

[54] **CURRENT LIMITED OSCILLATOR
ARRANGEMENT**

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315/106, DIG. 2, 206; 331/117 R, 183

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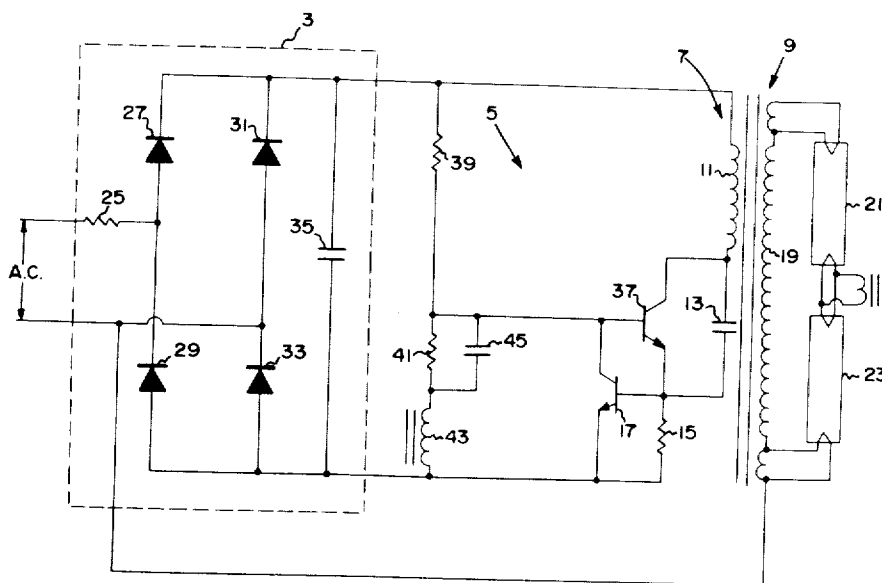
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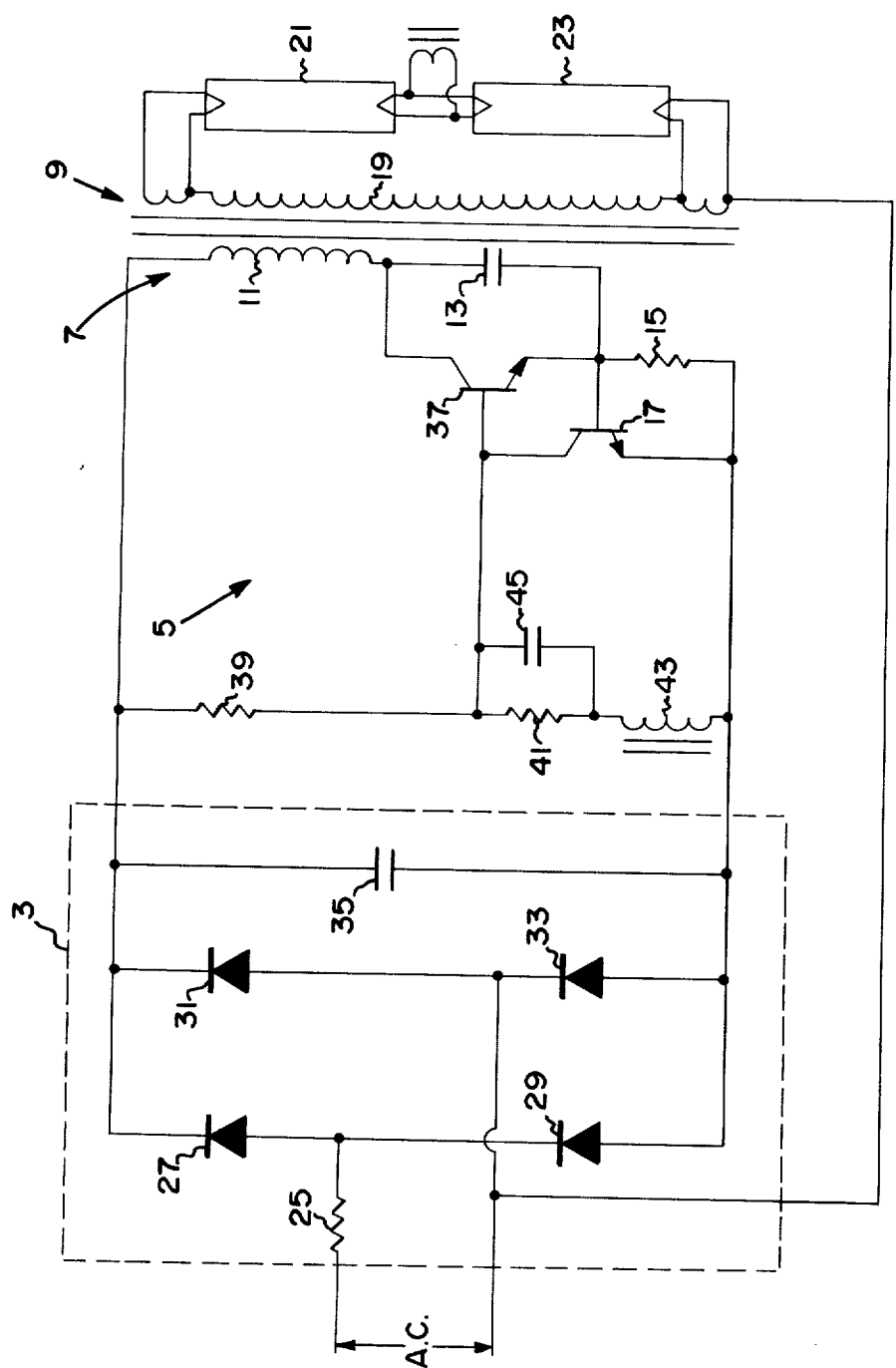
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[57] **ABSTRACT**

