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(54) **AN ARRANGEMENT AND A METHOD FOR PURGING AN ELECTRICAL CONTACT**

(57) The present invention relates to an arrangement for purging at least one electrical contact in an elevator safety circuit, comprising at least one electrical contact (110) comprising a first contact point (112) and a second contact point (114) coupled to a control unit (120) in the first contact point (112) and to a load (130) in the second contact point (114), a capacitor (140) coupled between the second contact (114) of the electrical contact (110) and a third voltage, V3, and wherein the control unit (120) is configured to selectively introduce a first voltage, V1, and a second voltage, V2, to the electrical contact (110). The invention also relates to a method for implementing the purging.

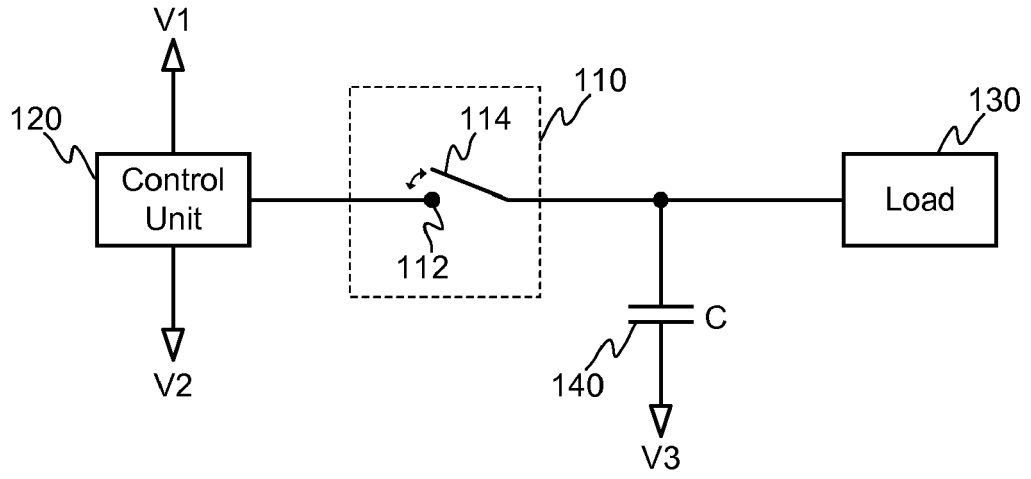

FIGURE 1

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Description

TECHNICAL FIELD

[0001] The invention concerns in general the technical field of elevator solutions. Especially the invention concerns maintenance of electrical conductivity in the elevator solutions.

BACKGROUND

[0002] Electrical contacts have wide range of application areas, wherein is a need to pass electrical current in a controlled manner from a first conductive material, such as metal, to another conductive material. The control may e.g. be achieved by adjusting a gap between the first and the other conductive material. Commonly known electrical contacts are e.g. electrical switches, relays and breakers. Typical contact material, in turn, is silver or a silver alloy having small amounts of nickel or copper therein, for example.

[0003] In elevator systems there are many application areas for the electrical contacts. Most common areas relate to safety supervision, power switches and different kinds of electro-mechanical interfaces. The electrical contacts especially in the safety area, and thus in safety circuits, have to meet many special requirements in order to maintain the safety in a use of elevators. A fault in a safety related electrical contact may e.g. stop the elevator and/or cause cancellation of position information which result delays in the operation.

[0004] At least one root cause for failures in the electrical contacts is degradation of conductive properties of the material used in the electrical contact or contacts. The degradation may originate from a contamination of the contact surfaces with foreign substances, such as dust and/or chemical vapors. The contamination may at least partially be prevented by ensuring that the air in the electrical contact space is as clean as possible. However, it is not possible to fully prevent the contamination of the contact surfaces. Then the question is if the electrical contacts shall be replaced with new ones or if they shall be cleaned in one way or another. Both these options generate costs in the use of elevators, which is not desirable. For this reason there already exist some technical solutions for cleaning the electrical contacts.

[0005] At least some prior art solutions are based on an idea to purge the foreign substances at least partially from the contact surfaces in the elevator systems by providing an electrical pulse to the electrical contact in question. The electrical pulse is generated by providing a high voltage or current to the contact. The drawback in the use of high voltage, such as 230 VAC, is a risk to get an electric shock from there e.g. when service personnel is making maintenance operations to the elevator. Use of high current, in turn, has a disadvantage that it heats the components and energy consumption is high. The use of high voltage and/or current also requires that used components are matched to such voltage/current levels, which typically means that the components are big in size which forces to implement the circuits in large circuit boards. This is not desirable due to limited space in elevator systems. Besides, use of high voltage in safety circuits, wherein the electrical contacts typically exist, require further safety circuits, such as residual-current devices (RCD), in order to fulfill standards existing in the technology area.

