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ELECTRICAL SYSTEM AND APPARATUS

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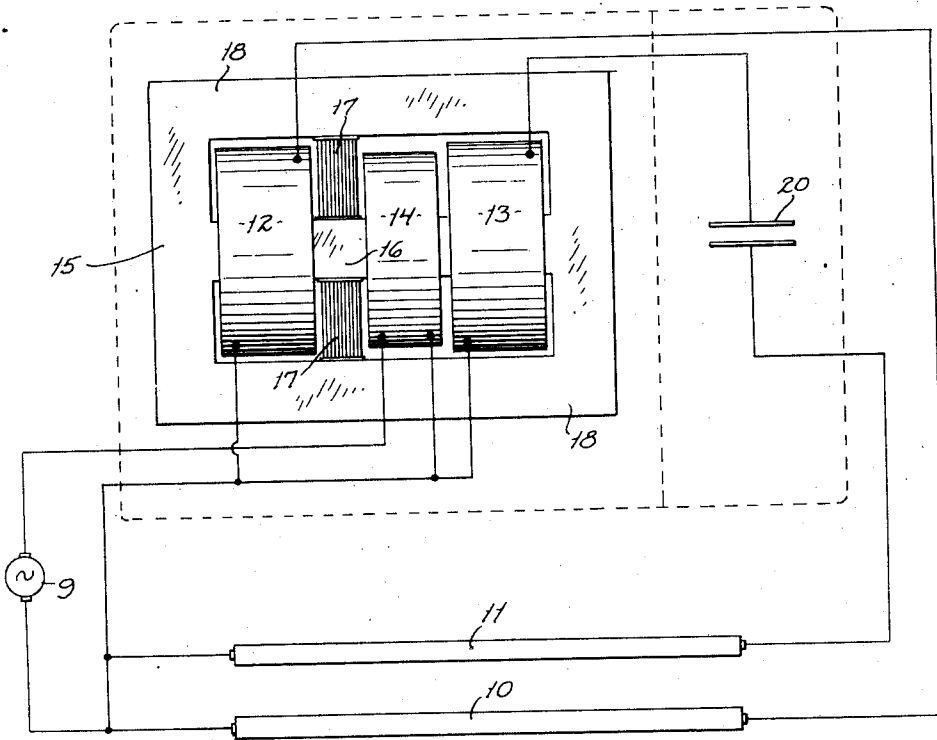


Fig. 1

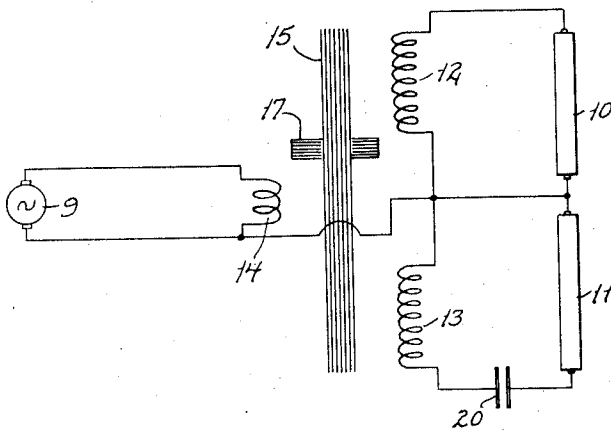


Fig. 2

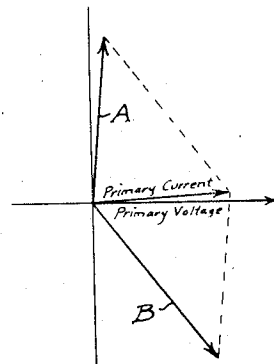


Fig. 3

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ELECTRICAL SYSTEM AND APPARATUS

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1 Claim. (Cl. 315-138)

This invention relates in general to electrical apparatus and particularly to that used for controlling and operating gaseous tubes, such as fluorescent light sources.

