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(54) Title: SHORT CIRCUIT PROTECTION DEVICE

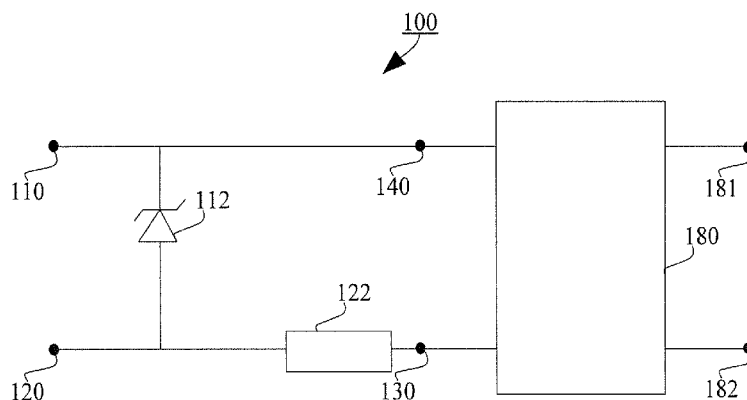


FIG.1

(57) Abstract: The invention discloses a short circuit protection device (100) which comprises a first terminal (110), a second terminal (120), a third terminal (130), a fourth terminal (140), wherein the third terminal and the fourth terminal are configured for connecting a load (180); a first voltage stabilizing element (112) disposed between the first terminal (110) and the second terminal (120); and a disconnecting device (122) disposed between the second terminal (120) and the third terminal (130), wherein the first disconnecting device (122) is configured to be disconnected when the current flowing through the first disconnecting device (122) exceeds a first predetermined current threshold, so as to electrically decouple the second terminal (120) from the third terminal (130). The short circuit protection device according to the present invention may effectively provide short circuit protection for the direct current power source of the appliances with non-isolation mode, so as to ensure the safety of the electronic components and the people therein. Additionally, the short circuit protection device has the advantages of low cost, small size and safety.

Short Circuit Protection Device

Field of the invention

The present invention relates to the field of electrical safety, and particularly to a short circuit protection device.

Background of the invention

In home appliances, more and more thyristor elements will be used for switching low power AC loads instead of expensive relays due to cost considerations. Typically, the control circuit of such a thyristor element has two types, namely isolation mode and non isolation mode.

The isolation mode has the following advantages, namely the DC signal is isolated from the AC signal, the ground of the DC signal is a safe ground and thus the low voltage signal will not induce safety issues; but the isolation mode also has the following disadvantage, namely the circuit must use photo coupler and thus the circuit is relatively more complicated and the cost of such a circuit is also increased. The DC-5V signal is connected with the live line L of the AC power supply in the non isolation mode and the ground is a virtual ground and keeps a 5V voltage difference to a 220V AC power supply (usually an urban power supply). The non isolation mode has the advantages of low cost and simplified circuit, but also has the following disadvantage, namely the DC is actually DC high voltage and thus causes short circuit or other safety issues (especially some special components, such as a turbidity sensor or a temperature sensor, since the housing is in contact with water in the cavity, once corrosion or damage occurs due to time, short circuit is easily caused and thus will cause damage or personal injury).

Furthermore, if the non isolation mode is not used, then it is possible that the ground of the intelligent connector parallel connected to the DC bus is connected with GND, and the DC ground GND is lowed and thus the voltage between the two ends of the connected intelligent connector and other components connected thereto will increase to 220V AC and thus be damaged, at the same time other safety issues

will occur. Therefore, isolation mode is desired, although the cost of the control circuit is increased due to the isolation mode.

Summary of the invention

In view of the above, it is desirable to provide a new type of short circuit protection device for using in home appliances, the short circuit protection device may effectively provide short circuit protection for the direct current power source of the appliances with non-isolation mode, so as to ensure the safety of the electronic components and the people therein. Additionally, the short circuit protection device has the advantages of low cost, small size and safety.

The present invention provides a short circuit protection device which comprises:

a first terminal, a second terminal, a third terminal, a fourth terminal, wherein the third terminal and the fourth terminal are configured for connecting a load;

a first voltage stabilizing element disposed between the first terminal and the second terminal; and

a disconnecting device disposed between the second terminal and the third terminal,

wherein the first disconnecting device is configured to be disconnected when the current flowing through the first disconnecting device exceeds a first predetermined current threshold, so as to electrically decouple the second terminal from the third terminal.

