

[54] LAMP BALLAST DEVICE
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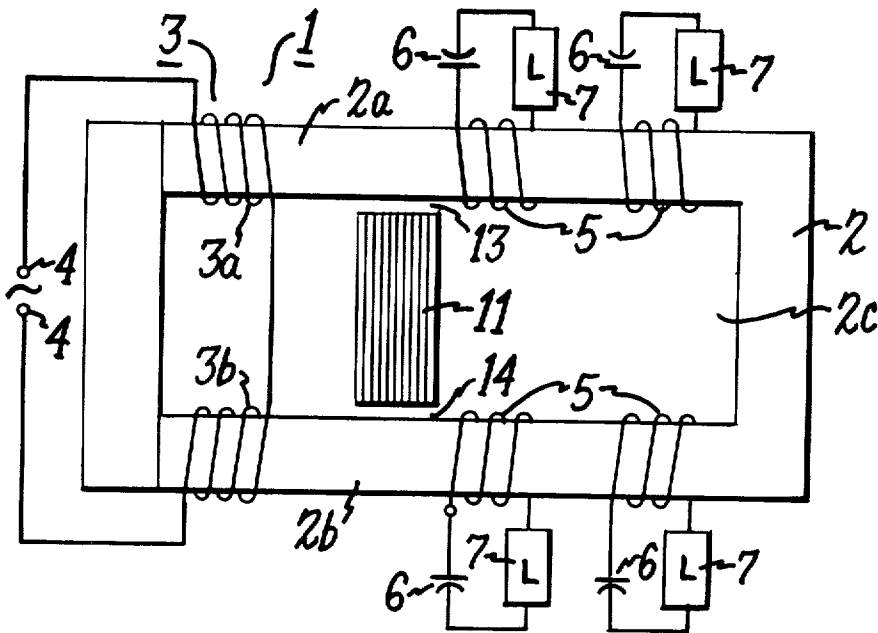
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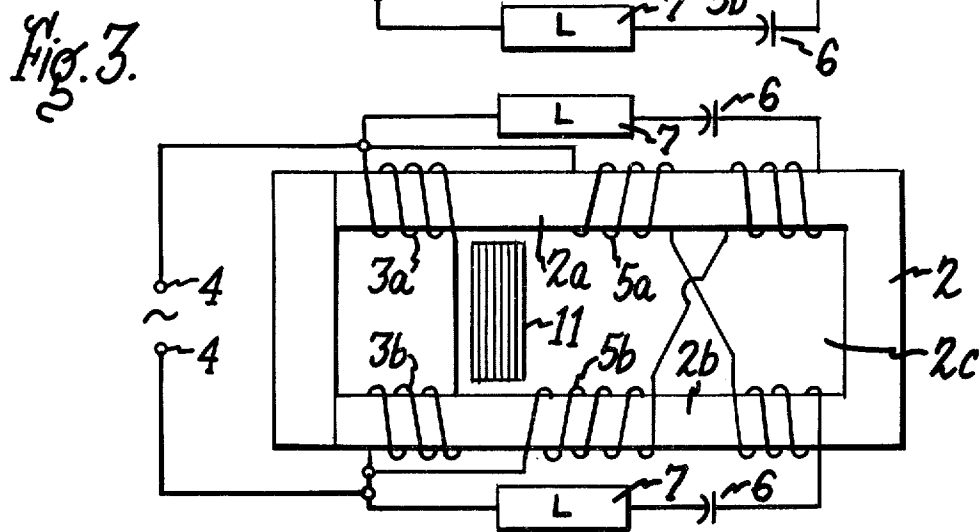
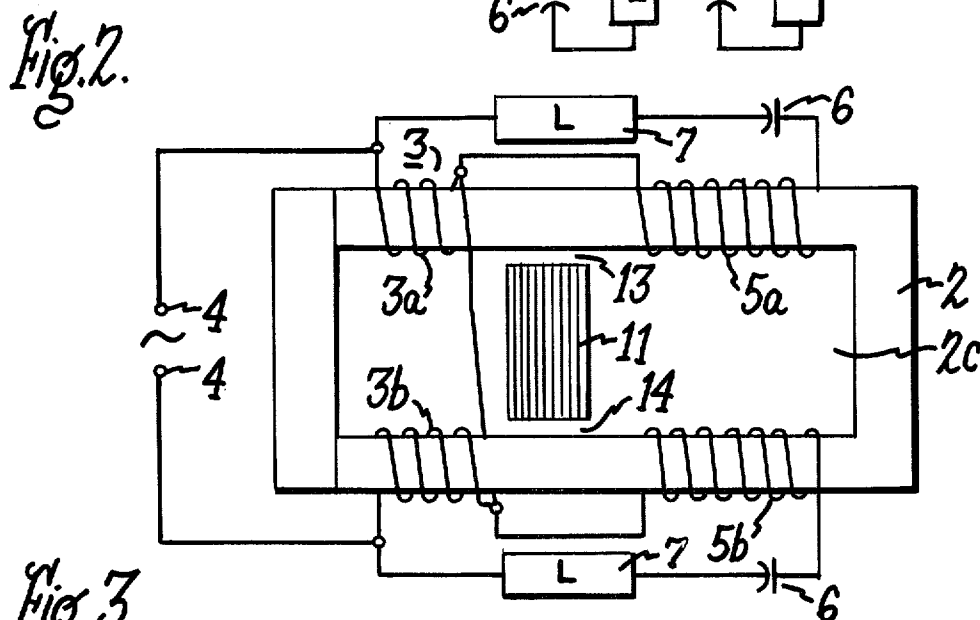
