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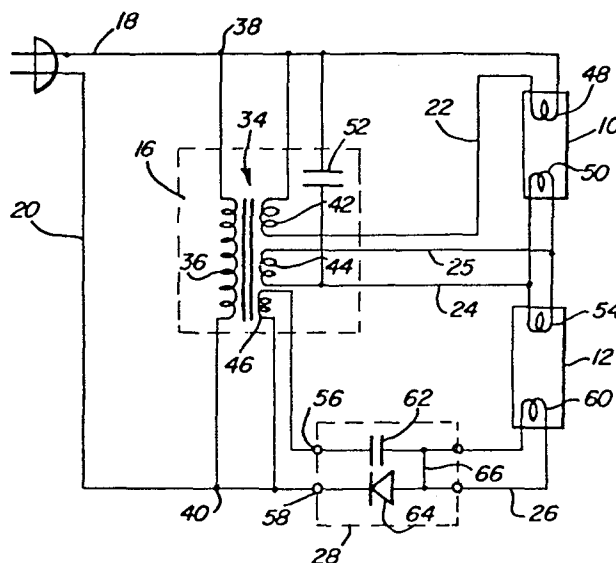
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54 **Output current controller for fluorescent lamp ballast.**

57 One (46) of the low voltage output windings (42, 44, 46) of a standard ballast circuit (16) is coupled to one filament (60) of a pair of series connected fluorescent lamps (10 and 12) through a regulating capacitor (62) and a current rectifying diode (64) which are connected in series across such output winding (46) and in parallel to the one filament.



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OUTPUT CURRENT CONTROLLER FOR
FLUORESCENT LAMP BALLAST

This invention relates to operation of electron discharge devices, such as fluorescent lamps, that require the use of a ballast circuit for starting purposes.

5 Generally, the ballast circuit for multiple fluorescent lamps include a power supply transformer having a plurality of low voltage output windings connected to the opposite filaments of the lamps, with a capacitor connected to one of the output
10 windings to control the supply under starting and running conditions. Various regulating devices for ballasted fluorescent lamps are known or have been proposed to protect lamp filaments and for other purposes, requiring extensive and often special
15 circuit modifications.

It is an important object of the present invention to provide a low cost current control device capable of being readily interfaced with existing ballasted fluorescent lamp assemblies to
20 improve ballast efficiency and prolong lamp life expectancy.

In accordance with the present invention, the low voltage output of a standard ballast circuit connected to one of the filaments of a pair of
25 series connected fluorescent lamps is modified in

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such a manner as to reduce the current drawn and decrease the operating temperature of the ballast during start up without adversely affecting restart. Toward that end, a current controller is inserted
5 between said one of the lamp filaments and a low voltage output of the ballast circuit otherwise directly connected to such filament. The current controller includes a regulating capacitor, having a capacitance above 4.7 microfarads, that is cyclically
10 charged under control of a current rectifying diode through which a pulsating D.C. plate supply voltage is applied to said one of the filaments in order to maintain its associated lamp in a non-firing state during start up.

15 Figure 1 is a block diagram illustrating the installation of the present invention.

 Figure 2 is a circuit diagram illustrating in greater detail one embodiment of the invention.

 Figure 3 is a circuit diagram illustrating
20 another embodiment.

 Figure 4 is a graphical illustration of the voltage signal characteristic modified in accordance with the present invention.

 Referring now to the drawings in detail,
25 Figure 1 diagrammatically illustrates a pair of series connected electron discharge devices 10 and 12, such as fluorescent lamps, connected to an AC voltage source 14 through a standard ballast circuit 16. The power lines 18 and 20 from the source are
30 connected to the high voltage side of the ballast

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circuit which has a low voltage side from which outputs are applied across the electron discharge lamps 10 and 12 through output voltage lines 22, 24 and 26 under starting and running conditions. In accordance with the present invention, a current controller component 28 is placed in one of the three low voltage outputs of the standard ballast circuit for the series connected fluorescent lamps 10 and 12 in order to modify the characteristics of the output voltage and current otherwise operative to fire and run the lamps.

Figure 4 illustrates a standard waveform curve 30 characterizing a typical output signal of the ballast circuit showing a sloping square wave shape. Curve 32 represents the output signal modified by the current controller 28, showing an increase in voltage amplitude without any change in phase. The affect of such output signal modification is to apply a potential difference across the lamp 12 less than the firing voltage applied to lamp 10 for starting both lamps and drawing a reduced current. Further, the overall operating temperature of the ballast 16 is typically reduced from 129° F to approximately 112° F to effectively prolong the life thereof. Also, firing of the lamps at a lower temperature increases their life expectancy. Despite the fact that lamp 12 is maintained in an "off" firing state, immediate refiring occurs under the low potential difference across its opposite filaments to insure restart following power interruptions of short duration.