[0006] Hence, there is need to develop solutions which at least partially mitigate the drawbacks of the existing solutions.

SUMMARY

[0007] The following presents a simplified summary in order to provide basic understanding of some aspects of various invention embodiments. The summary is not an extensive overview of the invention. It is neither intended to identify key or critical elements of the invention nor to delineate the scope of the invention. The following summary merely presents some concepts of the invention in a simplified form as a prelude to a more detailed description of exemplifying embodiments of the invention.

[0008] An objective of the invention is to present an arrangement and a method for at least partially prevent degradation of conductive properties in material used in electrical contact or contacts. Another objective of the invention is that the arrangement and the method provide a mechanism to purge the electrical contact or contacts at least partly.

[0009] The objectives of the invention are reached by an arrangement and a method as defined by the respective independent claims.

[0010] According to a first aspect, an arrangement for purging at least one electrical contact in an elevator safety circuit is provided, wherein the arrangement comprising: at least one electrical contact comprising a first contact point and a second contact point coupled to a control unit in the first contact point and to a load in the second contact point, wherein the electrical contact is configured to establish a conductive path across the contact points when the first contact point and the second contact point are in electrically conductive contact with each other and to interrupt a conductive path across the contacts when the first contact point and the second contact point are separated; a capacitor coupled between the second contact of the electrical contact and a third voltage, V3; wherein the control unit is configured to selectively introduce a first voltage, V1, and a second voltage, V2, to the electrical contact.

[0011] The control circuit in the arrangement may be configured to determine a voltage difference over the at least one electrical contact when the first contact point and the second contact point are in electrically conductive contact and either the first voltage, V1, or the second voltage, V2, is introduced to the at least one electrical contact. The control circuit may also be configured to

selectively introduce the first voltage and the second voltage in response to a detection that the voltage difference over the at least one electrical contact exceeds a predetermined limit.

[0012] The control circuit may also be configured to receive an indication of an operational state of an entity wherein the safety circuit is arranged in order to determine a need for selectively introducing the first voltage, V1, and the second voltage, V2, to the electrical contact.

[0013] According to a second aspect, a method for purging at least one electrical contact in an elevator safety circuit is provided, wherein the safety circuit comprising: a control unit; at least one electrical contact comprising a first contact point and a second contact point coupled to a control unit in the first contact point and to a load in the second contact point, wherein the electrical contact is configured to establish a conductive path across the contact points when the first contact point and the second contact point are in electrically conductive contact with each other and to interrupt a conductive path across the contacts when the first contact point and the second contact point are separated; a capacitor coupled between the second contact of the electrical contact and a third voltage, V3; wherein the method comprising: selectively introducing a first voltage, V1, and a second voltage, V2, to the electrical contact by the control unit.

[0014] The method may further comprise, prior to the selectively introducing the first voltage, V1, and the second voltage, V2, to the electrical contact by the control unit, a step of determining a need for selectively introducing the first voltage, V1, and the second voltage, V2, to the electrical contact. The determination may comprise steps of: determining a voltage difference over the at least one electrical contact when the first contact point and the second contact point are in electrically conductive contact and either the first voltage, V1, or the second voltage, V2, is introduced to the at least one electrical contact; and triggering of selective introduction of the first voltage and the second voltage to the electrical contact in response to a detection that the voltage difference over the at least one electrical contact exceeds a predetermined limit.

[0015] The method may further comprise: receiving, in the control unit, an indication of an operational state of an entity wherein the safety circuit is arranged to in order to determine a need for selectively introducing the first voltage, V1, and the second voltage, V2, to the electrical contact.

[0016] Various exemplifying and non-limiting embodiments of the invention both as to constructions and to methods of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific exemplifying and non-limiting embodiments when read in connection with the accompanying drawings.

[0017] The verbs "to comprise" and "to include" are used in this document as open limitations that neither exclude nor require the existence of unrecited features. The features recited in dependent claims are mutually freely combinable unless otherwise explicitly stated. Furthermore, it is to be understood that the use of "a" or "an", i.e. a singular form, throughout this document does not exclude a plurality.

