

[54] **LAMP CIRCUIT**
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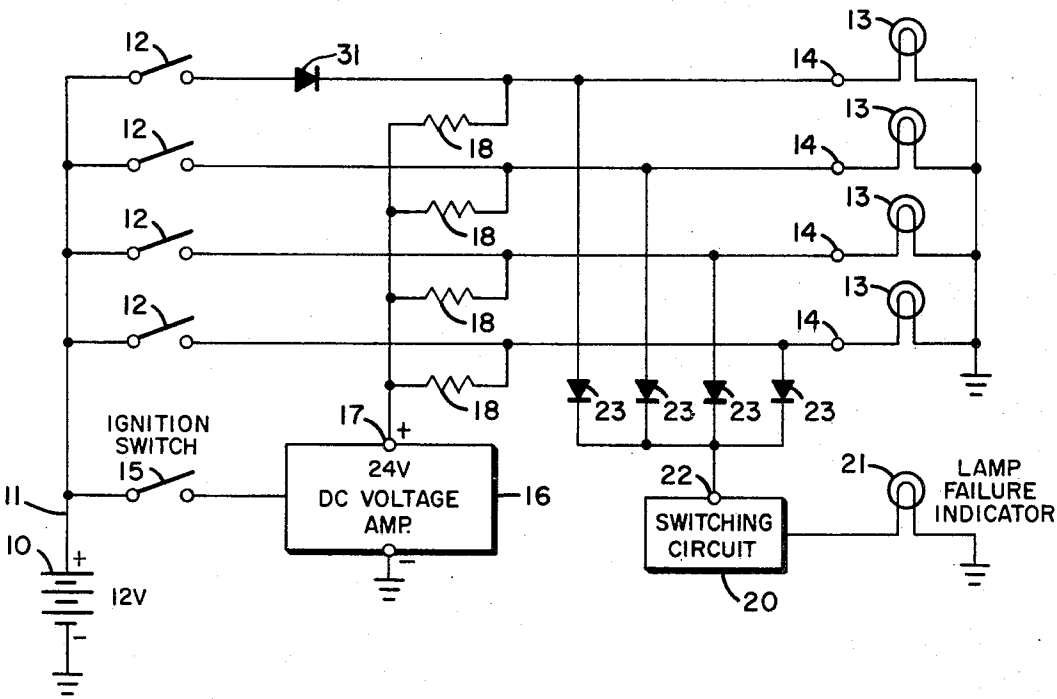
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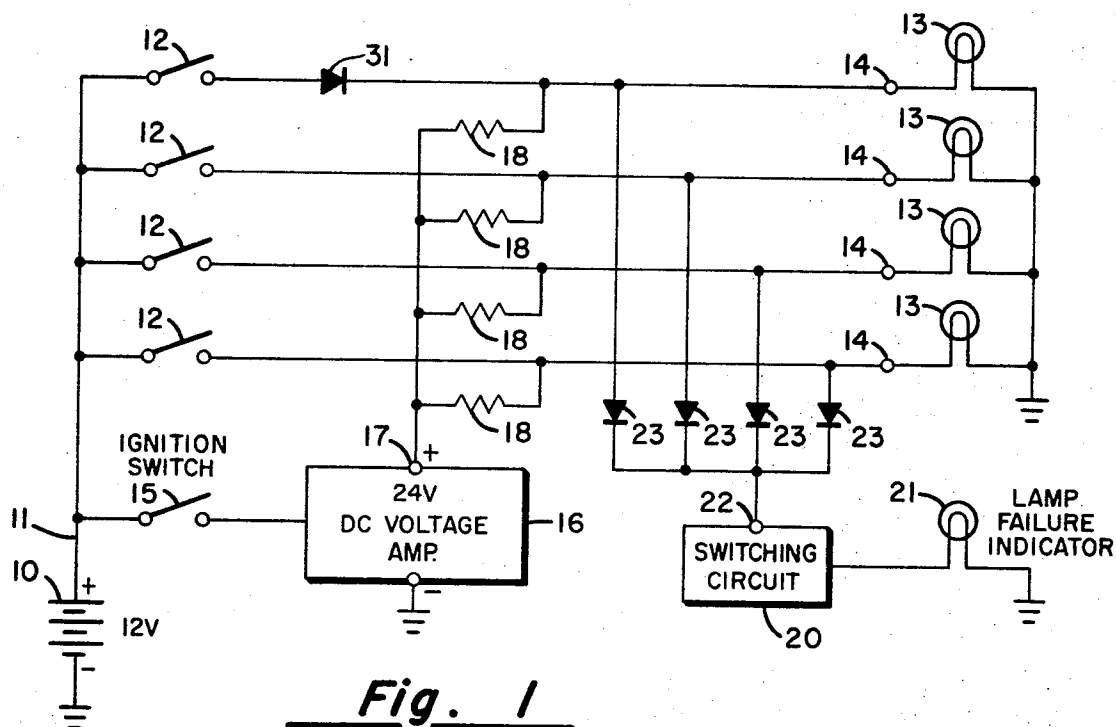
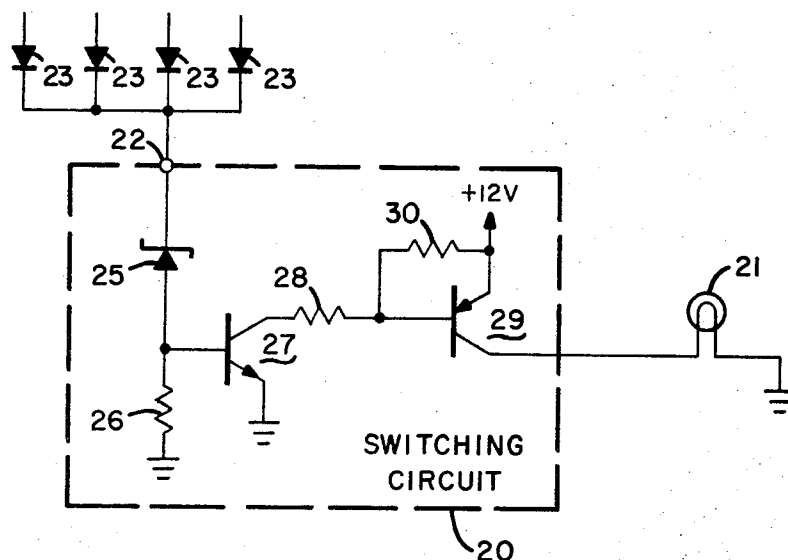
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[57] **ABSTRACT**