A current limiting oscillator circuit for a low pressure electric discharge lamp wherein an oscillator means is coupled to a DC potential source and to a load circuit coupled to the DC potential source with a current sampling means coupled to the oscillator means and a switching means coupling the current sampling means to the oscillator means whereby the switching means limits the current flow and renders the oscillator means non-conductive while the load circuit renders the oscillator means conductive.

12 Claims, 1 Drawing Figure





CURRENT LIMITED OSCILLATOR ARRANGEMENT

BACKGROUND OF THE INVENTION

This invention relates to a current limiting oscillator circuit and more particularly to a ballast circuit suitable for use with fluorescent lamps.

Generally, ballast circuits for fluorescent lamps include an auto-transformer operable at a 60-Hz rate whereby the lamp is rendered non-conductive at a rate of about 120-Hz. The auto-transformer is undesirably heavy and expensive. Also, the auto-transformer is purposefully designed to be inefficient in order to act as a current limiter whereby excessive current flow is prevented. Thus the lamp is saved from burnout by the inefficiency of the transformer. However, it can readily be deduced that such undesired features as energy waste and excessive heat generation accompany the designed transformer inefficiency. Moreover, the above-mentioned 120-Hz rate of lamp non-conductivity is well within the audio frequency range and results in undesired audible noise.

In another known form of ballast circuit, a transformer having a core of ferromagnetic material has a secondary winding coupled to a fluorescent lamp. A primary winding and a feedback winding are coupled to an oscillator in the form of a multivibrator or flip-flop circuit. The circuit operates under class D conditions with the collector current of one of the transistors saturating and effecting a saturated condition of the core material of the transformer. Thus, core material saturation is employed to limit the current flow and inhibit burnout of the fluorescent lamp.

Although the above-mentioned circuits have been and still are utilized in some fluorescent lamp arrangements, it has been found that each leaves something to be desired. For example, heavy and expensive but inefficient auto-transformers are something less than desirable. Also, circuitry depending upon transformer core material saturation condition tend to provide erratic and unpredictable performance.

OBJECTS AND SUMMARY OF THE INVENTION

An object of the present invention is to provide an enhanced current limiting oscillator circuit. Another object of the invention is to provide an improved ballast circuit suitable for use with a low pressure electric discharge lamp. Still another object of the invention is to improve the current limiting capabilities of an oscillator circuit with a negative feedback control circuit. A further object of the invention is to provide an improved current limiting oscillator circuit utilizing positive and negative feedback potentials.

These and other objects, advantages and capabilities are achieved in one aspect of the invention by an oscillator circuit means coupled to a DC potential source and to a load circuit including a transformer with a primary winding connected to the DC potential source and having a current sampling means coupled to the oscillator means and to a switching means connected back to the oscillator means whereby the switching means renders the oscillator means non-conductive when current flow therethrough exceeds a given amount and the load circuit renders the oscillator means conductive upon attainment of a given potential level.