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Figure 2 illustrates in greater detail a series reactor type of standard ballast circuit 16 including a transformer 34 having a primary winding 36 connected across the AC voltage lines 18 and 20 at its opposite terminals 38 and 40. Three secondary output windings 42, 44 and 46 are associated with the transformer 34. Secondary winding 42 is connected at one end to the terminal 38 of the primary winding and at its other end to one cathode filament 48 associated with lamp 10 through output line 22. The filament 48 is connected directly to line 18 to which the primary winding terminal 38 is also connected. The opposite cathode filament 50 of lamp 10 is connected across the secondary winding 44 by output voltage lines 24 and 25. A capacitor 52 is connected across lines 18 and 24 to complete the ballast circuit.

The filament 50 of lamp 10 is interconnected, in parallel with one filament 54 of lamp 12, to the secondary winding 44. The secondary winding 46 is connected across the input terminals 56 and 58 of the current controller 28 through which a low voltage output of the ballast 16 is connected by line 26 to the other cathode filament 60 of lamp 12. Input terminal 58 is directly connected to terminal 40 of the primary winding to which input voltage line 20 is connected.

The current controller 28 includes a regulating capacitor 62 connected to secondary winding 46 through terminal 56 for cyclic recharging. A current rectifying diode 64 is connected in series

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with capacitor 62 across the secondary winding 46 through jumper 66 and terminal 58 and thereby in parallel with capacitor 62 to both sides of the filament 60. The capacitordiode network formed by
5 the current controller will accordingly increase the expected magnitude of the voltage output of secondary winding 46 as reflected by the impure sinusoidal voltage curve 32 shown in Figure 4. A pulsating DC current is thereby fed to the filament
10 60 to establish the nonfiring potential difference across filaments 60 and 54. Firing voltage is therefore restricted to lamp 10 with a reduction in current drawn and the aforementioned decrease in temperature conditions.

15 In the embodiments illustrated, the AC voltage source has an operating voltage of 120 VAC to 347 VAC at a line frequency of approximately 50 to 60 Hz, while the regulating capacitor 62 has a capacitance value above 4.7 microfarads, below which
20 the lumen output level of the lamps become impractical. The capacitor 62 is furthermore non-poled so that a low AC output of 5 to 6 volts at terminal 56 may charge the capacitor negative or positive. When the capacitor charge reaches filament 60, both
25 capacitors 62 and 52 discharge to the other filaments. Capacitor 62 then recharges through diode 64. Such push pull action of the current controller 28 accounts for the output voltage modification aforementioned and the decrease in current and temperature conditions.

30 Figure 3 illustrates another embodiment of

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the invention wherein a transformer ballast type of standard lamp ballast circuit 16' is utilized for the lamps 10 and 12, which are interconnected in series and coupled to the low side of the ballast
5 circuit and to the current controller 28 as in the case of Figure 2. In Figure 3, the input voltage lines 18 and 20 from the AC source are connected across an inductive winding 68 of transformer 70 in the ballast circuit 16'. Winding 72 of transformer
10 70 is connected across lines 18 and 18'. The transformer 34' is connected across lines 18' to provide the low voltage outputs to the lamp filaments as hereinbefore described with respect to Figure 2.

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CLAIMS

1. In combination with at least two series connected electron discharge devices having heating filaments, an AC voltage source and standard ballast means having a high voltage side connected to the source
5 and a low voltage side connected to the filaments for applying a firing voltage reduced to an operating voltage level to start and run the devices, means for reducing the current and temperature conditions under which the devices operate to prolong the life of the
10 ballast means, comprising cyclically recharging capacitor means in series with the low voltage side of the ballast means for limiting current conducted to the filaments of one of the electron discharge devices to which the firing voltage is applied,
15 and current controlling means connected in parallel with the capacitor means to one of the filaments of the other of the electron discharge devices for maintaining a potential difference across the filaments thereof less than the firing voltage.
- 20 2. The combination of claim 1 wherein the electron discharge devices are lamps, the ballast means including a transformer having a primary winding forming the high voltage side connected to the source and a plurality of secondary windings forming the low
25 voltage side, said capacitor means coupling one of the secondary windings to the primary winding, means connecting said one of the secondary windings in parallel to one of the filaments of each of the lamps for applying the firing voltage across the pair of

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filaments of one of the lamps, the current controlling means operatively connecting a second of the secondary windings to the other of the filaments of the other of the lamps for establishing the potential difference
5 between the pair of filaments of the other of the lamps less than said firing voltage.

