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TRANSFORMER

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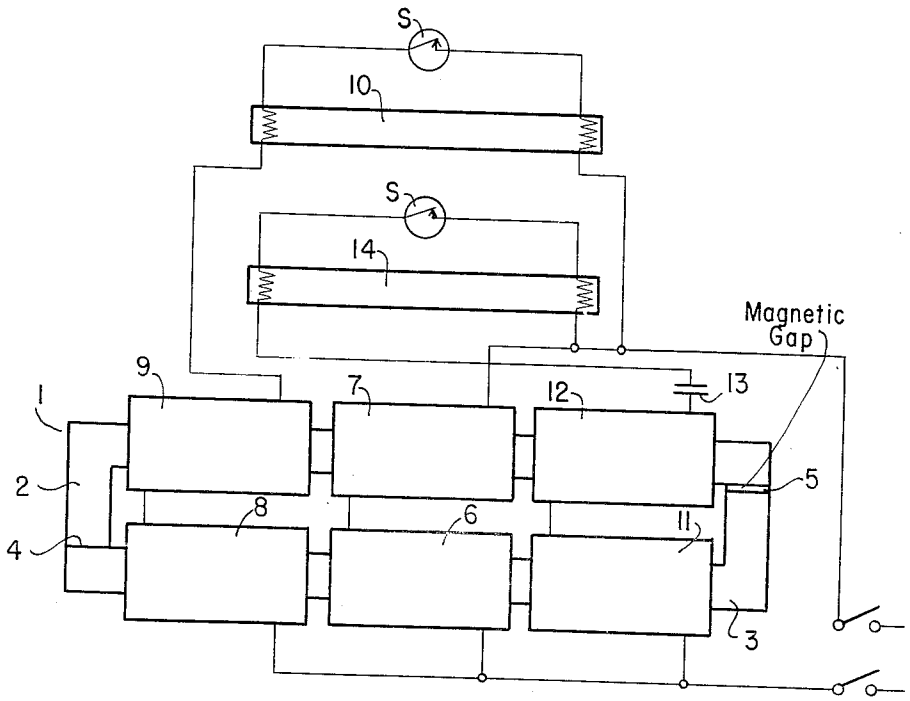

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TRANSFORMER

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8 Claims. (Cl. 323—44)

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This invention relates to electric transformers for hot cathode discharge lamps, particularly to a transformer for operating a plurality of fluorescent tube lamps.

Transformers of the type of the present invention are designed generally to operate a plurality of lamps, the circuit including a condenser in series with one of the lamps to cause it to take a leading current to correct for the lagging current taken by the other lamp.

Since the light output of fluorescent glow discharge lamps is proportional to the current, it is desirable to get a current which follows as closely as possible a sine wave. In a system employing transformers of the present type with a condenser in series with one of the members, a high voltage is set up in the coil which is in series with the condenser. This high voltage results in saturation of the portion of the transformer core in the region of the secondary that is connected with the condenser. The saturated condition of the core produces sharp peaks of the third harmonic in the resulting current wave. With increasing flux density the ratio of the third harmonic to the fundamental increases so that the resultant wave shape is peaked, deviating considerably from a true sine wave. The high peaks in the current wave tend to produce fluctuations in the light output of the lamp that is connected in series with the condenser. Since these light fluctuations are not compensated by fluctuations in the other lamp, namely, in the lamp which takes the lagging current, the net result is a stroboscopic effect which is objectionable. It is one of the objects of the present invention to produce a transformer of the otherwise conventional type used for this purpose and which transformer is so modified as to eliminate the current peaks in the one lamp, thereby reducing or substantially eliminating the stroboscopic effect due probably to the third harmonic that is produced as a result of the saturation of the iron transformer core. I have discovered that by introducing a short air or other non-magnetic gap in the magnetic circuit in the region of the secondary coils that are connected through the condenser to a lamp, the saturation effect is substantially eliminated, with resulting improvement in the wave shape and substantial elimination of the stroboscopic effect.

It is an object of the present invention to provide a transformer which can utilize present types of laminations and present types of manufacturing processes and in which an air gap can be provided to smooth out the otherwise peaked current

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waves on the leading lamp current supplying winding.