BRIEF DESCRIPTION OF THE DRAWINGS

The sole diagram illustrates a ballast circuit for a fluorescent lamp which includes a preferred embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

For a better understanding of the present invention, together with other and further objects, advantages and capabilities thereof, reference is made to the following disclosure and appended claims in connection with the accompanying drawing.

Referring to the drawing, a circuit arrangement suitable for use with a low pressure electric discharge lamp, such as a fluorescent lamp, includes a bridge-type rectifier circuit 3 coupled to an AC potential source. An oscillator circuit 5 is coupled to the rectifier circuit 3 and to a load circuit 7 which includes an output transformer 9 having a primary winding 11 in series connection with a capacitor 13 and coupled to the rectifier circuit 3. A current sampling means 15 is coupled to the oscillator circuit 5 and to a switching means 17 which is, in turn, connected back to the oscillator circuit 5. Moreover, the secondary winding 19 of the output transformer 9 is coupled to a pair, 21 and 23, of fluorescent lamps.

More specifically, the bridge-type rectifier circuit 3 includes a resistor 25 coupled to the AC source and to first and second oppositely poled diodes, 27 and 29. The first and second diodes, 27 and 29 are connected to third and fourth diodes 31, and 33 with a capacitor 35 connected intermediate the junctions of the first and third diodes 27 and 31 and the second and fourth diodes 29 and 33.

The oscillator circuit 5 includes a transistor 37 having a base connected by a resistor 39 to the junction of the first and third diodes 27 and 31 and via a series connected resistor 41 and transformer winding 43 to the junction of the second and fourth diodes 29 and 33 of the rectifier circuit 3. A capacitor 45 shunts the resistor 41. The collector of the transistor 37 is coupled to the junction of the series connected primary winding 11 and capacitor 13 of the load circuit 7.

The emitter of the transistor 37 is coupled to the capacitor 13 of the load circuit 7 and to the sampling resistor 15. In turn, the sampling resistor 15 is connected to the junction of transformer winding 43, and the second and fourth diodes 29 and 33 of the rectifier circuit 3.

Also connected to the emitter of the transistor 37 and to the sampling resistor 15 is the base of the transistor or switching means 17. The collector of the transistor 17 is connected to the base of the transistor 37 of the oscillator circuit 5 while the emitter of the transistor 17 is connected to the junction of the sampling resistor 15, transformer winding 43 and junction of the second and fourth diodes 29 and 33.

As to operation of the above-described circuit arrangement, a potential applied to the bridge-type rectifier circuit 3 from the AC potential source provide a DC potential which is applied to oscillator and load circuits, 5 and 7 respectively. Thereupon, the transistor 37 is rendered conductive by resistor 39 and transformer winding 43 and current flow therethrough is effected.

This flow of current through the transistor 37 is sampled by the sampling resistor 15. When the current flow

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reaches a given level, a potential is developed at the sampling resistor 15 of an amount sufficient to bias-on the transistor 17. Turning-on the transistor 17 reduces the base current and limits the collector current of transistor 37. This forces the induced voltage of transformer winding 43 to zero. Thus, a negative feedback system utilizing the sampling resistor 15, transistor 17, and transformer winding 43 has been employed to turn-off the transistor 37.

At the time when the transistor 37 is turned off, the potential at the junction of the series connected primary winding 11 and capacitor 13 rises. This series connected load circuit 7, including primary winding 11 and capacitor 13, is resonant at a given frequency, preferably about 20 KHz, and provide a positive feedback potential to the base of the transistor 37 whereupon conductivity thereof is effected.

Thus, current sampling is employed to effect development of a negative feedback potential at a given level of current flow whereby non-conductivity of the oscillator circuit 5 is achieved. Also, series resonance in the load circuit 7 is utilized to effect conductivity of the oscillator circuit 5.

Additionally, the collector to base junction of transistor 17 is utilized to inhibit the application of negative excursions in potential to the base of the transistor 37. Moreover, the capacitor 45 enhances the rate at which the charge on the capacitor 13 is dissipated.

Thus, there has been provided a unique oscillator circuit arrangement especially suitable as a ballast circuit for a fluorescent lamp. The arrangement is especially light in weight because of the utilization of a transformer which employs a core of ferromagnetic material having improved efficiency and reduced heat generating capabilities as compared with prior inefficient, heavy, and excessive heat developing transformer structures. Also, undesired noise is virtually eliminated by the high frequency, above the audio range, operation of the oscillator circuitry. Moreover, the apparatus is inexpensive and reliable with a definite control of current levels in the circuitry.