BRIEF DESCRIPTION OF FIGURES

[0018] The embodiments of the invention are illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings.

Figure 1 illustrates schematically an arrangement according to an embodiment of the invention.

Figure 2 illustrates schematically an arrangement according to another embodiment of the invention.

Figure 3 illustrates schematically an arrangement according to a still further embodiment of the invention.

Figure 4 illustrates schematically a method according to an embodiment of the invention.

Figure 5 illustrates schematically a method according to another embodiment of the invention.

DETAILED DESCRIPTION

[0019] The present invention relates to a solution for purging at least one electrical contact in an elevator safety circuit. An example of such an arrangement is schematically illustrated in Figure 1. The arrangement comprises at least one electrical contact 110 comprising a first contact point 112 and a second contact point 114. The at least one electrical contact is coupled to a control unit 120 in the first contact point 112 and to a load 130 in the second contact point 114. The load may be, but is not limited to, an electric motor providing power to an entity, such as a door, in the elevator. The load may also be a measuring device configured to monitor certain parameter in the elevator and/or a voltage meter arranged to measure voltage level on the second side of the elevator contact. The electrical contact 110 is configured to establish a conductive path across the contact points 112, 114 when the first contact point 112 and the second contact point 114 are in electrically conductive contact with each other and to interrupt a conductive path across the contacts 112, 114 when the first contact point 112 and the second contact point 114 are separated i.e. the electrically conductive contact is broken. The control unit 120 is configured at least to control input of two voltage levels V1, V2 differing from each other to the electrical contact 110. The control of input refers to a provision of the voltages V1 and V2 to the electrical contact 110. Hence, the control unit 120 may be implemented so that there may be arranged two electrical components to op-

erate as controllable switches, which are alternatively conducting. As a result either the voltage V1 or the voltage V2 is brought to the electrical contact 110.

[0020] The electrical components may e.g. be, but are not limited to, FET (Field Effect Transistor) based switches. Furthermore, the arrangement in the elevator safety circuit comprises a capacitor coupled between the second contact 114 and a third voltage V3. A capacitance of the capacitor 140 is advantageously selected so that the current for the 130 load is applicable in a frequency the voltages V1 and V2 are selectively input to the electrical contact 110. The voltage level V3 is selected so that the charging of the capacitor 140 may be adjusted to the application area.

[0021] Next the operation of the arrangement as illustrated in Figure 1 is described. As already mentioned the control unit 120 is configured to control the input of the voltages V1 and V2 in a predetermined frequency to the electrical contact 110. Advantageously, the electrical contact 110 is arranged in electrically conductive state when the voltages V1 and V2 are input. The input of the voltages V1 and V2 causes the capacitor 140 to charge and the current input to the load 130 is dependent on the capacitance of the capacitor 140 and the frequency used for inputting the voltages V1 and V2 in the arrangement. The frequency in which the voltages V1 and V2 are selectively input to the electrical contact 110 shall be high, such as 1000 Hz, in order to achieve desired effect. The desired effect is that at least part of contamination, such as dust and/or chemical vapors, formed on the surfaces of the first contact point 112 and the second contact point 114 may be purged. The purge is based on a phenomenon in which the input voltages V1 and V2 and their switching frequency cause heating of the electrical contact, i.e. the first and the second contact points 112, 114, when they are in electrically conductive state. Now, the foreign substances, such as impurities, on the surfaces of the electrical contacts get also heated in response to applying voltages V1 and V2 at high frequency to the electrical contact 110 and this causes at least partial purging of the electrical contact from impurities. This is because dielectric dissipation factor is the higher the higher the frequency in which the voltage is applied to the material in question i.e. increases heating of the impurities and even at least partial burning of them apart from the contact surfaces.

[0022] In some implementations, especially in elevator solutions, the safety circuits may comprise multiple electrical contacts in order to improve safety. The present invention, as schematically illustrated in Figure 2, may also be applied to in such implementations. In the implementation of Figure 2 there are multiple electrical contacts 110A, 110B, 110C, e.g. switches, by means of which it is possible control any operation behind the switches (illustrated as loads 130A, 130B, 130C). The multiple electrical contacts 110A, 110B, 110C may be purged with the present invention by arranging the control unit 120 to provide voltage levels V1, V2 to all electrical contacts 110A, 110B, 110C. Furthermore, capacitors 140A, 140B, 140C are arranged to each electrical contact branch as described. The number of branches is not limited to three, as illustrated in Figure 2, but may vary.