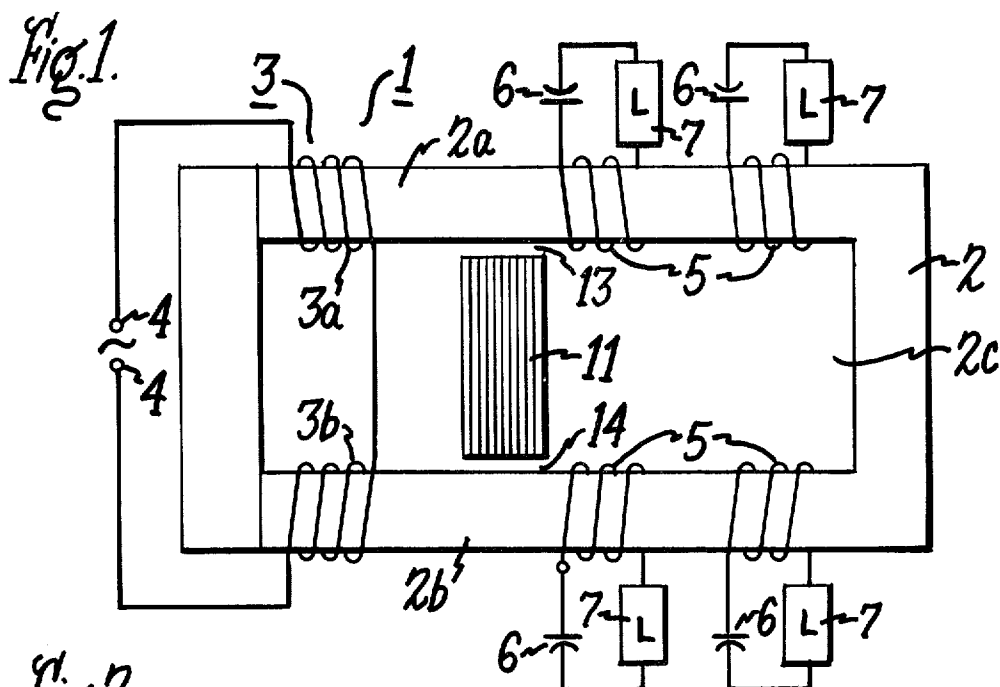
[52] U.S. Cl. 315/257; 315/137; 315/278; 336/165
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[58] Field of Search 315/DIG. 5, 137, 138, 141, 315/144, 282, 257, 258, 278, 276; 336/160, 165, 5

