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NONSTROBOSCOPIC CIRCUIT FOR GASEOUS DISCHARGE DEVICES

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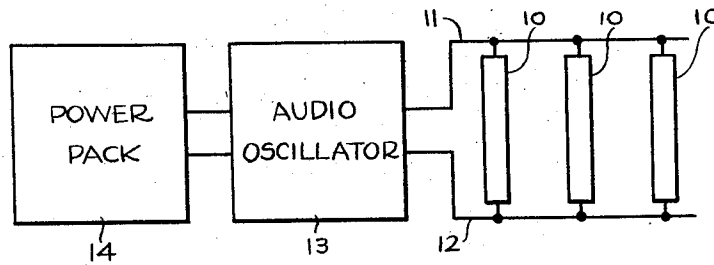


FIG. 1

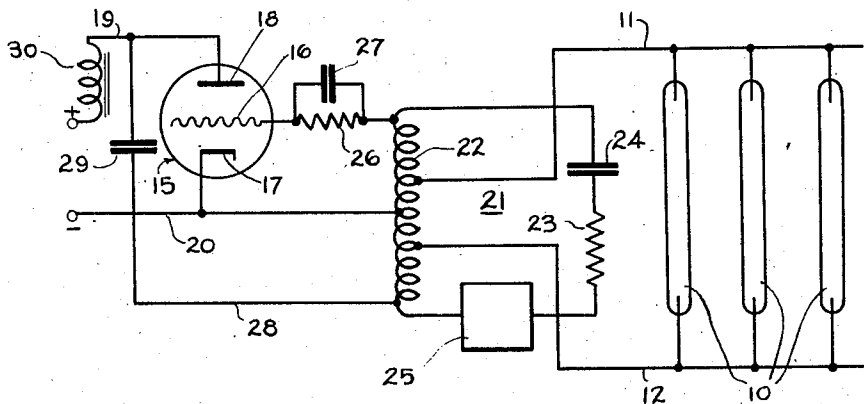


FIG. 2

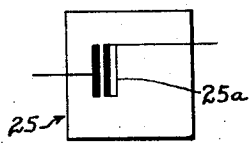


FIG. 3

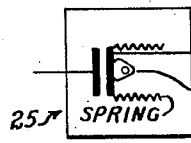


FIG. 4

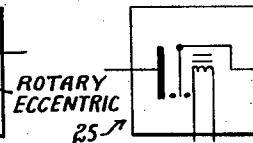


FIG. 5

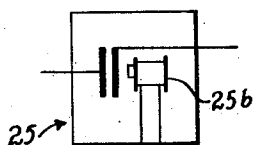


FIG. 6

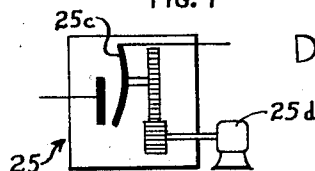


FIG. 7

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NONSTROBOSCOPIC CIRCUIT FOR GASEOUS DISCHARGE DEVICES

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10 Claims. (Cl. 315—194)

This invention relates to circuits for gaseous discharge devices and more particularly to circuits for operating the gaseous discharge tubes used in fluorescent illumination.

One of the great disadvantages of fluorescent lighting is the stroboscopic effect which is produced by the tubes. Since the light produced is caused by discharge which depends upon the voltage across the tube, as the voltage varies in the ordinary alternating current circuit, so the illumination varies.

If the tube is being used near moving objects, the stroboscopic effect produces eye-strain, distorted vision, and in places where rotating or moving machinery is subject to such light the results may be dangerous.

I consequently propose to impress an alternating voltage across the gaseous discharge device which will substantially eliminate the effects of the stroboscopic phenomenon produced.

The primary object of my invention is to provide novel and improved means for operating a gaseous discharge lighting tube with substantially no stroboscopic effects being produced.

A further object of the invention is to provide a novel oscillator for supplying an operating voltage for a fluorescent lighting tube.

A further object is to provide means for supplying an audio frequency voltage for operating a fluorescent lighting tube, the frequency of which voltage will continuously vary, either in accordance with a known pattern, or haphazardly.

