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Bolinger et al.

[11] **3,735,196**

[45] **May 22, 1973**

[54] **FLASHER CIRCUIT WITH OUTAGE INDICATION**

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[73] Assignee: **Meridian Industries, Inc.,** Southfield, Mich.

[22] Filed: **Mar. 23, 1972**

[21] Appl. No.: **237,569**

Related U.S. Application Data

[63] Continuation of Ser. No. 40,288, May 25, 1970, abandoned.

[52] **U.S. Cl.**.....**315/200 A,** 315/130, 315/201, 340/81 R

[51] **Int. Cl.**.....**H03b 3/282,** H05b 39/09

[58] **Field of Search**.....315/200 A, 130, 201; 340/81 R

[56] **References Cited**

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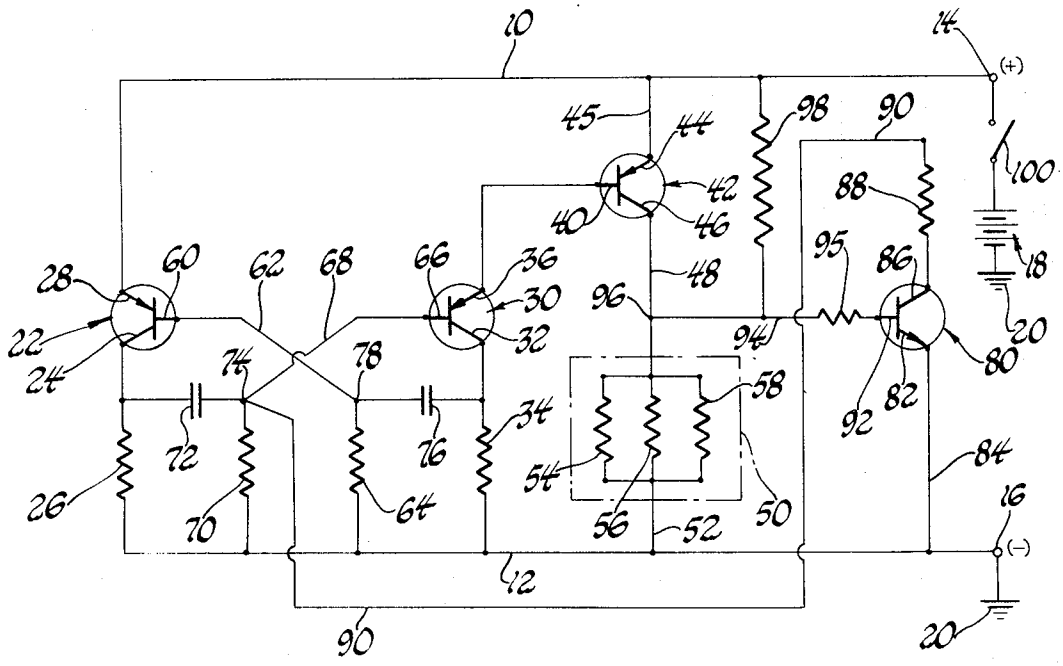
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Primary Examiner—John Kominski
Attorney—Gerald E. McGlynn, Jr. et al.

[57] **ABSTRACT**

A flasher circuit has a power transistor controlling a circuit with a load therein; a multivibrator produces a timed pulse signal to the power transistor for turning the power transistor "on"; and an additional transistor sensitive to the occurrence of an increased voltage drop across the load due to an outage is connected to the multivibrator for changing the time rate of the timed pulse signal.

