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INDICATOR LAMP IN A TRANSISTOR EMITTER FOLLOWER CIRCUIT WITH A LAMP WARMUP RESISTOR IN PARALLEL WITH THE TRANSISTOR

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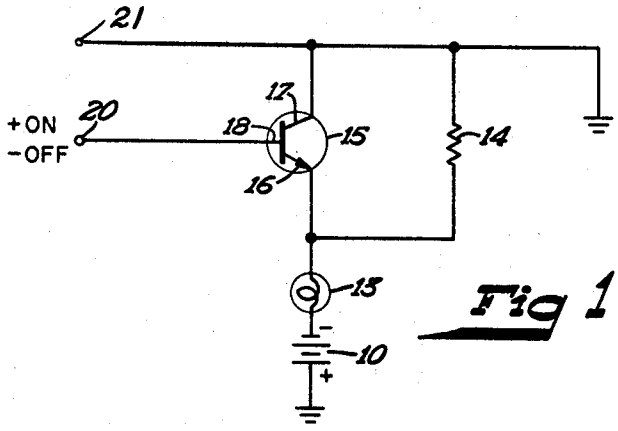


Fig 1

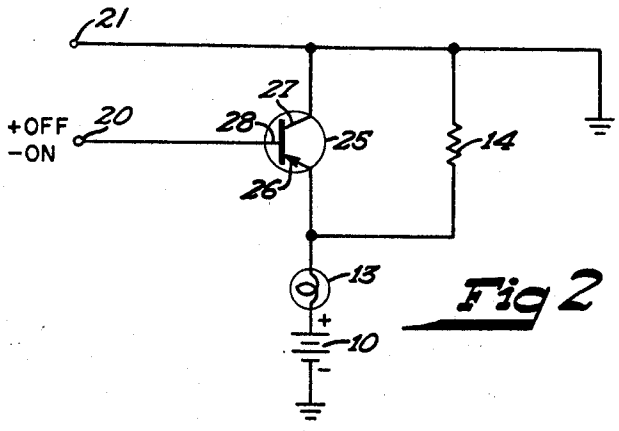


Fig 2

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INDICATOR LAMP IN A TRANSISTOR EMITTER FOLLOWER CIRCUIT WITH A LAMP WARMUP RESISTOR IN PARALLEL WITH THE TRANSISTOR

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ABSTRACT OF THE DISCLOSURE

An indicator lamp circuit in which a multi-junction transistor is used to switch the indicator lamp off and on. The transistor is connected in grounded-collector configuration, with the indicator lamp and a source of energy serially connected between the emitter and the collector of the transistor. A lamp pre-heat resistor is also connected across the emitter and collector of the transistor, The grounded collector transistor connection results in a decreased load to the source of signal energy, as well as removing the need for input impedance networks to the switching transistor.

This invention is concerned with control apparatus and more particularly with a transistorized indicator lamp circuit.

Indicator lamps find vast use in contemporary industry. By way of example, indicator lamps are often used in such items as computer consoles, machinery panels, and traffic panels. The need for and use of indicator lamps stretches from children's games to hospital operating rooms. Often the number of indicator lamps used in a single device becomes extremely large, such as in a computer console where a vast number of lamps may be used to indicate the true or false state of the computer bistable stages.

One problem which arises when a large number of indicator lamps must be used is the large load placed on the source of control signal energy by the circuits which control the indicator lamps. Another problem is the cost of the components which go to make up the control circuit for the indicator lamps.

The apparatus of this invention provides an indicator lamp circuit which presents a decreased load to the source of signal energy. Further, the apparatus of this invention provides an indicator lamp circuit made up of fewer components than presently known circuits.

