Jan. 29, 1963 J. A. McDERMOTT 3,076,123

BULB CHANGING MEANS

Filed July 6, 1959 2 Sheets-Sheet 1

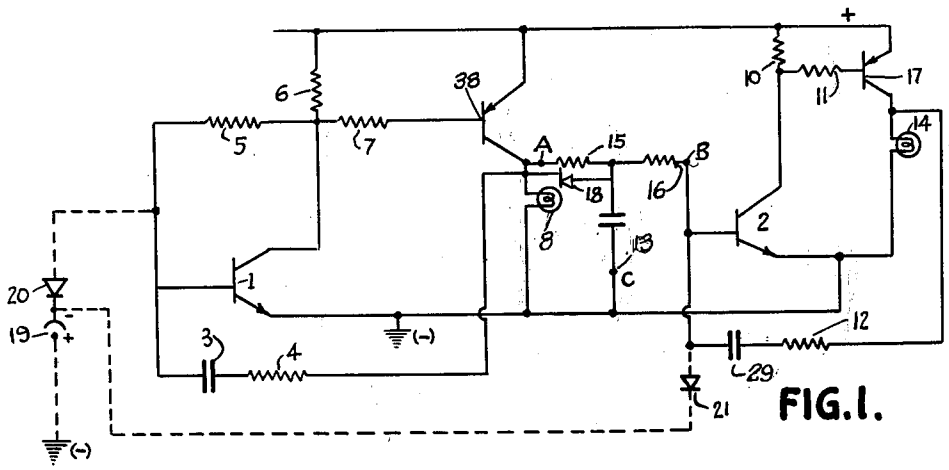
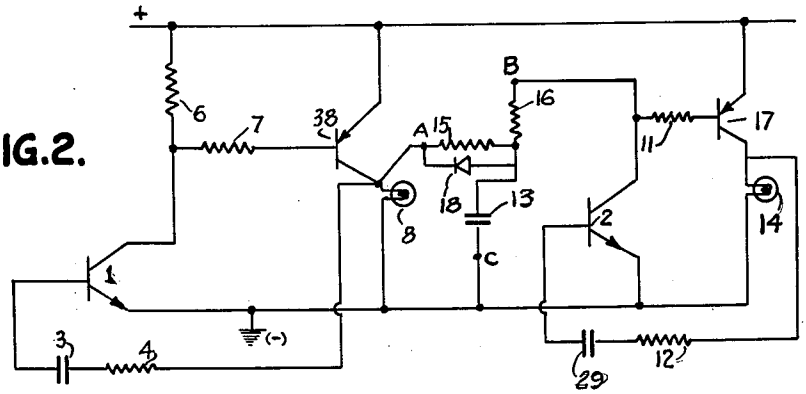


FIG.1.

FIG.2.



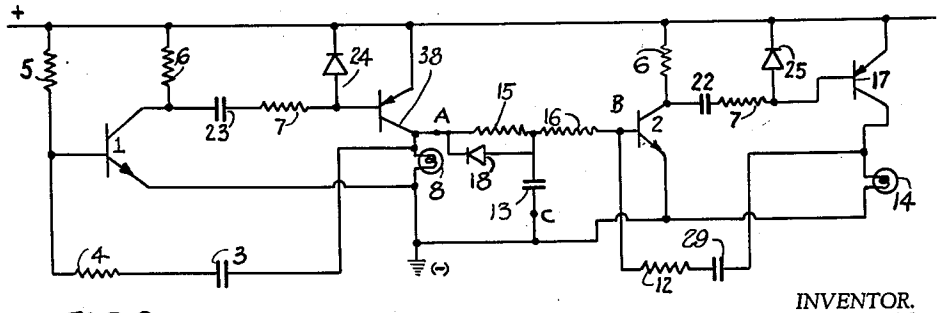


FIG.3.

