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[54] **APPARATUS FOR STARTING AND OPERATING ELECTRIC DISCHARGE DEVICES**
2 Claims, 1 Drawing Fig.

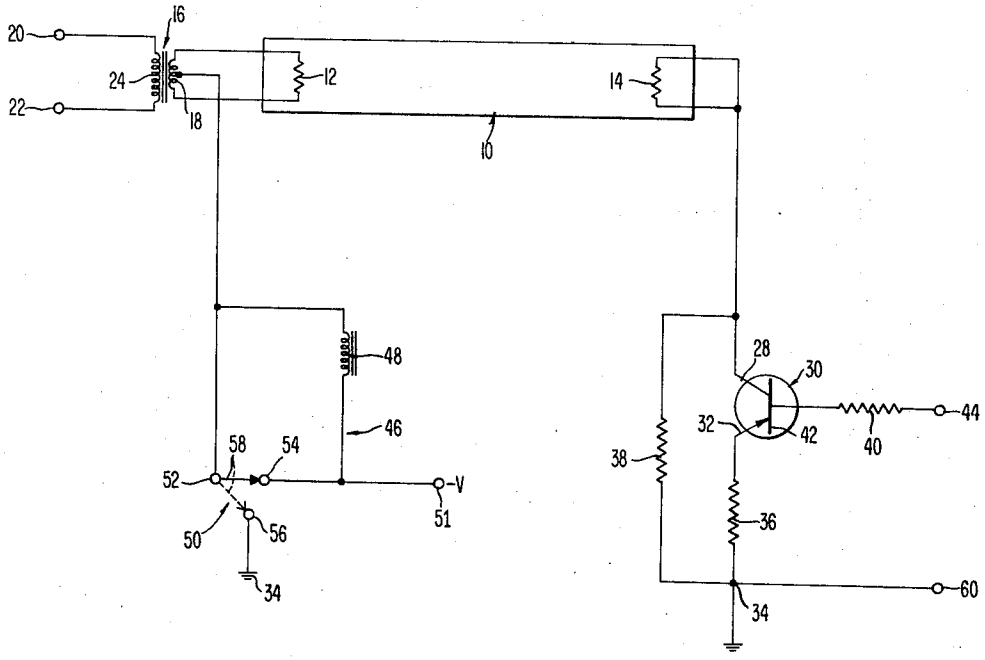
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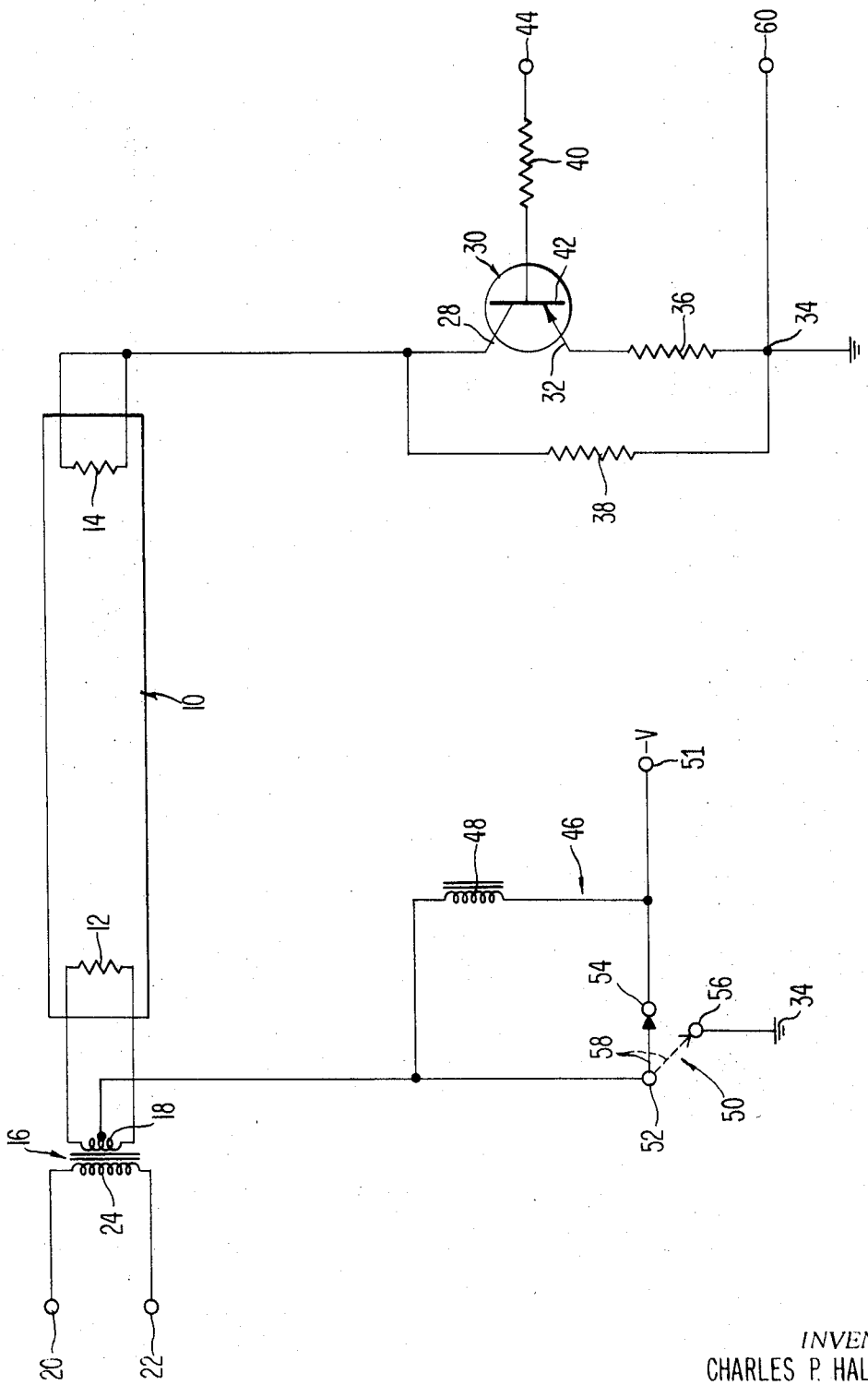
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ABSTRACT: A transistor drives a fluorescent discharge lamp with unidirectional current. By suitably pulsing and controlling the current, various lighting effects are obtained. An impedance element conducts current so as to keep the fluorescent lamp in a fired condition whenever the transistor is not driving current. After firing the fluorescent lamp, a ballast coil in a starting circuit is short-circuited, resulting in minimum DC loss in the starting circuit during normal operation.