Briefly described, this invention uses a grounded-collector transistor to drive a lamp connected in circuit with the transistor emitter electrode. A resistor is serially connected with the lamp across the source of electrical energy, and is of such a magnitude to prevent the lamp from coming on when the transistor is off, but to allow a sufficient amount of current to pass through the lamp to keep it in a standby or preheated stage for fast turn-on. Since a grounded-collector transistor configuration is used, the circuit gain is greater than that of the presently used grounded-emitter transistor configurations. Therefore, a reduced load is presented to the source of signal energy which turns the transistor off and on. Also there is no need for an input impedance network to the transistor base electrode, which again reduces the load to the signal energy, and lowers the number of components needed to drive the lamp.

In the drawings,

FIG. 1 is a schematic representation of a first embodiment of the circuit of this invention utilizing a NPN transistor; and

FIG. 2 is a schematic representation of a second embodiment of the circuit of this invention using a PNP transistor.

Referring now to FIG. 1, there is shown a source of energy, here shown as a battery **10**, having its positive terminal connected to a common ground. There is also shown an NPN transistor **15** having an emitter electrode **16**, a collector electrode **17**, and a base electrode **18**. Collector electrode **17** is connected to the common ground. Emitter electrode **16** is connected through a lamp **13** to the negative terminal of battery **10**. A resistor **14** is connected intermediate emitter electrode **16** and collector electrode **17**. Base electrode **18** is connected to an input terminal **20**, and collector electrode **17** is connected to an input terminal **21**.

Referring now to FIG. 2, there is again shown a source of energy as a battery **10**, now having a negative terminal connected to a common ground. There is also shown a PNP transistor **25** having an emitter electrode **26**, a collector electrode **27**, and a base electrode **28**. Collector electrode **27** is connected to the common ground. Emitter electrode **26** is connected through lamp **13** to a positive terminal on battery **10**. A resistor **14** is connected intermediate emitter electrode **26** and collector electrode **27**. Base electrode **28** is connected to an input terminal **20**, and collector electrode **17** is connected to a input terminal **21**.

In discussing the operation of the circuit of FIG. 1, first assume that a negative control signal is present at input **20**. This negative bias on base electrode **18** will back bias the emitter-base junction of transistors **15** to hold transistor **15** off. Therefore, substantially the only current flowing in the circuit will be from the positive terminal of battery **10**, through the common ground, through resistor **14** and lamp **13** to the negative terminal of battery **10**. The magnitude of the resistance of resistor **14** is chosen such that this current is not sufficient to light lamp **13** (that is, lamp **13** is not sufficiently incandescent to be visible to the human eye) but is enough to cause a preheating of lamp **13**.

Now assume that the control signal to input terminal **20** becomes positive. This bias will be felt on base electrode **18** and cause a forward biasing of the base-emitter junction of transistor **15**, to cause a current to flow from base **18** to emitter **16**, to turn on transistor **15**. A current will then flow from the positive terminal of battery **10**, through the common ground, from collector **17** to emitter **16** of transistor **15**, and through lamp **13** to the positive terminal of battery **10**. This current will be sufficient to light lamp **13**. Since lamp **13** has been preheated by the above described current flow through resistor **14**, the initial surge current through transistor **15** during its turn-on will be much less than the surge current necessary to light lamp **13** had lamp **13** been cold. This lower surge current will have the effect of a lower load felt by the source of control energy (not shown). Also inasmuch as transistor **15** is connected in a grounded-collector configuration, the load felt by the source of control energy will be less than had transistor **15** been connected in the usual grounded-emitter configuration. This latter feature is possible because the gain of a grounded-collector transistor amplifier is substantially equal to the gain of the transistor, while the gain of a grounded-emitter transistor amplifier is equal to approximately ⅓ to ½ the gain of the transistor. This discrepancy is due to the fact that grounded-emitter transistor stages normally require some impedance network at the control input to insure proper or satisfactory operation. This input impedance network will attenuate the input signal, thus causing an increase in the load to the source of control energy.