With the foregoing and other objects in view, which will appear more fully as the description proceeds, the invention consists of certain novel features of construction, arrangement and combination of parts and elements hereinafter fully described, symbolically illustrated in the accompanying drawing and particularly pointed out in the appended claims, it being understood that various changes in the form, proportion, size, minor details and arrangements of the various elements of the invention may be made without departing from the spirit or sacrificing any of its advantages.

For the purpose of facilitating an understanding of my invention, I have illustrated in the accompanying drawing a preferred embodiment thereof, an inspection of which, when considered in connection with the following description, my invention, its mode of construction, assembly and operation and many of its advantages should be readily understood and appreciated.

Referring to the drawing in which the same characters of reference are employed to indicate corresponding or similar parts throughout the several figures of the drawing:

Fig. 1 is a diagram of an arrangement for operating gaseous discharge devices in accordance with my invention.

Fig. 2 is a circuit diagram of an audio oscillator adapted for use in connection with my new invention.

Figs. 3 to 7, inclusive are schematic representations of various forms of frequency modulating condenser equipped with a movable plate.

In accordance with the objects of my invention, I provide an audio oscillator of any known design for supplying an exciting voltage to the fluorescent lighting device. As is well known, such a device has a low impedance and operates on a low voltage. The frequency may be of the order of 15,000 cycles per second. At this frequency it is impossible for the eye, which retains an image for about a tenth of a second, to follow the light produced while the excitation voltage goes through consecutive zero and peak points. The effect upon the retina obviously is as though the illumination were constant.

The stroboscopic effect produced by using this arrangement for illuminating moving machines, however, is not eliminated, since the moving machines which may be subject to the fluorescent illumination may have portions thereof moving at such speeds, rotary or reciprocal, which may be such multiples of the fluorescent light frequency that stroboscopic effects upon the observer's eye will be produced.

In order to eliminate this, I, therefore, vary the frequency of the exciting voltage so that it is virtually impossible for any moving object to synchronize with the fluorescent illumination.

This may be accomplished by adjusting the circuit conditions of the oscillator so that frequency stability of the circuit is practically nil. With this sort of arrangement, which is my preferred embodiment, the frequency pattern is not only distorted, and uneven, but is unpredictable. Still another method of preventing possible synchronism would be to vary the voltage in accordance with a certain pattern. Obviously the possibility of any mechanical device subject to the light of having a movement capable of synchronizing with flashes produced according to the frequency changes of such an oscillator is beyond contemplation.

It will be seen from the above that the general purport of my invention is the production

of an audio frequency voltage for exciting the gaseous discharge tube which voltage is frequency modulated in order that moving objects subject to illumination produced thereby will not be in synchronism with the light flashes of said gaseous discharge tube.

Referring now to Fig. 1, I have shown a plurality of gaseous discharge tubes 10, connected for use as fluorescent lighting devices. These tubes are coated internally thereof with a material which will fluoresce in the well-known manner when subjected to light rays of certain wavelengths. The tubes 10 are filled with an ionizable gas adapted to be excited, causing discharge between the electrodes of said tubes 10 under influence of electrical potential.

Means for initiating the electrical discharge through the fluorescent tubes is not shown or described although same may be used with my circuit. Such means are well-known to those skilled in the art, hence explanation thereof has been dispensed with.

The tubes 10 are shown fed through leads 11 and 12 by an audio oscillator 13 which in turn is powered in any convenient manner, as for example the power pack 14.

In Fig. 2, I have shown a circuit diagram of a Hartley oscillator which may be used in connection with my invention. A simple triode 15 is provided, having the usual grid 16, cathode 17, and plate 18. The plate lead 19 is connected to the positive side of a source of high voltage while the cathode 17 is connected by the cathode lead 20 to the negative side of the high voltage source. In accordance with usual practice, a frequency-determining tank circuit 21 is provided, and from which the audio frequency voltage is supplied to the feed leads 11 and 12. The tank circuit comprises an inductive reactance 22 including resistive components 23 and a capacitive reactance 24. The element 25 is also provided in the circuit, but this will be described below.

