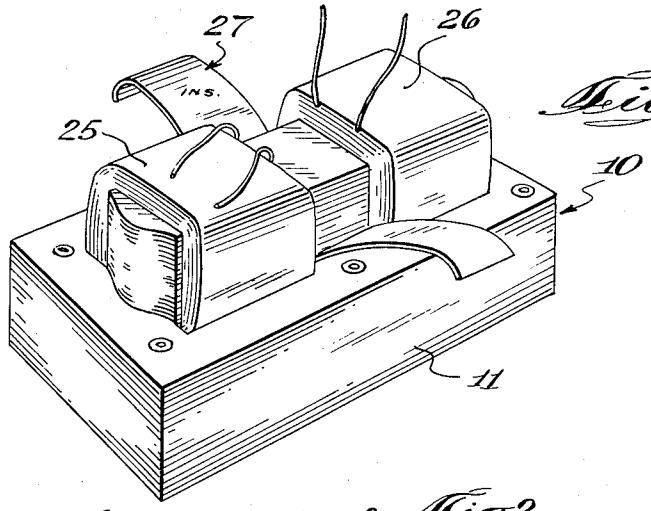



Fig. 1.

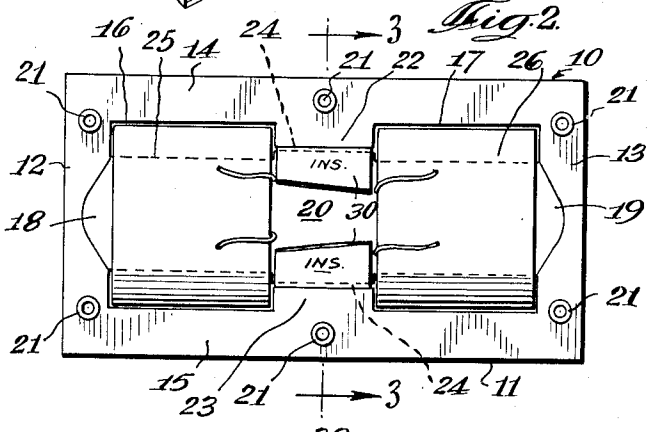



Fig. 2.

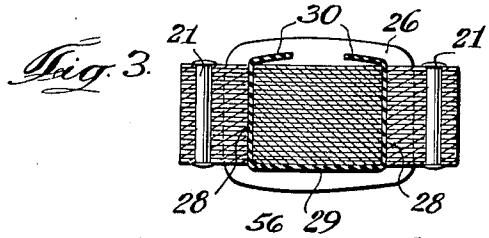



Fig. 3.

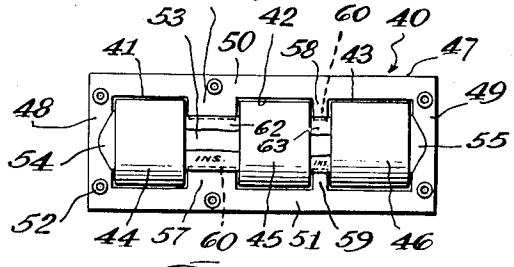



Fig. 6.

Fig. 4.

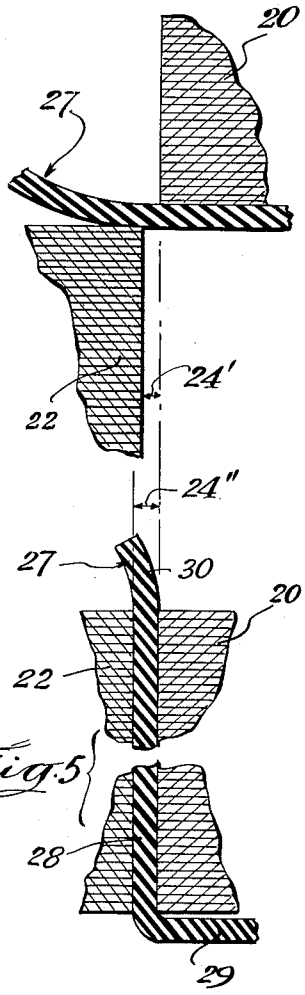



Fig. 5.

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# METHOD OF FORMING AIR GAPS IN A TRANSFORMER

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**Continuation of application Serial No. 105,007, July 15, 1949, now abandoned. This application April 11, 1952, Serial No. 281,706**

6 Claims. (Cl. 29—155.58)

This invention is concerned with a novel method for making a transformer or ballast construction.

This application is a continuation of my copending application entitled Ballast and Transformer Construction, Serial No. 105,007, filed July 15, 1949, now abandoned.

In certain types of ballasts or transformers, which collectively will hereinafter be termed "transformers," an important consideration is the elimination of noise. This is especially true in those transformers used in commercial and domestic fluorescent lighting fixtures where the transformer is required to provide a voltage for ignition of gaseous discharge devices as well as means for limiting the current flow once discharge has occurred. Where a non-magnetic gap is used in magnetic circuit for the purpose of providing a high reluctance element in said circuit, the high flux density pulling at the gap caused chattering or humming which is quite annoying. One of the principal objects of this invention is the employment of a method for making a transformer in which the elimination of the major portion of this noise will be effected.

