March 3, 1953 C. A. HOWLETT 2,630,478

LAMINATED MAGNETIC CORE FOR FLUORESCENT BALLAST SYSTEMS

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Fig. 1.

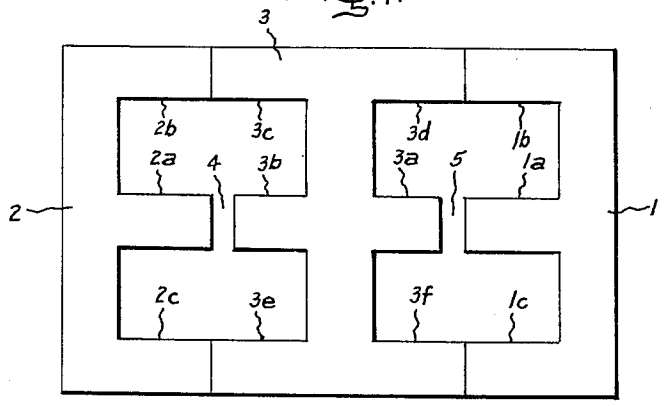


Fig. 2.

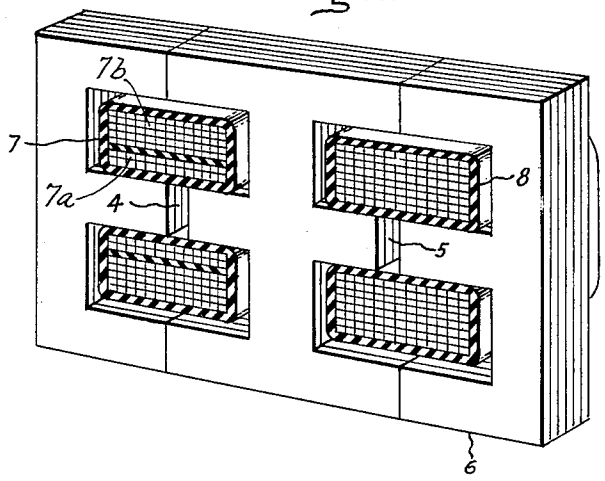
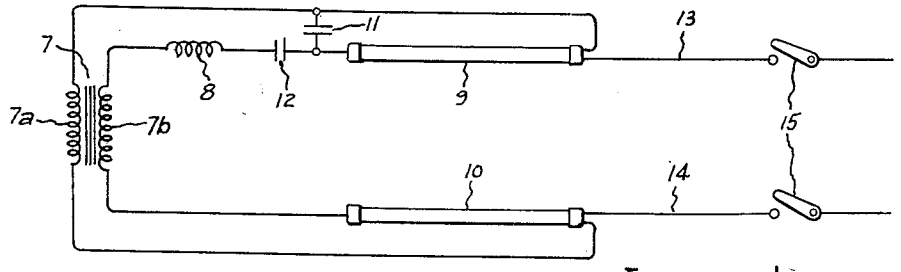


Fig. 3.



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LAMINATED MAGNETIC CORE FOR FLUORESCENT BALLAST SYSTEMS

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2 Claims. (Cl. 175—356)

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This invention relates to laminated magnetic core structures and, more particularly, to those core structures which are used in ballasts for fluorescent lamps.

One of the more important requirements of a good fluorescent light ballast is that it be quiet in operation. Oftentimes, noisy vibrations of the ballast case, or even of the fixture in which the ballast is placed, are caused by stray magnetic fields which leak away from the magnetic core or cores used in the ballast. Therefore, it is desirable to eliminate these stray fields as far as possible.

It has been known for some time that shell-type cores with center leg air gaps will give good results, since the center leg air gaps help reduce the amount of stray flux around any butt joints in the outside legs. Moreover, if the electrical winding or coils associated with the cores are positioned on the center leg so as to surround the air gaps, the coils will confine the stray flux within themselves and thus help prevent it from leaking into the case. This is easily accomplished in cores intended for use either in autotransformers or in reactors by building the core of layers of two E-shaped laminations, one at least having its center leg slightly shorter than the outside legs; thus, as the two outside legs are butted together, an air gap remains in the resultant center leg. However, for certain ballast applications, it is desirable to assemble an autotransformer and a reactor adjacent to each other on the same core with each having a distinct flux path. Up to this time, not satisfactory structure, other than one which mechanically, rather than magnetically, combines two separate cores, has been brought forward which combines the autotransformer and the reactor on the same core with each having its own distinct shell-type flux path containing a center leg air gap, the center leg air gap being in such position that it can be surrounded by a coil.

Therefore, it is an object of this invention to provide an improved unitary laminated magnetic core structure which embodies two distinct shell-type flux paths, each flux path having a center leg air gap in such a position that it, the air gap, can be surrounded by a winding.

It is a further object of this invention to provide an improved fluorescent light ballast by using the above-mentioned core structure.

The way in which this invention fulfills these objects can best be understood by referring to the following description together with the accompanying drawing, in which Fig. 1 is a plan

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view of one layer of a preferred embodiment of this invention; Fig. 2 is a perspective view of a core, made from a plurality of the layers shown in Fig. 1, together with the windings associated with it; and Fig. 3 is a fluorescent lamp circuit diagram employing a ballast embodying the core and coils shown in Fig. 2.