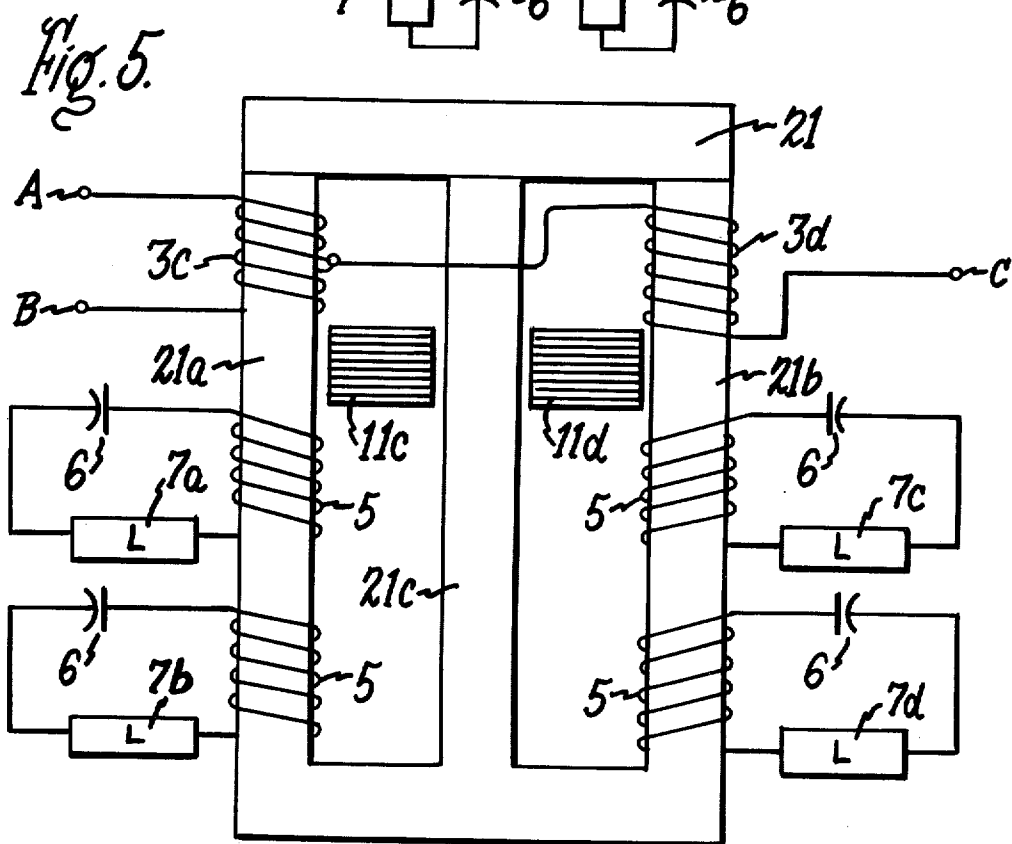
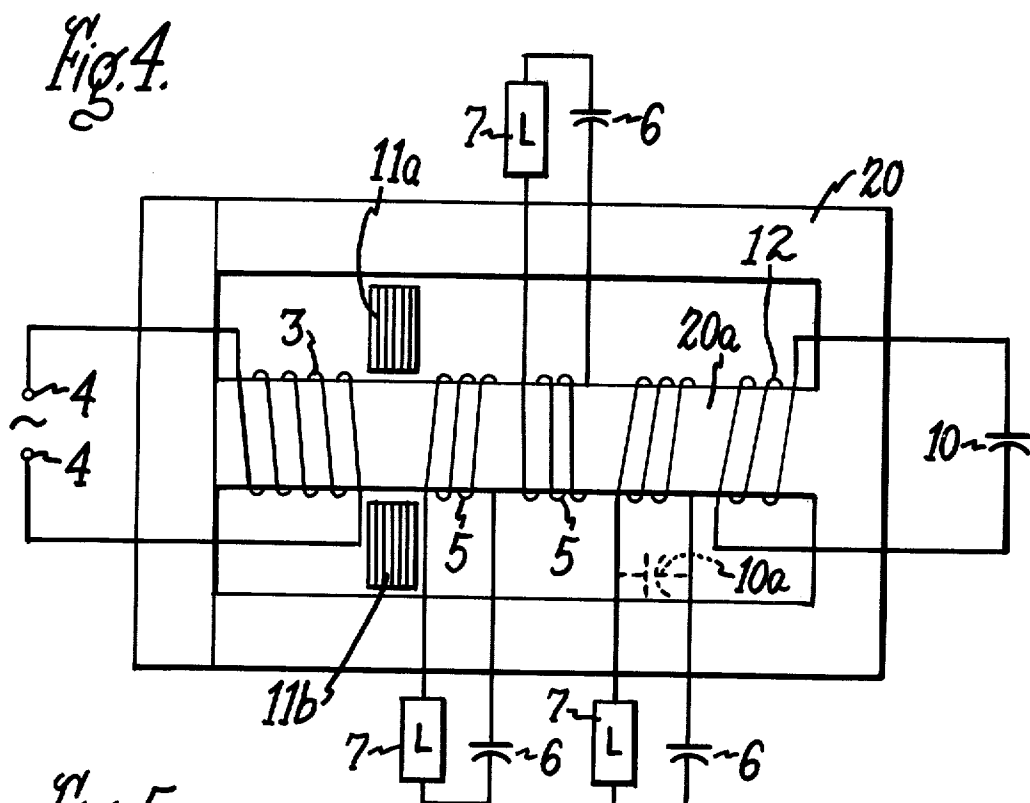
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[57] ABSTRACT
A plurality of high intensity discharge lamps are operated from a high leakage reactance transformer having a magnetic shunt extending across the window of a closed magnetic core. The primary winding of the transformer is arranged on one side of the magnetic shunt and a plurality of secondary windings are arranged on the opposite side of the shunt with a gaseous discharge lamp connected to each secondary winding.

