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O. KILTIE

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TRANSFORMER AND REACTOR FOR FLUORESCENT LIGHTING UNITS

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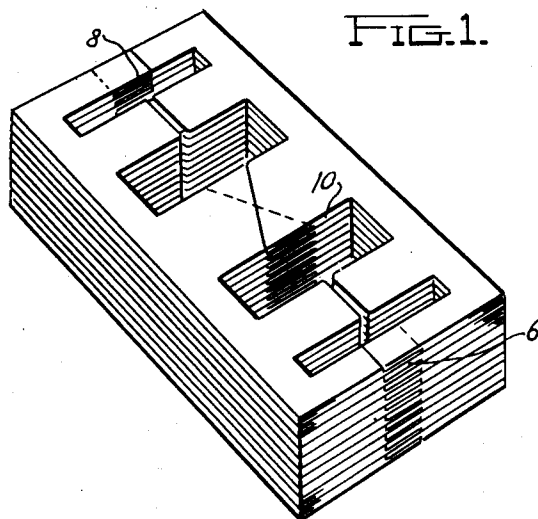


FIG. 1.

FIG. 2.

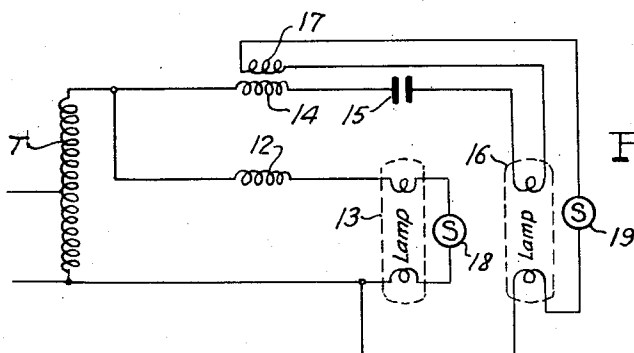
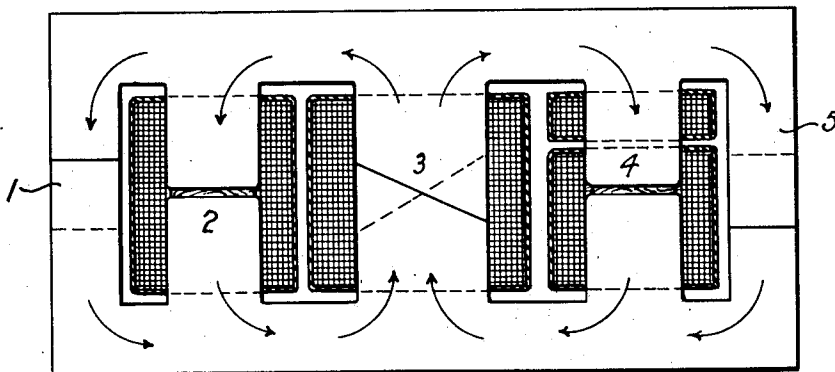


FIG. 3.

INVENTOR.
Ordean Kiltie
BY *Curran & Curran*

ATTORNEYS

UNITED STATES PATENT OFFICE

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TRANSFORMER AND REACTOR FOR
FLUORESCENT LIGHTING UNITS

Ordean Kiltie, Fort Wayne, Ind., assignor to
Ballastran Corporation, Fort Wayne, Ind., a
corporation of Indiana

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2 Claims. (Cl. 171-119)

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This invention relates to transformers and reactors of the type used in conjunction with fluorescent lighting tubes and is particularly directed to the core structure of such transformers.

Known reactors and transformers for fluorescent lighting units comprise, for the most part, cores made up of several different forms of laminations held together by clamps or bars. The magnetic circuits involved in these devices are necessarily such that the reactance of the units is high and the fringing flux set up around the core is quite extensive. Since the units are usually encased in metal there is a flux linkage between the core and the metallic case which sets up an undesirable vibration in the case so that the units hum, frequently to the extent of annoyance to the user. Attempts have been made in the past to prevent vibration of the cores by clamping the laminations tightly together either by bolts extending entirely through the cores or by clamping bands surrounding the stack of laminations. While such expedients may prevent noise which originates in the core itself they have relatively little effect on the noise produced by the case. If the magnetic path available to flux flowing in the outside legs of the cores is improved, the fringing flux and hence the noise resulting from case vibration, can be reduced.