The attainment of the above and further objects of the present invention will be apparent from the following specification taken in conjunction with the accompanying drawing forming a part thereof.

In the drawing:

The figure illustrates, diagrammatically, a transformer of the present invention connected in a circuit.

The transformer 1 of the present invention comprises an iron core formed of two similar stacks of L-shaped laminations, indicated at 2 and 3. The stacks 2 and 3 are in magnetic abutment with one another at 4 and are separated from one another at 5 by a short non-magnetic gap which may be an air gap or may be a space filled with any non-magnetic material, such as paper. The thickness of the air gap may be of the order of .01 to .03 inch, although it is to be understood that this size is merely illustrative and subject to change as needs be. On each one of the long legs of the two core sections there are located three coils, namely, a central primary coil and two end secondary coils. The central primary coils, indicated at 6—7, are connected in series and directly across an alternating current line which may be a 60 cycle 110 volt line. Two secondary coils 8 and 9 are connected in series with one another and to one side of the primary coils to constitute a step-up auto-transformer to supply current to a lamp 10 the opposite side of which is connected to the line. The two secondary coils 11 and 12 are also connected in series and also connected to one side of the primary coils to form a step-up auto-transformer and supply power through a condenser 13 to a lamp 14 the opposite side of which is also connected to the line. The lamps 10 and 14 are both of the hot cathode glow discharge type and are adapted to be started by the passage of current through filaments thereof that are connected in series by a starter switch S which may be of any standard type and which opens the series circuit after a short time interval and leaves the series circuit open so that the arc forms and is maintained within the lamp in the ionized space between the electrodes thereof, all as is well known in the art.

The air gap 5 may be placed anywhere in the magnetic circuit in the region of the secondary coils 11—12 that are connected in series with the condenser.

Measurements of the flux through the core show that if there were no air gap, such as the air

gap 5, in the magnetic circuit the flux in the magnetic circuit adjacent the leading secondary coils 11—12 is many times the flux density in the iron core in the region of the lagging secondary coils 8—9. It is this high flux density in the region of the leading secondary coils that is responsible for accentuation of the third harmonic in the resulting secondary current. By introducing the air gap at 5 the flux density is reduced, with a resulting substantial reduction of the third harmonic so that the flux density in the region of the leading secondary coils approaches the flux density in the lagging secondary coils 8—9.

In compliance with the requirements of the patent statutes I have here shown and described a preferred embodiment of my invention. It is, however, to be understood that the invention is not limited to the precise construction here shown, the same being merely illustrative of the principles of the invention. What I consider new and desire to secure by Letters Patent is:

1. A transformer for operating a plurality of separately operable glow discharge tubes with leading and lagging currents respectively, said transformer comprising an elongated core having parallel side legs, a primary comprising a pair of interconnected coils positioned, one on each leg of said core, and a pair of secondaries, each secondary comprising a pair of interconnected coils positioned on the legs of the core, each of said secondaries being connected to the primary to form an auto-transformer, the spacing between the secondaries being sufficient to inhibit leakage flux of one secondary from affecting the other secondary to produce any substantial alteration of the voltage therein, the core having a non-magnetic gap therein in the circuit of the primary magnetizing flux that passes through both secondaries and adjacent only one of the pairs of interconnected secondaries, thereby forming a high magnetic reluctance passageway in the magnetic circuit of the leakage flux of only one of said pairs of interconnected secondary coils to prevent saturation of said magnetic circuit.

2. A transformer for operating a plurality of separately operable hot cathode glow discharge tubes with leading and lagging currents respectively comprising an elongated core having parallel side legs; a primary comprising a pair of interconnected coils positioned, one on each leg of said core intermediate the ends thereof; and a pair of secondaries, each comprising a pair of interconnected coils positioned on the legs of the core, one pair at the primary being between the secondaries each end thereof, each of said secondaries being connected to the primary to form an auto transformer, the spacing between the secondaries alone being sufficient to prevent leakage flux of one secondary from affecting the other secondary to produce any substantial variation in the voltage therein, the core having a gap in the portion of the core through which the primary magnetizing flux for both secondaries passes, the gap being adjacent one of the secondaries and on the side thereof remote from the primary whereby the gap is in the magnetic circuit of the leakage flux of only one of said pairs of interconected secondary coils to prevent saturation of said magnetic circuit.

