

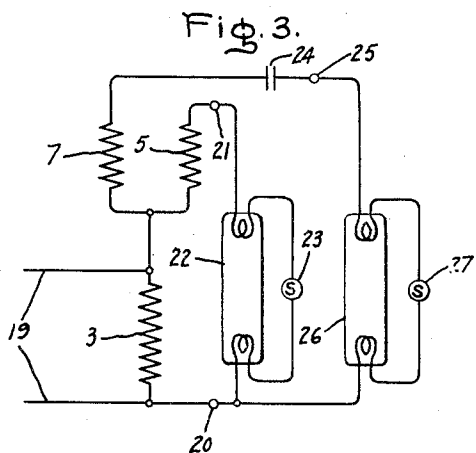
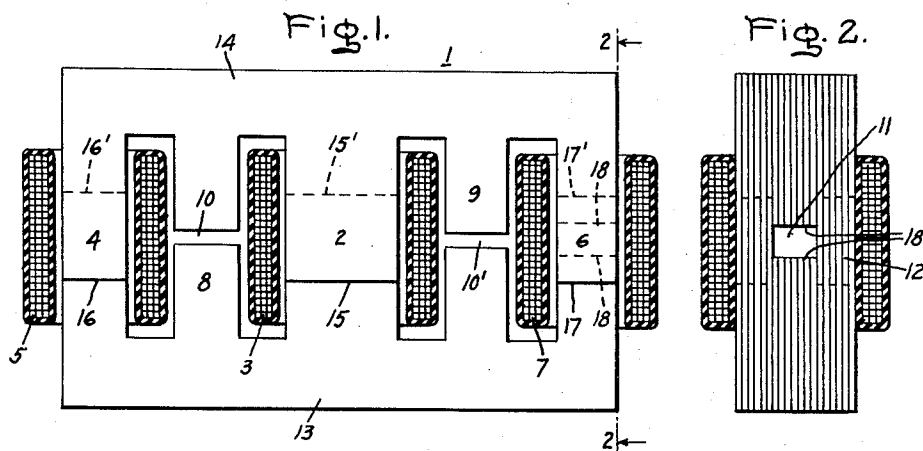
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INDUCTION APPARATUS

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INDUCTION APPARATUS

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4 Claims. (Cl. 171-777)

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This invention relates to induction apparatus and more particularly to improvements in two-lamp ballasts for electric discharge lamps.

Unitary ballast devices for a pair of fluorescent lamps, one of which operates with leading current and the other of which operates with lagging current, are known in the art. In accordance with this invention there is provided a novel device of this type which is of relatively low cost and efficient in operation. It is characterized by increasing the reluctance of the magnetic circuit of the portion of the device which supplies the leading current lamp circuit relative to the reluctance of a parallel magnetic circuit of another portion of the device which supplies the lagging lamp circuit so as to improve the leading current wave shape and at the same time give the desired starting or open circuit voltage and full load voltage with minimum size and amount of material. It is a modification of the device which is disclosed and broadly claimed in application Serial No. 731,559, filed February 28, 1947, in the name of Harold W. Lord, and assigned to the same assignee.

An object of the invention is to provide a new and improved electric induction apparatus.

Another object of the invention is to provide a new and improved electrical ballast device.

A further object of the invention is to provide an inexpensive low-loss two-lamp ballast.

The invention will be better understood from the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

In the drawing Fig. 1 is a sectional view of an embodiment of the invention, Fig. 2 is an end view taken on line 2-2 of Fig. 1, and Fig. 3 is a circuit diagram illustrating the electrical connections of the ballast.

Referring now to the drawing and more particularly to Fig. 1, there is shown therein a five-legged core 1. Mounted on the center leg 2 of the core is a common auto-transformer winding 3. Mounted on the outer leg 4 of the core is an extended autotransformer winding 5 for a lag lamp circuit and mounted on the outer leg 6 of the core is another extended autotransformer winding 7 for connection with a lead lamp circuit. The intermediate legs 8 and 9 are provided with central air gaps 10 and 10' respectively. These intermediate legs 8 and 9 act as magnetic shunts between the common winding and the respective extended windings so as to provide predetermined amounts of leakage reactance between those sets of windings.

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The outer leg 6 is provided with a special form of what is known variously as a bridged gap 11 or a restricted section 12. However, it will be noted that the restricted section is divided into two parts which are on the outside and the gap 11 which is bridged by the restricted section is in the center of the core, thus controlling the leakage of flux from both sides of the core which tends to take place due to the relatively high reluctance of the gap 11.

The core is made of stacked lamination layers, there being a five-legged punching 13 and a five-legged punching 14 in each layer. These punchings face each other with the ends of their center legs making butt contact at 15 in the outer layer shown in Fig. 1 and with the ends of the outer legs making butt contact at 16 and 17 in that layer. Alternate ones of a predetermined number of the outer layers are reversed so that, for example, in the layer directly below the outer layer which is visible in Fig. 1 the butt contact in the center leg will be at 15' and in the outer legs will be at 16' and 17' so that the butt joints in the center core leg 2 and the outer core legs 4 and 6 will be overlapped. The bridged gap 11 in the outer core leg 6 is obtained by making the legs of the punchings in the central part of the core equal in length and substantially less than half the over-all length of the other outer leg 4. Thus, the ends of the legs of the punchings forming the center portion of the core are at 18. It will be observed from Fig. 2 that this construction is symmetrical and has relatively high mechanical strength because of the bridges 12 on both sides of the gap 11.