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BULB CHANGING MEANS

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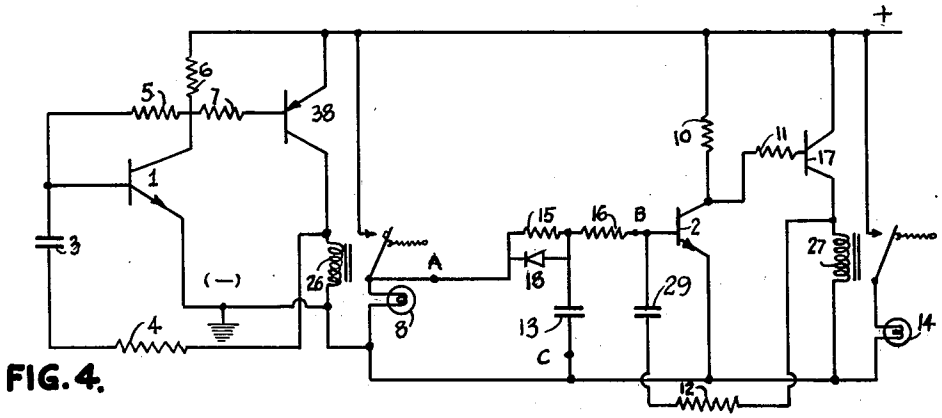

FIG. 4.

FIG. 5.

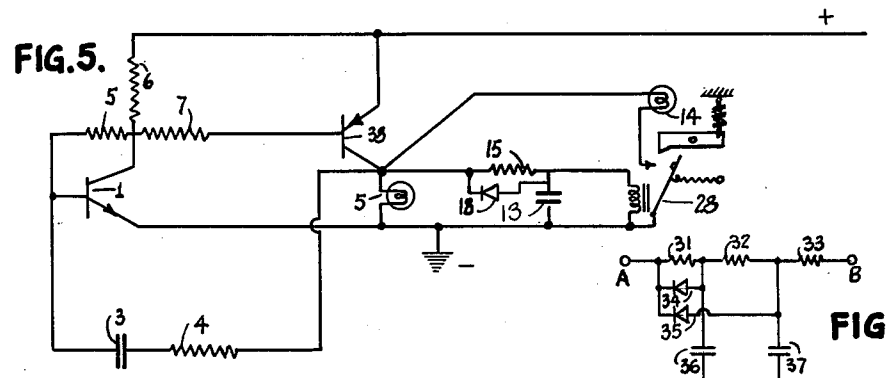

FIG. 7.

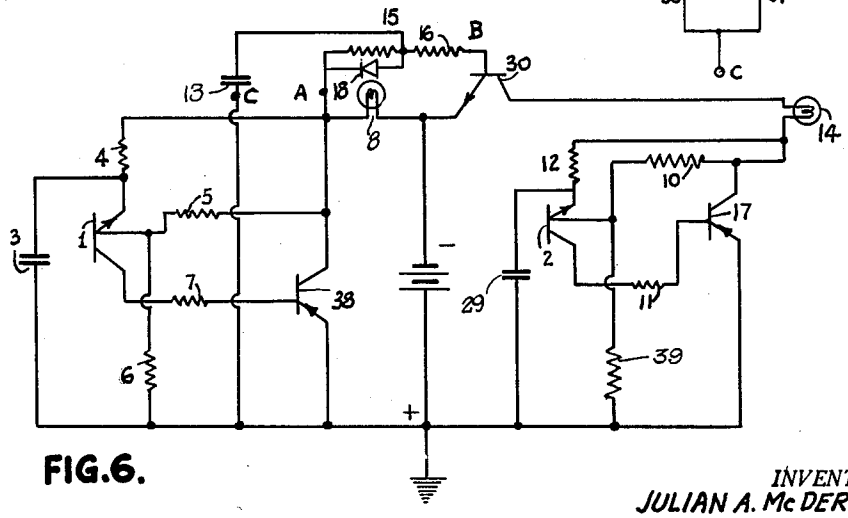

FIG. 6.