3. A transformer for operating a plurality of separately operable hot cathode glow discharge tubes with currents displaced in phase in the transformer secondary, said transformer comprising an elongated core, a primary positioned on said core, and a pair of secondaries positioned on the core, each of said secondaries being connected to the primary to form an auto transformer and having means whereby each secondary can be connected to one of the tubes, the spacing between the secondaries being sufficient to inhibit leakage flux of one secondary from affecting the other secondary to produce any substantial alteration of the voltage therein, the portion of the core through which the primary magnetizing flux for both secondaries passes having, adjacent one of said secondaries, a portion forming a high magnetic reluctance passageway in the magnetic circuit of the leakage flux of only one of said pairs of interconnected secondary coils to prevent saturation of said magnetic circuit.

4. A transformer for operating a plurality of separately operable hot cathode glow discharge tubes with currents displaced in phase in the transformer secondary, said transformer comprising an elongated core, a primary positioned on said core, and a pair of secondaries positioned on the core, each of said secondaries being connected to the primary to form an auto transformer and having means whereby each secondary can be connected to one of the tubes, the spacing between the secondaries being sufficient to inhibit leakage flux of one secondary from affecting the other secondary to produce any substantial alteration of the voltage therein, the core having a non-magnetic gap forming a high magnetic reluctance passageway in the magnetic circuit of the leakage flux of only one of said pairs of interconnected secondary coils to prevent saturation of said magnetic circuit, said gap being in series in the path of the magnetizing flux that passes through the primary and both secondaries.

5. Apparatus for supplying electrically displaced operating currents for a pair of gaseous discharge tubes, said apparatus comprising a transformer core, two secondaries and a primary between them and all positioned on the core, a condenser in circuit with only one of the secondaries to cause it to furnish a leading current, the other secondary furnishing lagging current, a portion of the primary magnetic flux path being of substantially greater reluctance than the reluctance of the rest of the primary flux path to prevent saturation of the magnetic circuit by flux resulting from a leading secondary current, said portion being adjacent the leading secondary and being in the leakage flux path thereof and outside of the leakage flux path of the lagging secondary thereby maintaining a greater reluctance in leakage flux path of the leading secondary than of the lagging secondary.

6. Apparatus for supplying electrically displaced operating currents for a pair of gaseous discharge tubes, said apparatus comprising a transformer core, two secondaries and a primary between them and all positioned on the core, a condenser in circuit with only one of the secondaries to cause it to furnish a leading current, the other secondary furnishing lagging current, the leading secondary comprising two spaced apart coils on the core, the core having a non-magnetic gap in the primary magnetic flux path between said two leading secondary coils to prevent saturation of the magnetic circuit by flux resulting from a leading secondary current.

7. Apparatus for supplying electrically displaced operating currents for a pair of gaseous discharge tubes, said apparatus comprising a

transformer core, two secondaries and a primary between them all positioned on the core, a condenser in circuit with only one of the secondaries to cause it to furnish a leading current, the other secondary furnishing lagging current, the core having a non-magnetic gap therein in the magnetic circuit of the primary magnetizing flux that passes through both secondaries and located adjacent only that secondary that is in circuit with the condenser to prevent saturation of said magnetic circuit by the magnetic flux resulting from a leading current in the secondary.

8. Apparatus for supplying electrically displaced operating currents for a pair of gaseous discharge tubes, said apparatus comprising an elongated transformer core having parallel side legs, a primary comprising a pair of interconnected coils positioned one on each leg of said core, and two secondaries each comprising a pair of series connected coils positioned on the legs of the core, each of said secondaries being connected to the primary to form an autotransformer, the spacing between the secondaries

being sufficient to inhibit leakage flux of one secondary from affecting the other secondary in an amount to produce any substantial alteration of voltage therein, a condenser in circuit with one of the secondaries to cause it to furnish a leading current, the core having a non-magnetic gap therein in the magnetic circuit of the primary magnetizing flux that passes through both secondaries and adjacent only that secondary that is in circuit with the condenser, thereby forming a high magnetic reluctance passageway in the magnetic circuit of the leakage flux of only the leading secondary coils.

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