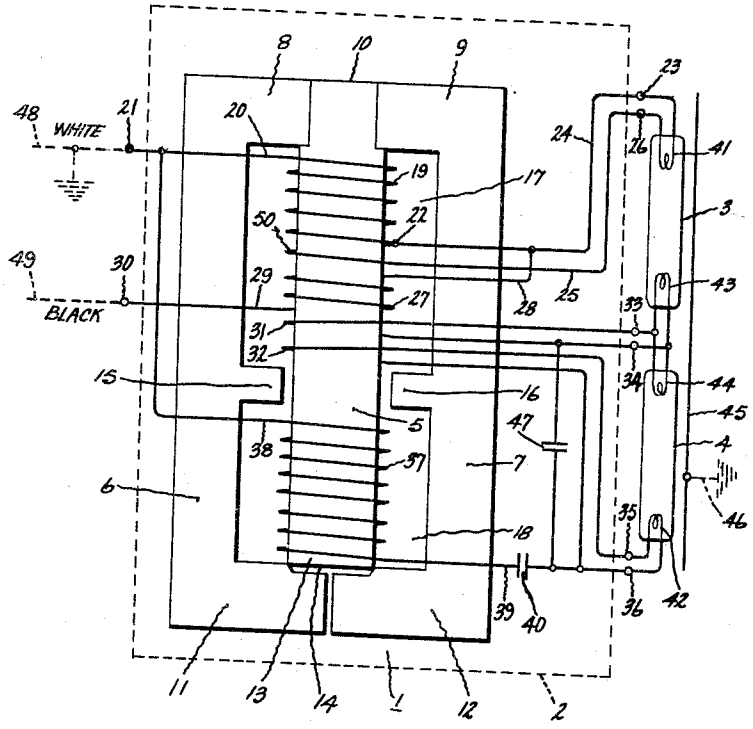
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BALLAST TRANSFORMER

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BALLAST TRANSFORMER

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This invention relates to ballast transformers for arc discharge devices and more particularly to the electrical connections of ballast transformers.

In the design of ballast transformers for operating one or more arc discharge devices, such as fluorescent lamps, it is frequently necessary to provide for operation on line voltages in excess of 120 volts, i. e. for example 208 to 236 volts. In such a design, it is desirable that the voltage from the pins of any lamp to ground be insufficient to cause a lethal current flow through the lamp so that in the event that one end of a lamp is disconnected from its holder and an individual is in contact with both the pins at the disconnected end of the lamp and the lamp fixture, the lamp will not fire and the current will not therefore be hazardous.

It is therefore an object of this invention to provide a ballast transformer for arc discharge devices wherein the voltage from any lamp cathode to ground is not sufficient to cause lethal current to flow through the device.

Further objects and advantages of this invention will be pointed out in the following description and the accompanying drawing, and the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

This invention in its broadest aspects provides a ballast transformer for operating arc discharge devices having a magnetic core with a primary winding and a secondary winding positioned thereon. The primary winding is adapted to be connected to an external source of alternating current while the secondary winding is connected in autotransformer relationship to the primary winding. Electrical leads are provided adapted to connect at least one arc discharge device across the secondary winding and a portion of the primary winding.

The single figure of the drawing schematically illustrates a ballast transformer constructed in accordance with this invention.

Referring now to the drawing, there is shown a ballast transformer, generally identified as 1, arranged in a housing or an enclosing case indicated by the dashed lines 2, and connected to operate two fluorescent lamps 3 and 4. The ballast transformer 1, which is shown here as being of the high leakage reactance type, comprises a center winding leg member 5 and a pair of oppositely disposed yoke members 6 and 7. The end legs 8 and 9 of yoke members 6 and 7 respectively are in abutment with the end 10 of center winding leg member 5 while the end legs 11 and 12 are spaced from the end 13 of center winding leg member 5 to provide a series air gap 14, as will be hereinafter more fully described. Magnetic shunts 15 and 16 are formed on the yoke members 6 and 7 respectively and define a primary winding window 17 and a secondary winding window 18.

