(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 002 868**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **78200379.2**

(22) Date of filing: **18.12.78**

(51) Int. Cl.²: **G 08 B 17/00**

(30) Priority: **26.12.77 JP 157038/77**

(43) Date of publication of application: **11.07.79**
Bulletin 79/14

(84) Designated Contracting States: **DE FR GB**

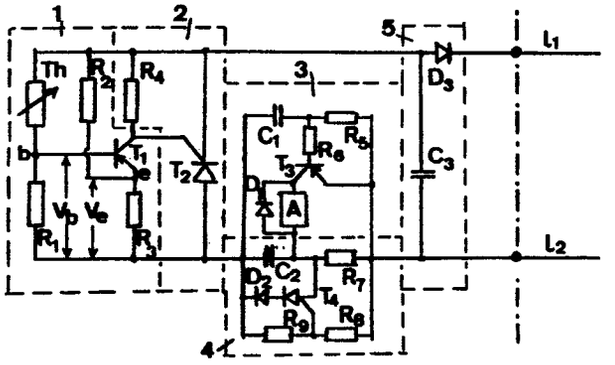
(71) Applicant: **Nohmi Bosai Kogyo Co., Ltd., No. 7 - 3 Kudan Minami 4-chome Chiyoda-ku, Tokyo 103 (JP)**

(72) Inventor: **Hirai, Shuji, No. 12-10, Kokuryo-cho 1-chome Chofu-shi, Tokyo (JP)**

(74) Representative: **Paschedag, Hansjoachim, c/o Cerberus AG Patentbüro alte Landstrasse 411, CH-8708 Maennedorf (CH)**

(54) Fire detector.

(57) Fire detector comprising fire sensing means and switching means short-circuiting the lines in the case of a fire which is so constructed that a large alarm current flowing through the detector once operated by a fire is promptly reduced to a small current, and the line voltage to which the detectors are connected is promptly returned from a voltage nearly equal to the short-circuit voltage to the normal voltage. Accordingly, even if fire detectors connected to plural detector lines are operated successively, there is no possibility of coming short of the capacity of the power source in the control panel, or even after a detector in a detector line has been operated, fire detection by another detector connected in the same detector line is still possible.



EP 0 002 868 A2

Fire Detector

This invention relates to a fire detector connectable to a control panel by electrical lines and comprising sensor means for sensing a fire phenomenon such as heat, smoke, gaz or light and operating switching means short-circuiting the lines and sensing an alarm current flowing in the lines to the control panel when a fire has been detected.

Fig. 1 shows a circuit diagram of a fire alarm system provided with fire detectors De of this kind in prior art.These fire detectors De may be connected in parallel with each other between a pair of lines ℓ_1 and ℓ_2 extending to a control panel Re.

The operation of this known fire detector is as follows:

When a sensor, e.g. thermistor Th of the detecting element De has received heat emitted by a fire, the resistance of the thermistor drops and the potential Vb at the junction point b of the thermistor Th and the resistor R_1 is also reduced. When the potential Vb has reached a voltage less than the emitter potential Ve of the transistor T_1 which is determined by the resistances of the resistors R_2 and R_3, the transistor T_1 will be turned ON and a thyristor T_2 will also be ON by a voltage drop occuring across resistor R_4. As a consequence, a current starts to flow from plus termi-

nal of the power source E located in the control panel Re through the reset key Kr, line ℓ_2, the parallel circuit of operation indicating lamp La and resistor R_5, thyristor T_2, line ℓ_1, diode D_4 and zone relay N operating as signal receiving relay. Then, relay N operates and closes its contacts n_1, n_2 and n_3. By the closed contact n_1 the operation of the relay N self-holds, through the contact n_2 a zone lamp Lf lights up, and further an operation indicating lamp La of the detector De lights up through the contact n_3 and the resistor R_{11}. In this case, the diode D_4 prevents the lines ℓ_1 and ℓ_2 from short-circuit due to the closing of the contact n_1.