3. The improvement as defined in claim 2 wherein said current controlling means comprises a second regulating capacitor connecting said other of the
10 filaments of the other of the lamps to the second of the secondary windings, and a diode connected in series with the regulating capacitor across the second of the secondary windings.

4. The combination of claim 3 wherein the primary
15 winding includes opposite terminals connected to the AC source and respectively to the second and a third of the secondary windings, said third of the secondary windings being directly connected to the other of the filaments of said one of the lamps.

20 5. The improvement as defined in claim 4 wherein the regulating capacitor has a capacitance above 4.7 microfarads.

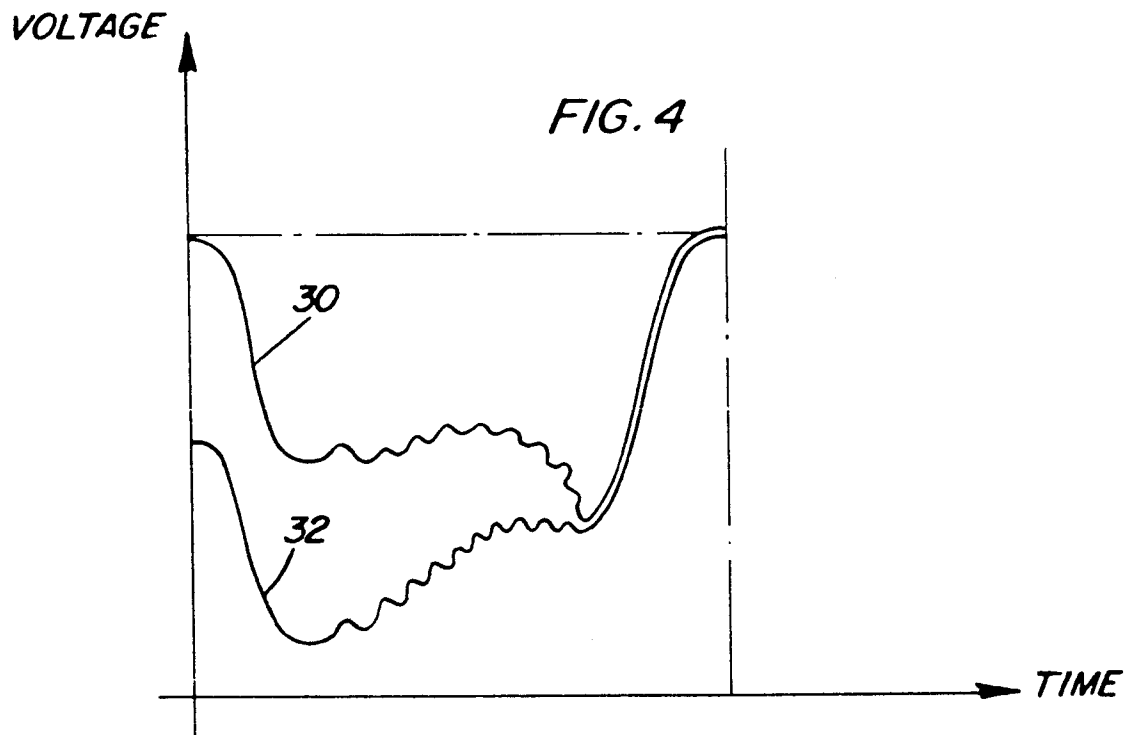
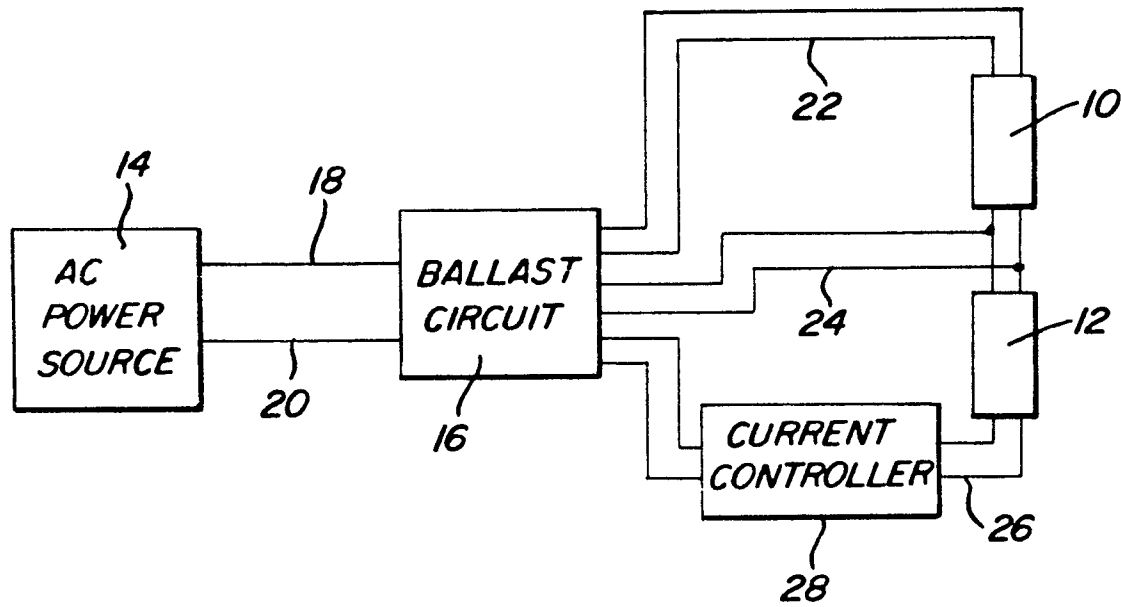
6. The improvement as defined in claim 2 wherein the regulating capacitor has a capacitance above 4.7
25 microfarads.