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APPARATUS FOR STARTING AND OPERATING ELECTRIC DISCHARGE DEVICES

BACKGROUND OF THE INVENTION

This invention relates generally to electric discharge devices and more particularly to apparatus for starting and operating fluorescent discharge lamps. While not limited thereto, the invention finds special application in the display field for demonstrating to an observer various lighting conditions. Thus the invention might be used, for example, in a display apparatus to provide a light source behind various types of transparencies, filters, etc. so as to simulate and convey more clearly to an observer such display conditions as contrast, brightness, resolution, flicker, color, visual acuity, adaptation, etc.

SUMMARY OF THE INVENTION

One of the objects of the present invention is to provide improvements in circuits for driving electric discharge devices.

A more specific object of the invention is to provide improvements in circuits for driving fluorescent discharge lamps.

Another object of the invention is to provide a driving circuit for fluorescent discharge lamps with means for obtaining various lighting effects.

A further object of the invention is to provide a circuit for driving fluorescent discharge lamps with unidirectional current flow.

Still a further object of the invention is to provide a circuit for varying the light output of fluorescent discharge lamps but without varying the frequency from the alternating power source whenever such a source is used for heating a lamp filament.

Another object of the invention is to provide such a circuit in which the frequency of the light variations which can be used is maximum.

Another more specific object of the invention is to provide a transistor driver circuit for fluorescent discharge lamps in which ionization is maintained in operation even when the input signal to the transistor is at zero level.

A further object of the invention is to provide a starting circuit for fluorescent discharge lamps whose DC loss during normal operation is minimum.

Still another object of the invention is to provide a starting and operating circuit for fluorescent discharge lamps which is economical to manufacture.

In accordance with the above objects and considered first in one of its broader aspects, apparatus in accordance with the invention may comprise a fluorescent lamp having first and second filaments, means for heating the first filament, a current source which is operable for driving unidirectional current through the fluorescent lamp after the fluorescent lamp is started, and a starting circuit which is operable for applying a starting potential between the filaments.