When such fire detectors De are used for a fire alarm system, in the event of a fire, a large current nearly equal to the short-circuit current flows through the lines ℓ_1 and ℓ_2 via the thyristor T_2. Furthermore, if any further detector connected with the detector lines (not shown in the circuit diagram) is actuated successively, there is the possibility of coming short of the capacity of the power source E located in the control panel Re. Additionally, such a fire alarm system has the disadvantage that when a detector connected between lines ℓ_1 and ℓ_2 has actuated, no other detector connected to the same lines is able to detect a fire because the voltage between lines ℓ_1 and ℓ_2 will drop to a voltage nearly equal to the short-circuit voltage which is not sufficient for operating the other fire detectors.

This invention aims at obtaining a fire detector avoiding the above mentioned draw-backs of prior art and whereby even if fire detectors connected to plural detector lines are operated successively, there is no possibility of coming short of the capacity of the power source in the control panel, and whereby even after one detector in a detector

line has been operated, fire detection by other detectors connected to the same detector line is still possible.

This object is achieved by providing a timer circuit arranged in one of said lines having a predetermined switching time during which the alarm circuit is allowed to pass to the control panel in order to operate s signal receiving relay and after lapse of which the line current is reduced to a smaller value sufficient for holding the operation of said switching circuit.

Embodiments of this invention are described hereinafter in connection with the drawings in figures 2 - 6.

Fig. 2 shows a circuit diagram of an embodiment of a fire detector of this invention.

Fig. 3 shows time charts showing operating conditions of various parts of this embodiment.

Fig. 4 and Fig. 5 show circuit diagrams of two kinds of control panels connected with embodiments of this invention.

Fig. 6 shows a circuit diagram of a part of another embodiment of the invention.

Fig. 2 shows a circuit diagram of an embodiment of a fire detector of this invention. This fire detector De consists of a fire detecting circuit 1, a switching circuit 2 operated by the output of the circuit 1, a timer circuit 3 which is so constructed that when the circuit 2 has operated a large current nearly equal to the short-circuit current flows through the signal receiving relay N located in the control panel via the circuit 2 for a sufficient time for

operating the said relay, an operation indicating circuit 4 which forms an oscillation circuit for lighting up the operation indicating lamp upon completion of the operations of the circuit 3, and a power source voltage stabilizing circuit 5. The fire detecting circuit 1 and the switching circuit 2 are the same as the corresponding circuits shown in Fig. 1, the timer circuit 3 and the operation indicating circuit 4 are arranged side by side and connected in series to the line ℓ_2, and the power source voltage stabilizing circuit 5 is connected between the lines ℓ_1 and ℓ_2 extending to the control panel Re, shown in fig. 4.

The operation of this fire detector is described hereinafter in connection with a control panel shwon in fig. 4 and the time charts shwon in fig. 3. In supervisory condition, a small supervisory current flows from the line ℓ_2 to the line ℓ_1 through resistors R_8 and R_9 in the circuit 4, a parallel circuit consisting of resistor R_1, thermistor Th and resistors R_3, R_2 in the circuit 1, and a diode D_3. Since the current is very small, the voltage produced between both ends of the series circuit of resistors R_8 and R_9 is also rather low.

When the thermistor Th has received heat emitted by a fire, the resistance of the thermistor will decrease and the potential Vb at the junction point b will drop as shown in fig. 3 (a). When the potential Vb has dropped lower than the emitter voltage Ve of the transistor T_1, the transistor T_1 will be turned ON, a voltage nearly equal to the power source voltage will be applied to both ends of the timer circuit 3 and the operation indicating circuit 4, and a charge current of the condenser C_1 arranged in the timer circuit 3 will flow through the emitter and the base of transistor T_3 via resistor R_6 which causes transistor T_3 to turn ON.

Condenser C_2 in circuit 4 will be charged in an instant via transistor T_3 and relay A which has a small internal resistance and is used for operating auxiliary devices, e.g. for driving an interlocked controller to close an air conditioning duct in the room in fire. When the charge voltage of the condenser C_2 has exceeded the gate voltage of the N-gate thyristor T_4, the thyristor T_4 will be ON. The state of operations of the transistor T_3 and the relay A is shown in fig. 3 (c).

