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(54) **Safety device for lighting systems formed by a plurality of lamps connected in series**

Überwachungseinrichtung für Beleuchtungssysteme gebildet aus mehreren Lampen in Reihenschaltung

Dispositif de surveillance pour systèmes d'éclairage comportant plusieurs lampes connectées en série

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Description

[0001] The present invention relates to a safety devices associated to feeding devices for a plurality of lamps connected in series, in particular for discharge lamps, that are used in industrial and/or public lighting systems.

[0002] Lighting systems of medium-high power, which have heretofore been provided, often use discharge lamps connected preferably in series.

[0003] This allows known feeding source to provide the desired current intensity, in relation to the number of the lamps that are installed.

[0004] In case of failure, the traditional systems are provided with a current transformer in series with the load mesh, generally with the secondary winding of the power supply transformer, which operates, by a suitable control unit, transition and protection devices provided on the supply mesh, i.e. on the primary winding of the power supply transformer (Figure 1).

[0005] During the short time passing between the system damage, e.g. a lamp failure, and the subsequent intervention of the transition and protection device on the primary mesh, the full tension of the secondary supply winding V2 is applied to the broken lamp terminals (Figure 1a).

[0006] It is possible, after the damaged lamp has been substituted or repaired by specialised operator, to restore, by means of the control unit, the load mesh supply.

[0007] If the damage is not correctly identified and therefore the system continues to go wrong; the full voltage of the secondary supply winding V2 continues to be localized on the terminal points of the system damaged part, which is dangerous to persons present near the damaged lighting system.

[0008] This undesired situation can occur with particular frequency in all lighting systems which are operated only for a predetermined period of time, i.e. in accordance with discontinued cycles.

[0009] In case the damage occurs while the lighting system is not in operation, when the system is turned on, it should bear a start-up transient state during which the transition and protection devices would not be able to operate within the proper time because of the technical-operational characteristics of the discharge lamps.

[0010] Because of this problem, during the time between the set-to-on moment and the intervention of the transition and protection device on the primary mesh, the full supply voltage V2 is still applied to section in which the failure has occurred. This constitutes a very serious danger for people located thereby.

[0011] Document WO-A-87/07730 discloses a fixture for checking the continuity of a cable having wires running between terminals in two end connectors. The cable is designed so that a single path is provided by each wire and its associated terminals. The connectors are plugged into mating receptacles on the fixture which also includes an array of associated light emitting diodes and an array of pins. The user touches the stylus of a manually movable probe against each pin. Only the associated light emitting device will be energised if there is good continuity for a given path in the cable.

[0012] Non energising of the associated device or energising any other device indicates a lack of continuity and the source thereof.

[0013] Document WO-A-74/18811 describes a method and apparatus for feeding a plurality of fluorescent lamps connected in series which are fed at the start-up with a variable voltage having a frequency that is varied during a selected time period, between a minimum value and a maximum value. This makes the start-up of the lamps taking place with a convenient voltage value. Subsequently, the lamps are fed with constant current having nominal frequency.

[0014] Document EP 768.810 discloses a ground fault detection system for airfield lighting systems, including electronic circuitry arranged to detect a ground fault of the lighting system. The current sensed by the leakage sensing circuitry is recorded and the current measured value of current flow is then related to the extent of ground fault condition. The function of the device is long term monitoring of the insulation resistance of the high voltage series circuit.

[0015] Therefore, this invention was evolved with the general object of providing a safety device for lighting systems formed by a plurality of loads, preferably lamps connected in series, which can verify the metallic continuity of the system, in which it is disposed, before power is applied.

[0016] Another object of the present invention is to propose a safety device, which guarantees safety for persons present near the system, in the whole area occupied by this system.

[0017] Yet another object of the present invention is to propose a safety device, which is obtained by a simple technical solution, which is extremely functional, reliable and cheap and which can be used also in already existing and/or obsolete systems.

[0018] The above mentioned objects are obtained in accordance with the contents of claims.

[0019] The characteristic features of the present invention will become more fully apparent from the following detailed description of a preferred but not the only embodiment, taken in conjunction with the accompanying drawings, in which:

- Figure 1 is a schematic view of a conventional circuit diagram used for lighting systems;
- Figure 1a is a schematic view of a particular part of this circuit diagram, in a particular operation condition;
- Figures 2, 3 are views of the principle circuit diagram of the proposed safety device, in two particularly significant operation conditions.