A lamp is connected to a first energy source which normally energizes the lamp and is connected to a second energy source through a relatively high impedance which does not energize the lamp. A solid state switching circuit is connected across the lamp. When the lamp is conductive its relatively low impedance prevents the second energy source from activating the switching circuit but when the lamp is open-circuited, the second energy source activates the switching circuit to give an indication of its inoperative condition.

13 Claims, 2 Drawing Figures





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1

LAMP CIRCUIT

BACKGROUND OF THE INVENTION

1. Field of the Invention

In general, the invention is directed toward a lamp testing circuit which can be used merely for testing individual lamps or for monitoring normal lamp-lighting circuits in order to obtain a signal indication when a lamp burns out. In particular, the invention appears to have its greatest value for use in monitoring the various lamp circuits in an automobile and so it will be described as used for that purpose although no limitation thereto is intended.

2. Description of Prior Art

Although a number of circuits have been developed over the years for testing and monitoring lamp circuits and particularly automobile lamp circuits, most of these earlier circuits use electromagnetically operated relays which themselves are a source of trouble, especially when used under the environmental and operational conditions that most automobiles are subjected to. Additionally, the prior art circuits have used a separate sensing or testing circuit for each lamp circuit thereby creating duplication of circuits. Furthermore, in the prior art circuits, the lamp energizing circuit had to be activated in order to test the lamp. This is not always preferred since from time to time it may be desirable to test the lamps in a number of different lamp circuits without having to energize each of the circuits individually.