Referring to Fig. 1, the lamination layer comprises two E-shaped laminations or punchings 1 and 2 and a roughly double-E-shaped lamination or punching 3. By double-E-shaped it is meant that punching 3 is roughly shaped in the form of two E's back-to-back. Punching 3 has center legs 3*a* and 3*b* which are shorter than its outside legs 3*c*, 3*d*, 3*e* and 3*f*. The legs of the E-shaped laminations 1 and 2 are here shown as all of the same length, but the center legs 1*a* and 2*a* may be shorter than the outside legs 1*b*, 1*c*, 2*b* and 2*c*, if so desired. The outside legs of the E-shaped laminations 1 and 2 are butted against the outside legs 3*c*, 3*d*, 3*e* and 3*f* of the double-E-shaped lamination 3, thus leaving air gaps 4 and 5 between the center legs 3*a* and 3*b* of the double-E-shaped lamination 2 and the center legs 1*a* and 2*a* of the E-shaped laminations 1 and 2.

In Fig. 2, a number of layers formed as in Fig. 1 are stacked together to form a magnetic core structure 6. An autotransformer winding 7 is positioned on one center leg surrounding its air gap 4, while a reactor winding 8 is positioned on the other center leg surrounding its air gap 5. Each winding, thus, has its own distinct shell-type flux path, each path having separate legs and one separate yoke, but both paths sharing one common yoke, the common yoke being the stem of the double-E-shaped laminations.

Fig. 3 shows how the windings 7 and 8 may be connected in a fluorescent light ballast system. This particular system is composed of two fluorescent lamps 9 and 10, the autotransformer winding 7 with a primary or common portion 7*a* and an extended portion 7*b*, the reactor winding 8 and two capacitors 11 and 12. Alternating electric power is supplied to the system through lines 13 and 14, which are connected by switch 15 to a power supply. For safety reasons, connection is made to the autotransformer through the lamp sockets so that when either lamp is removed the autotransformer loses its excitation.

The operation of the circuit shown in Fig. 3 is as follows: Assume the switch 15 to have just been closed, thus energizing the system. Immediately the lamp 10 will have the supply voltage plus the voltage of the winding portion 7*b* impressed across it, since there is a closed path,

except for lamp 10, for alternating current flow from line 13 to line 14 through capacitors 11 and 12, the reactor 8 and the extended portion 7b of the autotransformer 7. Lamp 10 breaks down and current begins to flow. Capacitor 11 is of such magnitude that it now is the major impedance of the circuit, the voltage drop across it being but slightly less than the voltage originally impressed on lamp 10. Since capacitor 11 is in parallel with lamp 9, its voltage causes lamp 9 to break down and current passes through lamp 9. The circuit now assumes its steady state condition with current flowing from line 13 through lamp 9, capacitor 12, reactor 8, the autotransformer extended portion 7b, and lamp 10, all in series to line 14.

The sequented starting of the lamps is very rapid and for all ordinary purposes both lamps start substantially simultaneously and instantaneously when switch 18 is closed.

The reactor 8 and the capacitor 12 constitute a net capacitive current limiting or ballasting series impedance for the lamps. The reactor 8 improves the lamp current and voltage wave shapes so as to increase the effective lamp wattage and light output. It also has a stabilizing effect on the circuit with variations in supply voltage. The air gap 5 associated with the reactor 8 controls its reactance as to both magnitude and linearity.

The air gap 4 associated with the autotransformer 7 increases its magnetizing current so as to compensate for the leading load current produced by the net capacitive impedance in series with the lamps and thereby achieve substantially unity input power factor for the system.

Although this circuit is not broadly new to the art, applicant's novel core and coil structure, hereinbefore described, which combines the autotransformer 7 and the reactor 8 in a single electromagnetic unit of desirable characteristics in such a system, is believed to be novel.

While I have described only one preferred embodiment of my invention by way of illustration, many modifications will occur to those skilled in the art and it will, therefore, be understood that I intend by the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

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

1. A laminated magnetic core structure formed to provide two distinct shell-type flux paths, each layer of said core being formed of three

laminations, two being roughly E-shaped and one being roughly double E-shaped, the outside legs of said E-shaped laminations being butted against the outside legs of said double-E-shaped laminations, one center leg of a lamination in each pair of butted laminations being shorter than its outside legs to provide an air gap between said center legs of said double-E-shaped laminations and the center legs of said E-shaped laminations, each of the pairs of center legs between which there is an air gap constituting a separate winding leg portion of said core structure.

2. A fluorescent lamp ballast including a unitary laminated magnetic core having two distinct shell-type flux paths, each layer of said core having three laminations, two of said laminations being roughly E-shaped and one being roughly double-E-shaped in the form of two E's back-to-back, the outside legs of said E-shaped laminations butted against said outside legs of said double-E-shaped laminations, the center legs of said double-E-shaped laminations being slightly shorter than the outside legs, to provide two air gaps between said center legs of said double-E-shaped laminations and the center legs of said E-shaped laminations; an autotransformer winding positioned on a pair of opposed center legs surrounding a portion of each of said opposed center legs and the intervening air gap and a reactor winding positioned on the other pair of opposed center legs surrounding a portion of each of said other opposed center legs and the intervening air gap.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,803,868	Porter	May 5, 1931
1,875,358	Sola	Sept. 6, 1932
2,310,742	Ford	Feb. 9, 1943
2,346,621	Sola	Apr. 11, 1944
2,352,073	Boucher et al.	June 20, 1944
2,440,540	Farr	Apr. 27, 1948
2,561,855	Gould	July 24, 1951

FOREIGN PATENTS

Number	Country	Date
606,024	France	June 5, 1926