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TRANSISTOR CONTROLLED GASEOUS INDICATOR

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Fig. 1.

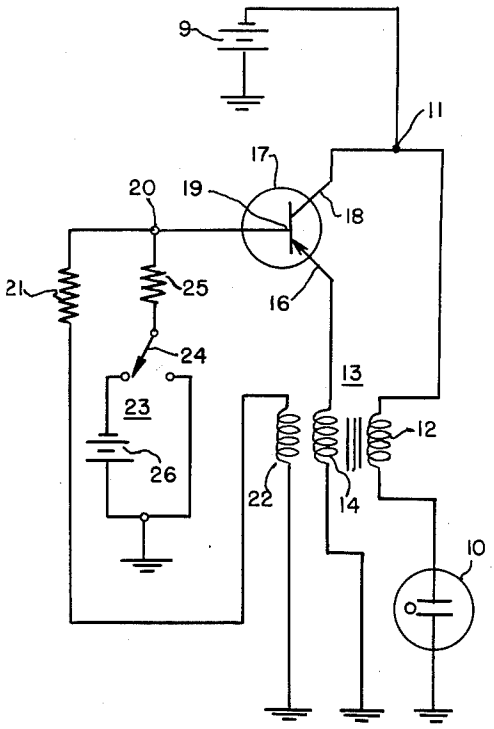
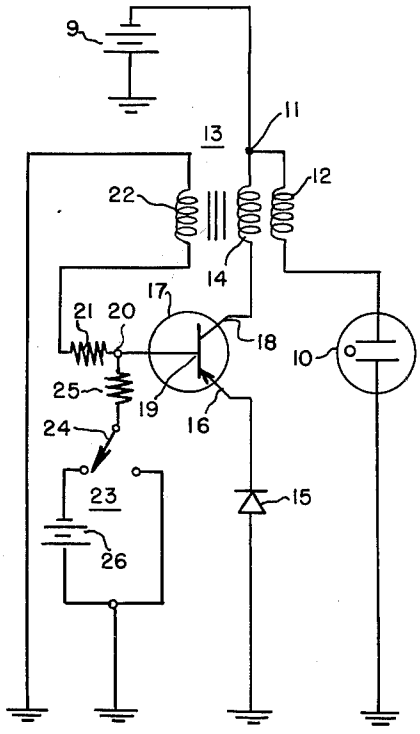


Fig. 2.



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TRANSISTOR CONTROLLED GASEOUS INDICATOR

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This invention relates in general to indicating devices and more specifically to improved circuits for operating gaseous glow indicator devices.

One type of gaseous glow indicator device includes a neon indicator tube which is operated by a high voltage alternating current or direct current voltage source. The operation of neon tubes by this method is quite acceptable when a high voltage A.C. or D.C. supply having an appropriate current carrying capacity is available. Ordinarily, a neon tube requires approximately 85 or 90 volts to initiate the glow discharge while having an extinguishing potential of approximately 60 volts. Thus, sources of voltage supply in the order of 100 volts and having a current carrying capacity of approximately two milliamps are required for proper neon tube operation.

There are many circuits in which a gating source is required to switch a neon tube to its respective on-and-off conditions. For example, in computer circuits using flip-flops or toggles, it is desired to indicate the respective operating half of the flip-flop by one of the alternate states of operation of the neon tube. In view of a trend toward the construction of these computer circuits having solid state circuitry to minimize power consumption and space requirements, transistor operation to switch the neon tube is considered desirable.

One form of transistor switch for operating a neon indicator tube places the emitter-collector circuit of a switching transistor in series with a neon tube across a high voltage supply source. When the transistor is switched off representing a high impedance, the neon tube is extinguished but when the transistor is turned on representing a low impedance, sufficient voltage is applied across the neon tube to ignite the tube giving an on indication. This type of switching system is quite undesirable since the transistor must be of a high voltage type inasmuch as nearly the full line potential is placed across the transistor when it is in its off condition. High voltage transistors suitable for this arrangement are very expensive and would make the use of a large number of indications unfeasible and impractical. Additionally, modern day logic circuitry utilizing transistors, generally operates from a low voltage supply in the order of 25 volts. According to the prior state of the art therefore, in order to operate neon indicators for the transistor logic circuitry, an additional power supply whose sole function is to furnish 100 volts for this one purpose is required.

Accordingly, one of the objects of this invention is to provide an improved circuit for operating a gaseous glow indicator tube.

Another object of the invention is to provide an improved circuit for operating a normally high voltage gaseous indicator tube from a low voltage power source.

Still another object of the invention is to provide a circuit, operating from a low voltage source of power supply, utilizing a low voltage transistor for switching a neon indicator tube to its alternate states of operation.