The primary object of the present invention is to provide a transformer and ballast reactor for fluorescent lighting fixtures and similar installations which comprises a core made up of a single form of lamination and in which the magnetic circuit is greatly improved.

Another object of the invention is to provide a core for a transformer and ballast reactor in which clamps and similar mechanical binding means to hold the laminations against movement are eliminated.

Another object of the invention is to provide a core for a ballast and transformer unit in which the impedance of the unit, and hence of the load, may be adjusted by increasing or decreasing the width of one or more air gaps but in which such adjustment does not seriously affect the magnetic circuit in the remaining legs of the core.

Still another object of the invention is to provide a core for a transformer and ballast reactor which is capable of inexpensive and rapid production and assembly and which will operate more efficiently than known devices over a wider range of frequency and with less noise.

Other objects and advantages of the invention will become apparent from the following speci-

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fication, reference being had to the accompanying drawings in which

Fig. 1 is a perspective view of an assembled core, several coils having been eliminated for purposes of clarity; Fig. 2 is a longitudinal sectional view of the core with the surrounding coils indicated diagrammatically; and Fig. 3 is a circuit diagram indicating the connections between the unit and a pair of fluorescent lamps.

Referring to the drawings and particularly to Figs. 1 and 2, it will be seen that the core comprises sets of facing laminations made of identical stampings and results in a structure having opposed sides or bodies connected by legs 1, 2, 3, 4, and 5. The laminations are so shaped that the outer ends which will comprise the legs 1 and 5 are of different length, one being shorter than the medial distance and the other longer than the medial distance between the two opposed sides. The laminations which will comprise the legs 2 and 4 in the final assembly are of the same length and are equal to slightly less than the medial distance from side to side of the finished core so that an air gap may be established in these legs.

The laminations which will comprise the center leg 3 are cut diagonally from side to side so that a portion of the lamination extends beyond the center of the core and an equal portion is shorter than the medial distance.

It will be seen that if the laminations so cut are brought face to face with each other a butt joint occurs in the outside legs 1 and 5 and a similar but slanting butt joint occurs in the center leg 3. However, by stacking a few laminations with the joints abutting, as indicated, and then by stacking the next succeeding group of laminations oppositely, that is with the slope of the center laminations running in the opposite direction as indicated in the dotted line in Fig. 2 and with the longer element of that lamination which was previously indicated in the leg 1 now reversed to occur in leg 5, an overlapping joint will be made in the outside legs as at 6 and 8 in Fig. 1 and a similar overlapping joint as at 10 will occur in the center leg. This reversal has no effect on the spacing of the laminations which comprise the legs 2 and 4 since as previously stated, these laminations are of the same dimensions.

It is preferred to repeat this reversal in making up the core as shown in Fig. 1 so that a small group, perhaps four or five of the laminations, meets its facing lamination in a butt joint and then the laminations are reversed so that an overlapping joint occurs between groups. The

magnetic path thus available for flux in the outside legs thus includes not only the butt joint occurring between the small groups but also the overlapping joint between successive groups. The overlapping path is not seriously affected by opening or closing the stack to increase or decrease the gap between the butt jointed laminations so that adjustments may be made in the air gaps in legs 2 and 4 without seriously changing the reluctance of the path in legs 1 and 5. Similarly, adjustment of the air gaps in legs 2 and 4 does not seriously alter the magnetic characteristics of the center leg 3 since this, again, has a magnetic path formed by overlapping joints between successive groups of laminations.