When the thyristor T_4 has been ON, a large signal current being nearly equal to the short-circuit current will flow from the line ℓ_2 to the line ℓ_1 via T_3, A, T_4 and light emitting diode D_2 working as signal receiving relay and located in the control panel to operate. When the relay N has been operated it will perform the first control such as stopping of air conditioner etc. in the zone in fire, and at the same time the contacts n_1, n_2 and n_3 will be closed and the operation of the relay N will become self-hold, the zone lamp Lf will be lit by the contact n_2, and a current for lighting up the operation indicator D_2 of the detector De will be supplied to the operation indicating circuit 4 through the contact n_3 and the resistor R_{11}. In this case while a large signal current flows through the lines ℓ_1 and ℓ_2, the transistor T_5 is ON by a voltage produced in the resistor R_{11} via the load resistance R_{13}, and the counter circuit C counts "one" by a voltage produced in the resistor R_{13}. But at this time no output is produced by the counter circuit C and the transistor T_6 cannot be ON, and accordingly, the relay B for performing the second control such as to control the smoke ventilator etc. cannot be operated.

Time t_1 while the transistor T_3 located in the timer circuit 3 of the detector De is ON can be determined to be a desirable value by the time constant determined by the resis-

tance of the resistor R_5 and the capacity of the condenser C_1. In this case the resistance or the resistor R_6 shall be sufficiently larger than that of the resistor R_5. When the transistor T_3 has been OFF, the N-gate thyristor T_4 located in the operation indicating circuit 4 which forms the oscillation circuit will be OFF, and the circuit 4 will begin to oscillate normally with a regular frequency given by the time constant determined by the resistance of the resistor R_7 and the capacity of the condenser C_2. Hereafter the diode D_2 is flickering as shown in fig. 3 (d). Furthermore, when the transistor T_3 has been OFF, the current flowing in the lines through the thyristor T_2 will be changed-over to a smaller value just above the minimum self-holding current for maintaining the self-holding of the thyristor T_2. This minimum self-holding current flows through the resistors R_8 and R_9, and the line voltage applied to the actuated detector De is reset to the almost normal voltage. Fig. 3 (e) shows a periodical change of the line current $I\ell$ flowing through the lines ℓ_1 and ℓ_2, and fig. 3 (f) shows a periodical change of the line voltage V between the lines ℓ_1 and ℓ_2.

Now, when another detector connected with the same detector circuit has actuated, the line voltage $V\ell$ will drop during the time t_1 soon after the actuation to a voltage nearly equal to the short-circuit, but the minimum self-holding current of the thyristor T_2 of the previously actuated detector is supplied by the discharge current of the condenser C_3 located in the power supply stabilizing circuit 5 through the resistors R_8 and R_9. The transistor T_5 located in the control panel is ON by the voltage produced again in resistor R_{11} by the actuation of this other detector, and the counter circuit C counts "two" and the transistor T_6 is also ON by the output of the switching circuit 2 at that

time, thus, relay B is operated to perform the second control such as to control the smoke ventilator etc.

Fig. 5 shows a circuit diagram of another control panel Re which may be used in connection with the detectors De according to fig. 2. What differs this control panel from that shown in fig. 4 is merely the fact that the driving part D of an electromagnetic rotary switch unit F is driven by every ON of the transistor T_5 and the wiper W of the rotary switch RS is advanced on the contacts No. 0 to No. 3 step by step, and when the wiper W arrives at the contact No. 2, a circuit to perform the second control is formed.

Fig. 6 shows a circuit diagram of the timer circuit 3 and the operation indicating circuit 4 in which an amperemeter - type operation indicator M is used instead of the light emitting diode D_2 located in the operation indicating circuit 4 of the fire detector De shown in fig. 2. The embodiment shown in fig. 6 is just the same as that shown in fig.2 except the operation indicating circuit 4. In this circuit a diode D_8 for protecting the aperemeter-type operation indicator M is connected in parallel with a series circuit of the amperemeter-type operation indicator M and a resistor R_{14} and further a resistor R_7 is connected in series with the parallel circuit. The operation indicating circuit 4 is connected with the timer circuit 3 as shown in fig. 6. In this embodiment, in the event of fire, when the thyristor T_2 of the detector De has been ON, the large signal current flowing through the transistor T_3 and the relay A mainly flows through the diode D_8, and the supervisory current in the supervisory condition and the self-holding current of the thyristor T_2 flow through the resistors R_7, R_{14}, and the indicator M. The indicator M is operated by a part of the large signal current and is self-held by the self-holding current of the thyristor T_2

It should be noted that the heat sensing thermistors in the above described embodiments of the invention could be replaced by other sensing elements responding to other fire phenomena such as smoke, gas or light. For example the sensing circuit of the detector De may comprise an ionization chamber in series with a reference element, a photoelectric element or a semiconductor gas sensing element, instead of a thermistor.