Certain prior constructions have provided gap fillers such as wood, paper, and the like, but the principal difficulty therein has been the problem of inserting the material and maintaining the gap spacing. Another object of the invention lies in the employment of my novel method enabling the speedy and positive installation of gap filler materials and enabling thereby easily to maintain the gap spacing.

Another object of the invention lies in the provision of a method of the character described which may be employed for making a transformer in which any desired gap spacing may be obtained during assembly of the transformer.

Other objects and many advantages of the invention will become apparent as a description of my new method is developed, including the ease and rapidity with which such transformers may be made by employing my method, the economy and simplicity thereof and the elimination of any need for tools or expensive equipment when using the said method.

In the drawings:

Fig. 1 is a perspective view of a transformer prior to finally being assembled by my new method, and showing my new construction.

Fig. 2 is a top plan view of the ballast of Fig. 1, but same being shown after assembly.

Fig. 3 is a sectional view taken through the ballast of Fig. 2, along line 3—3 and in the indicated direction.

Fig. 4 is a fragmentary sectional view taken generally through the transformer at the line 3—3 of Fig. 2, but showing the parts of the transformer prior to assembly, that is, in the condition of Fig. 1. The scale is greatly enlarged.

Fig. 5 is a view identical with that of Fig. 4, but showing the parts of the transformer after assembly. Fig. 5 has been vertically aligned with Fig. 4 to show expansion of the transformer shell.



Fig. 6 is a top plan view showing a type of transformer which is different from that of Figs. 1–3, but which is made according to my invention.

At the outset it is pointed out that my invention is limited to a type of ballast or transformer where a non-magnetic gap is formed between the side edges of a central leg and a shell, so that the side legs of the shell can expand. Thus, there is shown in the drawings a shell-type transformer 10 which consists of an outer rectangular shell or frame 11 formed of end yokes 12 and 13, side legs 14 and 15 and having winding windows 16 and 17 therein. The inner edges of the yokes 12 and 13 are notched to receive the ends 18 and 19 of the central winding leg 20 in tight engagement. The shell 11 is formed of a stack of laminations held together by rivets 21 and the central winding leg 20 is likewise formed of a stack of laminations. As customary in a transformer of this kind, the winding leg laminations are punched from the shell laminations to provide perfect and tight fit of ends 18 and 19.

The side legs 14 and 15 each have an inwardly directed extension 22 and 23 adapted to face opposite edges of the winding leg 20 and thereby form a gap 24 on either side. The width of gaps 24 is designed to be a few thousandths of an inch narrower than the smallest gap with which the shell is to be used. This width, is indicated at 24′ in Fig. 4, and will be achieved if the ballast 10 is assembled with air gaps, i. e. no filler in gaps 24. Under these circumstances, windings 25 and 26 are placed upon winding leg 20. The assembled leg 20 and windings 25 and 26 are then placed over the center of the shell 11, with the windings 25 and 26 aligned with their respective windows 16 and 17, and the leg 20 pressed down into the shell 11. This is a common method of assembly.

I vary this method by inserting beneath the winding leg 20, at the position of extensions 22 and 23, a strip 27 of hard, pressed, insulating fiber material, having a thickness equal to the desired thickness of each gap 24. This phase of assembly is shown in Fig. 1, and Fig. 4. Now the leg 20 is pressed home into the frame 11, carrying the strip member 27 therewith. This causes the side legs 14 and 15 to spread outwardly in order to accommodate strip member 27. Obviously, the gap 24 is now very tightly filled and has increased in thickness from 24′ as shown in Fig. 4 to 24″ as shown in Fig. 5. The member 27 now forms gap filler portions 28, a bottom portion 29 and free ends 30 which may be trimmed off if desired.

It will be seen that as the winding leg 20 and its windings 25 and 26 are being pressed into the shell 11, the side legs 14 and 15 must be spread apart to accommodate strip 27. As an example, if it is desired that the eventual gaps of different types of transformers being made with the shell 11 run from say .006 inch to .015 inch in thickness, the shell 11 and leg 20 may be designed so that the gap thickness 24′ is .005 inch in width. In assembly of any of the different types of transformers, the thickness of the strip 27 is merely chosen to be from .001 inch to .010 inch thicker than gap 24′, so that the legs 14 and 15 will be spread apart during assembly. I have found it practical where the gap desired is greater than the thickness of easily obtained strip material, to use a plurality of strips in place of the single strip 27, the combined thickness of the plurality of strips being equal to the desired gap thickness.

In Figs. 1 to 3, I have shown my invention applied to the production of a transformer 10 having two winding windows 16 and 17 and hence having only air gaps 24 between the pair of windows.