In order to match the low impedance of the tubes 10 with the comparatively high impedance of the tank circuit 21, the leads 11 and 12 are connected at points close to the centertap of the inductance 22. Thus the impedance looking into the tank circuit 21 may be of the same order as that looking into tube circuit through leads 11 and 12, thereby providing maximum power transfer.

Oscillators operate by making them provide their own input, hence a portion of the power output is fed back to the input circuit. The voltage from one end of the inductance 22 is therefore fed to the grid 16 through the grid leak 26 and grid condenser 27. The opposite end of the inductance 22 is connected to the plate lead 19 through the lead 28 and the direct current blocking condenser 29. The input voltage is obviously 180° out of phase with the output voltage. Center point of the inductance is obviously connected to the cathode 17.

The circuit constants of the oscillator are adjusted so that the frequency of the voltage produced by the tank circuit 21 is about 15000 cycles. These are long waves out of the range of ordinary radio broadcast reception and thus present no problems on that account.

The frequency at which the oscillator operates is intended to vary from any given value, either plus or minus any convenient amount. Thus, stability of frequency is an undesirable feature of my oscillator. Various manners of

assuring an absence of constant frequency should immediately suggest themselves to the person skilled in the art. Some of these are outlined below:

(1) The plate supply voltage may be made variable by any well-known means.

(2) The triode may be arranged to operate upon the unstable portions of its characteristics.

(3) The circuit elements may be chosen to vary in characteristics with temperature.

(4) The tank circuit 21 may be chosen to have a very low Q, which will not only result in very unstable frequency, but also in a high power output.

(5) The operating conditions of the triode may be chosen so that same operates with a comparatively high power output.

Perhaps as good a method as any is to operate upon the elements of the tank circuit 21. This is shown in the drawing by means of the element 25 symbolically represented. For the usual circuit the frequency of an oscillator is about that of resonance of the tank circuit, or

$$\text{Frequency} \approx \frac{1}{2\pi\sqrt{LC}}$$

Thus frequency is inversely proportional to the square root of the capacitance or the inductance. Thus, if for example the capacitance C of the tank circuit is increased, the frequency will decrease as the square, and so on. If we, therefore, arrange a capacitance in the tank circuit having an electrode 25^a (Fig. 3), say made of a bi-metal, to move with changes of atmospheric temperature and thereby cause variations in the capacitance, we can produce the desired changes in frequency.

The element 25 may take the form of a mechanically (Fig. 4) or electrically (Fig. 5) vibrated diaphragm which diaphragm comprises one plate of a condenser. Thus the vibrations of the plate or diaphragm will modulate the frequency produced by the tank circuit in accordance with the cycle of vibration, without disturbing the amplitude. Another scheme would include an ordinary 60 cycle electromagnetic vibrator 25^b (Fig. 6) to change the capacitance of the element 25 and thereby alter the frequency a given amount positive and negative 60 times a second.

Another possible form which might be taken might be an air condenser having one plate 25^c (Fig. 7) constantly rotated by a motor 25^d or the like. By making the shapes of the plate in peculiar configurations the modulation of frequency may be of a pattern insuring impossibility of synchronism.

Various electronic circuits may be utilized for supplying the modulation of the oscillator frequency in manners known to the art.

In all of the above it should be remembered that it is important to retain the amplitude of the oscillations produced. Instability may cause the oscillations to die out or become intermittent at some visible or synchronous frequency and entirely spoil the effect desired.

It is believed, that my invention, its mode of construction and assembly, and many of its advantages should be readily understood from the foregoing without further description, and it should also be manifest that while a preferred embodiment of the invention has been shown and described for illustrative purposes, the structural details are nevertheless capable of wide

variation within the purview of my invention as defined in the appended claims.

What I claim and desire to secure by Letters Patent of the United States is:

1. In a circuit including gaseous discharge illuminating means, means supplying an excitation potential thereto comprising an audio frequency oscillator including a tank circuit and producing an audio frequency potential, and means including a condenser having a vibrating diaphragm as one plate thereof in the tank circuit of said oscillator for varying the frequency of the output voltage of said oscillator in an unstable manner without disturbing the amplitude.