13 Claims, 5 Drawing Figures







LAMP BALLAST DEVICE

The present invention relates to electrical ballast devices for gaseous discharge lamps, and more particularly concerns a ballast device for starting and operating a plurality of gaseous discharge lamps.

It is an object of the invention to provide an improved ballast device of the above type which is simple and economical in construction and reliable in operation.

A particular object of the invention is to provide a ballast device of the above type which is capable of operating a plurality of gaseous discharge lamps from a single ballast transformer.

Still another object of the invention is to provide a ballast device of the above type which operates the plurality of gaseous discharge lamps in a relatively uniform manner.

Other objects and advantages will become apparent from the following description and the appended claims.

With the above objects in view, the present invention in one of its aspects relates to electrical ballast apparatus for operating a plurality of gaseous discharge lamps comprising, in combination, a transformer having a magnetic core providing a closed magnetic circuit, primary winding means on a first portion of the core and secondary winding means on a second portion of the core, magnetic shunt means arranged on the core between the primary winding means and the secondary winding means, the secondary winding means comprising a plurality of secondary windings, and a plurality of gaseous discharge lamps connected respectively to the plurality of secondary windings.

The invention will be better understood from the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a schematic diagram of a ballast device illustrating an embodiment of the invention comprising an isolation type of transformer;

FIG. 2 is a diagrammatic view of another embodiment of the invention using an autotransformer type of ballast;

FIG. 3 is a diagrammatic view of an embodiment of the invention wherein the secondary windings are cross-connected;

FIG. 4 is a diagrammatic view of an embodiment of the invention incorporating a peaking capacitor; and

FIG. 5 is a diagrammatic view of an embodiment of the invention using a three phase ballast.