SUMMARY

The normal lamp energizing circuit consists of an energy source, a lamp and an on-off switch connected in series in the usual fashion. A second energy source is connected through a relatively high impedance to the energizing terminal of the lamp and a solid state on-off switching circuit is connected across the lamp and controls the operation of an indicator which gives an indication of the operating condition of the switching circuit. Only if the lamp is open-circuited will the switching circuit be switched to its operating condition. The lamp cannot be energized by this second energy source so the lamp is tested without being energized. A number of lamp circuits can be tested merely by connecting each one to the second energy source through a separate high impedance and to the input of the switching circuit by individual isolating diodes. As a further feature the circuit can be arranged so that in an automobile the lamp circuits are tested when the ignition switch is turned on so there is no need to close the switch in each of the individual lamp energizing circuits.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a functional illustration of a preferred embodiment of the invention illustrating four separate lamp energizing circuits in parallel; and

FIG. 2 is a schematic illustration of a typical switching circuit which can be used in the embodiment shown in FIG. 1.

2

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As mentioned earlier, the invention will be described as it would be used in conjunction with the usual automobile lamp energizing circuits, although no limitation thereto is intended. It will become clear that the invention can be utilized with its attendant advantages and features in individual lamp energizing circuits or a number of parallel lighting circuits for testing the lamps.

A first DC source 10 may be a 1 volt battery having its negative terminal connected to ground and the positive terminal connected to power line 11. Also connected to the power line 11 are a number of open-close or on-off switches 12 which control the turning on and off of the respective series connected lamps 13. Typically, the switches may be located on the dashboard of an automobile as for turning on and off the headlights and the taillights, or may be in the turn signal mechanism or may be controlled by the brake pedal as for the brakelights, etc. One terminal 14, which may be referred to as the energizing terminal of each of the lamps 13, is connected to one end of the respective switches 12 and the other side of the lamp is connected to ground to complete the series circuit with the battery 10.

The power line 11 is also connected through the automobile ignition switch 15 to a second DC energy source 16. The latter preferably is merely a voltage doubling circuit which, when energized by the 12 volt output from battery 10, will produce approximately a 24 volt positive output at terminal 17. Connected between each of the respective lamp energizing terminals 14 and the positive potential output terminal 17 of DC energy source 16 are resistors 18. The ohmic value of each of these resistors 18 is selected so that the energy source 16 is not able to energize any of the lamps 13. Typically, with no limitation thereto being intended, the lamps may have a resistance in the order of 10 ohms and for a 24 volt DC potential from source 16, the resistors 18 may be about 10,000 ohms.

A switching circuit 20 is also coupled to lamp terminals 14 and contains a lamp-failure indicator which itself, may be in the form of lamp 21. The latter is preferably located on the automobile dashboard so it can be seen at a glance. The input terminal 22 of switching circuit 20 is connected to the energizing terminal 14 of each of the respective lamps 13 by a suitably oriented isolating diode 23. As will be described later in greater detail, the switching circuit 20 can be activated by an input to its input terminal 22 from any of the four lamp energizing circuits to which it is connected. Ordinarily, switching circuit 20 is in the inoperative stage so that indicator 21 is not energized.

When a driver enters the automobile and turns on the ignition key to close ignition switch 15, the energy from the battery 10 provides an input to the voltage amplifier 16 so that it will produce its 24 volt output. Because of the high impedance ratio between the resistors 18 and the lamps 13, as long as the latter are conductive and are not open-circuited, the energizing potential at terminal 14 from energy source 16 is virtually at ground or zero level. This, then, does not affect the input to the switching circuit 20. In the event that any one of the lamps 13 should be open-circuited,

no current will flow from the terminal 17 through the corresponding resistor 18 so that the full 24 volt potential from source 16 appears at terminal 14. This high potential level is transferred to input terminal 22 of switching circuit 20 by the appropriate diode 23 and causes the switching circuit to go into operation or become enabled to produce an output signal to energize the indicator 21. This provides a visual or, if desired, some other type of signal to the automobile driver to tell him that one of the lamps, a headlight, tail-light or signal light, for example, is not functioning correctly. It should be noted that none of the lamp energizing switches 12 is closed at this time so that daytime or nighttime the test of the lamps is automatically made as soon as the ignition switch is closed.