The light from a fluorescent source, as now generally used, is intermittent, and, hence, produces a stroboscopic effect whenever a single lamp is used in a fixture. An effort has been made to minimize such effect by operating a pair of lamps in a single fixture, and in such manner that one of the lamps is operating at maximum brightness whenever the other is operating at minimum brightness, and vice versa. A suggestion for accomplishing that result has included the use of two transformers, one for each lamp, with provision for producing a lagging current in one lamp circuit and a leading current in the other. The lagging current has been produced by means of a reactance, such as a choke coil separate from the transformer, while the leading current has been obtained by means of a capacitance, such as a condenser. The size and weight of a choke coil, however, in addition to the transformers, make the assembly undesirable for use in a lamp fixture where the space available is quite restricted.

Another suggestion was to continue the use of two transformers, but to include a magnetic shunt path between the primary and the secondary of one transformer, so as to attain the lagging current, and at the same time to retain the condenser in the secondary circuit of the other transformer so as to obtain the leading current. While this suggestion reduced the necessity for an exterior article, such as a choke coil, nevertheless, it still required considerable space in a fixture, because of the use of a plurality of primary winding coil sections.

An object of the present invention is to produce a transformer wherein a single primary winding coil section will operate a pair of secondary winding coil sections which are in circuit with a pair of gaseous tubes, and wherein the lagging current may be attained in one of the tubes without the necessity for a device, such as a choke coil separate from the transformer.

I carry out my invention by utilizing a single core structure having a single primary winding coil section and a plurality of secondary winding coil sections, which are so arranged on the core that the primary winding coil section is disposed between the two secondary winding coil sections. Each secondary coil section is connected to one of a pair of gaseous tubes, and the two tubes are placed sufficiently close together

that they cooperate to furnish light for a common field. A lagging current is produced in one of the tube circuits by means of a shunt which is provided in the core between the primary winding coil section and one of the secondary winding coil sections, whereas a leading current is provided in the other tube by means of a condenser connected in series with the other secondary winding coil section and with the other tube.

The foregoing arrangement of core, coils, reactance, capacitance and tubes has solved a problem in this art by producing a unitary structure of small, compact size, which will substantially eliminate the stroboscopic effect of a pair of gaseous tubes, when used for illuminating a common field. The utilization of a single primary winding core section, as compared to a double transformer, has reduced the weight and size of the structure, thereby facilitating its installation within a lamp fixture. Furthermore, the use of a single primary winding coil section, as compared to a double transformer, permits the use of wire of a smaller diameter in the primary coil, because the wire need be only large enough to carry a current which is the vectorial sum of, and in practice smaller than either of, the leading and lagging primary currents corresponding to the two secondaries. Preferably, however, the wire in the primary winding is made large enough to carry either the leading or lagging current alone, if but one lamp is in operation.

The advantage gained by using a single primary winding coil section with a pair of secondary coil sections, as aforesaid, is due to the fact that a lagging current flows in one secondary circuit while a leading current flows in the other. The two corresponding primary currents add vectorially in the single primary winding and thereby result in a total current which is less than either component alone.

Referring now to the drawing, Fig. 1 shows a transformer embodying my invention; Fig. 2 is a wiring diagram, and Fig. 3 is a vector diagram for the current flowing in the respective coils.

In Fig. 1, I have shown two gaseous tubes 10 and 11 which are arranged to be energized by current flowing from the secondary windings 12 and 13, respectively, of the transformer. A single primary winding coil section 14, energized from a source of alternating current supply 9, is used for energizing the secondary winding coil sections 12 and 13, while all of the coils are mounted upon the single core structure 15. In the preferred arrangement, the core structure

is of the shell type having a central leg 16 upon which all of the coils are mounted.

To obtain a lagging current in the circuit for the tube 10, I utilize shunt means 17 in the core structure between the central leg 16 and the outer legs 18, and to obtain a leading current in the other tube 11, I provide a condenser 20 in series with the circuit for the tube 11.