6 Claims, 4 Drawing Figures



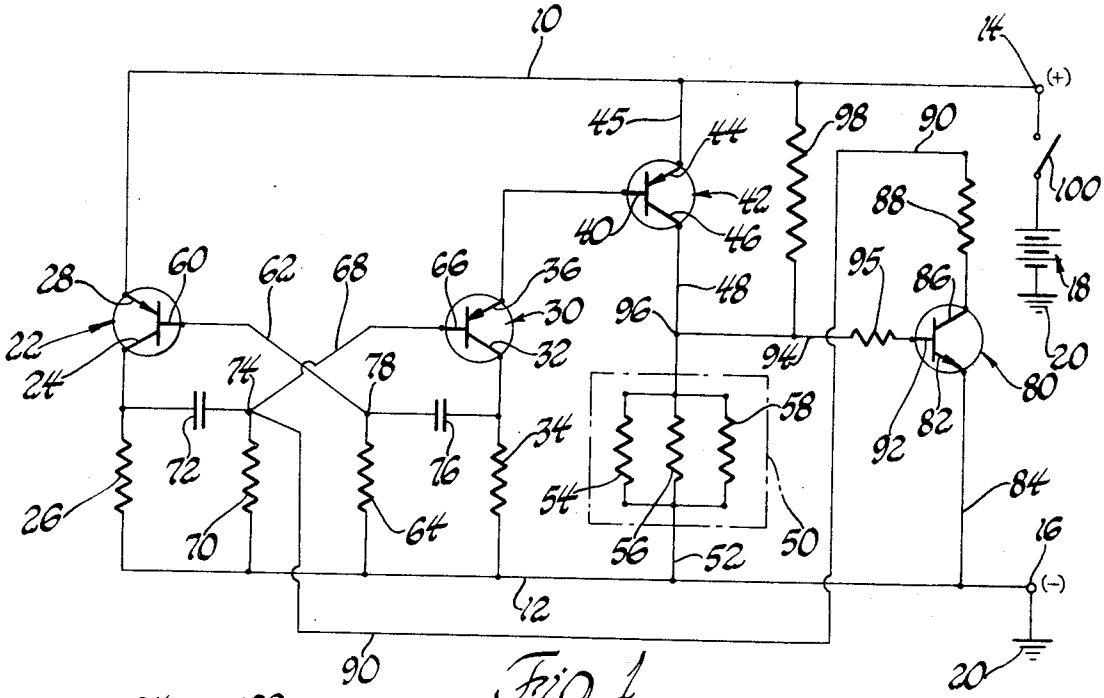


Fig. 1

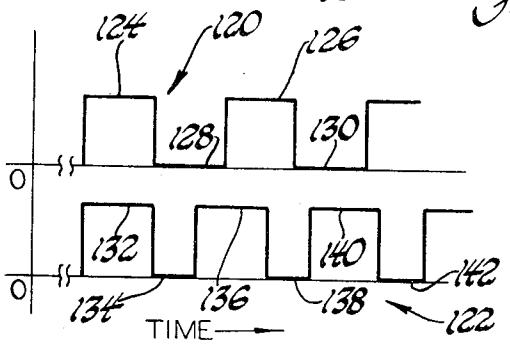


Fig. 2

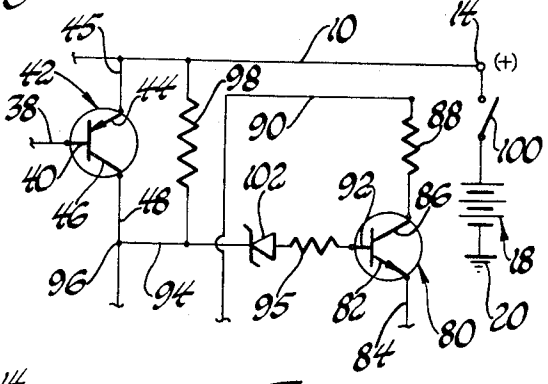


Fig. 3

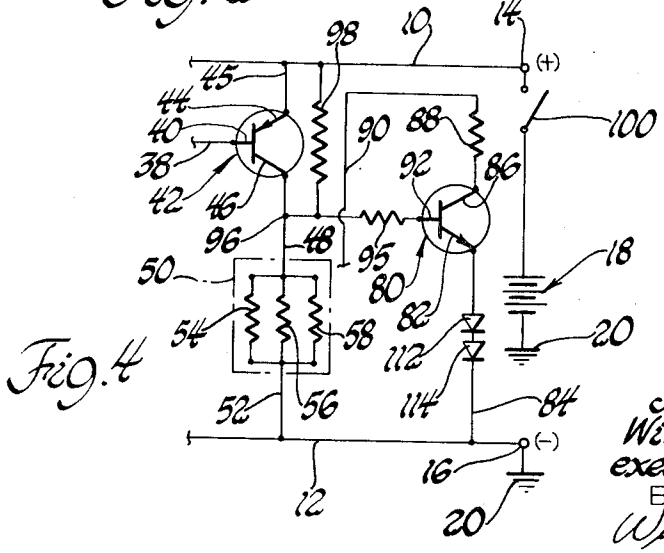


Fig. 4

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FLASHER CIRCUIT WITH OUTAGE INDICATION

This is a continuation of application Ser. No. 40,288, filed May 25, 1970 now abandoned.