In such a manner, the first disconnecting device is disconnected before the first voltage stabilizing element is damaged when the third terminal is short connected to the ground, and thus the voltage between the first terminal and the second terminal remains within a certain range of the nominal voltage of the first voltage stabilizing element and no too high voltage is loaded between the first terminal and the second terminal, and thus protecting the electronic component connected between the first terminal and the second terminal and preventing damage due to excessive high voltage.

In one embodiment of the present invention, the short circuit protection device

further comprises a second disconnecting device disposed between the first terminal and the fourth terminal, wherein the second disconnecting device is configured to be disconnected when the current flowing through the second disconnecting device exceeds a second predetermined current threshold, so as to electrically decouple the first terminal from the fourth terminal.

In such a manner, the short circuit between the first terminal and the ground due to high voltage breakdown of the load connected between the third terminal and the fourth terminal is prevented and thus the safety risk of current leakage is also prevented, when the first disconnecting device is disconnected because the current flowing through the first disconnecting device exceeds a first predetermined current threshold.

In one embodiment of the present invention, the short circuit protection device further comprises a fifth terminal and a sixth terminal, wherein the sixth terminal is configured for connecting a load and a second voltage stabilizing element is disposed between the first terminal and the fifth terminal, and a third disconnecting device is disposed between the fifth terminal and the sixth terminal, wherein the third disconnecting device is configured to be disconnected when the current flowing through the third disconnecting device exceeds a third predetermined current threshold, so as to electrically decouple the fifth terminal from the sixth terminal.

In one embodiment of the present invention, the fifth terminal is a data input. In such a manner, the short circuit protection device according to the present invention may be applied in the control network of the modern bus based intelligent home appliances.

In one embodiment of the present invention, the potential of the positive terminal of the first voltage stabilizing element and the second voltage stabilizing element is not above the potential of the negative terminal respectively. In such a manner, the first voltage stabilizing element and the second voltage stabilizing element function well to protect the respective electronic components.

In one embodiment of the present invention, the first voltage stabilizing element and the second voltage stabilizing element are a TVS regulator tube and/or a

thyristor.

In one embodiment of the present invention, the first disconnecting device and/or the second disconnecting device and/or the third disconnecting device are a fuse and/or a self-recovery circuit protection element.

In one embodiment of the present invention, a direct current power source with a first voltage is connected between the first terminal and the second terminal.

In one embodiment of the present invention, the first terminal is connected to the live line of the mains supply.

In one embodiment of the present invention, an intelligent connector and a load thereof are connected between the third terminal and the fourth terminal.

The short circuit protection device according to the present invention may effectively provide short circuit protection for the direct current power source of the appliances with non-isolation mode, and thereby to effectively protect the electronic components connected therewith; furthermore, the short circuit protection device according to the present invention can be used in the modern bus based home appliances, and thus only the appliance which has problem is disconnected and other appliances connected to the same bus and the bus itself can function well.

Brief description of drawings

In the following, embodiments illustrated in connection with the drawings will be described in details, and the forgoing and other features of the invention will become more apparent.

Fig.1 illustrates a structural diagram of one embodiment of the short circuit protection device according to the present invention;

Fig.2 illustrate a structural diagram of another embodiment of the short circuit protection device according to the present invention; and

Fig.3 illustrate a structural diagram of another embodiment of the short circuit protection device according to the present invention.

Identical or similar components will be denoted with identical or similar reference numerals throughout the drawings

Detailed description of embodiments

In the following detailed description of preferred embodiments, reference will be made to the drawings which constitute a part of the invention. By way of examples, the drawings illustrate particular embodiments in which the invention can be practiced. The illustrated embodiments are not intended to exhaust all of embodiments of the invention. It can be appreciated that other embodiments can be utilized instead thereof or structural and logic modifications can be made thereto without departing from the scope of the invention. Accordingly, the following detailed description will not be limiting, and the scope of the invention will be defined in the appended claims.