As above-mentioned, this invention has the merit that when these fire detectors are used in a fire alarm system, a large current flowing through the detector once operated is promptly reduced to a small current, and the line voltage to which the detectors are connected is promptly returned from a voltage nearly equal to the short-circuit voltage to the voltage nearly equal to the normal voltage, and accordingly even if the fire detectors connected to plural detector lines are operated successively, there is little possibility of overlapping the large currents flowing through these detectors and therefore there is no possibility of coming short of the capacity of power source located in the control panel, and the detection of fire by another detector is possible even after an already actuated detector connected is with the same detector line.

Claims

1. Fire detector connectable to a control panel (Re) by electrical lines (ℓ_1, ℓ_2) and comprising sensor means (Th) for sensing a fire phenomenon such as heat, smoke, gaz or light and operating switching means (T_2) short-circuiting flowing in the lines to the control panel when a fire has been detected, characterised by a timer circuit (3,4) arranged in one of said lines and having a predetermined switching time (t_1) during which the alarm circuit is allowed to pass to the control panel in order to operate a signal receiving relay (N) and after lapse of which the line current is reduced to a smaller value sufficient for holding the operation of said switching circuit (T_2).

2. A fire detector as claimed in claim 1, wherein operation indicating means (D_2) are provided for indication the line current and an oscillation circuit (4) producing pulsating current in the lines when the line current has been reduced to said smaller value by said timer circuit (3), said pulsating current being sufficient for operating said indication means (D_2).

3. A fire detector as claimed in claim 1, wherein said timer circuit (3) comprises relay means (A) for operating an external auxiliary device within said predetermined switching time (t_1).