[0023] Some aspects of the present invention relate to determination if the purge of the electrical contact(s) shall be triggered or not. Namely, it may be advantageous to purge the electrical contact(s) periodically rather than constantly. The periodic purging may be established by tying the triggering of the purging to a predetermined event. According to a first embodiment of the present invention, as it comes to the triggering of the purging, a measuring device 310, such as voltage meter, is arranged to determine voltage difference over the electrical contact 110. This is schematically illustrated in Figure 3. When the electrical contact 110 is set in a conductive state and the voltage V1 is input to the electrical contact, it may be determined if there is voltage difference over the electrical contact 110. In case there is no voltage difference over the electrical contact, or it is less than a predetermined limit, it may be concluded that the electrical contact works properly and there is no foreign substance on the surfaces of the first and/or the second contact point. On the contrary, if the voltage difference exceeds a predetermined limit, it may be concluded that there is need to trigger the purging of the electrical contact in the manner as described. The idea here is that the foreign substance increases resistance in the path which may be seen as a voltage drop between the measurement points. The determination of the triggering of the purging may be performed, for example, by a control unit 120 into which measurement data from the measuring device 310 is input. Alternatively or in addition, a device may be arranged to execute the measurement data analysis as well as outputting instructions for the control unit 120 in order to perform the purging.

[0024] Furthermore, the triggering of the purging may be arranged to be dependent on some predetermined event originating from a device or a system in which the safety circuit is implemented. The purpose is to detect a conductive state of the electrical contact(s) in order to provide a purging signal, i.e. alternating current AC, to the electrical contact(s) at that time. For example, in a context of door solutions in which the electrical contacts of the doors are in conducting state when a door is closed and in non-conducting state when the door is open. Hence, the control unit may be configured to monitor door status, i.e. if the door is open or closed, and based on this information trigger the purging of the electrical contacts in such instant of time that the electrical contact 110 is in a conductive state.

[0025] Moreover, the provision of voltages V1 and V2, i.e. the purging signal, may also be implemented so that the control unit 120 is configured to provide the purging signal for a predetermined period of time to the electrical contact 110. The period of time may be determined in a control unit 120 with a timer implementation, which timer is initiated to run when the purging signal is input to the

electrical contact 110. Additionally, the control unit may receive information from an external entity, such as a sensor, on an operational state of the electrical contact 110. Then the control unit 120 may be configured to trigger the control signal with a pre-condition that the electrical contact 110 is in a conductive state. According to still further embodiment the control unit 120 may be configured to control the electrical contact(s) 110 in order to initiate the purging. This may e.g. be arranged so that the control unit 120 is arranged to be a slave for some master unit which operates the entity marked as load in the figures. When the master unit is not operating, e.g. not controlling, the load, it may deliver an indication signal to the control unit 120 and authorize the control unit 120 to control the electrical contacts, or any elements driving the electrical contacts to open and closed states, in order to perform the purging.

[0026] Figure 4 illustrates schematically a method according to an embodiment of the invention. In the method a first voltage, V1, and a second voltage, V2, are selectively introduced 410 to at least one electrical contact 110 by a control unit 120 as described. In some further embodiment, as schematically illustrated in Figure 5, the method may comprise a step of determining 510 if there is a need for purging the one or more electrical contacts in the elevator safety circuit. The determination may comprise a measurement of a parameter by means of which it is possible to make a decision if the surfaces of the contact points in the electrical contact are at least partly covered with impurities or not. Such a parameter may be a voltage over the electrical contact, as already described. Additionally, the determination may also comprise an analysis of the measured parameter in order to determine if there is need for purging. According to some other embodiment of the invention the determination may comprise a monitoring of a certain event relating to the safety circuit. For example, it may comprise a determination of an operational state of the safety circuit or an entity into which the safety circuit is arranged. The triggering, i.e. introduction of the first and the second voltages to the at least one electrical contact, is initiated in response to a detection that the operational state meets a predetermined criterion or criteria. Moreover, the determination of a need for purging may also comprise a step to confirm that the at least one electrical contact is in an electrically conductive state.