The invention will be more clearly understood when the following detailed description of the preferred embodiment thereof is read in conjunction with the accompanying drawing which is described below.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE in the drawing is a chematic circuit diagram of apparatus constructed in accordance with the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to the details of the drawing, an electric discharge device illustrated in one form as a florescent discharge lamp 10 is provided with a cathode filament 12 and an anode filament 14. The filament 12 is connected to a suitable source of heating potential in the operation of the invention, one form of which may include a transformer 16 whose secondary winding 18 is connected to the cathode filament 12, and a source of alternating potential, not shown, such as a 115 volt 60 cycle supply to which the terminals 20 and 22 of the primary winding 24 may be connected.

The anode filament 14 is connected to the collector electrode 28 of a transistor 30 which has its emitter electrode 32 coupled to a point of reference potential 34 such as ground, for example, through a resistor 36. An impedance element illustrated in one form as a resistor 38 is shunted across the electrodes 28 and 32 and has one of its ends connected to the point of reference potential 34 and the other of its ends connected to the collector 28. A resistor 40 is connected between the base 42 of the transistor and an input terminal 44.

A starting circuit 46 comprises a ballast coil 48 and a switching device 50. The ballast coil 48 has one end connected, through the secondary winding 18, to the cathode filament 12 and the other end connected to a source of negative potential 51. The switching device 50 has a terminal 52, contacts 54 and 56, and a contact arm 58.

In the operation of the apparatus, a heating potential is first applied to the cathode filament 12 by connecting the terminals 20 and 22 to a suitable source of alternating current potential. The contact arm 58 of the switch 50 is moved to the dotted-line position so as to break contact with the contact 54 and make contact with the contact 56, and thereby permit energy to build up in the ballast coil 48. The contact arm 58 is then returned to the solid-line position so as to short circuit the ballast coil 48. During this return of the contact arm 58, the energy in the ballast coil 48 discharges and causes a large starting potential to be induced in the ballast coil. This starting potential is applied between the filaments 12 and 14 so as to cause the fluorescent lamp 10 to fire. Current will now flow from the negative supply 51 and through the switch arm 58, the secondary winding 18, the filaments 12 and 14 and lamp 10 and the resistor 38. The resistor 38 conducts what might be termed a "trickle" current, so that with the transistor 30 not conducting at this time, the trickle current keeps the fluorescent lamp 10 ionized and in a fired condition.

In order to vary the light output from the lamp 10, suitable signals, such as pulses of appropriate levels and repetition rates, may be applied to the input terminals 44 and 60 of the transistor 30. By thus controlling the amount of unidirectional current flowing in the lamp 10 or by controlling the duty cycle of this current, or both, various lighting conditions such as those previously discussed can be demonstrated.

It is noted that since the resistor 38 maintains a trickle current to keep the lamp 10 ionized, it is not necessary to fire and start the lamp each time it is desired to commence operating or pulsing the transistor 30. It is also seen that the feature of shorting the ballast coil, after starting, results in minimum DC loss in the starting circuit during normal operation, so that a ballast coil of inexpensive design may be employed, if desired. It is also noted that by placing the transistor at the anode end of the fluorescent lamp, the necessity of having the transistor drive the capacitance to ground of a filament transformer is avoided. The result of this latter feature is that the transistor 30 can be pulsed at maximum frequencies so as to increase the range of flicker frequencies of the fluorescent lamp 10.

While there has been shown and described a specific apparatus for starting and operating electric discharge devices, it is to be understood that this is but one embodiment of the invention and that the invention is capable of being constructed and arranged in a variety of circuit configurations without departing from its true spirit and scope. Accordingly, the invention is not to be limited by the specific apparatus disclosed, but only by the subjoined claims.

We claim:

1. Apparatus comprising an electric discharge device having first and second filaments, means for heating said first filament, a transistor having one of its electrodes connected to said second filament and another of its electrodes coupled to a point of reference potential, a starting circuit operable to be connected between said first filament and said point of reference potential and then to be disconnected in the process of applying a starting firing potential between said filaments to

enable said transistor to drive unidirectional current through said electric discharge device, and an impedance element shunted across said electrodes and effective to conduct a current flowing through said electric discharge device for keeping said electric discharge device in a fired condition whenever said transistor is not driving current, and wherein said starting circuit comprises a ballast coil and a switching device, said ballast coil having one terminal connected to said first filament and another terminal connected to a voltage source, and said switching device being operable to a first condition to connect said first filament and said one terminal to said point of reference potential to build up energy in said ballast coil and to a second condition to permit discharge of said energy for firing said electric discharge device and to short circuit said ballast coil.

2. Apparatus according to claim 1 wherein said electric discharge device is a fluorescent lamp.