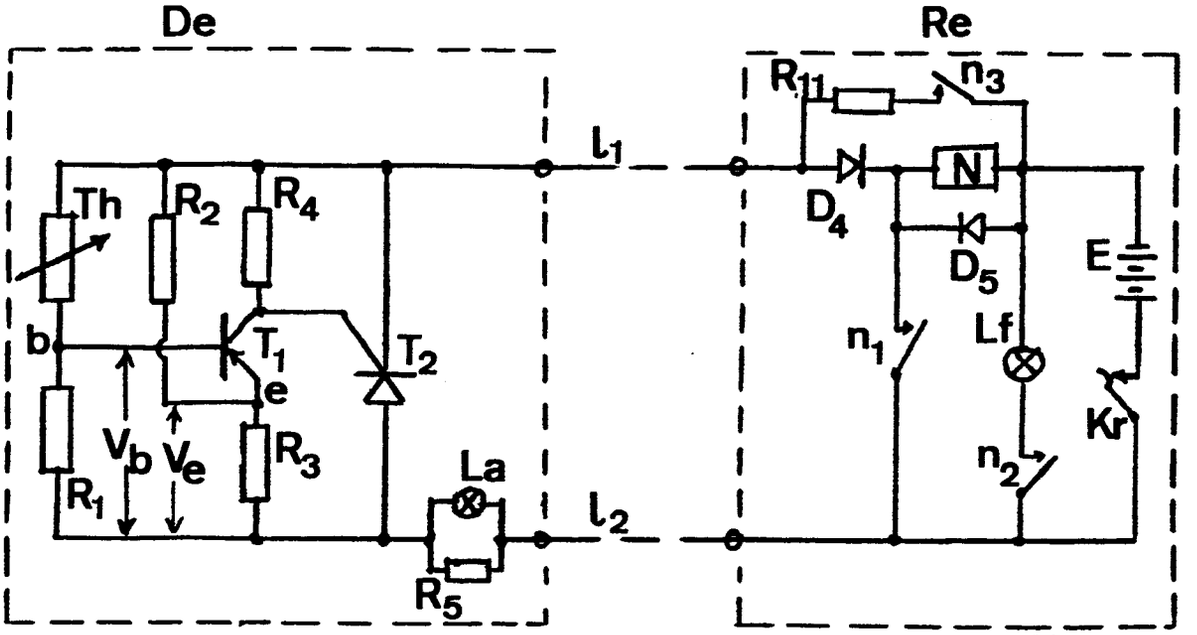

De
Re
Th
R2
R4
b
T1
T2
e
Vb
Ve
R1
R3
La
R5
l1
l2
R11
n3
N
D4
D5
E
n1
Lf
Kr
n2

FIG. 1

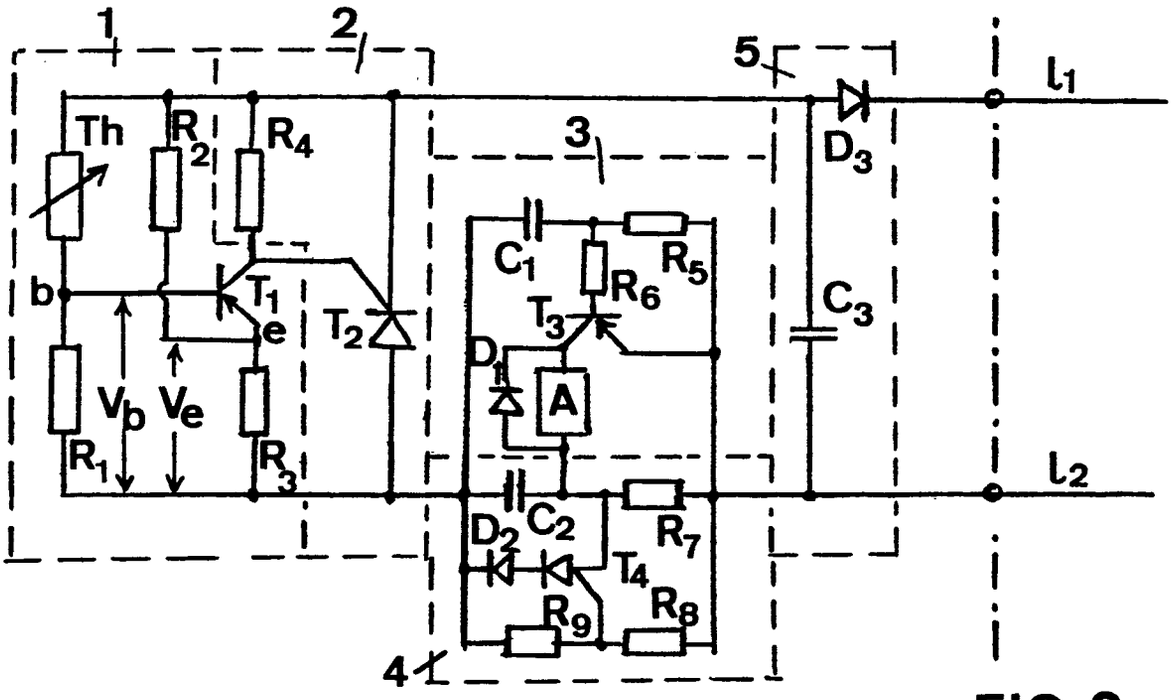

1
2
3
4
5
Th
R2
R4
b
T1
T2
e
Vb
Ve
R1
R3
C1
R5
R6
T3
D1
A
C2
D2
T4
R7
R8
R9
C3
D3
l1
l2