[0027] Advantageously, the voltage levels V1 and V2 are selected so that the voltage level of the AC current generated through selective introduction of the first and the second voltages to the electrical contact is 50 V in maximum. This meets extra low voltage limit defined for elevator solutions and thus mitigates need to implement additional safety solutions in order to handle any high currents possibly generated in the safety circuit. Moreover, the AC current used in safety circuits is typically around 100 mA, which may be at least partly achieved in the present invention by optimal selection of the capacitor in the circuit.

[0028] As may be understood from the description the capacitor or the capacitors operates in the circuit so that it, or they, generates high current, such as 20...1000 mA, to the electrical contact with the AC current. Naturally, the capacitor functions also as a filter towards the load. As said the advantage of the invention is that the implementation generates an applicable current for achieving the advantages of the present invention without using high voltages. A rating of the capacitor is at least partly dependent on a rice time of the voltage which, in turn, is at least partly dependent on internal resistances of components and any external current limiting resistances if used, among other possible reasons. As a non-limiting example of a capacitance value of an applicable capacitor with 50 μs rise time is 1 μF and such a capacitance generates a current peak of ~0,5 A. The voltage levels of the first, second and third voltages may e.g. be the following: V1=24 V, V2=0/24 V, V2=0/24V.

[0029] The specific examples provided in the description given above should not be construed as limiting the applicability and/or the interpretation of the appended claims. Lists and groups of examples provided in the description given above are not exhaustive unless otherwise explicitly stated.

Claims

1. An arrangement for purging at least one electrical contact in an elevator safety circuit, comprising
at least one electrical contact (110) comprising a first contact point (112) and a second contact point (114) coupled to a control unit (120) in the first contact point (112) and to a load (130) in the second contact point (114), wherein the electrical contact (110) is configured to establish a conductive path across the contact points (112; 114) when the first contact point (112) and the second contact point (114) are in electrically conductive contact with each other and to interrupt a conductive path across the contacts (112; 114) when the first contact point (112) and the second contact point (114) are separated,
a capacitor (140) coupled between the second contact (114) of the electrical contact (110) and a third voltage, V3,
wherein the control unit (120) is configured to selectively introduce a first voltage, V1, and a second voltage, V2, to the electrical contact (110).

2. The arrangement according to the claim 1, wherein the control circuit (120) is configured to determine a voltage difference over the at least one electrical contact (110) when the first contact point (112) and the second contact point (114) are in electrically conductive contact and either the first voltage, V1, or the second voltage, V2, is introduced to the at least one electrical contact (110).

3. The arrangement according to the claim 2, wherein the control circuit (120) is configured to selectively introduce the first voltage and the second voltage in response to a detection that the voltage difference over the at least one electrical contact (110) exceeds a predetermined limit.

4. The arrangement according to any of the preceding claims, wherein the control circuit (120) is configured to receive an indication of an operational state of an entity wherein the safety circuit is arranged in order to determine a need for selectively introducing the first voltage, V1, and the second voltage, V2, to the electrical contact (110).

5. A method for purging at least one electrical contact in an elevator safety circuit, comprising

- a control unit (120),
- at least one electrical contact (110) comprising a first contact point (112) and a second contact point (114) coupled to a control unit (120) in the first contact point (112) and to a load (130) in the second contact point (114), wherein the electrical contact (110) is configured to establish a conductive path across the contact points (112; 114) when the first contact point (112) and the second contact point (114) are in electrically conductive contact with each other and to interrupt a conductive path across the contacts (112; 114) when the first contact point (112) and the second contact point (114) are separated,

a capacitor (140) coupled between the second contact (114) of the electrical contact (110) and a third voltage, V3,
the method comprising:

- selectively introducing (410) a first voltage, V1, and a second voltage, V2, to the electrical contact (110) by the control unit (120).

6. The method according to claim 5, the method further comprising, prior to the selectively introducing the first voltage, V1, and the second voltage, V2, to the electrical contact (110) by the control unit (120), a step of determining (510) a need for selectively introducing (410) the first voltage, V1, and the second voltage, V2, to the electrical contact (110).

7. The method according to claim 6, wherein the determination (510) comprises steps of:

- determining a voltage difference over the at least one electrical contact (110) when the first contact point (112) and the second contact point (114) are in electrically conductive contact and either the first voltage, V1, or the second voltage, V2, is introduced to the at least one electrical contact (110), and
- triggering of selective introduction (410) of the first voltage and the second voltage to the electrical contact (110) in response to a detection that the voltage difference over the at least one electrical contact (110) exceeds a predetermined limit.