[0020] With reference to the above described Figures, reference numeral 3 generally designates a plurality of loads, e.g. discharge lamps, connected in series and supplied by outlet terminals of a first generator GAC.

[0021] The first generator GAC is preferably an AC generator, capable of supplying a voltage V2 variable within acceptable values.

[0022] The input terminals of the first generator GAC are supplied via a first switching means 4 connected to a control unit C. A current transformer 5, whose primary winding is connected in series with the plurality of lamps 3 (see Figure 1), sends its output signal to the control unit C.

[0023] The proposed safety device 1 is connected in series with the lamps 3, which define a load mesh 3a supplied by the output terminals of the first generator GAC.

[0024] An electric contactor 11, normally closed, and a detection mesh 3b are connected to the output terminals of the safety device 1.

[0025] The detection mesh 3b, that is power supplied by a second generator GDC, e.g. a low voltage generator, includes a pair of second electric contactors 12, mechanically connected to each other and normally open, an impedance Z, preferably with high power factor, and a current measuring device 90.

[0026] An isolation electric contactor 13, normally closed and connected to earth, is connected to the output terminals of the second generator GDC, that is preferably a DC generator. According to known techniques, the isolation electric contactor is connected to earth via a low impedance connection, that produces a zero reference potential.

[0027] All the electric contactors, that is the first electric contactor 11, the second electric contactors 12 and the isolation electric contactor 13, are operated in proper phase relation, by a unique actuator 10, e.g. an electric-mechanical relay operated in turn by the control unit C.

[0028] Operation of the proposed safety device 1 will be described in the following, with particular reference to two most characteristic operation conditions.

[0029] When in normal operation conditions for the load mesh 3a, the nominal load current runs through each lamp 3 and the current transformer 5.

[0030] With these, say nominal operation condition, the first electric contactor 11 and the isolation electric contactor 13 of the safety device 1 keep their closed position, while the second electric contactors 12 are open (Figure 2).

[0031] When the first electric contactor 11 is closed, a non-operative condition I is established and the safety device 1 is set off.

[0032] At the start moment, many adjustment transient effects occur due to the diverse characteristics of the lamps 3. In this moment, a possible previous failure could cause the full supply voltage V2 of the load mesh 3a to be applied to the terminals of one lamp 3 (Figure 1a).

[0033] This condition can often occur in those systems which do not work continuously, typically a lightening system, and is particularly dangerous for people located close to the failure point.

[0034] In case it is desired to test previously the metal continuity of the circuit to prevent such dangerous situations, after maintenance operations or after repairing or after a check operation scheduled according to a monitoring program, before the supply tension is applied, the safety device 1 can be activated.

[0035] The safety device 1 can be operated manually or by the control unit C, only if the first generator GAC is not powered.

[0036] When the safety device 1 is active, the load mesh 3a can be connected in series with the detection mesh 3b by the relay 10, that opens the electric contactor 11.

[0037] Opening of the first electric contactor 11 determines an operative condition 0 for the safety device 1.

[0038] At the same time, when the first electric contactor 11 opens, the second electric contactors 12, that are mechanically connected to the first electric contactor, are closed, also due to the action of the relay 10.

[0039] In phase relation with the second electric contactor 12 closing and with the first electric contactor 11 opening, the second generator GDC sends a predetermined detection continue current, that runs through the load mesh 3a and the detection mesh 3b (Figure 3).

[0040] If the integrity of the load mesh 3a is ascertained by the measuring means 90, due to the detection current flowing through a closed circuit, the control unit C stores this data and, possibly, operates the first switching means 4 to close, so that the lamps 3 are powered.

[0041] Otherwise, the failure is displayed by means of a predetermined sound or optical signal.

[0042] The presence of such safety device 1 in a lighting system guarantees safe conditions for the people present nearby, with any anomalous operation condition of the system.

[0043] By checking the integrity of the lighting system in which it is installed, the safety device 1 prevents all possible anomalous and dangerous effects provoked by the full supply voltage on the terminals of a single load 3, both because of the high value and because of the risky way in which this condition occurs.

[0044] The claimed solution prevents various possible accidents for the maintenance team and for other people, that inadvertently can take an excessively close position in the operation zone of the lighting system.