BACKGROUND OF THE INVENTION

Heretofore various circuits have been proposed for use as flasher circuits. However, such flasher circuits have been, and often still are, susceptible to the occurrence of a particular lamp or bulb, within the overall load, becoming burned out. Such occurrences can become dangerous where, for example, the flasher circuit is employed as a directional turn indicator on motor vehicles or an emergency flashing system as on school buses or the like, because the vehicle operator may not have knowledge that a particular lamp or bulb is burned out and is assuming that all pedestrians as well as other vehicles are aware that he is signaling his particular intent to perform a particular vehicular maneuver.

Accordingly, the invention as herein disclosed and described is directly concerned with the solution of the above as well as other related problems.

SUMMARY OF THE INVENTION

According to the invention, a switching circuit comprises electrical load means, a load circuit containing said electrical load means, first load switching means in circuit with said load circuit, second means for producing a cyclic control signal for causing said first means to be at times rendered conductive, and additional means responsive to the occurrence of an outage condition in said load means and being effective in response thereto to vary the cycle time of said cyclic control signal.

Various general and specific objects and advantages of the invention will become apparent when reference is made to the following detailed description considered in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

In the drawings, wherein certain details may be omitted, for purposes of clarity, from one or more views:

FIG. 1 is a schematic wiring diagram of a flasher circuit employing the invention disclosed herein;

FIG. 2 illustrates, in comparison, two graphs depicting two different modes of operation of the circuitry of FIG. 1; and

FIGS. 3 and 4 are fragmentary schematic wiring diagrams illustrating modifications of the invention shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now in greater detail to the drawings, FIG. 1 illustrates a flasher circuit with outage indication means as comprising conductors **10** and **12** having their respective ends **14** and **16** adapted for connection to a suitable source of electrical potential **18** and ground as at **20**. A first transistor **22** has its collector electrode **24** connected in series with a resistor **26** and conductor **12** while its emitter electrode **28** is connected to conductor **10**. Similarly, a second transistor **30** has its collector electrode **32** connected, in series with a resistor **34**, to conductor **12** while its emitter electrode **36** is connected via conductor **38** to the base terminal **40** of a load or power switching transistor **42** which, in turn, has its emitter **44** connected to conductor **10** by means of conductor **45** and its collector terminal **46** connected via conductor **48** to electrical load **50**. The other side of load **50** is connected to conductor **12** by means of a conductor **52**.

Accordingly, for purposes of discussion, conductors **45, 48** and **52** may be considered as comprising a load circuit within which the power transistor **40** and load **50** are situated. Further, for purposes of clarity and ease of description, the load **50** is shown as comprising a plurality of loads **54, 56** and **58** arranged in parallel. Such loads **54, 56** and **58** may be thought of as comprising a plurality of flasher lamps carried as by an automotive vehicle or even, for example, a school bus.

Base electrode **60** of transistor **22** is electrically connected, via conductor **62**, in series with a resistor **64** which has its other end connected to conductor **12** while base terminal **66** of transistor **30** is connected to conductor **12** by means of a conductor **68** and resistor **70**.

A first capacitor **72** has one side connected to a point electrically between resistor **26** and collector terminal **24** of transistor **22** while its other side is connected to conductor **68** as at **74**. Somewhat similarly, a second capacitor **76** has one side connected to a point electrically between resistor **34** and collector electrode **32** of transistor **30** while its other side is connected to conductor **62** as at a point **78**.

A fourth transistor **80** has its emitter **82** connected to conductor **12**, as by conductor portion **84**, while its collector **86** is connected to a resistor **88** which, in turn, is connected to point **74** as by a conductor **90**. The base terminal **92** of transistor **80** is connected, via conductor **94**, to conductor **48** as at a point **96**. A resistor **98** is connected at its opposite ends to conductors **10** and **94** so as to be in parallel to power transistor **42**.

It can be seen that each of transistors **28, 30** and **42** are of the P-N-P type while transistor **80** is of the N-P-N type. Generally, in the P-N-P type conduction therethrough will occur when the emitter is made sufficiently positive with respect to the collector and base while in the N-P-N type conduction therethrough will occur when the emitter is made sufficiently negative with respect to the collector and base.