The operation of the circuit of FIG. 2 is essentially similar to that of the circuit of FIG. 1, with the exception that the transistor **25** is a PNP transistor as opposed to

the NPN transistor **15** of FIG. 1. Assume in FIG. 2 that the control input to input terminal **20** is positive. This positive bias will be felt on base **28** to back bias the emitter-base junction of transistor **25** to keep transistor **25** off. A current will then flow from the positive terminal of battery **10**, through lamp **13** and resistor **14**, and through the common ground to the negative terminal of battery **10**. As was the case in the operation of the circuit of FIG. 1, the magnitude of resistance of resistor **14** is chosen such that this last described current is sufficient to preheat lamp **13**, but not sufficient to cause visible incandescence. Assume now that the control signal to input terminal **20** becomes negative. This negative bias will be felt on base electrode **28** to forward bias the emitter-base junction of transistor **25** causing a current flow from either emitter electrode **26** to base electrode **28**. This will cause transistor **25** to turn on and a current will flow from the positive terminal of battery **10** through lamp **13**, from emitter electrode **26** to collector electrode **27**, and through the common ground to the negative terminal of battery **10**. As was the case in the circuit of FIG. 1 the turn-on or surge current of transistor **25** will be less, due to the fact that lamp **13** had been preheated. Also, the grounded-collector configuration of transistor **25** will have the same effect of lowering the load to the source of control energy (not shown).

It is thus apparent that this invention as described above comprises a unique transistorized lamp circuit capable of lighting a given lamp with fewer components, and at the same time presenting a lower load impedance to the source of control energy. Especially when applied to situations in which a large number of indicator lamps are necessary, such as computer consoles, this savings in components and control power represents an important advance over the prior art.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A semiconductor lamp circuit comprising:
a source of energy;
multi-junction semiconductor switch means including input, output and control electrodes;
means connecting said output electrode to a first terminal on said source of energy;
lamp means;
means connecting said lamp means intermediate said input electrode and a second terminal on said source of energy;
impedance means connected intermediate said input and output electrodes; and
a pair of input terminals connected, respectively, to said control electrode and said output electrode and adapted to receive control signals for turning said semiconductor switch means off and on.

2. Indicator lamp circuit apparatus comprising:
a source of energy;
a multi-junction transistor having emitter, collector and base electrodes;
means connecting said collector electrode to one terminal on said source of energy;
an indicator lamp;
means connecting said indicator lamp intermediate said emitter electrode and another terminal on said source of energy;
impedance means connected intermediate said collector and emitter electrodes; and
a pair of input terminals connected, respectively, to said base electrode and said collector electrode and adapted to receive control signals for varying the conductive state of said transistor.

3. A transistorized lamp circuit comprising:
a source of electrical energy having positive and negative terminals;
a NPN transistor having emitter, collector and base electrodes;
means connecting said collector electrode to said positive terminal;
a lamp;
means connecting said lamp intermediate said emitter electrode and said negative terminal;
a resistor connected intermediate said collector and emitter electrodes; and
a pair of input terminals connected, respectively to said base electrode and said collector electrode and adapted to receive control signals for changing the conductive state of said NPN transistor.

4. A transistorized lamp circuit comprising:
a source of electrical energy having positive and negative terminals;
a PNP transistor having emitter, collector and base electrodes;
means connecting said collector electrode to said negative terminal;
a lamp;
means connecting said lamp intermediate said emitter electrode and said positive terminal;
a resistor connected intermediate said collector and emitter electrodes; and
a pair of input terminals connected, respectively, to said base electrode and said collector electrode and adapted to receive control signals for changing the conductive state of said PNP transistor.

5. A transistorized indicator lamp circuit comprising:
a source of electrical energy;
a multi-junction transistor having emitter, collector and base electrodes;
means connecting said transistor in grounded-collector configuration across said source of electrical energy, said means including an indicator lamp;
control means connected to said base electrode and said collector electrode for turning said transistor off and on; and
impedance means connected in parallel with said transistor and in series with said indicator lamp, so that when said transistor is off a preheat current flows through said indicator lamp.

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