Claims

1. A lighting system comprising a plurality of lamps (3) connected in series along a load mesh (3a), which is supplied by a first generator (GAC) connected to a power supply via first switching means (4), a con-

trol unit (C) connected to said switching means (4) for controlling power supply to said first generator (GAC) , and a safety device, the safety device (1) including:

a detection mesh (3b) including a second generator (GDC), and a measuring means (90) connected in series with the detection mesh for measuring the current flowing through the detection mesh (3b) so as to test the continuity of the load mesh (3a);

the safety device being **characterised in that** :

first operative means (11) are connected in series with said load mesh (3a) and operated by an actuator (10) operated by said control unit (C) in phase relation with deactivation condition of said switching means (4), with the first operative means (11) being movable between two positions, namely a non-operative position (I), in which they close the load mesh (3a), and an operative position (O), in which the load mesh (3a) is open because of non-integrity of the load mesh (3a) due to the terminals of the operative means (11) being disconnected from each other;

the detection mesh (3b) is derived from the terminals of said operative means (11) when they are in the operative position (O);

the current measuring means (90) are connected with the control unit (C) ;

the current measuring means (90), in operation, informs the control unit (C) if there is any current flow when the first operative means (11) are in the operative position (O);

The control unit (C), in operation, allows the operation of the first operative means (11) and first switching means (4), and therefore supply power to the load mesh (3a) only after the current flow through the load mesh (3a) and the detection mesh (3b), when the first operative means (11) are in the operative position (O), has been detected.

2. Safety device as in claim 1, **characterised in that** said detection mesh (3b) includes at least one impedance (Z) aimed at limiting the current flowing through the detection mesh (3b), and second operative means (12), that are operated in phase relation with said first operative means (11) by the said actuator (10) due to a command received by the control unit (C), for disconnecting the detection mesh (3b) from the load mesh (3a) when the said first operative means (11) is set to the non-operative position (I).

3. Device as in claim 2, **characterised in that** said first and second operative means (11,12) include electric contactors.

Patentansprüche

1. Beleuchtungssystem mit mehreren Lampen (3), die in einem Lastkreis (3a) in Reihe geschaltet sind, welcher von einem ersten Generator (GAC) gespeist wird, welcher mit einer Leistungsversorgung über erste Schaltmittel (4) verbunden ist, einer Steuereinheit (C), die mit den Schaltmitteln (4) verbunden ist, um die Leistungszufuhr zu dem ersten Generator (GAC) zu steuern, und einer Sicherheitseinrichtung, welche Sicherheitseinrichtung (1) umfasst:

einen Detektorkreis (3b), der einen zweiten Generator (GDC) enthält, und ein Messmittel (90), das mit dem Detektorkreis in Reihe geschaltet ist, um den durch den Detektorkreis (3b) fließenden Strom zu messen und dadurch die Kontinuität des Lastkreises (3a) zu prüfen;
welche Sicherheitseinrichtung **dadurch gekennzeichnet ist, dass**:

erste Betriebsmittel (11) mit dem Lastkreis (3a) in Reihe geschaltet sind und von einem Aktuator (10) betätigt werden, der von der Steuereinheit (C) in Phasenbeziehung zu dem Deaktivierungszustand der Schaltmittel (4) betätigt wird, wobei die ersten Betriebsmittel (11) zwischen zwei Stellungen bewegbar sind, und zwar eine Außerbetriebsstellung (I), in der sie den Lastkreis (3a) schließen, und eine Betriebsstellung (O), in der der Lastkreis (3a) offen ist, und zwar wegen Unterbrechung des Lastkreises (3a), da die Anschlüsse der Betriebsmittel (11) voneinander abgetrennt sind;
dass der Detektorkreis (3b) von den Anschlüssen der Betriebsmittel (11) abgeleitet ist, wenn sie sich in der Betriebsstellung (O) befinden;
dass die Strom-Messmittel (90) mit der Steuereinheit (C) verbunden sind;
dass die Strom-Messmittel (90) im Betrieb die Steuereinheit (C) darüber informiert, ob es, wenn sich die ersten Betriebsmittel (11) in der Betriebsstellung (O) befindet, einen Stromfluss gibt;

dass die Steuereinheit (C) im Betrieb den Betrieb der ersten Betriebsmittel (11) und der ersten Schaltmittel (4) und somit eine Leistungszufuhr zu dem Lastkreis (3a) erst zulässt, nachdem der Stromfluss durch den Lastkreis (3a) und den Detektorkreis (3b) in der Betriebsstellung (O) der ersten Betriebsmittel (11) detektiert worden ist.

2. Sicherheitseinrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** der Detektorkreis (3b) umfasst: mindestens eine Impedanz (Z) zum Begrenzen des durch den Detektorkreis (3b) fließenden Stromes und zweite Betriebsmittel (12), die in Phasenbeziehung zu den ersten Betriebsmitteln (11) durch den Aktuator (10) aufgrund eines von der Steuereinheit (C) empfangenen Befehls betätigt werden, um den Detektorkreis (3b) vom Lastkreis (3a) abzutrennen, wenn die ersten Betriebsmittel (11) in die Außerbetriebsstellung (I) eingestellt sind.

3. Sicherheitseinrichtung nach Anspruch 2, **dadurch gekennzeichnet, dass** die ersten und zweiten Betriebsmittel (11, 12) elektrische Schalter umfassen.

Revendications

1. Système d'éclairage comprenant une pluralité de lampes (3) connectées en série le long d'un réseau ce charges (3a) qui est alimenté par un premier générateur (GAC) connecté à une source d'alimentation par l'intermédiaire de premiers moyens de commutation (4), une unité de commande (C) connectée auxdits moyens de commutation (4) pour commander l'alimentation en énergie envoyée au premier générateur (GAC) et un dispositif de sécurité, le dispositif de sécurité (1) comprenant:

un réseau de détection (3b) incluant un second générateur (GDC), et des moyens de mesure (90) connectés en série au réseau de détection pour mesurer le courant circulant dans le réseau de détection (3b) afin de tester la continuité du réseau de charges (3a);
le dispositif de sécurité étant **caractérisé en ce que**:

des premiers moyens opérationnels (11) sont connectés en série avec ledit réseau de charges (3a) et sont activés par un actionneur (10) activé par ladite unité de commande (C) en relation de phase avec une condition de désactivation desdits moyens de commutation (4), les premiers moyens opérationnels (11) étant déplaçables entre deux positions, à savoir une position non active (I), dans laquelle ils ferment le réseau de charges (3a), et une position active (O), dans laquelle le réseau de charges (3a) est ouvert en raison de la non intégrité du réseau de charges (3a) due au fait que les bornes des moyens opérationnels (11) sont déconnectées les unes des autres;
le réseau de détection (3b) dérivé desdits moyens opérationnels (11) lorsqu'il sont dans la position de active (O);
les moyens (90) de mesure de courant sont connectés à l'unité de commande (C);
en fonctionnement, les moyens (90) de mesure de courant indiquent à l'unité de commande (C) s'il existe un flux de courant lorsque les premiers moyens opérationnels (11) sont dans la position active (O);
en fonctionnement, l'unité de commande (C) permet le fonctionnement des premiers actifs opérationnels (11) et des premiers moyens de commutation (4), et par conséquent envoie une énergie au réseau de charges (3a) uniquement après que le flux de courant traversant le réseau de charges (3a) et le réseau de détection (3b), lorsque les premiers moyens opérationnels (11) sont dans la position active (O), a été détecté.

2. Dispositif de sécurité selon la revendication 1, **caractérisé en ce que** ledit réseau de détection (3b) inclut au moins une impédance (Z) destinée à limiter le courant circulant dans le réseau de détection (3b), et les seconds moyens opérationnels (12), qui sont activés dans une relation de phase avec lesdits moyens opérationnels (11) par ledit actionneur (10) sous l'effet d'une commande reçue par l'unité de commande (C), pour déconnecter le réseau de détection (3b) du réseau de charges (3a) lorsque lesdits premiers moyens opérationnels (11) sont réglés dans la position non active (I).

3. Dispositif de sécurité selon la revendication 2, **caractérisé en ce que** lesdits premiers et seconds moyens actifs (11, 12) incluent des contacteurs électriques.