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BULB CHANGING MEANS

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14 Claims. (Cl. 315—88)

This invention relates broadly to transistor controlled flasher circuits, and more specifically to means whereby a spare bulb can be switched in automatically when a bulb in the flasher circuit burns out. Flasher lamps, i.e., lamps which intermittently flash on and off are frequently positioned in areas where emergencies exist. It is therefore of the utmost importance that the bulbs in such lamps function perfectly at all times. One of the reasons for flasher lamp failure is bulb burn-out. Bulbs frequently burn out at times when those who are responsible for their maintenance are not aware of the burn-out or are not available to replace them.

With this in mind, it is the principal object of the present invention to provide means for coupling the basic circuit to an arrangement which will cause a reserve bulb to switch in and flash when the bulb in the basic circuit has burned out.

A further purpose of the present invention resides in the provision of means whereby the burn-out of the filament in the main circuit bulb enables a coupling condenser to become sufficiently charged to serve as a source of energy to switch in a second circuit containing a reserve bulb.

And it is yet another advantage of the present invention to provide means whereby the switching in of a reserve bulb when the bulb in the basic circuit burns out is instant.

These and other meritorious aims and advantages, which will become more fully apparent as the description hereof proceeds, are attained by the novel combination and arrangement of few and simple parts, hereinafter described, and illustrated in the accompanying drawings, constituting a material component of the present disclosure, and in which:

FIGURE 1 is a schematic circuit diagram of an arrangement for switching in a reserve bulb when the bulb in the basic circuit has burned out, the circuit here illustrated being so arranged that, when the filament in the bulb of the basic circuit burns out, a coupling condenser becomes sufficiently charged to serve as source of energy to activate a circuit which controls a reserve bulb.

FIGURE 2 shows a circuit similar to that illustrated in FIGURE 1, the difference residing in the method of charging the condensers.

FIGURE 3 illustrates another modified circuit, wherein the transistors are coupled through condensers.

FIGURE 4 illustrates a circuit similar to the one shown in FIGURE 1, except that in this modified circuit the bulbs flash through a pair of relays.

FIGURE 5 shows another modified circuit, wherein a mechanical relay latching arrangement is used instead of the secondary flashing circuit illustrated in the other forms.

FIGURE 6 shows yet another reserve bulb switching arrangement, wherein another combination of resistors, condensers and transistors is used.

FIGURE 7 shows still another reserve bulb switching arrangement applicable to all.

Referring in greater detail to the drawings, and specifically to FIGURE 1 thereof, the numeral 1 refers to an NPN transistor, and the numeral 38 refers to a PNP transistor, both of the said transistors being in the main circuit. The main circuit further comprises a timing condenser 3, a plurality of resistors, respectively referred to by the numerals 4, 5, 6 and 7 which control the operation of the main circuit and of a bulb 8 and a switch 9.

The secondary circuit comprises a plurality of resistors respectively numbered 10, 11 and 12 which control the secondary circuit. The condenser of the secondary circuit is illustrated at 29 and the numeral 14 refers to the secondary or reserve bulb. It will be noted that the basic circuit and the secondary circuit are alike, except that the secondary circuit does not have the equivalent of the resistor 5 of the basic circuit. Numeral 13 refers to the condenser in the linkage circuit between the primary and secondary flashing circuits.

The circuit values are so selected, that the charging and discharging of the condenser 3 will be obtained. The PNP transistor becomes conductive whenever its base becomes negative. Cycling of the condenser will thus cause the bulb 8 to flash. Every time the bulb 8 flashes, a potential is applied to the coupling condenser 13 through resistance 15. The current leaks back through the bulb on the "off" period and the voltage reaches a maximum value. This voltage, which is applied to the secondary circuit through resistance 16 is insufficient to cause the operation of the secondary flasher circuit. However, if bulb 8 burns out, condenser 13 becomes charged from the current of the transistor 38. This puts a potential on the condenser 13 through the resistance 15. Thus the circuit including the transistors 2 and 17, bulb 14, resistors 10, 11, 12 and 16 and condenser 29 becomes activated, flashing the bulb 14.