FIG. 2

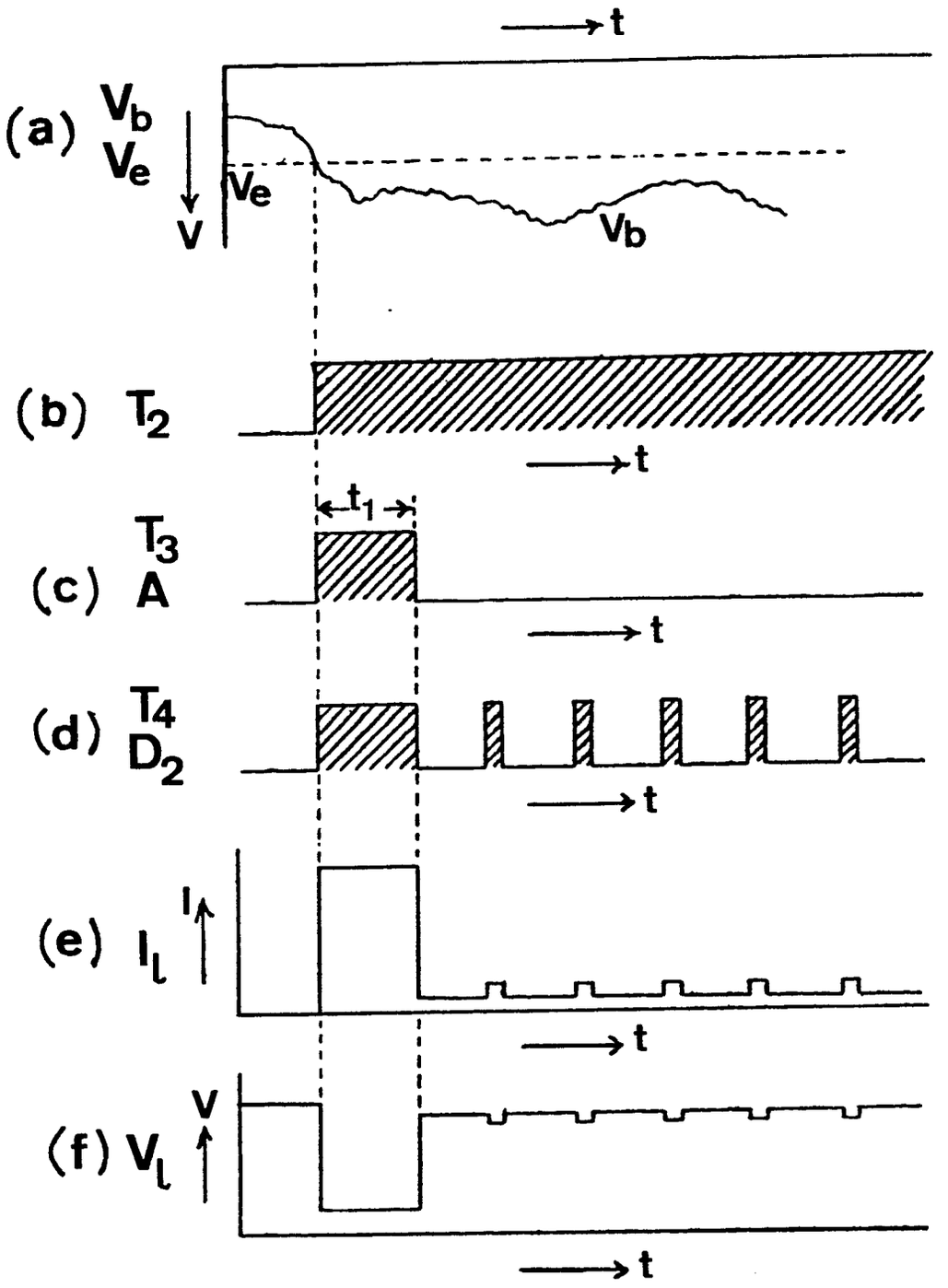


FIG.3

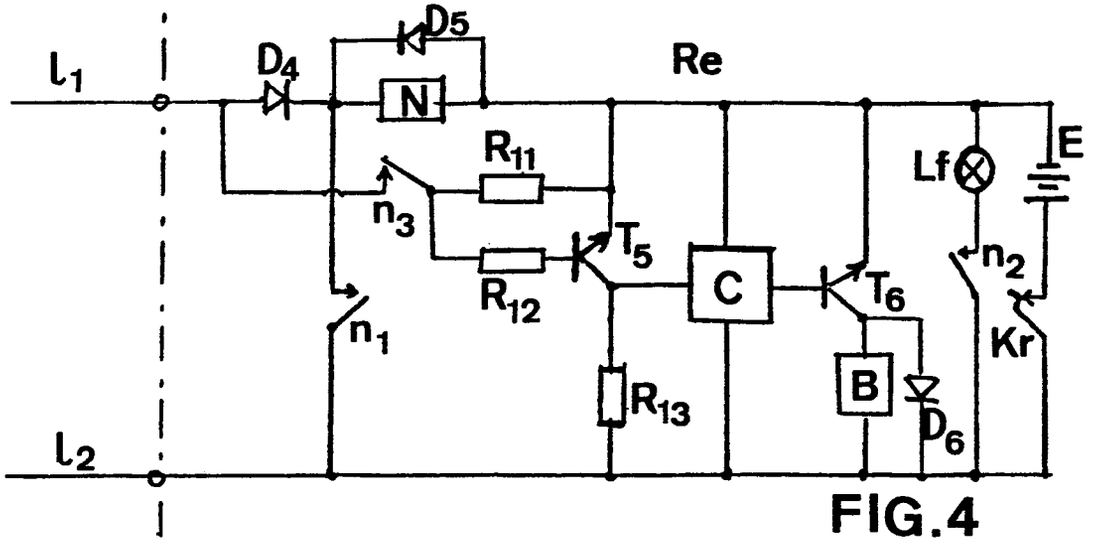