FIG.1

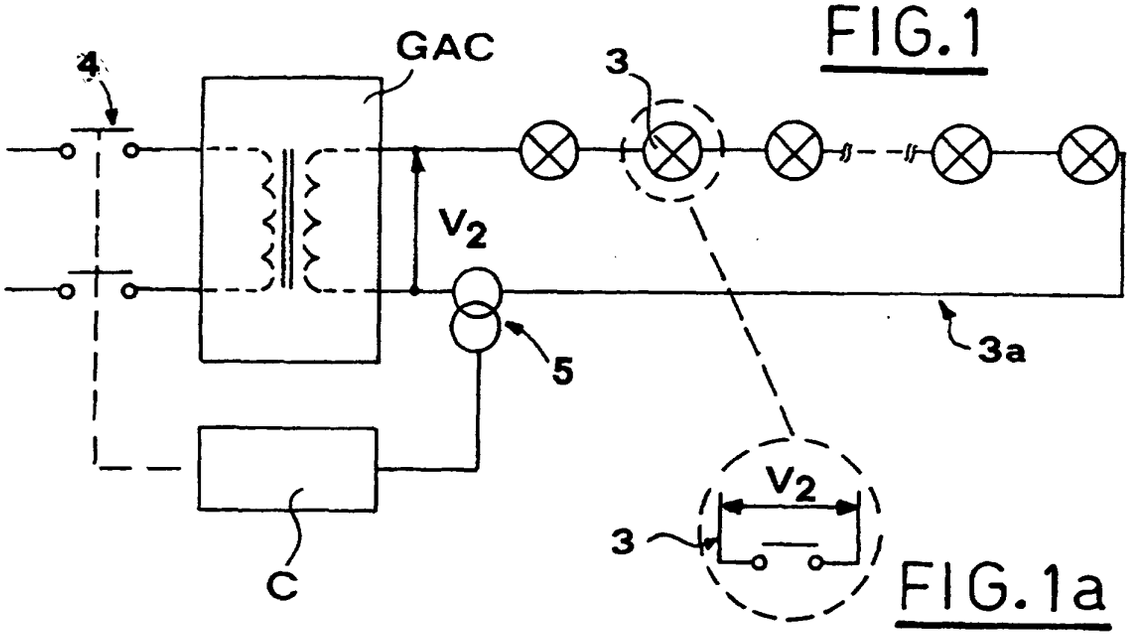

FIG.1a