While there has been shown and described what is at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention as defined by the appended claims.

What is claimed is:

1. Current limiting oscillator circuitry comprising:

a DC potential source;

load circuit means including a transformer having an inductive reactance means connected to said DC potential source and a secondary winding coupled to a low pressure electric discharge lamp;

oscillator means coupled to said DC potential source and to said inductive reactance means of said load circuit means;

sampling means coupling said oscillator means connected to said inductive reactance means to a potential reference level; and

switching means coupled to said sampling means and to said oscillator means and intermediate said oscillator means and said potential reference level whereby current flow exceeding a given level through said oscillator means and inductive reactance of said load circuit means as determined by said current sampling means activates said switching means which limits current flow in said oscillator

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tor means to effect development of a potential at said load circuit means in an amount greater than said DC potential source for application to said low pressure electric discharge lamp.

2. The current limiting oscillator circuit of claim 1 wherein said load circuit means includes an inductive reactance means in the form of a transformer winding on a ferromagnetic core and said switching means limits the current flow through said transformer winding to a level less than the saturation current level of said core.

3. The current limiting oscillator circuit of claim 1 wherein said sampling and switching means provides a negative feedback potential and said load circuit means provides a positive feedback potential for said oscillator means.

4. The current limiting oscillator circuit of claim 1 wherein said switching means includes a unidirectional conduction capability whereby the negative-going potential applied to said oscillator means is limited.

5. A low pressure electric discharge lamp circuit comprising:

an AC potential source;

rectifier means coupled to said AC potential source to provide a DC potential source;

oscillator means coupled to said DC potential source; load circuit means including a transformer having a primary winding coupled to said DC potential source and to said oscillator means and a secondary winding coupled to said low pressure electric discharge lamp;

current sampling means coupled to said oscillator means connected to said primary winding of said load circuit means and to a potential reference level; and

switching means coupled to said current sampling means and to said oscillator means and intermediate said oscillator means and said potential reference level whereby current flow through said oscillator means and primary winding of said load circuit means above a given level as determined by said current sampling means activates said switching means which limits current flow in said oscillator means and primary winding of said load circuit means to effect development of a potential at said load circuit means in an amount greater than said DC potential source for application to said low pressure electric discharge lamp.

6. The low pressure electric discharge lamp circuit of claim 5 wherein said oscillator means is in the form of a transistor having a collector coupled to said load circuit means; an emitter coupled to said load circuit means, said current sampling means, and said switching means; and a base coupled to said switching means, said rectifier means, and said load circuit means.

7. The low pressure electric discharge lamp circuit of claim 5 wherein said transformer of said load circuit means includes a ferromagnetic core and said switching means limits the current through said transformer and oscillator means to a level less than the saturation level of said ferromagnetic core.

8. The low pressure electric discharge lamp circuit of claim 5 wherein said switching means includes a unidirectional current conduction capability for limiting the negative-going potential applied to said oscillator means from said load circuit means.

9. The low pressure electric discharge lamp circuit of claim 5 wherein a negative feedback potential from

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said switching means and a positive feedback potential from said load circuit means are applied to said oscillator means whereby a desired current limited oscillation is effected.

10. A ballast circuit for a flourescent lamp comprising: 5
an AC potential source;
rectifier means coupled to said AC potential source to provide a DC potential source;
load circuit means including an output transformer 10
having a ferromagnetic core with a secondary winding coupled to a flourescent lamp and a primary winding coupled to said DC potential source;
oscillator means coupled to said primary winding of 15
said transformer in said load circuit means and including a transistor coupled to said DC potential source;
current sampling means coupled to said oscillator means and to a potential reference level; and 20

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switching means coupled to said current sampling means and to said oscillator means and intermediate said transistor of said oscillator means and said potential reference level, said switching means limiting current flow in said transistor of said oscillator means to effect a reduced current flow and increased potential at said load circuit means with said increased potential at said load circuit means in an amount greater than said DC potential source applied to said low pressure electric discharge lamp.

11. The ballast circuit of claim 10 wherein said sampling means and said switching means limits the current flow through said oscillator means to a level less than the saturation level of said output transformer.

12. The ballast circuit of claim 10 wherein said oscillator means operates at a frequency higher than the audio frequencies.

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