Fig.1 illustrates a short circuit protection device 100 which comprises a first terminal 110, a second terminal 120, a third terminal 130, a fourth terminal 140, a first voltage stabilizing element 112 disposed between the first terminal 110 and the second terminal 120, and a disconnecting device 122 disposed between the second terminal 120 and the third terminal 130, wherein the first disconnecting device 122 is configured to be disconnected when the current flowing through the first disconnecting device 122 exceeds a first predetermined current threshold, so as to electrically decouple the second terminal 120 from the third terminal 130. In practice, an intelligent connector and a load 180 thereof are connected between the third terminal 130 and the fourth terminal 140, the intelligent connector and the load 180 thereof have a first connection end 181 and a second connection end 182, wherein the second connection end 182 and the above-mentioned third terminal 130 are directly connected. When the DC ground of the load namely the second connection end 182 is short connected to the Ground GND, the third terminal 130 is thereby connected to the Ground GND, because the second connection end 182 is directly connected with the third terminal 130; meanwhile, when the potential at the second terminal 120 drops to the nominal operating voltage (usually 6V) of the first voltage stabilizing element, the first voltage constant element 112 will function as a short protection element and thus the voltage between the first terminal 110 and the second terminal 120 is now 6V; at this time the current flowing through the first voltage constant element will be large and this current will flow through the first

disconnecting device 122, such as a fuse. In general, the first voltage constant element 112 can only bear a limited current, therefore the first disconnecting device 122 is configured to be disconnected before the first voltage constant element 112 is damaged, so as to ensure that the first voltage constant element 112 functions well to keep the voltage between the two ends of the input power source in a range of 0-6V, and thereby to protect the input power source and other components connected thereto.

In other words, in such a manner, when the third terminal is short connected to the Ground GND, the first disconnecting device 122 is disconnected before the first voltage constant element 112 is damaged, so as to make sure that the voltage between the first terminal 110 and the second terminal 12 is kept in the range of the nominal constant voltage of the first voltage constant element 112 and thus no high voltage is loaded between the first terminal 110 and the second terminal 120, so as to protect the electronic component connected between the first terminal 110 and the second terminal 120 from damage caused by relative high voltage.

In one embodiment, a DC power source 170 with a first voltage is connected between the first terminal 110 and the second terminal 120, the DC power source is for example a battery or a DC power source converted by an AC/DC converter, the voltage is generally 5V.

Furthermore, the first terminal 110 is connected to the live line of the mains supply. Namely, the first terminal 110 is the live line of the mains supply but also the positive terminal of the DC power source.

The embodiments illustrated above could satisfy the requirements of the circuit design when the whole circuit contains an over current protection component. However, the circuit has the following drawbacks when the whole circuit does not contain any over current protection component: the intelligent connector and the load 180 thereof will be breakdown due to over voltage and at this time the first terminal 110 is connected to the Ground GND and thus the electronic components connected between the first terminal 110 and the second terminal 120 will be damaged. In order to prevent the presence of this situation, Fig. 2 illustrates another embodiment according to the present invention, the short circuit protection device

further comprises a second disconnecting device 124 disposed between the first terminal 110 and the fourth terminal 140, wherein the second disconnecting device 124 is configured to be disconnected when the current flowing through the second disconnecting device 124 exceeds a second predetermined current threshold, so as to electrically decouple the first terminal 110 from the fourth terminal 140. In other words, when the first disconnecting device 122 is disconnected because the current flowing through the first disconnecting device exceeds a first current threshold, the circuit could also prevent the risk of leakage due to the first terminal 110 being short connected to the Ground GND in case of over voltage breakdown of the intelligent connector and load 180 thereof connected between the third terminal 130 and the fourth terminal 140.

Furthermore, as described in the background of the invention, the use of a communication bus for controlling various home appliances has become a trend, therefore a terminal for controlling must be designed in addition to the design of the positive and negative power supply terminals in the design of home appliances, and the short circuit protection for the terminal for controlling also needs to be designed. Fig. 3 illustrates another embodiment according to the present invention, as can be seen from Fig. 3, the short circuit protection device further comprises a fifth terminal 150 and a sixth terminal 160, wherein the sixth terminal is configured for connecting a load and a second voltage stabilizing element 114 is disposed between the first terminal 110 and the fifth terminal 150, and a third disconnecting device 126 is disposed between the fifth terminal 150 and the sixth terminal 160, wherein the third disconnecting device 126 is configured to be disconnected when the current flowing through the third disconnecting device 126 exceeds a third predetermined current threshold, so as to electrically decouple the fifth terminal 150 from the sixth terminal 160. The principle of offering short circuit protection to the sixth terminal 160 is similar with that of offering short circuit protection to the third terminal 130 and thus the description of such a principle is omitted here. In order to apply the embodiment illustrated in Fig. 3 in the home appliances with bus, the fifth terminal 150 is designed to be a data input. In such a manner, the short circuit protection device can be used in the control network for intelligent home appliances

based on data bus.