FIG.4

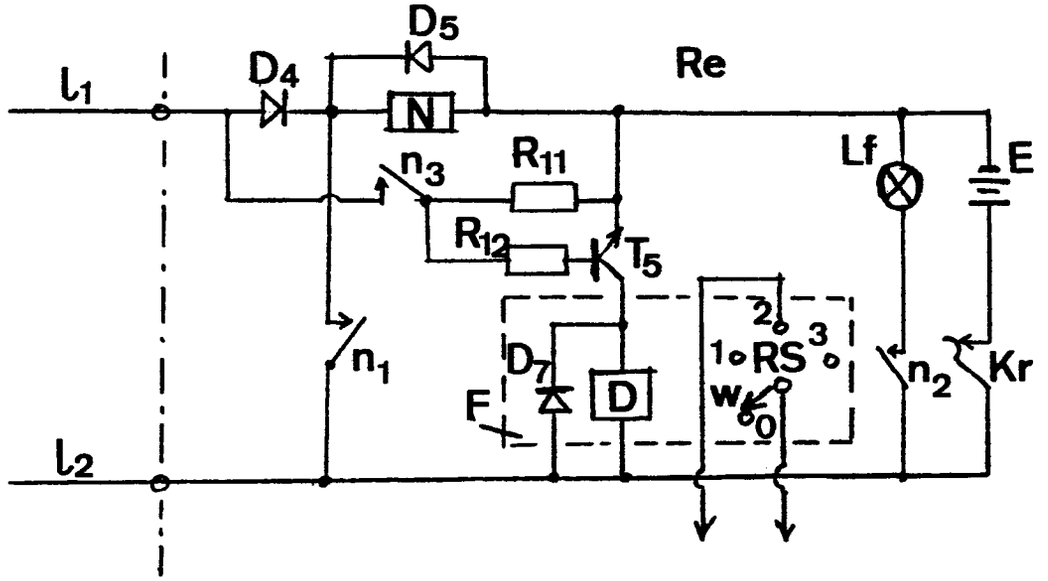


FIG. 5

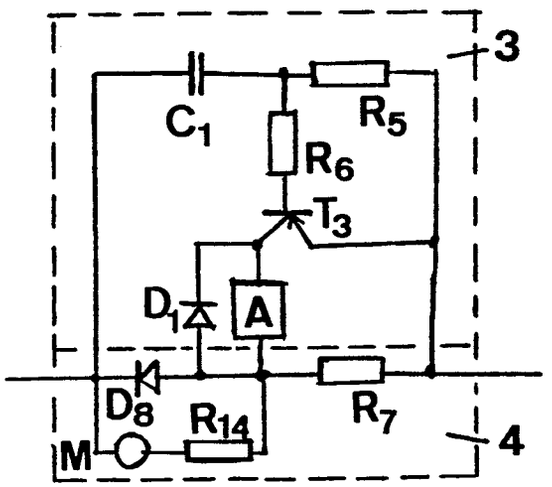


FIG. 6