During the flashing of bulb 8 in the basic circuit, it is desirable to keep the voltage on the storage condenser 13 at a minimum, in order to keep losses in the secondary flasher circuit at a minimum. To do this, a rectifier 18 may be added to the circuit. On each flash of the main bulb 8, current flows into the condenser 13 through the resistance 15. When the flash ends, the condenser discharge resistance is lower than the charging resistance, due to the rectifier. This arrangement has no important effect on the operation of the secondary bulb flasher circuit after it begins to become activated.

To consider the operation of the basic circuit illustrated in FIGURE 1, it is assumed that the NPN type transistor 1 is back biased. As the condenser 3 becomes charged through resistors 5 and 6, the condition changes, supplying base current to the transistor 38 which becomes conductive, thus lighting the bulb. Resistor 7 is provided for current limitation. As transistor 1 conducts, its collector voltage drops toward ground, which effects a reduction in the current flowing through resistor 5 into the base of transistor 1, so that the condenser 3 then supplies base current necessary to keep the bulb activated. When the condenser 3 current becomes insufficient to keep transistor 38 in saturation, the voltage across the bulb drops. This is coupled via condenser 3 to the base of transistor 1, back biasing the emitter to base diode, initiating the "off" time. The condenser now discharges through the resistor 5, causing the cycle to repeat. Typical resistor values are (4) 2.7K; (5) 68K; (6) 2.7K; (7) 470 ohms; capacitor 20 mfd.; voltage 6 v. and bulb 150 ma. rated.

The secondary flasher circuit is generally similar except that resistor 5 is eliminated and instead the transistor 38 is linked to supply power to the timing transistor 2.

The circuit shown in FIGURE 2 is similar to the circuit shown in FIGURE 1 insofar as the actuating of the reserve bulb circuit is concerned. The operation of the main flasher circuit shown in FIGURE 2 differs from that shown in FIGURE 1 only in the network through which the condensers are charged. Similar circuit elements are referred to by the same reference numerals as in the circuit shown in FIG. 1.

The circuit shown in FIGURE 3 is substantially similar

to that shown in FIGURE 1 except that the NPN and the PNP transistors in each flasher circuit are coupled through condensers. Equivalent elements are referred to by the same reference numerals as in FIGURE 1. The coupling condensers are referred to by the numerals **22** and **23** respectively. The rectifiers **24** and **25** respectively in the primary and secondary circuits allow the charges to leak off the coupling condensers **22** and **23** between flashes.

FIGURE 4 shows a circuit similar to that shown in FIGURE 1 except that the bulbs are not flashed directly. They are flashed through relays **26** and **27**. Equivalent elements are referred to by the same reference numerals as in FIGURE 1.

In the circuits shown in FIGURES 1 through 4, the linkage circuit **13**, **15** and **18** is similarly used to activate the flasher circuit for the reserve bulb.

FIGURE 5 shows a mechanical latching relay substituted for the secondary flashing circuit heretofore disclosed. The elements are the same as those used in the primary flashing circuit illustrated in FIGURE 1. The linkage circuit also is the same except that in this disclosure the resistance **16** is not necessary and is therefore eliminated. The latching relay is illustrated at **28**. Manual reset is here required. Whenever lower powered units use this arrangement, it will be found to be desirable to utilize a sensitive relay which operates the latching relay, but the entire assembly is in effect a latching relay. Only one complete flasher circuit is necessary in this arrangement.