In the above described three embodiments, the potential of the positive terminal of the first voltage stabilizing element 112 and the second voltage stabilizing element 114 is not above the potential of the negative terminal respectively. This is also the work condition of the voltage stabilizing element. The above mentioned first voltage stabilizing element 112 and/or the second voltage stabilizing element 114 are a TVS regulator tube and/or a thyristor.

In one embodiment of the invention, the first disconnecting device 122 and/or the second disconnecting device 124 and/or the third disconnecting device 126 are a fuse and/or a self-recovery circuit protection element.

The short circuit protection device can effectively provide short circuit protection in case of applying non isolation mode circuit design and thus effectively protect the electronic components connected thereto; moreover, the short circuit protection device can be used in the modern home appliance design with bus and can only disconnect the home appliance connected to the bus which fails, but does not have negative influence to other home appliances connected to the same bus and the functionality of the bus.

Those ordinarily skilled in the art can appreciate and make other variants to the disclosed embodiments upon study of the description, the disclosure, the drawings and the claims. In the claims, the term “comprise” will not preclude another element or step, and the term “a/an” will not preclude plural. In a practical application of the invention, an element may perform functions of a plurality of technical features recited in a claim. Any reference numerals in the claims shall not be construed to be limiting of the scope of the invention.

CLAIMS

1. A short circuit protection device (100), comprising:

a first terminal (110), a second terminal (120), a third terminal (130), a fourth terminal (140), wherein the third terminal and the fourth terminal are configured for connecting a load (180);

a first voltage stabilizing element (112) disposed between the first terminal (110) and the second terminal (120); and

a first disconnecting device (122) disposed between the second terminal (120) and the third terminal (130),

wherein the first disconnecting device (122) is configured to be disconnected when the current flowing through the first disconnecting device (122) exceeds a first predetermined current threshold, so as to electrically decouple the second terminal (120) from the third terminal (130).

2. The short circuit protection device (100) according to claim 1, characterized in that the short circuit protection device further comprises a second disconnecting device (124) disposed between the first terminal (110) and the fourth terminal (140), wherein the second disconnecting device (124) is configured to be disconnected when the current flowing through the second disconnecting device (124) exceeds a second predetermined current threshold, so as to electrically decouple the first terminal (110) from the fourth terminal (140).

3. The short circuit protection device (100) according to claim 1, characterized in that the short circuit protection device (100) further comprises a fifth terminal (150) and a sixth terminal (160), wherein the sixth terminal is configured for connecting a load, and a second voltage stabilizing element (114) is disposed between the first terminal (110) and the fifth terminal (150), and a third disconnecting device (126) is disposed between the fifth terminal (150) and the sixth terminal (160), wherein the third disconnecting device (126) is configured to be disconnected when the current flowing through the third disconnecting device (126) exceeds a third predetermined current threshold, so as to electrically decouple the fifth terminal (150) from the sixth terminal (160).

4. The short circuit protection device (100) according to claim 3, characterized in

that the fifth terminal (150) is a data input.

5. The short circuit protection device (100) according to claim 3, characterized in that the potential of the positive terminal of the first voltage stabilizing element (112) and the second voltage stabilizing element (114) is not above the potential of the negative terminal respectively.

6. The short circuit protection device (100) according to claim 3, characterized in that the first voltage stabilizing element (112) and/or the second voltage stabilizing element (114) are a TVS regulator tube and/or a thyristor.

7. The short circuit protection device (100) according to claim 3, characterized in that the first disconnecting device (122) and/or the second disconnecting device (124) and/or the third disconnecting device (126) are a fuse and/or a self-recovery circuit protection element.

8. The short circuit protection device (100) according to claim 1, characterized in that a direct current power source with a first voltage is connected between the first terminal (110) and the second terminal (120).

9. The short circuit protection device (100) according to claim 1, characterized in that the first terminal (110) is connected to the live line of the mains supply.