If any of the switches 12 is closed when the ignition switch 15 is closed, the 12 volt potential will appear at the corresponding energizing terminal 14 whether the lamp is good or bad. This energy level is not high enough to energize or enable the switching circuit 20 so it will not be able to respond with an indication of a lamp failure even if the lamp is bad. This means, then, that the lamps can only be tested if the ignition switch is closed before the respective lamp energizing switches 12 are closed. By far the overwhelming majority of automobile drivers operate their cars in that sequence, even at night. However, there are some drivers who, at nighttime, will first turn on their lights before turning on the ignition. The embodiment shown and described in FIG. 1 will not operate to test the headlight lamps when that occurs although the test will still be made automatically during daytime operation. However, the circuit can be made foolproof even against the operator who turns his lights on first. This is done by placing a suitably selected diode 31 between the energizing switch 12 and the energizing terminal 14 of its corresponding lamp, oriented so the anode of the diode is towards the positive side of battery 10. This will permit the lamps to be automatically tested in the individual energizing circuits regardless of the position of the lamp energizing switch 12. With said diodes in the circuit, in the event a lamp 13 is open-circuited, there will be no current flow from the battery 10 through switch 12 to the lamp so the diode will be back-biased and the full 24 volt potential from source 16 will appear at the energizing terminal 14 and produce a suitable input to switching circuit 20 to give the indication of a defective lamp. If the lamp is good, the diode is merely a low impedance conductor.

Although the embodiment illustrated in FIG. 1 shows isolating diodes 23 connected to the input of the switch circuit 20, if only a single lamp energizing circuit were used so that only one input was applied to the input terminal 22, then, of course, there would be no need for isolating diodes and there would be a straight wire connection between terminal 14 and input terminal 22. Also, although it is preferable that the output from energy source 16 not appear until ignition switch 15 is closed, it is possible that energy source 16 could be independent of the ignition switch. It could be a separate supply, for example, a 24 volt battery that is always operative and not dependent upon the closing of the ignition switch. If so, it would be best to prevent continuous current drain from source 16 by connecting some type of on-off switch to output terminal 17.

FIG. 2 illustrates a typical solid-state switching circuit in schematic form. A zener diode 25 is connected in series with a resistor 26 between the input terminal 22 and ground. Typically, the zener 25 has a breakdown potential in the order of seventeen volts so anything below that potential level at input terminal 22 will not appear across resistance 26. Attached to the junction of the zener diode 25 and resistance 26 is the base element of npn transistor 27 which has its emitter connected to ground and its collector connected through a resistance 28 to the base element of a pnp transistor 29. The emitter of transistor 29 is connected directly to positive 12 volt energy source, which may be battery 10 of FIG. 1, and the base element is also connected to the same source through a resistance 30. In the collector circuit is indicator lamp 21 which is connected to ground.

Ordinarily, while the energy level at input terminal 22 is below that necessary to cause breakdown of the zener diode 25, transistor 27 is virtually cut off and since both the emitter and base of transistor 29 are therefore at the same energy level, it similarly will be cut off and lamp 21 will not be energized. However, when the zener 25 breaks down, this will cause transistor 27 to conduct, changing the emitter base bias on transistor 29 allowing it to conduct to a sufficient degree to energize lamp 21. Typically, with no limitation thereto being intended, the following are values of and designations for the elements shown in the circuit diagram of FIG. 2.

Ref. No.	Component	Type
23	Diode	Silicon 1N4001 (Motorola)
25	Zener Diode	17 volt
26, 28, 30	Resistor	5,000 Ohm
27	Transistor	2N914
29	Transistor	2N1132

A further variation of the invention may comprise a lamp energizing circuit having an energy source, a resistor and the lamp connected in series and the switching circuit connected to the junction of the lamp and the resistor. In this arrangement the potential of the energy source typically should be about twice that needed to energize the lamp and the resistance value should be about equal to that of the lamp. For example, a ten ohm resistance and ten ohm lamp connected in series to a 24 volt supply. When the lamp conducts the voltage across it is about twelve volts which would be insufficient to trigger the switching circuit. If the lamp is open, then the full 24 volts appears across it which will trigger the switching circuit.