In Fig. 6, however, I have shown my invention applied to a transformer 40 having three windows 41, 42 and 43 for accommodating the windings 44, 45 and 46 respec-

tively. The transformer 40 is constructed in much the same way as transformer 10, being formed of an outer shell 47 having end yokes 48 and 49 and side legs 50 and 51. The stack is held together by rivets 52 and there is a central winding leg 53 which has pointed ends 54 and 55 adapted to engage within notches formed in the yokes 48 and 49. Because of the presence of three windows 41, 42 and 43 instead of the two of transformer 10, there are formed two pairs of inwardly directed extensions 56 and 57 between windings 44 and 45; and 58 and 59 between windings 45 and 46. The form of transformer 40 illustrated has a considerable difference in the width of extensions 56 and 57 and the extensions 58 and 59. The latter are shown to be quite narrow, relatively speaking. My invention is applicable to such constructions irrespective of the size of the inwardly directed extensions. As a matter of fact, if gaps were formed without extensions, the invention could likewise be practised. In transformer 40 there are two pairs of gaps, shown at 60 and 61, and there are also shown the strip members therein which correspond in function and construction to strip 27. Thus strip 62 is disposed in gaps 60 and strip 63, which is relatively narrow, is disposed in gaps 61. Only the two free ends of the strips are visible in the said Fig. 6.

The parts of transformer 40 are assembled in the identical manner described in connection with transformer 10, and the explanation of the manner of associating the strips 62 and 63 with their respective gaps can be dispensed with since the manner of associating strip 27 with gaps 24 is identical.

The invention contemplates the method of association with a transformer having expansible legs and a central winding member and gaps formed between the winding member and the legs, of gap filler means having thickness greater than the width of said gaps prior to said association, whereby the legs will be spread by the gap filler means. Obviously certain methods may be devised for inserting the gap filler means other than those explained herein, but my invention is intended to cover all of these as come within the scope of the appended claims.

What is claimed and desired to be secured by Letters Patent of the United States is:

1. The method of forming air gaps in a transformer having a resilient shell which surrounds a central winding leg together with the windings mounted thereon, said leg having end portions press fitted in the respective end portions of the shell and there being air gaps intermediate said end portions, comprising; machining the shell to provide a spacing at the air gap region which is less than the air gap spacing desired in the finished transformer, providing at least one strip of rigid insulating material having a thickness equal to the dimension of the desired air gap, and press fitting the leg, windings and insulating strip simultaneously into the shell in a movement expanding the shell to accommodate the insulating strip in said spacing.

2. The method of forming air gaps in a transformer having a resilient shell which surrounds a central winding leg together with the windings mounted thereon, said leg having end portions press fitted in the respective end portions of the shell and there being air gaps intermediate said end portions, comprising: forming the shell to provide a spacing at the air gap region which is less than the air gap spacing desired for the completed transformer, providing a strip of rigid insulating material having a thickness equal to the dimension of the desired air gap, positioning the winding leg and its windings over the entrance to said shell with the strip located between the shell and winding leg and then press fitting the winding leg, windings and strip simultaneously into the shell in a movement expanding side portions of the shell to accommodate the strip in said spacing.

3. The method of forming air gaps in a transformer having a resilient shell which surrounds a central winding leg together with the windings mounted thereon, said leg having end portions press fitted in the respective end portions of the shell and there being air gaps intermediate said end portions, comprising: forming the shell to provide a spacing at the air gap region which is less than the air gap spacing desired for the completed transformer, providing a strip of rigid insulating material having a thickness equal to the dimension of the desired air gap, positioning the winding leg and its windings over the entrance to said shell with the strip located between the shell and winding leg and then press fitting the winding leg, windings and strip into the shell in a movement pulling the strip into the spacing at the air gap region with a portion of the strip stretched across the bottom of the winding leg.

4. The method of forming air gaps in a transformer having a resilient shell which surrounds a central winding leg together with the windings mounted thereon, said leg having end portions press fitted in the respective end portions of the shell and there being air gaps intermediate said end portions, comprising: forming the shell to provide a spacing at the air gap region which is less than the air gap spacing desired for the completed transformer, providing a strip of rigid insulating material having a thickness equal to the dimension of the desired air gap, positioning the winding leg and its windings over the entrance to said shell with the strip located between the shell and winding leg and then press fitting the winding leg, windings and strip into the shell in a movement forming the strip into a substantially U-shaped formation, with the sides of the U-formation disposed in the said spacing and the bottom of the U-formation stretched across the bottom of the winding leg.

5. The method of forming air gaps in a transformer having a resilient shell which surrounds the core together with windings mounted thereon, said core having end portions frictionally engaged with the respective end portions of the shell and there being air gaps intermediate said end portions, comprising: machining the shell to provide a spacing at the air gap region which is less than the air gap spacing desired for the completed transformer, providing a strip of rigid insulating material having a thickness equal to the dimension of the desired air gap, arranging said core, windings and strip at the entrance to the shell with the length of the strip perpendicular to the longitudinal axis of the shell and protruding beyond the side portions of the shell a substantial amount, and then press fitting the core, windings and strip simultaneously into the shell in a movement pulling said protruding portions of the strip into the spacing at said air gap regions.

6. The method as described in claim 5 in which said pulling movement forms the strip into a substantially U-shaped formation having the sides thereof abutting the side portions of the shell and the connecting bottom of the U-formation stretched across the bottom of the core.

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