The electrical connections of the device are shown in Fig. 3. The common winding 3 acts as the primary winding of an autotransformer which is connected across an input circuit 19. The extended winding 5 is in series with the common winding 3 and these windings are autotransformer connected so that together they constitute the secondary winding. This secondary winding has terminals 20 and 21 which are adapted to be connected to a lag lamp circuit which is shown as including a conventional hot cathode fluorescent lamp 22 which is provided with any suitable starter, such as a glow type starter 23. This circuit is called a lag circuit because of the substantial inductive leakage reactance of the autotransformer which is produced by the magnetic shunting action of the core leg 8. This causes the current in this circuit to lag the impressed voltage. The extended winding 7 is likewise connected in series with the

common winding 3 so that together these windings provide a high leakage reactance secondary autotransformer winding and this combination is connected in series with the capacitor 24 which in practice is ordinarily located in the same housing as the structure shown in Fig. 1. The terminals of this lead circuit of the device comprise the common terminal 20 and a terminal 25 and this circuit is normally completed by another hot cathode fluorescent lamp 26 which will ordinarily be provided with a starter 27 similar to starter 23.

The core shown in Fig. 1 permits the assembly of all three coils of windings 3, 5 and 7 at the same time and also makes possible machine stacking of the punchings. By putting cement in the gaps 10 and 10' of the legs 8 and 9 and by using wedges between the coils and the core it is possible to eliminate any additional core clamping means. Because the extended windings of both the lead and lag circuits function as autotransformers as well as reactances for current limiting, a considerable saving is made as the amount of copper used is substantially less than when separate series reactors are used with a low reactance transformer. The amount of iron used is also reduced because of the five-legged core design. The reduction of these two items makes for the other desirable features of less watts loss and reduced weight. A typical ballast constructed in accordance with this invention provides a minimum of 200 volts open circuit to the lamps. The amount of flux in the outer core leg 4 is regulated by the size of the gaps 10 and 10' in the leg 8 and by the current in windings 5 and 7. The amount of flux through the outer leg 6 is a function of the size of the gaps 10 and 10', in the leg 9 the current in windings 5 and 7, the cross section of the restricted sections 12 and the length of the bridged gap 11. These dimensions are properly balanced to provide correct starting current, running current and open circuit voltage for the lead lamp 26.

While there has been shown and described a particular embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications can be made therein without departing from the invention and, therefore, it is aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

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

1. A two-lamp ballast comprising, in combination, a five-legged core, a common autotransformer primary winding on the center leg of said core, extended autotransformer secondary windings respectively on the outer legs of said core, air gaps respectively in the intermediate legs of said core, said common winding and one of said extended winding being serially autotransformer connected between terminals for a lag lamp circuit, a capacitor, and a gap in the outer core leg which carries the other extended winding, said other extended winding and said common winding being serially autotransformer connected in a series circuit with said capacitor between terminals for a lead lamp.

2. A two-lamp ballast comprising, in combination, a five-legged core, a common autotransformer winding on the center leg of said core, extended autotransformer windings respectively on the outer legs of said core, air gaps respectively in the intermediate legs of said core, terminals for a lag lamp circuit, said common wind-

ing and one of said extended windings being serially autotransformer connected between said terminals, a bridge gap in the outer core leg which carries the other extended winding, a capacitor, and terminals for a lead lamp circuit, said other extended winding and said common winding being serially autotransformer connected in a series circuit with said capacitor between said last-mentioned terminals.

3. A unitary ballast for a lagging current discharge lamp circuit and a leading current discharge lamp circuit comprising, in combination, a five-legged core of stacked lamination layers, each lamination layer comprising a pair of facing five-legged punchings with a yoke portion interconnecting their respective legs, the center and outer legs of the punchings in a predetermined number of the outer layers on each side of said core having abutting ends, said abutting ends being off center in each layer, said layers being reversed so that said abutting ends are overlapping, the intermediate legs of the punchings being of equal length which is less than half the sum of the lengths of the center legs of the punchings of each layer whereby the intermediate core legs have central gaps, the legs of a predetermined number of intermediate punchings at one end thereof being equal and shorter than the intermediate legs of said punchings whereby one outer core leg has a central gap which is bridged on both sides, a common autotransformer winding on the center leg of said core, separate extended autotransformer windings mounted respectively on the outer legs of said core, a capacitor, lead circuit terminals between which said common winding and the extended winding which is on the leg having the bridged gap are serially connected with each other and with said capacitor, and lag circuit terminals between which said common winding and the other extended winding are serially autotransformer connected.

4. In combination, a five-legged core of stacked lamination layers, each lamination layer comprising a pair of facing five-legged punchings with a yoke portion interconnecting their respective legs, the center and outer legs of the punchings in a predetermined number of the outer layers on each side of said core having abutting ends, said abutting ends being off center in each layer, said layers being reversed so that said abutting ends are overlapping, the intermediate legs of the punchings being of equal length which is less than half the sum of the lengths of the center legs of the punchings of each layer whereby the intermediate core legs have central gaps, the legs of a predetermined number of intermediate punchings at one end thereof being equal and shorter than the intermediate legs of said punchings whereby one outer core leg has a central gap which is bridged on both sides.

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