The windings are disposed on the legs in such a manner that an auto-transformer winding is placed around the center leg 3 and a winding in which a component of the current is lagging with respect to the voltage of the transformer is placed around the leg 2. The coil around the leg 4 is preferably divided into two parts one of which is connected in series with the transformer and with a capacitor to form a constant current device in which there is a current component that leads the voltage of the transformer. The other coil on the leg 4 is inductively coupled to the "lead" coil and may be used as a compensating coil in the circuit.

In Fig. 3 the coil over the center leg is indicated at T. The coil carrying the lagging current is indicated at 12 and it will be seen that this coil is in series with one cathode of fluorescent lamp 13, the opposite element of said lamp being connected to the end of the transformer T. The coil carrying the leading current disposed around leg 4 is indicated at 14 in Fig. 3 and the capacitor with which it is in series is designated 15. This assembly supplies voltage to a lamp 16, the cathode of which is connected to the capacitor and to the compensating coil around leg 4 which is designated 17 in Fig. 3. Starting switches for the lamps are indicated at 18 and 19 respectively.

It will be seen that the flux linkages between the legs of the core are such that coils 12 and 14 can be utilized to add voltage to the voltage from the auto transformer T so that the size of the auto transformer may be reduced in practice. It will also be seen that there are no loaded elements on the outside legs 1 and 5 so that the flux through these legs is unimpeded and does not contribute to the load current of the auto transformer T. Since the magnetic circuit in legs 1 and 5 is improved over that which would be present with only butt joints between the laminations the tendency for the flux to leave the laminations and enter the surrounding case is materially reduced.

Assembly of the core is accomplished by stacking small groups of laminations alternately and inserting them into the openings of the several coils and holding the coils in place with wooden wedges. Wooden or paper spacers may be used to determine accurately the size of the air gaps in legs 2 and 4. Prior to final assembly a coating of a plastic cement is applied to the overlapping portions of the small groups of laminations. This cement will enter between the laminations themselves but more effectively will serve to hold the small groups tightly in place since there is a substantial cemented area between the successive groups of laminations in both the outside legs and in the center leg.

It has been found that this cementing operation alone serves to hold the core against vibration, and with the coils wedged in place around legs 2, 3, and 4 the entire assembly is so free of noise that it may be used directly adjacent fluorescent lighting fixtures without objectionable hum. If desired, the entire reactor may be potted in the usual transformer compound before placing it in the case.

It will be seen that, a single form of lamination being used for the entire unit, die cost is kept to a minimum and the assembly of the units is greatly facilitated over units in which a large number of different lamination forms are required. It will also be seen that I have provided a core which can be held together by cement alone without the necessity of using the usual clamping bands or bolts.

While the invention has been shown in connection with a specific form and disposition of the core legs it will be appreciated that numerous modifications and changes may be made therein without departing from the spirit of the invention as defined in the appended claims.

What I claim is:

1. A core for a transformer and reactor, which comprises a plurality of layers of identical laminations stacked in facing relationship with two laminations to each layer, a short leg and a long leg on opposite ends of each lamination, at least one other leg positioned between the end legs which forms an air gap with its counter part on the lamination facing it, said laminations being so stacked that overlapping joints are formed between certain successive laminations in each end leg and being relatively movable toward and away from each other to maintain said facing relationship and to increase or decrease the width of said air gap without breaking said overlapping joints, and a coil disposed about the leg intermediate the end legs.

2. A core for a transformer and reactor, which comprises a plurality of layers of identical laminations stacked in facing relationship with two laminations to each layer, a short leg and a long leg on opposite ends of each lamination, a central leg midway between the end legs having one side longer than the other so as to form an angled butt joint with its counter part on the lamination facing it, a pair of legs located between each end leg and the central leg, the laminations in said pair of legs being of such length as to provide air gaps therein, said laminations being so stacked that overlapping joints are formed between certain successive laminations in each end leg and in the central leg and being relatively movable toward and away from each other to maintain said facing relationship and to increase or decrease the width of said air gap without breaking said overlapping joints, and coils disposed about the central leg and the adjacent pair of legs.

ORDEAN KILTIE.

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