2. In a circuit including gaseous discharge illuminating means, means supplying an excitation potential thereto comprising an audio frequency oscillator including a frequency determining circuit and producing an audio frequency potential, and frequency modulating means in the frequency determining circuit of said oscillator for varying the frequency of the output voltage thereof in an unstable manner without disturbing the amplitude said last mentioned means including a condenser having a vibrating diaphragm as one plate thereof.

3. In a circuit including gaseous discharge illuminating means, means supplying an excitation potential thereto comprising an audio frequency oscillator including a frequency determining circuit and producing an audio frequency potential, and frequency modulating means in the frequency determining circuit of said oscillator for varying the frequency of the output voltage thereof in an unstable manner in accordance with a predetermined irregular pattern, without disturbing the amplitude of the oscillations produced, said last mentioned means including a condenser having a vibrating diaphragm as one plate thereof.

4. In a circuit including gaseous discharge illuminating means, means supplying an excitation potential thereto comprising an audio frequency oscillator including a frequency determining circuit and producing an audio frequency potential, and frequency modulating means in the frequency determining circuit of said oscillator for varying the frequency of the output voltage thereof haphazardly, without disturbing the amplitude, said last mentioned means including a condenser having a vibrating diaphragm as one plate thereof.

5. In a system for operating fluorescent illuminating means, means supplying an exciting voltage to said illuminating means comprising an audio frequency oscillator including a tank circuit, means including a condenser having a movable member as one plate thereof in the tank circuit of said oscillator for varying the frequency of the output voltage of said oscillator in an unstable manner without disturbing the amplitude of the exciting voltage operating said fluorescent illuminating means, the instability of the frequency being such that synchronism with any moving objects which may be subject to the illumination from said fluorescent illuminating means is made impossible, whereby stroboscopic effects are voided.

6. In combination in an electrical lighting

system in which the light source comprises a relatively low voltage gaseous discharge illuminating device productive of stroboscopic phenomenon when operating with alternating current of constant frequency; an electrical source supplying said device with low voltage alternating current of constant amplitude; and frequency modulating means continually varying the frequency of the current non-synchronously and thereby non-stroboscopically relative to moving objects; said means being without effect upon the amplitude of the current; said current reaching said device and being utilized thereby in the modulated frequency, constant amplitude condition and maintaining the device in a non-stroboscopic running state of substantially unvarying illuminating brilliance.

7. In combination in an electrical lighting system in which the light source comprises a gaseous discharge illuminating device of a type conventionally productive of stroboscopic effects; a source of low voltage audio-frequency current for said device including an audio-frequency oscillator and a supporting circuit operating to supply the current to said device at constant amplitude irrespective of frequency variations to assure unvarying brilliance of illumination; and frequency modulating means in said circuit active continually while the circuit is energized to vary the frequency of said current non-synchronously relative to moving objects.

8. In combination in a non-stroboscopic lighting system wherein the illumination is produced by a low impedance gaseous discharge device, a source of audio-frequency current for said device comprising a power oscillator including a tank circuit having an inductive reactance, means in said tank circuit acting during the operation of the circuit to modulate the frequency produced by the oscillator in the circuit non-synchronously relative to moving objects said means being operative without disturbing the amplitude of the current supplied through the tank circuit, and leads connecting said gaseous discharge device to tapped points close to the center of said inductive reactance affording substantial balance between the low impedance of the gaseous discharge device and the relatively higher impedance of the tank circuit.

9. A lighting system as defined in claim 8 in which the power oscillator is of the Hartley type, and the tank circuit includes a capacitive reactance and a resistive component to have a relatively low Q factor.

10. In combination in a lighting system wherein the source of illumination is a low impedance gaseous discharge device; a source of audio-frequency current for said device comprising a power oscillator including a tank circuit having an inductive reactance, a capacitive reactance and a resistive component to lower the Q factor substantially; and leads connecting said gaseous discharge device to tapped points close to the center of said inductive reactance affording substantial balance between the low impedance of the gaseous discharge device and the relatively higher impedance of the tank circuit.

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