A first primary winding section 19 is arranged on center winding leg member 5 in primary winding window 17 and has an input lead at one end 20 connected to an external terminal 21. Primary winding section 19 has a tap 22 connected to an external terminal 23 by means of output lead 24 and its other end 25 is connected to external

terminal 26. Another primary winding section 27 is arranged on center winding leg member 5 in primary winding window 17 and has one end 28 connected to tap 22 on primary winding section 19 by means of lead 24 and has an input lead at its other end 29 connected to external terminal 30.

A pair of cathode heating windings 31 and 32 are also arranged on center winding leg member 5 in primary winding window 17 with cathode heating winding 31 being connected to external terminals 33 and 34 and cathode heating winding 32 being connected to external terminals 35 and 36.

A secondary winding 37 is arranged on center winding leg member 5 in secondary winding window 18 and has one end 38 connected to end 20 of primary winding section 19 thereby providing an autotransformer connection. The other end 39 of secondary winding 37 is connected by an output lead to external terminal 36 with a power factor correction capacitor 40 being arranged in series therewith. Cathode 41 of lamp 3 is adapted to be connected to external terminals 23 and 26 and cathode 42 of lamp 4 is adapted to be connected to external terminals 35 and 36. Cathodes 43 and 44 of lamps 3 and 4 respectively are adapted to be connected in parallel to external terminals 33 and 34. Lamps 3 and 4 may be conventionally mounted in a metallic fixture, shown schematically at 45, which may be connected to a ground, as at 46. In order to provide for series-sequence starting of lamps 3 and 4, a capacitor 47 is provided connected across lamp 4. This particular starting arrangement for two lamps in series is well known in the art and will not be further discussed. While a series sequence connection of two lamps has been shown, this invention is equally applicable to operation of a single lamp or to more than two lamps.

In order to ensure that the voltages appearing between any of the cathodes 41, 42, 43, and 44 and the fixture 45 are not sufficiently high to cause the lamps to fire and thus to cause lethal current to flow, external terminal 21 is adapted to be connected to the white or grounded side 48 of an external source of alternating current while external terminal 30 is adapted to be connected to the black or high side 49 of the source. Assuming that the voltage between any lamp cathode and ground should not exceed 180 volts and that 218 volts appears across supply leads 48 and 49, primary winding section 19 may be arranged so that 118 volts appears thereacross and primary winding section 27 may be arranged so that 100 volts appears thereacross. Cathode heating winding section 50 defined between tap 22 and end 25 of primary winding section 19 and cathode heating windings 31 and 32 may be conventionally arranged to have 3.5 volts appearing thereacross. Secondary winding section 37 may be arranged to have 170 volts appearing thereacross, all of the voltages referred to herein being under open circuit conditions. Since the voltage applied between cathode 41 ground is no higher than the sum of the voltages appearing across primary winding section 19 between end 20 and tap 22 plus the voltage appearing across cathode heating section 50, in the illustrative example, no more than 121.5 volts would appear between the pins of the lamp 3 connected to cathode 43 and fixture 45 in the event the cathode 43 end of lamp 3 were removed from its holder, a value considerably less than 180 volts. In the case of lamp 4, the maximum voltage which would be available between the pins connected to cathode 42 and fixture 45, should that end of the lamp be removed from the holder, would be 125 volts which is the 121.5 volts which would appear at cathode 43 of lamp 3 plus the 3.5 volts appearing across cathode heating winding 31, again considerably less than 180 volts. It will also be seen that the maximum voltage applied between cathode 42 of lamp 4 and ground is the voltage appearing across secondary winding

37 plus the voltage appearing across cathode heating winding 32, or 173.5 volts. Thus, the voltage appearing across the pins connected to cathode 44 of lamp 4 and the fixture 45, should that end of the lamp be disconnected from the holder, would be no more than 173.5 volts, still less than 180 volts. The voltage appearing across the pins connected to cathode 41 and the fixture 45, should that end of lamp 3 be removed from the holder, will be no more than the voltage appearing on the pins of cathode 44 of lamp 4 plus the voltage across cathode heating winding 31, or 177 volts. It is thus seen that while the voltage appearing across cathodes 41 and 42 of lamps 3 and 4 respectively to operate the lamps may be the sum of the voltages appearing across primary winding section 19, cathode heating section 50, primary winding section 27, secondary winding 37, and cathode heating winding 32 or 295 volts, the voltage appearing between any one lamp cathode and the fixture is always less than 180 volts by virtue of the connection of end 20 of primary winding section 19 to the white or grounded side 47 of the power supply line. The voltages given above are illustrative only and other voltage values may be utilized in practicing this invention. It will also be readily understood that the core structure shown is merely by way of example and that any other suitable core structure may be utilized.