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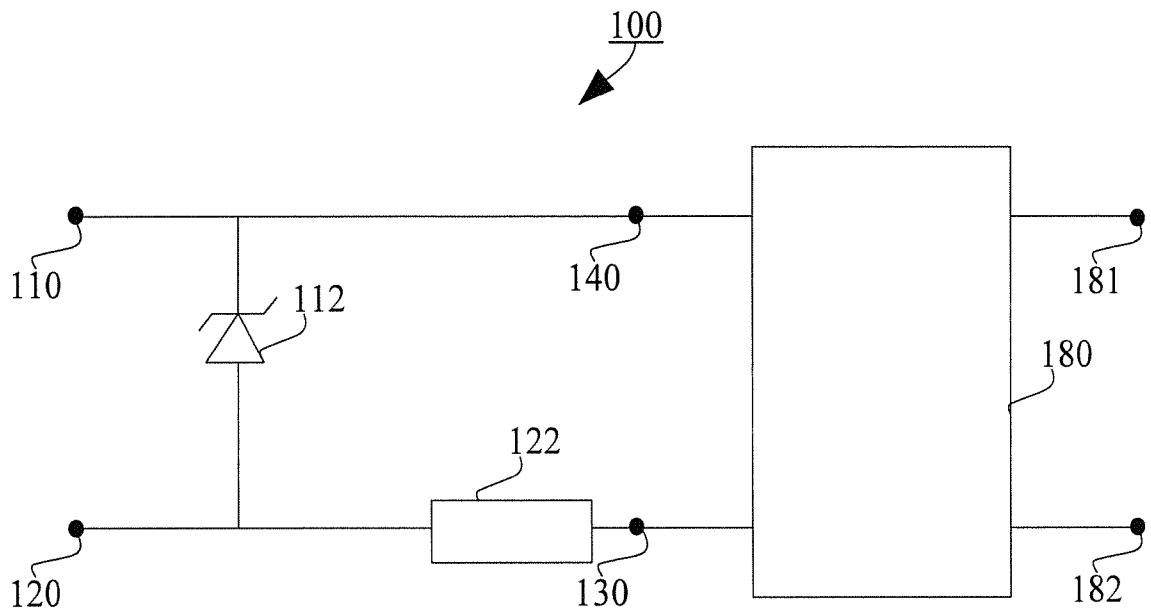


