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T. T. SHORT
ELECTRICAL APPARATUS
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Fig. 1.

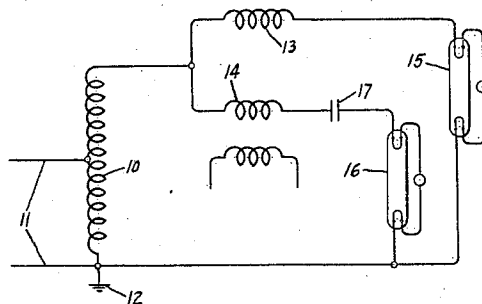
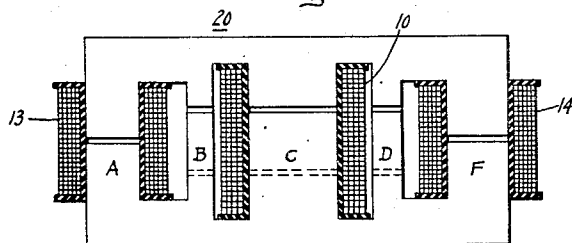


Fig. 2.



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ELECTRICAL APPARATUS

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3 Claims. (Cl. 315-228)

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My invention relates to an electric apparatus suitable for operating electric discharge devices such as fluorescent lamps.

The operation of electric discharge devices usually requires some sort of a ballast, and it has been customary to employ auto transformers for stepping up the voltage when a sufficient amount of voltage is not present and a reactor in series with the auto transformer and lamp for acting as a ballast. In the manufacturing of these ballasts it has been customary to employ separate core structures for the auto transformer, and each of the reactors, and then place these separate core structures in a single casing.

An object of my invention is to form an electrical apparatus for operating a pair of lamps in which all the coils are mounted on an integral core structure.

Another object of my invention is to balance suitably the flux flowing through the various legs of the core structure.

My invention will be more fully set forth in the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out in the claims annexed to and forming a part of this specification.

Referring to the drawing, in Fig. 1 a conventional lamp circuit is shown including an auto transformer 10 coil-connected across a suitable source of supply 11. One end of the auto transformer is grounded at 12 and the other end is connected to ballasting elements including reactor coils 13 and 14. The coil 13 is connected to a lamp 15, and the coil 14 is connected to a lamp 16. In order to have the lamps fire out of phase, a capacitor 17 is connected between the coil 14 and the lamp 16.

In Fig. 2 I have illustrated my improved 5-legged core suitable for operating a pair of fluorescent lamps and include a core structure 20 including legs A, B, C, D, and F. The coil 10 surrounds the winding leg C and is connected to the suitable source of supply and acts as an auto transformer. The coil which surrounds the leg A may be connected to either the lead or the lag lamp, and in the construction illustrated in the drawing, the winding leg A is surrounded by the coil 13 which is connected to the lag lamp, while the leg F is surrounded by the coil 14 which is connected to the lead lamp. In order to operate the device successfully, I have found that it is necessary that the sum of the fluxes through the legs A and F shall equal in magnitude the flux flowing through the center leg C. By doing this

it is possible to reduce the cross sectional area of the legs B and D to a minimum, as the flux in the various legs A, C and F are out of phase, and by balancing the fluxes in this manner the legs B and D need only carry the vector difference of these fluxes.

Since the coil 10 is connected to a separate source of supply and the coils 13 and 14 are connected to a load, we may consider that in this apparatus there are three separate sources forcing flux through the core structure, and in order to balance the fluxes in the manner described above it is necessary to choose the relationship between the number of turns and the cross sectional area of the winding legs so that the arithmetic sum of the fluxes in the two outside legs will equal the flux in the center leg. Given a certain value of flux in the center leg C, which, of course, is determined by the number of turns in the coil 10 and the voltage across which the coil 10 is connected, there will be a certain optimum value of relationship between the number of turns and the area of the legs for the coils surrounding the two outside legs. This optimum of turns in coils 13 and 14 is such that the flux in the legs A and F will add up to equal the total flux in the leg C. Assuming a uniform core density in the three legs, then the sum of the areas of the legs A and F shall equal the cross sectional area of leg C. If, however, the core densities are not equal, the cross sectional area will vary inversely with the differences in density.

Since the current flowing through the coils 13 and 14 are out-of-phase by about 60 degrees and each is about 30 degrees out-of-phase with the current flowing through the main transformer winding 10, the fluxes passing through the legs A and F will be out-of-phase by about 60 degrees. Since the flux in the reactor legs A and F is out-of-phase with the flux passing through the leg C by approximately 30 degrees, the two legs B and D must carry the unbalance or the vector difference between the flux in the outside legs and the center leg.

Although I have shown and described particular embodiments of my invention, I do not desire to be limited to the particular embodiments described, and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of my invention.

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

1. An electric apparatus for operating lead and lag discharge lamps including a five legged core, an autotransformer coil around a center leg and

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being adapted to be connected to a source of supply, a ballast reactor coil around one outside leg having one end adapted to be connected to the lag lamp, another ballast reactor coil around another outside leg having one end adapted to be connected to a lead lamp, the other ends of said ballast reactor coils being connected to said transformer, the size of the legs and the number and direction of turns being so adjusted that the arithmetic sum of flux through the outside legs shall equal the flux in the center leg during normal operation, and with the flux flowing through the fourth and fifth legs being the vector difference between the flux in the center leg and in the outside legs.

2. In combination, a unitary five-legged core, a complete low leakage reactance transformer on one leg, separate reactor coils on two of the other legs respectively, said reactor coils being proportioned to carry equal currents which respectively lead and lag the transformer voltage by equal phase angles, the number of turns of said reactor coils being equal to each other such that their respective fluxes are equal to half the transformer exciting flux, the areas of the reactor carrying core legs being half the area of the transformer carrying core leg for equal flux density in all three legs, the areas of the two remaining core

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legs being less than the areas of the two last-mentioned core legs and being adapted respectively to carry the vector resultant of half the transformer exciting flux and the flux of a different one of said reactor coils, the relative polarities of said reactor coil fluxes being such that the fluxes in said two remaining legs are equal and of minimum value which is substantially less than the flux in the reactor coil carrying legs whereby the areas of said two remaining core legs are equal and can be a minimum which is substantially less than the area of the reactor coil carrying legs for equal flux density in all five core legs.

3. An electric apparatus for operating a pair of electric discharge devices comprising in combination, a magnetic core having five legs and a pair of yokes for respectively connecting the corresponding ends of said legs, the center leg having an autotransformer winding mounted thereon, the two outside legs being each of half the cross-sectional area of the center leg, and a separate reactor winding on each of said outer legs, the two remaining legs having equal cross-sectional areas which are substantially less than the cross-sectional area of the outer legs, the reactor coils being connected in parallel circuit relation with each other and in series circuit relation with said transformer.

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