OPERATION OF THE INVENTION

Generally, transistors **22** and **30** comprise a multivibrator the operation of which is generally as follows. Let it now be assumed that a related control switch **100** has been closed and that transistor **22** has just switched "on," creating current flow through the emitter-collector circuit **28, 24** and that transistor **30** has switched "off" or its non-conducting state.

At the instant that transistor **22** so switches "on," capacitor **72** would have been fully charged so that the side thereof connected to point **74** is positive with respect to the other side of capacitor **72** which is connected between resistor **26** and collector **24**. At this same time capacitor **76** will be in a discharged state.

Capacitor **72** now starts charging toward the opposite polarity by virtue of being essentially connected to **10** when transistor **22** is conducting and the emitter-collector circuit **28, 24,** thereof is completed. It can also be seen that because of the charge that existed on capacitor **72** at the instant that transistor **22** went into conduction and its connection to base electrode **66** of transistor **30**, via conductor **68**, the emitter-base circuit **36, 66,** of transistor **30** are reverse biased (the base **66**

being positive with respect to emitter 38) thereby keeping transistor 30 in an "off" or non-conductive state.

At this same time, capacitor 76 will start to charge essentially through the emitter-base circuit 28, 60, of transistor 22, and resistor 34. Such charging current of capacitor 76 holds transistor 22 conductive or "hard on"; further, even when charging of capacitor 76 is completed, transistor 22 will remain conductive by virtue of the base current provided through resistor 64.

As the potential across capacitor 72, holding transistor 30 "off," is reduced, a condition is finally attained where the capacitor 72 voltage can no longer maintain transistor 30 in the non-conductive state. As transistor 30 starts to become conductive, by virtue of a biasing current through resistor 70, the collector to emitter voltage thereof drops and the now charged capacitor 76 starts to discharge, resulting in a reverse bias driving transistor 22 into non-conduction. When transistor 22 is thusly driven into non-conduction, the voltage across its emitter 28 and collector 24 increases causing capacitor 72 to again start charging through the emitter-base circuit of conductive transistor 30.

At the instant that transistor 30 became conductive, capacitor 76 was charged so as to have its side connected to point 78 positive relative to its side connected between collector 32 and resistor 34. However, as transistor 30 becomes conductive, capacitor 76 starts to charge toward the opposite polarity by virtue of the emitter-collector circuit 36, 32 being conductive and because of the current flow through resistor 64. As described with reference to capacitor 72, so now capacitor 76 produces a reverse bias on transistor 22 holding it in a non-conductive or "off" state.

During the time that transistor 30 is conducting, capacitor 72 is being charged so that its side connected to a resistor 70 will be positive with respect to the side thereof connected between collector 24 and resistor 26. Such charging of capacitor 72 is the consequence of the base current from transistor 30 which also serves to hold the transistor 30 in its "on" or conductive state. Transistor 30 is also maintained conductive for some period after capacitor 72 has been fully charged because of the base bias provided by resistor 70.

However, as capacitor 76 continues to discharge and the voltage thereacross approaches zero, the voltage holding transistor 22 in a non-conductive state decreases and transistor 22 starts to again become conductive. This initiates the regenerative cycle which results in the rapid "turn on" of transistor 22 and "turn off" of transistor 22 as well as the subsequent rapid "turn off" of transistor 22 and "turn on" of transistor 30.

It can be seen that when transistor 30 is in a conductive state, the emitter-base 44, 40, circuit of load or power transistor 42 is biased into conduction thereby completing the circuit through the emitter 44 and collector 46 thereof causing energization of the load 50 comprised of parallel loads 54, 56 and 58. As should be apparent from the preceding, power or load transistor 42 is made conductive during the period that multivibrator transistor 30 is conductive. Therefore, when transistor 30 is cyclically rendered non-conductive, as previously described, power transistor 42 is also rendered non-conductive causing the load circuit to be opened as between load circuit conductor portions 45 and 48.

For purposes of discussion, load 50 may be considered as comprising, for example, a plurality of lamps 54 and 56 situated so as to be visible externally of a vehicle while load 58 may represent a relatively small indicator lamp carried within the vehicle so as to be visible to the vehicle operator.