FIG.1

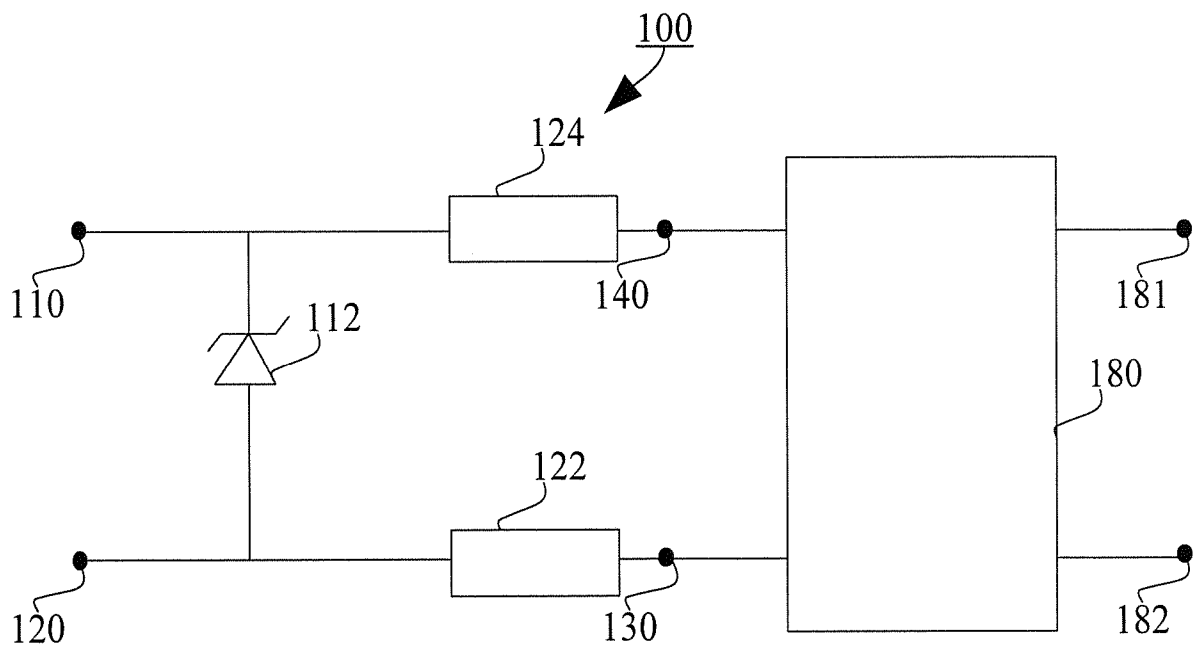


FIG.2

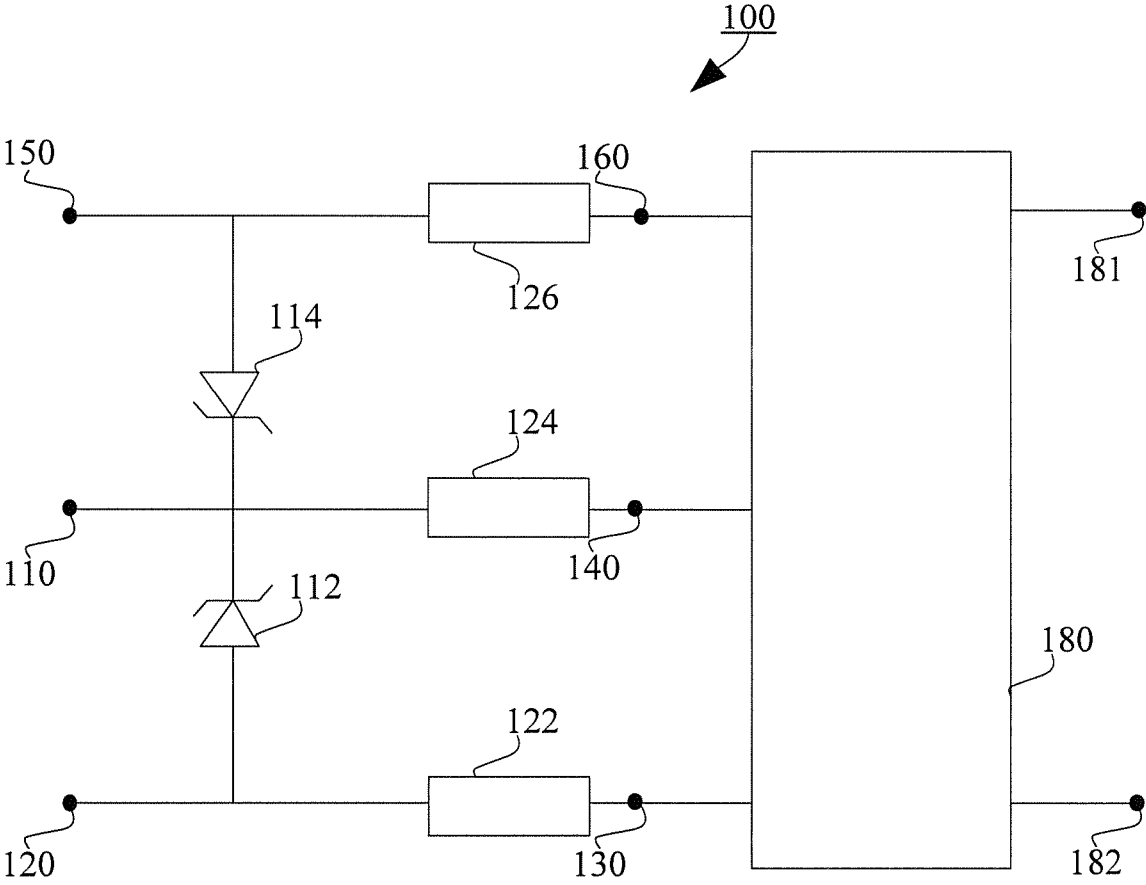


FIG.3

INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER

INV. H03K17/74 H04B3/54 H02J7/00 H02H9/00 B60L11/18
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04B H03K H02J H02H B60L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 256 627 A (BRITISH THOMSON HOUSTON CO LTD) 7 October 1926 (1926-10-07) figure 1 -----	1-9

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 256627 A	07-10-1926	FR 622737 A GB 256627 A	04-06-1927 07-10-1926