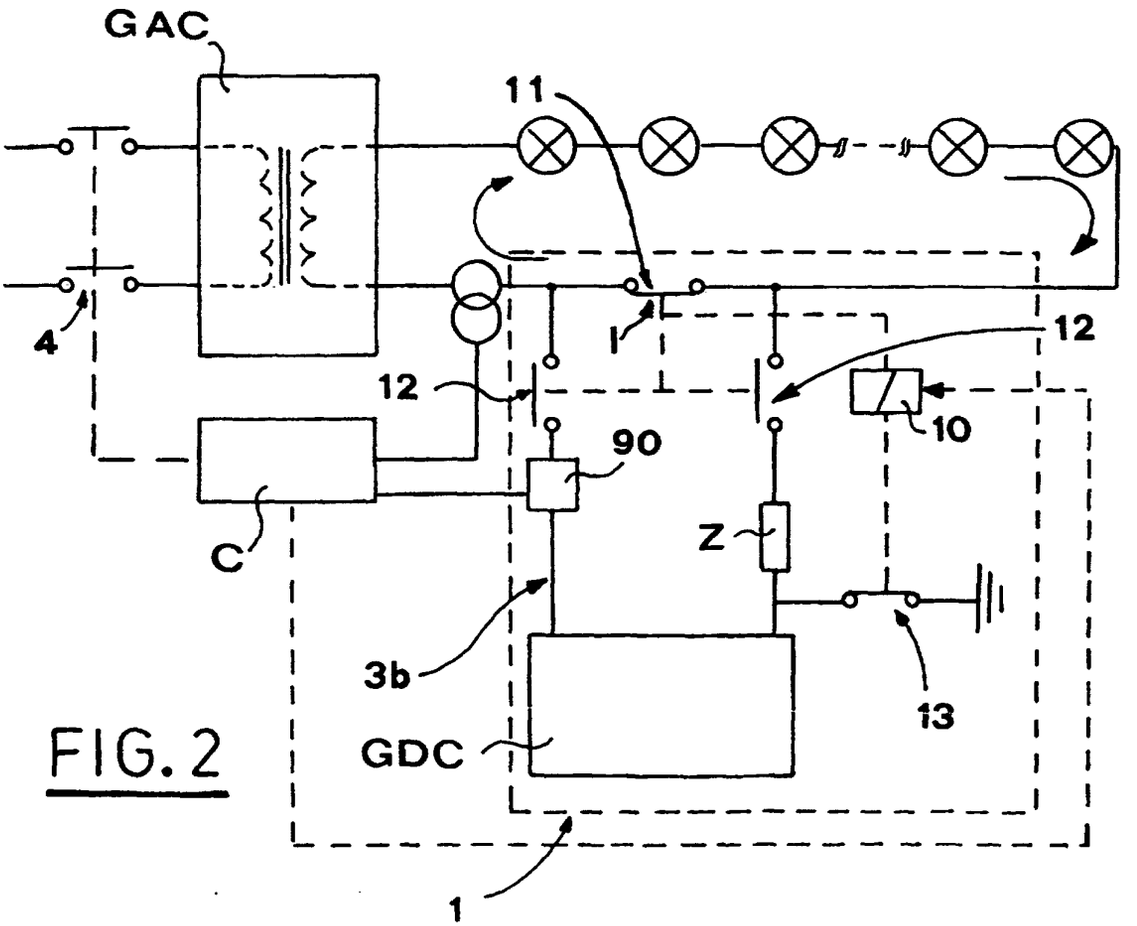

FIG.2

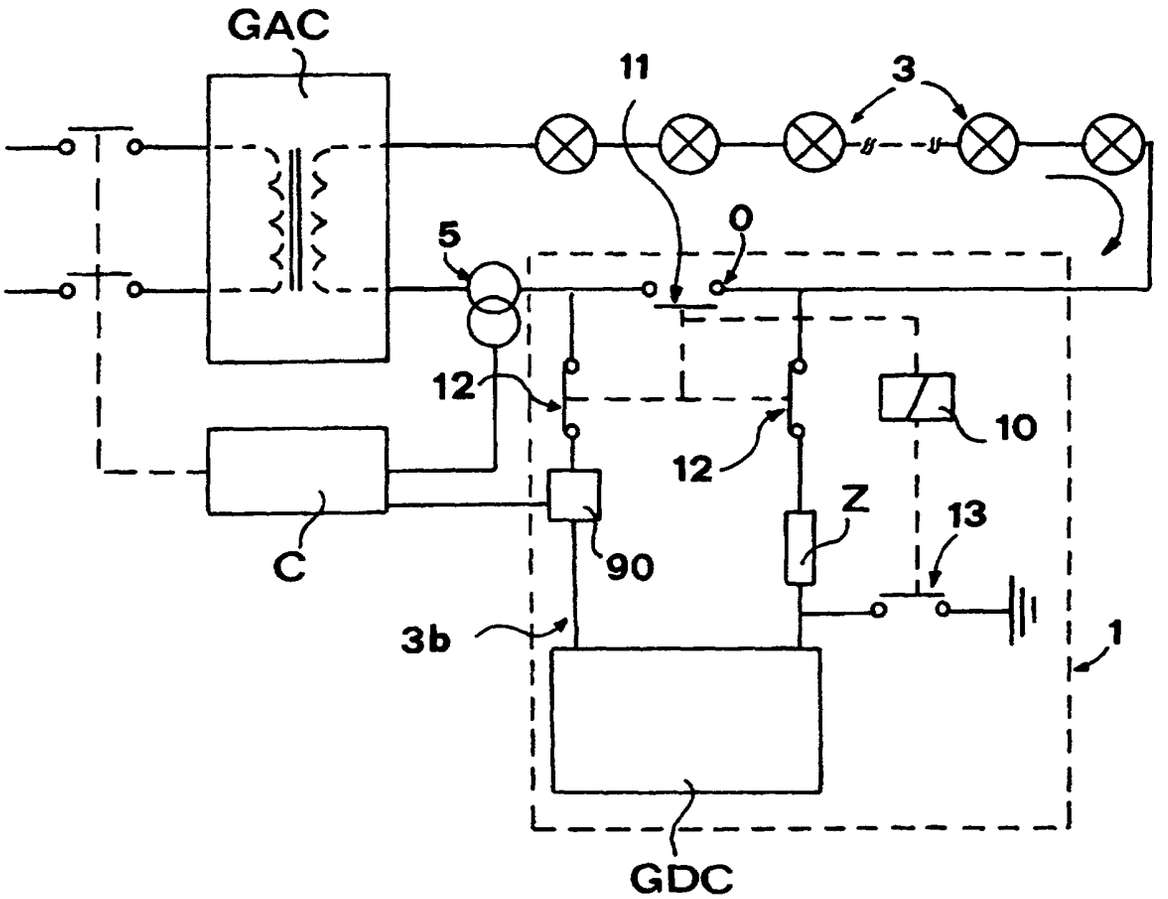

FIG. 3