Accordingly, with the above assumptions, it can be see that whenever transistor 30 is cyclically made inductive, the power or load transistor 42 is likewise turned "on" thereby completing the circuit through the load circuit, comprised of conductors 45, 48 and 52, and load 50 causing the externally situated lamps 54 and 56 to be energized, creating an external signal, and indicator lamp 58 to be simultaneously energized creating an internal indicator signal for the operator.

As can be seen, resistor 98 is in parallel with the power transistor 42 and, therefore, combines with the load 50 to in effect form a voltage divider. For purposes of illustration, let it be assumed that resistor 98 has a resistance value comparatively very high to that of load 50 and that its resistance value is in the order of nine times the effective resistance value of load 50. Therefore, whenever transistors 30 and 42 are "off," 9/10 of the voltage drop occurs across resistor 98 while 1/10 of the total voltage drop, across conductors 10 and 12, occurs across the load 50. However, it should be remembered that the effective resistance of load 50 is determined by the following:

$$R_o = R_1R_2R_3/R_1R_2+R_1\ R_3+R_2R_3$$

where:

R_o = effective resistance;

R_1 = resistance of load 58;

R_2 = resistance of load 56; and

R_3 = resistance of load 54.

Now let it be assumed that for some reason one of the external loads or lamps, such as, for example, lamp 54, has become burned-out thereby in effect causing such lamp 54 to appear as an electrically open branch circuit. Consequently, the effective resistance of load 50 will now increase because the effective resistance will be determined by the following:

$$R_n = R_1R_2/R_1+R_2$$

where:

R_n = new effective resistance;

R_1 = same unchanged resistance of load 58; and

R_2 = same unchanged resistance of load 56.

For purposes of illustration, let it be assumed that R_n is now of a value twice that of original effective resistance R_o. With this assumption, it then becomes apparent that with, for example, lamp 54 being burned-out whenever transistors 30 and 42 are "off" 9/11 of the voltage drop will occur across resistor 98 while 2/11 of the total voltage drop will occur across the load 50, which is now comprised of lamps 56 and 58.

Accordingly, in view of the above, it can be seen that with load transistor 42 in its "off" or non-conductive state and with the occurrence of an outage in the total load 50, the resulting increase in voltage drop across the load 50 and transistor 80 base-emitter divide, due to the outage, is sufficient to cause transistor 80 to become conductive thereby completing a cycle time modifying circuit from point 74 through conductor 90, resistor 88, collector 86, emitter 82, conductors 84 and 12 to ground at 20.

The effect of such a cycle time modifying circuit will be better appreciated when the circuit described by resistor **26**, capacitor **72**, resistor **70** and conductor **12** joining resistors **70** and **72** is first considered. From previous description, it should be apparent that capacitor **72** had been fully charged at the moment that transistor **22** was turned "on" and transistor **30** was turned "off." At the moment that transistor **30** was turned "off" capacitor **72** starts to discharge generally in the loop defined by resistors **70, 26** and conductor **12** therebetween and in so doing reverse biases transistor **30** so as to keep it in its "off" condition. Obviously, in view of the above, the length of time that transistor **30** will be held "off" is dependent on the length of time required to sufficiently discharge capacitor **72** which, in turn, is primarily dependent on the value of resistor **70.**

Therefore, whenever the cycle time modifying circuit is completed, as described above, resistor **70** is effectively placed in parallel with resistor **88** which results in an effective resistance value less than the resistance value of either resistor **70** or **88.** The lowering of the resistance value reduces the time required to sufficiently discharge capacitor **72** and, therefore, reduces the "off" time portion of the overall operating cycle of transistor **30.**

This is graphically illustrated in FIG. **2** by the comparative curves **120** and **122** with curve **120** representing a normal operation without outage and curve **122** representing operation of the flasher circuitry with an outage. If, in curve **120,** portions **124** and **126** represent the "on" times while portions **128** and **130** represent the "off" times of transistor **30** and if, in curve **122,** portions **132, 136** and **140** represent the "on" times while portions **134, 138** and **142** represent the "off" times of transistor **30,** it can be seen by comparison that the "on" time of transistor **30** remains the same whether or not an outage exists in the overall load **50** while the "off" time of transistor **30** is reduced whenever an outage is present.