Referring now to the drawings, and particularly to FIG. 1, there is shown a ballast apparatus constructed in accordance with the invention and comprising transformer 1 having a closed magnetic core 2 of U-I type formed of a stack of magnetic steel laminations and defining a core window 2c. Primary winding 3 of transformer 1 arranged at one end of core 2 comprises winding 3a wound on one leg 2a of core 2 in series with winding 3b wound on the opposite spaced leg 2b of core 2, and is connected to terminals 4 of a source of alternating current. The secondary of ballast transformer 1 comprises a plurality of isolated secondary windings 5 arranged near the other end of the core 2, with two of the windings arranged on core leg 2a and the other two windings arranged on opposite core leg 2b. To each secondary winding 5 is connected a gaseous discharge lamp 7, such as a mercury, metal halide, or sodium vapor type lamp, and a capacitor 6 in series

with the lamp. Capacitors 6 provide leading current in the secondary circuits and thereby assist in establishing the desired saturation in the secondary core portions for regulating power in the secondary circuits, in a manner well understood by those versed in the art.

Magnetic shunt 11 is arranged extending across core window 2c between primary winding 3 and secondary windings 5 for providing leakage reactance in transformer 1. Shunt 11 typically comprises an assembly of superposed magnetic laminations and is spaced at its opposite ends from the opposite core legs by non-magnetic gaps 13, 14 which may be air gaps or spaces occupied by insulating spacer material.

By virtue of the described arrangement of the secondary windings on one side of the magnetic shunt, it is possible in accordance with the invention to operate any desired number of gaseous discharge lamps and to achieve substantially independent lamp operation with the illustrated ballast device.

Capacitors 6 in the secondary circuits, in addition to the function previously mentioned and serving as current limiting impedances, enable all of lamps 7 to ignite and operate by preventing the lamp which starts first from excluding sufficient magnetic flux from the secondary core to enable the remaining lamps to start and operate.

FIG. 2 shows an embodiment of the invention in which a pair of secondary windings 5a, 5b each with series connected capacitor 6 and lamp 7 are connected in autotransformer relation with primary windings 3a, 3b. While only two secondary windings are shown, it will be understood that any desired number may be used and similarly connected.

FIG. 3 shows an embodiment of the invention wherein a pair of secondary windings 5c and 5d are arranged such that each secondary winding has a portion wound on one core leg 2a and another portion wound on the other core leg 2b, with the portions of each winding connected to each other in voltage aiding relation, as shown. By such arrangement of the secondary winding portions the wattages in the several lamps are balanced, so that in the event of outage of one lamp, the variation of wattage in the remaining lamp or lamps is kept to a minimum.

FIG. 4 shows an embodiment of the invention in which a transformer core 20 of E-I type is used, with the primary winding 3 and a plurality of isolated secondary windings 5 being wound on the central leg 20a of core 20 on opposite sides of magnetic shunts 11a, 11b. In this embodiment a peaking capacitor 10 connected to an isolated auxiliary secondary winding 12 on core leg 20a is employed for making a higher starting voltage available for starting the lamps. If desired, a peaking capacitor 10a may alternatively be connected across one (or more) of the lamp circuits in shunt with the lamp series capacitor 6, as shown in interrupted lines. The isolated peaking capacitor arrangement is preferred, however, to avoid any disadvantages which might be attendant on the rapid current discharge through the lamp in the alternative arrangement mentioned.

FIG. 5 shows an embodiment of the invention as applied to a three-phase ballast device. In this embodiment, transformer core 21 of E-I type has outer legs 21a, 21b and center leg 21c, and primary windings 3c, 3b on outer core legs 21a, 21b are interconnected as shown with terminals A, B and C for connection of the primary to a three-line, three-phase current supply. A

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plurality of secondary windings 5 with associated lamps 7a, 7b, 7c, 7d are wound on the outer core legs at the opposite side of magnetic shunts 11c, 11d as previously described. In such arrangement, the current through lamps 7c and 7d on core leg 21b will be 90° out of phase with respect to that in lamps 7a and 7b on core leg 21a. As a result, the stroboscopic effects which may be associated with a similar ballast arrangement connected to a single phase supply are largely eliminated.