A further object of the invention is to provide circuits for operating a neon indicator tube from a low voltage source of supply through switching transistors which may be operated from a positive or negative input signal. High voltage switching transistors of the prior art have been primarily of the PNP type requiring a negative base signal for operation. In practice, the NPN type of high

voltage switching transistor due to its extreme cost has required that an additional inverting circuit be used when the normal sense of input signal has been of a positive polarity. The present invention utilizing inexpensive low voltage transistors of both the PNP and NPN type allows for ready operation from either a positive or a negative input signal and is thus more flexible as to usage.

In brief, a circuit according to the invention in order to operate a neon indicator tube generates a series of high voltage pulses sufficient to ignite the neon tube from a low voltage source of power supply. The power supply, of itself, is incapable of operating the tube. This voltage generating means comprises essentially a blocking oscillator which operates at a sufficiently high frequency to give the impression of a continuous glow of the neon tube.

The invention is described both as to its organization and operation in connection with the following description to be read in conjunction with the accompanying drawings in which:

FIG. 1 is a circuit diagram of one form of the invention, and

FIG. 2 is a circuit diagram of an alternate form of the invention.

An oscillator circuit embodying the invention is shown in FIG. 1 and includes a neon indicator tube **10** comprising the conventional two electrodes with one electrode connected to a common ground or reference terminal and the other electrode connected to a terminal **11** of a low voltage source of supply **9** typically valued at minus 23 volts. The connection from the second electrode of neon tube **10** is through a secondary or load winding **12** of transformer **13**. The primary winding **14** of the transformer is also connected from one of its ends to the common ground connection and its other end to the emitter electrode **16** of switching transistor **17**. The collector electrode **18** of the transistor receives its voltage supply from the minus 23 volt supply connected to terminal **11**. The base electrode **19** of the transistor is connected to junction point **20** and receives a signal through current limiting resistor **21** and the feedback winding **22** of transformer **13**. The other end of winding **22** is also connected to the common ground. Junction **20** further receives an input through current limiting resistor **25** which is connected to input gate **23** to the common ground. Gate **23** is illustrated as including a switching means **24** which may selectively provide an input signal of minus 6 volts or zero volts depending upon whether the switching means is connected to the negative terminal of battery **26** or directly to ground. It is understood that the gate **23** is illustrated as including a battery and mechanical switch merely for convenience of illustration and description but that it is anticipated that the invention may be used where these two levels of signal are generated electronically, as for example by the two voltage levels present at a single output terminal of a flip-flop circuit, or the like.

Referring now to FIG. 2, like elements have received corresponding reference numerals. The circuit is shown as including a neon indicator tube **10** connected to a common ground and to terminal **11** of the low voltage source of supply **9** providing a typical minus 23 volts. The connection is through transformer secondary winding **12** and it is understood as to both FIGS. 1 and 2 that the source of voltage supply may be a battery or any other conventional source of supply with its positive terminal connected to the common ground. The collector **18** of transistor **17** receives its voltage supply through primary winding **14** of transformer **13** and has its emitter electrode **16** connected to ground through a diode **15**. The diode **15** may be any inexpensive germanium or silicon diode although the latter is preferred in view of its greater reliability, temperature sta-

bility and higher cutoff voltage. The diode is included in the emitter circuit to assure the cutoff condition of transistor 17 when the gating signal rises to zero volts. The diode 15 is poled in its forward direction so as to present a low impedance when the transistor 17 is in its conducting state. The base electrode 19 is connected through junction 20 to ground along two paths. One path includes current limiting resistor 21 and feedback winding 22 of transformer 13 while the other path includes current limiting resistor 25 and gate circuit 23 to the common ground. A gate 23, as in FIG. 1, is illustrated as including a switch 24 which may provide a minus 6 volts or zero volts depending upon its relative position.

In operation of the circuit illustrated in FIG. 1, when the gate 23 provides a zero volt input signal to the base of transistor 17, the relatively high impedance of winding 14 provides a bias to place the transistor in a non-conducting state. A negative 6 volt input applied to the base 19 of PNP transistor 17 is of proper polarity and magnitude to cause the transistor to begin conduction through the emitter-collector circuit. Conduction through winding 14 generates a voltage across the load secondary 12 as well as across feedback winding 22. Winding 22 is regeneratively coupled so as to present a more negative signal through junction 20 to the base 19. This feedback results in a rapid build-up of conduction toward the saturation condition of transistor 17. At this time the energy stored in transformer 13 must be dissipated in the load and the magnetizing current decreases causing a reverse induced voltage to turn off transistor 17 in a blocking oscillator fashion. The alternating voltage generated across the load winding 12 is superimposed upon the D.C. supply voltage and the combination of these voltages is developed across neon tube 10. The frequency of oscillation of the blocking oscillator is chosen by proper selection of components and circuit parameters and may be of the order of 100,000 cycles per second.