Accordingly, in view of the preceding, it should be apparent that the invention herein disclosed and described provides means for producing a timed signal to load switching means, in order to cause said load switching means to become cyclically closed and opened, and additional means sensitive to the occurrence of an outage in the load for varying the cycle time of the means for producing a timed signal in order to thereby produce a switching rate indicative of an abnormal load condition. Various other embodiments and modifications of the invention are of course possible and FIGS. **3** and **4** hereof illustrates only two of such modifications. In both FIGS. **3** and **4** only so much of the circuit of FIG. **1** is repeated as is considered sufficient to disclose the modification. All elements in FIGS. **3** and **4** which are like or similar to those of FIG. **1** are identified with like reference numbers.

Referring to FIG. **3,** it can be seen that a zener diode **102** is provided in circuit with conductor **94** and resistor **95.** As is known, a zener diode will maintain a substantively constant voltage once its break-down voltage attained. Accordingly, the effect of providing zener **102** is to require the occurrence of some predetermined higher value of voltage drop to occur across the load **50** before transistor **80** will be permitted to become conductive in the manner previously described. This may be especially of value in situations where the voltage drop across the normal load is close to the value required to cause transistor **80** to become conductive and both operating and ambient temperatures may be such as to at times cause transistor **80** to conduct even when there is no outage.

Another arrangement for accomplishing the same result is illustrated in FIG. **4** wherein diodes **112** and **114** are situated in series in the emitter circuit. The use of such diodes (one or more in series) also required the attainment of a higher voltage to be impressed across the base-emitter diode of transistor **80** as well as the diodes **112, 114** before transistor **80** becomes conductive.

In view of the preceding, it should be apparent that functional equivalents could be substituted for the various sections of the circuitry as well as components or elements contained therein. Also, as should be apparent, the circuitry disclosed could be practiced employing N-P-N transistors for those that are shown as P-N-P and vice versa where appropriate polarity changes are made as is well known in the art.

Although only three embodiments of the invention have been disclosed and described, it should be apparent that other embodiments and modifications of the invention are possible within the scope of the appended claims.

We claim:

1. In a flasher circuit of the type adapted to intermittently energize a load from a voltage source and including means for producing intermittent control signal impulses, and a switching device having its output connected between the load and the voltage source and having its input connected with said means and adapted to be switched between on and off conditions in response to said control signal impulses to connect and disconnect the load and the voltage source, said load comprising plural signal lamps connected in parallel directly across the voltage source whereby the entire voltage of the source is applied to the load when the switching device is on, the improvement comprising a resistor connected across the output of said switching device and in series with the load whereby the resistor and load constitute a voltage divider across the voltage source when the switch is off, the voltage across the load during the interval when the switching device is off being less than a predetermined value when all of the plural signal lamps are operative and being greater than the predetermined value when one of said signal lamps is open circuited, and control means having an input connected with the junction of the load and the resistor and being responsive to the voltage across a portion of said voltage divider for producing an output when the voltage across the load is greater than said predetermined value, thereby being indicative of an open circuit condition of one of said lamps.

2. The invention as defined in claim **1** wherein said control means has its input connected across said load and includes a voltage threshold device adapted to become conductive at said predetermined voltage.

3. The invention as defined in claim **1** wherein said control means is operatively coupled to the input of said switching device to change the action thereof upon the occurrence of an open circuit condition of one of said signal lamps.

4. The invention as defined in claim wherein said switching device is a power transistor and said control means comprises a control transistor having its input connected across said load.

5. The invention as defined in claim 1 wherein said means for producing intermittent control signal impulses is a multivibrator including first and second cross-coupled transistors and wherein said switching device is a power transistor having its input operatively connected with the second transistor of the multivibrator and having its output connected with said load across the voltage source, said control means comprising a control transistor having its input connected across said load.

6. The invention as defined in claim 5 wherein said multivibrator comprises a pair of resistance capacitance cross-coupling networks connected respectively with said first and second transistors for controlling the conductive interval thereof, said control transistor having its output connected to one of said networks whereby the conductive interval of one of the transistors in the multivibrator is changed when the control transistor changes from one conductive condition to another in response to an increase of load voltage during the nonconductive interval of the power transistor.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,735,196 Dated May 22, 1973

Inventor(s) John F. Bolinger; Wilhelm K. Kolster, deceased

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 3, line 50, "22" should be --30--.

Col.4, lines 8-9, "inductive" should be --conductive--.

Col. 5, line 51, "illustrates" should be --illustrate--.

Col. 6, line 64, after "claim" insert --1--.

Signed and sealed this 25th day of December 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

FORM PO-1050 (10-69)

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