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7. The combination of claim 2 wherein the primary winding includes opposite terminals connected to the AC source and respectively to the second and a third of the secondary windings, said third of the secondary
5 windings being directly connected to the other of the filaments of said one of the lamps.

8. The combination wherein the electron discharge devices are lamps having respective filaments therefor interconnected while the other filaments are independent
10 of each other, the ballast means including a transformer having a primary winding forming the high voltage side connected across the AC voltage source and three secondary windings forming the low voltage side, one of the secondary windings being connected across the
15 interconnected filaments, a second of the secondary windings being directly connected to one of the independent filaments, the capacitor means coupling said one of the secondary windings to one of the independent filaments, the current controlling means
20 including a regulating capacitor connecting a third of the secondary windings to the other of the independent filaments, and current rectifying means connected in series with said regulating capacitor across the third of the secondary windings for
25 establishing a potential difference across the filaments of the other of the two lamps less than the firing voltage.

FIG. 1



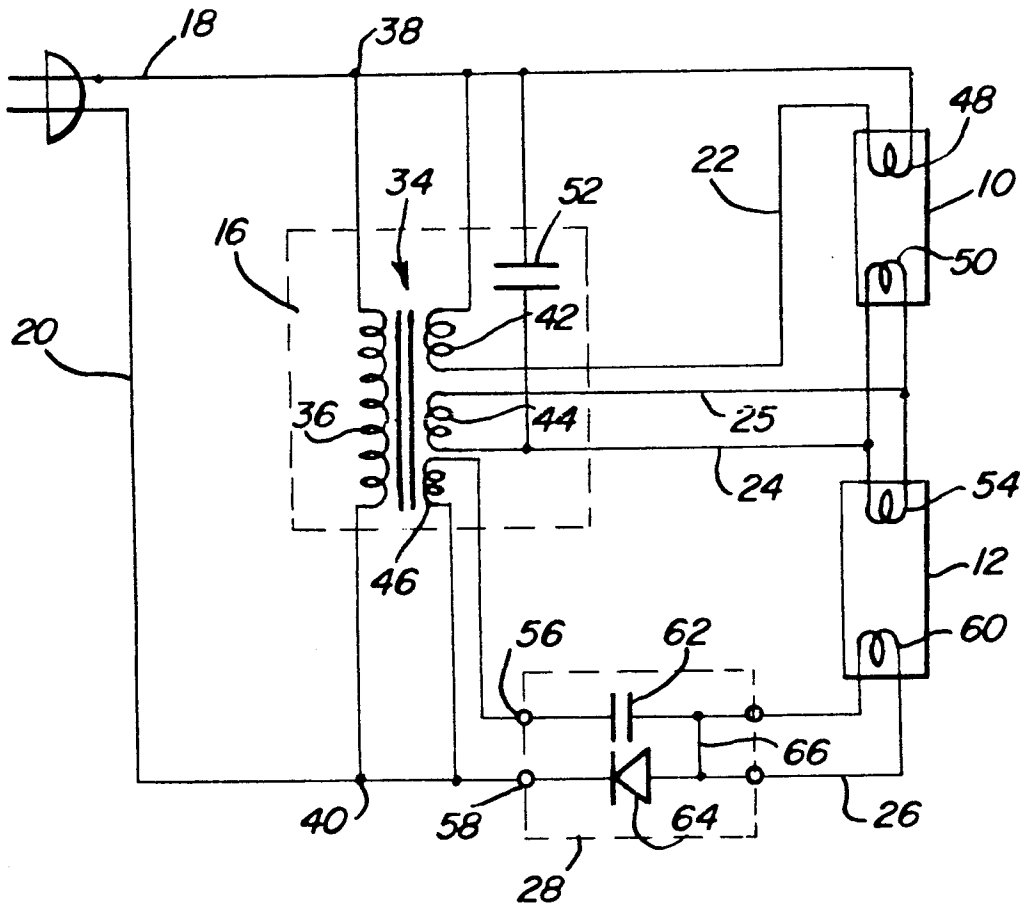
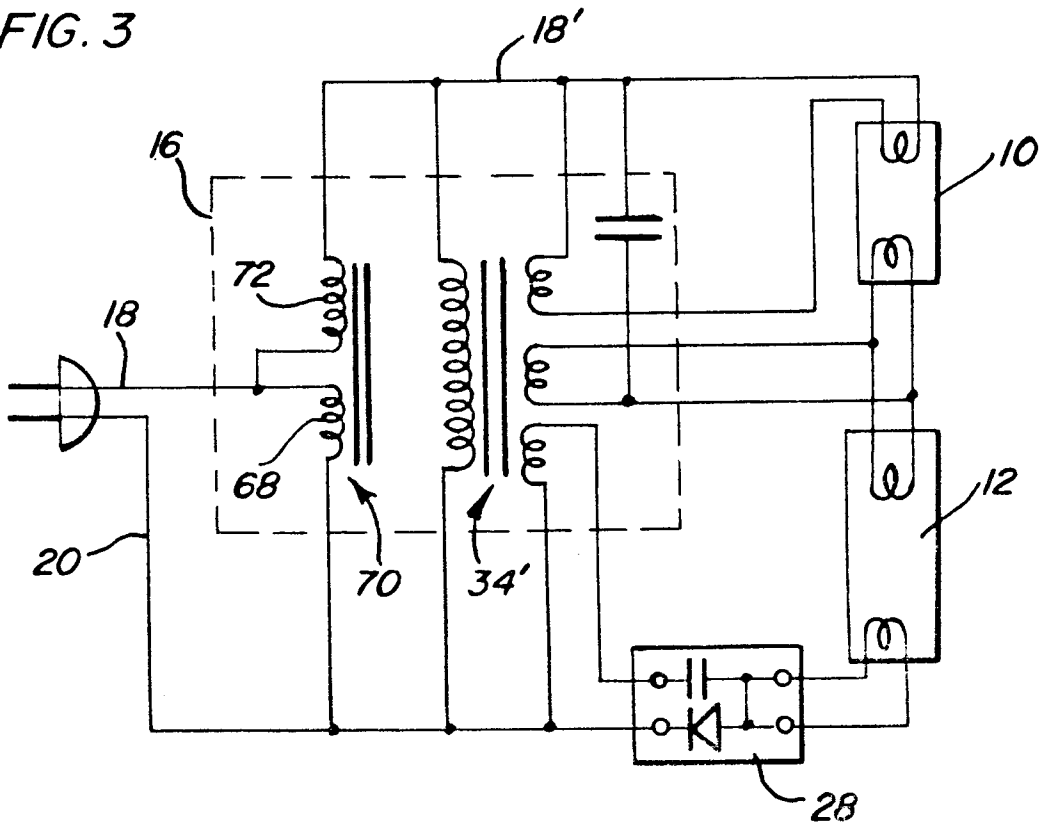


FIG. 3





European Patent
Office

EUROPEAN SEARCH REPORT

0150585

Application number

DOCUMENTS CONSIDERED TO BE RELEVANT			EP 84308357.7
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	DE - A1 - 3 143 823 (HITACHI) * Abstract; claims 1-4; fig. 1,2 *	1-3,8	H 05 B 41/14
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A	US - A - 3 921 032 (HALLAY) * Abstract; fig. 1; claims 1-15 *	1-3,8	
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A	US - A - 3 954 316 (LUCHETTA) * Abstract; fig. 2; claims 1-5 *	1,8	TECHNICAL FIELDS SEARCHED (Int. Cl.4) H 05 B 41/00 H 05 B 37/00 H 05 B 39/00
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A	US - A - 3 866 087 (POWELL) * Abstract; fig. 1-3; claims 1-10 *	1,8	
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A	GB - A - 1 554 138 (WESTINGHOUSE) * Fig. 1; claims 1-3 *	1,8	

The present search report has been drawn up for all claims			
Place of search VIENNA		Date of completion of the search 26-04-1985	Examiner VAKIL
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			