Under these frequency conditions, the neon tube appears to present a continuous glow when gate 23 provides the minus 6 volt input. The superimposed D.C. voltage added to the alternating voltage across load winding 12 tends to cut down on the dissipation of the transistor. The arrangement utilizing the D.C. supply is also considered advantageous in view of its lowering the A.C. voltage requirements necessary to initially fire the neon tube. A portion of the necessary current needed to drive the load comes directly from the 23 volt supply voltage and lessens the load on the oscillator circuit.

In view of the location of relatively high impedance winding 14 in the emitter circuit, it is not considered necessary to include a diode to bias transistor 17 to cutoff although a diode (not shown) may be included just as is shown in FIG. 2. Furthermore, since feedback winding 22 has to have a fairly large number of turns in this circuit arrangement, resistor 21 may be eliminated without deleterious effect of circuit operation. Also, the arrangement of FIG. 1 having the bias of transistor 17 provided by the impedance of winding 14 is considered advantageous in situations where the input signal provided by gate 23 might undesirably increase to levels greater than the minus 6 volts ordinarily used. In that instance, when the base 19 increases its voltage greatly, the emitter 16 increases its voltage accordingly and prevents possible destruction of the transistor.

In the operation of FIG. 2, starting from a cutoff condition of transistor 17, when a negative voltage is applied from input gate 23 the collector 18 begins to draw current and develop a voltage across load winding 12 and feedback winding 22. The voltage applied from winding 22 to the base 19 is of proper polarity to cause a regenerative action in the transistor 17 until the transistor becomes saturated. The collapse of the field energy stored in the transformer 13 develops a reverse potential across both secondary windings in a blocking oscillator fashion. Here, as in FIG. 1, the voltage developed across winding 12 is superimposed upon the minus 23 volt supply assisting in the operation of firing the neon tube. This circuit may also operate at a frequency sufficiently high to give the appearance of continuous ignition of the neon tube.

The circuit constants may vary in accordance with known engineering design but in a typical installation, transistor 17 may be a PNP type 2N404, transformer 13 may be formed of a ferrite toroidal core with winding 12 having 120 turns, winding 14 having 10 turns, and winding 22 having 2 turns. Resistor 21 may have a typical value of 5,000 ohms, resistor 25 may have a typical value of 40,000 ohms, and the neon tube may be a type NE2. The value of resistor 23 is selected as being relatively high in order to present a substantially constant current source to the base of transistor 17.

Although the circuits of the present invention have been described and illustrated as including PNP type transistors, it is understood that other types of transistors as well as NPN transistors may be substituted without departing from the teachings presented. If NPN transistors are used, it is understood that the operation will be the same when the power supply is changed from minus 23 volts to plus 23 volts and when the input signal from gate 23 varies between a level of zero volts and plus 6 volts. In FIG. 2 or if used in FIG. 1, it will also be necessary to reverse the terminal connections of diode 15.

There has thus been described circuits capable of providing the necessary voltages for operation of neon tubes from a source of supply which of itself would be incapable of firing the neon tubes. Since the device operates from the standard supply voltage utilized elsewhere in inexpensive transistorized circuitry, it eliminates the need for separate supply voltages. Furthermore, it provides a simple indicator assembly having a minimum number of parts which may readily be mounted on a tubular structure and provided with a potting compound having the glow tube viewing window visible for ready insertion into display panels. Modifications may be made to the circuits described in a well-known manner without departing from the spirit of the invention.

What is claimed is:

1. A circuit for controlling the operation of a gaseous glow lamp comprising a glow lamp, a supply source whose potential is not as great as the firing potential of said lamp in a series circuit including a transformer load winding coupled to a transformer core, a generating circuit for providing an alternating current potential across said load winding superimposed on said potential of said supply source to enable a repetitive firing and extinguishing operation of said lamp, said generating circuit including a gated blocking oscillator circuit having a transistor with a base electrode, an emitter electrode and a collector electrode, a primary winding coupled to said core and in the collector-emitter circuit of said transistor, a positive feedback winding coupled to said core and connected to said base electrode, bias means for maintaining said transistor in an off condition, and a gate circuit providing one of two selected levels of potential for overcoming said bias means to gate on said blocking oscilllator in response to one of said potential levels.

2. A circuit as recited in claim 1 wherein said bias means includes a diode poled in a forward direction with respect to said current flow through said primary winding.

3. An indicator circuit for indicating an electrical condition comprising, a transistor switching circuit shiftable between two states of conduction and including a transistor having a base electrode, an emitter electrode and a collector electrode, gating means electrically connected to said base electrode and selectively providing two levels of fixed potential, an emitter-collector path including a

power source and primary transformer winding, a core coupled to said winding, a feedback winding coupled to said core and connected to said base electrode for regeneratively coupling energy to cause said transistor switching circuit to oscillate between said two states of conduction when said gating means is in one of its two conditions, a gaseous glow lamp connected in a series circuit including said power source and a load winding coupled to said core to provide a superimposed alternating potential upon said power source potential, said series circuit providing sufficient potential to ignite said lamp only when said gating means provides one of said levels of potential.

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