FIGURE 6 shows the spare bulb switching arrangement used in flasher circuits wherein another combination of resistors, condensers and transistors is used. In the primary flashing circuit of this arrangement, **3** is the timing condenser, **1** is the NPN transistor, **38** is the PNP transistor, **8** is the bulb in the primary circuit, and the resistors controlling the function of the primary circuit are respectively numbered **4**, **5**, **6** and **7**. As in the circuits hereabove referred to, the resistors **15** and **16** provide the linkage to the secondary flasher circuit, and the rectifier **18** keeps the voltage on the linkage storage condenser **13** down until bulb **8** in the primary circuit burns out. The numeral **13** refers to the timing condenser in the secondary circuit **2**, is the NPN transistor, **17** is the PNP transistor, **14** is the bulb, and **10**, **11**, **12** and **39** are the resistors controlling the secondary circuit. Failure of bulb **8** in the primary circuit results in the building up of a charge on the linkage condenser **13**. This puts a charge on the base of the circuit transfer transistor **30** causing it to become conductive, thereby providing means to activate the secondary flasher circuit. The switching arrangement may be positioned in any appropriate part of the secondary circuit or in the leads to the NPN transistor **2**.

It has been mentioned hereabove that effective operation of the circuit illustrated in FIGURE 1 requires that the voltage on the linking condenser **13** be kept at the lowest possible value in order to keep the power losses in the secondary flasher circuit at a minimum. This value can be further reduced by the use of a network as shown in FIGURE 7 which can be substituted at points indicated at ABC in the drawings for the resistors **15** and **16** and the condenser **13** in the several views hereabove referred to. Either or both rectifiers **34** and **35** might be eliminated if circuit operation or a particular combination of components so indicate.

Photoeletcric control of the circuits hereabove referred to can be obtained if desired by connecting the rectifier **18** illustrated in FIGURE 1 and a photoelectric or photovoltaic cell of conventional construction to one side of the timing condenser. When the sun shines upon the cell, it generates a potential, stopping the flashing of the primary flashing circuit. It does not control the secondary flasher circuit, so that automatic indication is obtained if a bulb burns out. Bulb burn-out in the primary circuit is indicated when the secondary flasher circuit continues to operate even when the sun shines.

Automatic control of the bulbs of both the primary and the secondary circuits can be obtained by the addition of a rectifier as illustrated at **21** in FIGURE 1. Photoelectric control can be obtained in a similar manner in connection with any of the other circuits hereabove referred to. Obviously, more than one reserve bulb may be used by adding to the circuits by the use of the methods hereabove described. Obviously, too, any pairs of transistors may be used in a single constructive entity.

There have thus been shown and described means for switching in a reserve bulb in the event of the burn-out of the bulb in the primary circuit, in the principal form of the embodiment and in several modifications thereof. Applicant reserves the right however, to make such changes therein as might come within the scope of the appended claims without thereby departing either from the spirit or the scope of the present invention.

What is claimed as new is:

1. In a circuit to flash an incandescent light bulb having two terminals and including an NPN and a PNP type transistor operating together to achieve oscillation, said circuit including a resistor, one side of said resistor connected to one terminal of said bulb, a condenser, said condenser connected between the other side of said resistor and the other terminal of said bulb, and means to switch in a second bulb when said first named bulb burns out, said switching means actuated by the voltage rise of said condenser when the first named bulb burns out.

2. The combination with a circuit to flash an incandescent bulb having two terminals, said circuit including a PNP and an NPN type transistor operating together to achieve oscillation, a resistor, said resistor connected to one terminal of said bulb, a condenser, said condenser positioned between the other side of said resistor and the other terminal of said bulb; means to switch in a second bulb when the first named bulb burns out, said switching means activated by the voltage rise of the condenser when the first named bulb burns out.

3. In combination, a circuit including a PNP and an NPN type transistor operating together to achieve oscillation to flash an incandescent bulb having two terminals, a resistor, one side of said resistor connected to one of the terminals of said bulb, a condenser, said condenser connected between the other side of said resistor and the other terminal of said bulb, a second flasher circuit including an incandescent bulb, and means to switch in said second named bulb when said first named bulb burns out, said means activated by the voltage rise on the condenser when said first named bulb burns out.

4. A flasher circuit including an NPN and a PNP type transistor operating together to achieve oscillation, a bulb in said circuit, said bulb adapted to flash as result of such oscillation, a resistor-condenser combination, said resistor-condenser combination connected to said bulb, and a second bulb adapted to be switched into said circuit by the increase of the voltage on said condenser when said first named bulb burns out.