We claim:

1. A lamp testing circuit comprising:

a source of electrical energy;

a lamp;

conducting means connecting said energy source in circuit with said lamp to energize the lamp;

another electrical energy source;

a dc impedance coupling the output of said another source to the junction of the lamp and its energizing circuit;

a sensing circuit;

electrical conducting means coupling said sensing circuit to the junction of the lamp and its energizing circuit; and

an indicator coupled to said sensing circuit for producing a signal indication when said sensing circuit detects that the lamp is not energized.

2. The invention as set forth in claim 1 wherein the conducting means coupling the input of said sensing circuit to said junction comprises a diode.

3. The invention as set forth in claim 1 wherein the another energy source and its associated dc impedance are characterized by being unable to energize the lamp even if it is conductive and being able to energize said sensing circuit only when the lamp is nonconductive.

4. The invention as set forth in claim 3 wherein the conducting means between the said first-mentioned energy source and the lamp has negligible impedance.

5. The invention as set forth in claim 3 wherein the conducting means between the said first-mentioned energy source and the lamp comprises a selectively operable on-off switch and a unidirectional conductor in series with the energy source and the lamp.

6. The invention as set forth in claim 4 wherein said first mentioned energy source is about twice the energy level of the other energy source and the impedance associated with said another energy source is in the order of about one thousand times that of the lamp.

7. Lamp energizing and testing circuit, comprising: a first energy source; a selectively operable open-close switch, conducting means and a lamp connected in series with said first energy source for energizing the lamp when the switch is closed; a second energy source having an energy level substantially greater than the first energy source; electrical resistance coupling the output of the second energy source to the energizing terminal of the lamp, the impedance of said resistance being such that said second energy source will not energize the lamp; a transistorized circuit capable of being operably switched between conducting and nonconducting conditions; an indicator connected to the output of said switching circuit for indicating the operating condition of said switching circuit; conducting means coupling the input of said switching circuit to the junction of the lamp and said electrical resistance whereby said switching circuit is caused to operate in one condition when said lamp is nonconductive and in the other condition when the lamp is conductive.

8. The invention as set forth in claim 7 wherein the conducting means to the input of the switching circuit includes a diode.

9. The invention as set forth in claim 7 wherein the conducting means in series with the lamp and switch includes a diode.

10. Lamp energizing and testing circuits, comprising, in combination: a first energy source; a plurality of lamp energizing circuits connected in parallel to said first energy source; each of said lamp energizing circuits comprising, a selectively operable open-close switch, conducting means and a lamp connected in series with the first energy source for energizing the respective lamp when the corresponding respective switch is closed; a second energy source having an energy level substantially greater than the first energy source; a plurality of electrical resistors, each resistor coupling the output of said second energy source to the energizing terminal of a respectively different one of said lamps, the impedance value of each resistor being such that the second energy source will not energize the lamp; a transistorized switch circuit selectively operable in either a conducting or nonconducting condition; an indicator connected to the output of the switch circuit for indicating the operative condition of said circuit; and a plurality of diodes, each diode connected between the input to said switching circuit and a respectively different junction of a resistor and its associated lamp.

11. The invention as set forth in claim 10 wherein the conducting means in each lamp energizing circuit includes a diode.

12. In an automobile electrical circuit in which a lamp is energized by a main energy source through an on-off switch, a circuit for testing the conductivity of the lamp, comprising:

a second energy source having an energy level substantially greater than said main energy source; a dc impedance connecting said second energy source to the lamp filament; a sensing circuit electrically coupled to the lamp filament, said sensing circuit being activated by said second energy source when said lamp is nonconductive; and an indicator coupled to said sensing circuit for producing a signal indication when said sensing circuit is activated.

13. The invention as set forth in claim 12 wherein said second energy source and the dc impedance are such that the second energy source cannot energize the lamp.

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