While we have shown and described a particular embodiment of this invention, further modifications and improvements will occur to those skilled in the art. We desire that it be understood therefore that this invention is not limited to the form shown and we intend in the appended claims to cover all modifications which do not depart from the spirit and scope of this invention.

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

1. Ballast apparatus for starting and operating arc discharge devices comprising a housing, a high reactance transformer within said housing having a primary winding and a secondary winding, an autotransformer connection internal said housing between one end of said primary winding and one end of said secondary winding, said windings being wound in voltage aiding relationship, means including a first input lead connected to said autotransformer connection and extending external said housing for making a grounded connection to an alternating current source, a second input lead connected to the other end of said primary winding and extending external said housing for making an ungrounded connection to said alternating current source, a tap on said primary winding, and a pair of output leads respectively connected to said tap and to the other end of said secondary winding and extending external said housing for connection across at least one arc discharge device, the voltage appearing between either output lead and said first input lead being less than that developed between said output leads.

2. The ballast apparatus of claim 1 including a power factor correcting capacitor connected in one of said output leads.

3. The ballast apparatus of claim 1 wherein said high reactance transformer has a pair of cathode heating windings in the region of its primary winding, each cathode heating winding having one end respectively connected within said housing to a different one of said output leads and having a lead connected to its other end and extending external said housing.

4. Ballast apparatus for starting and operating a pair of arc discharge devices comprising a housing, a high reactance transformer within said housing having an elongated magnetic core and primary and secondary windings on side-by-side regions of said core, an autotransformer connection internal said housing between one end of said primary winding and one end of said secondary winding, said windings being wound in voltage aiding relationship, means including a first input lead connected to said autotransformer connection and extending external said housing for making a grounded connection to an alternating current source, a second input lead connected to the other end of said primary winding and extending external said housing for making an ungrounded connection to said alternating current source, a tap on said primary winding, a pair of output leads respectively connected to said tap and to the other end of said secondary winding and extending external said housing for connection across a pair of arc discharge devices in series, the voltage appearing between either output lead and said first input lead being less than that developed between said output leads, a power factor correcting capacitor within said housing connected in one of said output leads, said transformer having three cathode heating windings on said core in the region of said primary winding, two of said heating windings each having one end respectively connected within said housing to a different one of said output leads and having its other end extending external said housing, and a starting capacitor connected internal said housing between said third heating winding and one of said output leads.

5. Ballast apparatus for starting and operating arc discharge devices comprising a fixture for supporting said devices, a high reactance transformer having a primary winding and a secondary winding, an autotransformer connection between one end of said primary winding and one end of said secondary winding, said windings being wound in voltage aiding relationship, a grounded connection between said autotransformer connection and said fixture including a first input lead, a second input lead connected to the other end of said primary winding, a tap on said primary winding, and a pair of output leads respectively connected to said tap and to the other end of said secondary winding for connection across at least one arc discharge device supported in said fixture, whereby the voltage developed between either output lead and said first input lead being less than that developed between said output leads.

6. Ballast apparatus for starting and operating arc discharge devices comprising a source of alternating current having one side grounded, a high reactance transformer having a primary winding and a secondary winding, an autotransformer connection between one end of said primary winding and one end of said secondary winding, said windings being wound in voltage aiding relationship, a first input lead connecting said autotransformer connection to said grounded side of said alternating current source, a second input lead connected from the other end of said primary winding to the other side of said alternating current source, a tap on said primary winding, and a pair of output leads respectively connected to said tap and to the other end of said secondary winding for connection across at least one arc discharge device, whereby the voltage developed between either output lead and said first input lead being less than that developed between said output leads.

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