5. A flasher circuit including an NPN and a PNP type transistor operating together to achieve oscillation, an incandescent bulb in said circuit, the oscillation resulting in flashing of said bulb, a second circuit including an incandescent bulb, and means interconnecting said first named circuit and said second named circuit whereby oscillation of said second circuit occurs and said second bulb flashes whenever said bulb in said first named circuit burns out.

6. A flasher circuit including an NPN and a PNP type transistor operating together to achieve oscillation, a linking condenser and a bulb in said circuit, the oscillation of the transistors causing flashing of said bulb, a second generally similar circuit, said second circuit including an incandescent bulb, said first named circuit and said second named circuit so interconnected that failure of said first named bulb results in the accumulation of a charge

on said linking condenser activating said second named circuit and flashing said second named bulb.

7. In a flasher circuit for an incandescent bulb including an incandescent bulb and an NPN and a PNP type transistor operating together to achieve oscillation whereby causing the flashing of said bulb, a second circuit including a reserve bulb, said first named circuit so designed that failure of said first named bulb causes a continuous voltage to be applied across the terminals of said first named bulb, and switching means actuated by said continuous voltage to switch in said reserve bulb.

8. In a flasher circuit for an incandescent bulb including an incandescent bulb and an NPN and a PNP type transistor operating together to achieve oscillation whereby flashing said bulb, said circuit so designed that failure of said bulb causes a continuous voltage to be applied across the terminals of said bulb, a second circuit, an incandescent bulb therein, and switching means actuated by said continuous voltage activating said second circuit and flashing said bulb therein.

9. In a transistor operated flasher circuit including an incandescent bulb, means for switching in a reserve bulb when said first named bulb burns out, said switching means including a second circuit, an incandescent bulb therein, a resistor-condenser-resistor combination, said combination connected to said first named bulb, and said combination serving as a source of energy causing the activation of said second named circuit and said second named bulb when said first named bulb burns out.

10. In a transistor operated flasher circuit including an incandescent bulb, means switching in a reserve bulb when said first named bulb burns out, said switching means including a resistor-condenser-resistor combination, and rectifier, said rectifier adapted to leak off the charge on the condenser between flashes as long as the bulb filament remains intact.

11. In a transistor operated flasher circuit including an incandescent bulb, means switching in a reserve bulb when said first named bulb burns out, said switching means including a resistor-condenser-resistor combination, said combination connected to said first named bulb,

and said combination constituting the source of energy whereby to activate means switching said reserve bulb into said circuit.

12. In a transistor operated flasher circuit including an incandescent bulb, means switching in a reserve bulb when said first named bulb fails, said means including a resistor-condenser-resistor combination, a rectifier, said rectifier adapted to leak off the charge on the condenser between flashes as long as the first named bulb filament is intact thereby causing the reserve bulb to be switched into said circuit.

13. In a flasher circuit including an incandescent bulb and an NPN and a PNP type transistor operating together to achieve oscillation whereby flashing said bulb, a timing condenser in said circuit, a second circuit including an incandescent bulb, said circuits so coupled as to cause flashing of said second named bulb upon failure of said first named bulb, a rectifier, a photoelectric cell, and said rectifier and said photoelectric cell connected to one side of said timing condenser in said first named circuit whereby to stop oscillation and flashing when light of sufficient intensity strikes said cell.

14. In a flasher circuit including an incandescent bulb and an NPN and a PNP type transistor operating together to achieve oscillation whereby flashing said bulb, a timing condenser in said circuit, a second circuit including a timing condenser and an incandescent bulb, said circuits so coupled as to effect flashing of said second named bulb upon failure of said first named bulb, a rectifier, a photoelectric cell, said rectifier and said photoelectric cell connected to one side of said timing condenser in said first named circuit, and a second rectifier, said second named rectifier connected between one side of said timing condenser in said second circuit and said photoelectric cell whereby oscillation of either circuit stops when light strikes the photoelectric cell.

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