The foregoing arrangement of coils, core, shunt and condenser provides two secondaries having a common primary and results in a dissymmetrical type of structure wherein one secondary, designated 12, operates to produce a constant current output to a load circuit, while the other operates to impart a constant voltage output to a load circuit. The shunt 17 limits the current in the secondary 12, after the tube 10 has been placed in operation, while the condenser 20 limits the current in the secondary 13, after the tube 11 has been placed in operation.

The production of a lagging current in one tube circuit and a leading current in the other tube circuit results in the primary coil operating at approximately unity power factor, and thereby effects a distinct saving in cost of construction, and increases the efficiency of operation by providing the best type of loading for the power source. Moreover, the use of a single primary for operating two secondary winding sections reduces the amount of wire in the primary and permits the size of the primary wire to be made smaller than would be the case if an individual primary winding was used with each secondary winding. This is due to the fact that the currents due to the respective secondary windings add vectorially in the primary and, hence, result in a total current flowing in the primary which is less than that flowing due to either secondary. This may be observed from an inspection of the vector diagram shown in Fig. 3, which illustrates the results obtained from a test of a transformer embodying the present invention.

In Fig. 3, line A, shows a flow of current in the primary winding 14 of 1.26 amperes with only the leading current tube 11 in operation, while line B shows a flow of 1.52 amperes in the primary winding 14 with only the lagging current tube 10 in operation. The resulting component gives a flow of only 1.08 amperes in the primary with both lamps in operation; hence, the primary for normal operation need be large enough only to carry the current indicated by the resulting component. In practice, however, the wire size of the primary coil is made sufficiently large enough to carry the maximum current that may flow with either tube in operation.

An example of an apparatus for carrying out my invention may be illustrated by using as a source of supply alternating current at 118 volts

and 60 cycle. The load circuit embodies two gaseous tubes, such as those designated as standard 40 watt, fluorescent tubes. The transformer has a core stack substantially 1" x 1" in cross section; a primary coil embodying 510 turns of #22 wire; two secondary coils, each having 2,000 turns of #26 wire; a shunt disposed between the primary and one secondary coil of a size sufficient to limit the current to approximately 370 milliamperes on short circuit; and a condenser of 1.75 microfarads capacity. A transformer made in accordance with the foregoing specification will result in a current of approximately 380 milliamperes in the condenser or leading current circuit, and approximately 360 milliamperes in the shunt or lagging current circuit.

An important advantage of apparatus employed in the present invention is the fact that starting switches, with their attendant objections of moving parts and requirements for maintenance, are eliminated, because the open circuit voltage of the secondaries, and, hence, the initial voltage produced by the transformer, is sufficiently high to strike the desired arc in each tube. The tubes are non-stroboscopic; the system can be operated at substantially unity power factor; and the transformer can be reduced in size, thereby greatly facilitating its use within the space limits of a fluorescent lamp fixture. A further advantage is the fact that the lamps are started immediately upon energization of the transformer, whereas with starting switches there was a time interval between the energization of the transformer and the lighting of the tube.

I claim:

A system for lighting gaseous tubes comprising in combination, a transformer embodying a shell type core having a single complete primary circuit including a winding mounted on said core, and having two complete secondary circuits including coil sections mounted on said core, said primary winding and said secondary coil sections being disposed in axially spaced relationship on said core with one secondary coil section on each side of said primary winding, means connecting the primary winding to a source of alternating current, two gaseous tubes, means connecting one of the secondary circuits to one of the tubes, and means connecting the other secondary circuit to the other of said tubes, said transformer having magnetic shunt means disposed only between the primary winding and one of the secondary coil sections, and having the other secondary coil section disposed in close proximity to the primary coil winding, and capacitance means in the tube circuit associated with said last-named secondary coil section.

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