Although not shown, slots of suitable size and shape may be provided in the transformer core under the secondary windings in accordance with known practice to provide reduced cross-sections of the core in these areas for obtaining desired secondary magnetizing reactance and thereby controlling current to the lamps.

By virtue of arranging a plurality of secondary windings all on one side of the magnetic shunt of the ballast transformer in accordance with the invention, only one shunt need be used in each core window, thus reducing the number of shunts and the area of window space which would otherwise be necessary. This feature, together with the advantage obtained by the use of a single ballast core and coil assembly for operating a plurality of gaseous discharge lamps, makes possible a ballast device of less weight, lower losses and reduced cost compared to known ballast apparatus used for similar purposes.

While the present invention has been described with reference to particular embodiments thereof, it will be understood that numerous modifications may be made by those skilled in the art without actually departing from the scope of the invention. Therefore, the appended claims are intended to cover all such equivalent variations as come within the true spirit and scope of the invention.

I claim:

1. Electrical ballast apparatus for operating a plurality of gaseous discharge lamps comprising, in combination, a transformer having a magnetic core providing a closed magnetic circuit, primary winding means on a first portion of said core and secondary winding means on a second portion of said core, magnetic shunt means arranged on said core between said primary winding means and said secondary winding means, said secondary winding means comprising a plurality of secondary windings on one side of said magnetic shunt means, and a plurality of gaseous discharge lamps connected respectively to said plurality of secondary windings.

2. Electrical ballast apparatus for operating a plurality of gaseous discharge lamps comprising, in combination, a transformer having a magnetic core providing a closed magnetic circuit, primary winding means on a first portion of said core and secondary winding means on a second portion of said core, magnetic shunt means arranged on said core between said primary winding

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means and said secondary winding means, said secondary winding means comprising a plurality of secondary windings, a plurality of gaseous discharge lamps connected respectively to said plurality of secondary windings, and a capacitor connected in series with each of said gaseous discharge lamps.

3. Apparatus as defined in claim 2, said secondary windings being isolated from each other.

4. Apparatus as defined in claim 2, said core having opposite spaced legs, said primary winding means comprising coil portions wound on said spaced legs.

5. Apparatus as defined in claim 4, said secondary windings being connected to said primary winding means in autotransformer relation therewith.

6. Apparatus as defined in claim 4, said secondary windings being wound on different ones of said spaced core legs.

7. Apparatus as defined in claim 4, said secondary windings including first and second windings each having coil portions arranged on different ones of said spaced core legs, said coil portions of each of said first and second windings being interconnected in voltage aiding relation.

8. Apparatus as defined in claim 1, and a peaking capacitor connected to said secondary winding means.

9. Apparatus as defined in claim 8, said secondary winding means comprising an auxiliary winding, said peaking capacitor being connected to said auxiliary winding.

10. Apparatus as defined in claim 8, said peaking capacitor being connected across one of said lamps.

11. Electrical ballast apparatus for operating a plurality of gaseous discharge lamps comprising, in combination, a transformer having a magnetic core providing a closed magnetic circuit, primary winding means on a first portion of said core and secondary winding means on a second portion of said core, magnetic shunt means arranged on said core between said primary winding means and said secondary winding means, said secondary winding means comprising a plurality of secondary windings, and a plurality of gaseous discharge lamps connected respectively to said plurality of secondary windings, said primary winding means having three terminals for connection to a three-phase current supply.

12. Apparatus as defined in claim 11, said transformer core comprising spaced outer legs and a central leg, said primary winding means comprising a pair of winding portions wound respectively on said spaced outer core legs, one of said winding portions being connected intermediate the other winding portion.

13. Apparatus as defined in claim 12, said plurality of secondary windings being wound on said outer core legs.

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