8. The method according to any of the preceding claims, the method further comprising:

- receiving, in the control unit (110), an indication of an operational state of an entity wherein the safety circuit is arranged to in order to determine a need for selectively introducing the first voltage, V1, and the second voltage, V2, to the electrical contact (110).

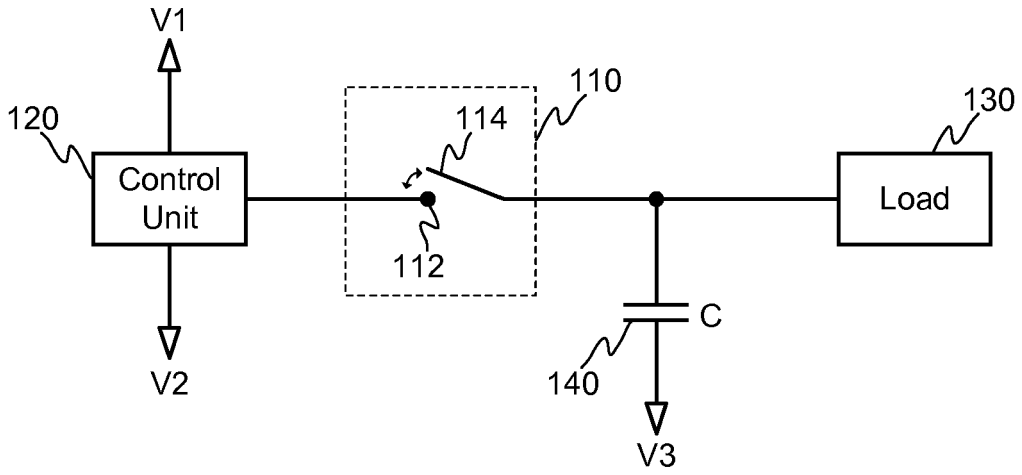

FIGURE 1

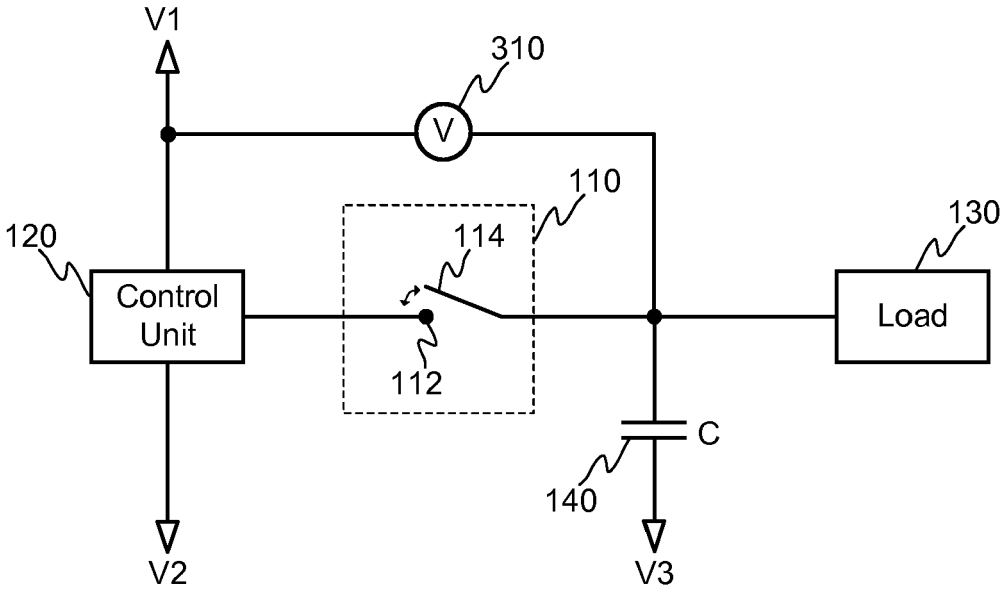

FIGURE 3

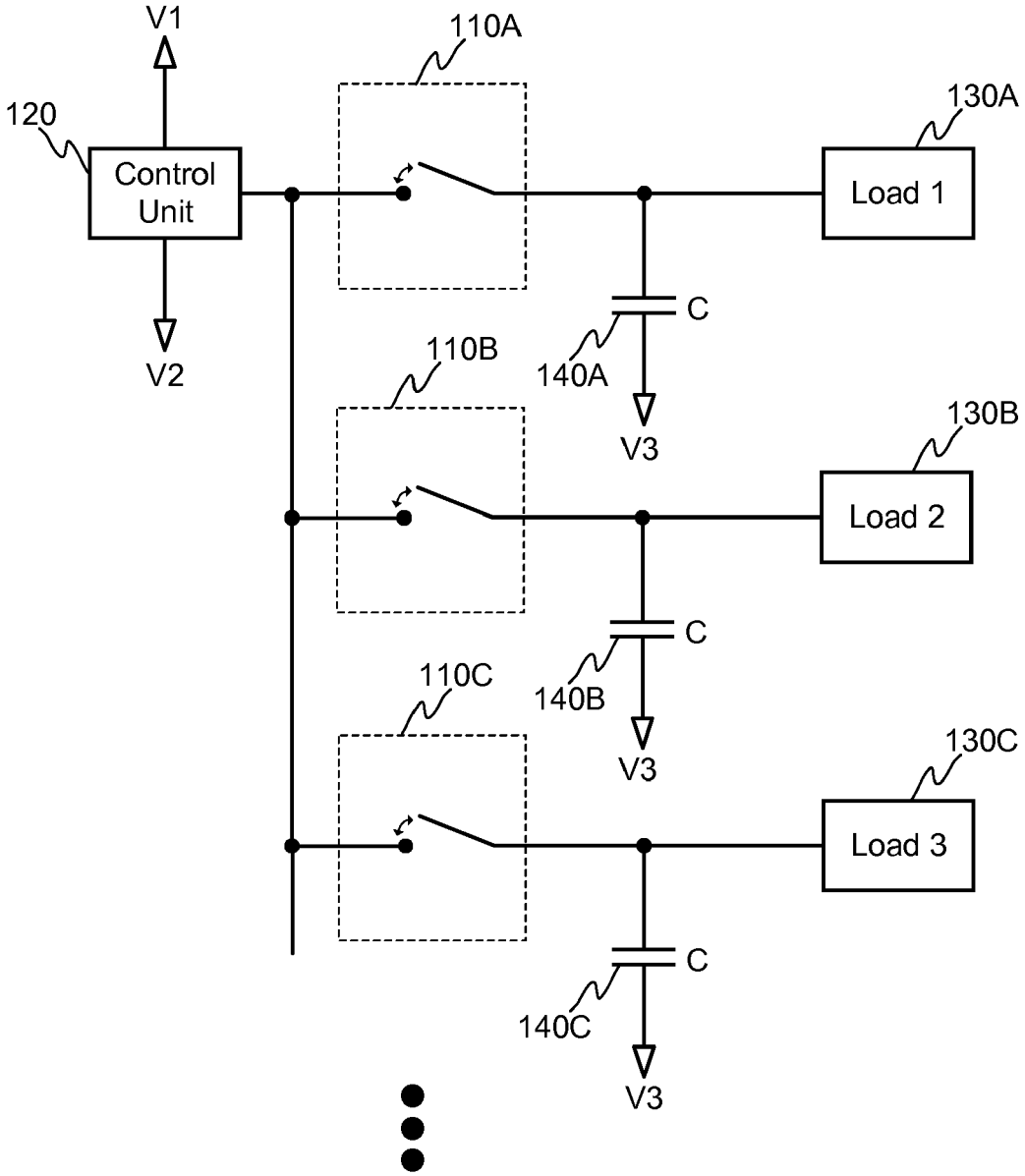
V1
110A
120
130A
Control Unit
Load 1
C
140A
V2
110B
V3
130B
Load 2
C
140B
110C
V3
130C
Load 3
C
140C
V3

FIGURE 2

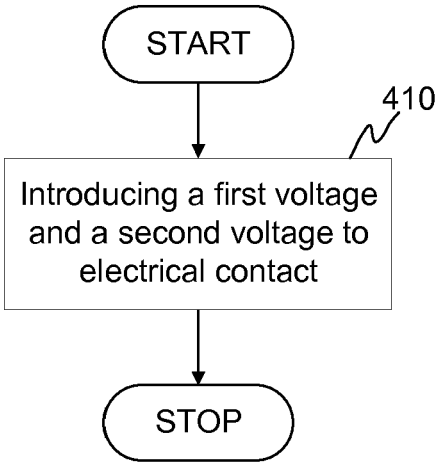

FIGURE 4

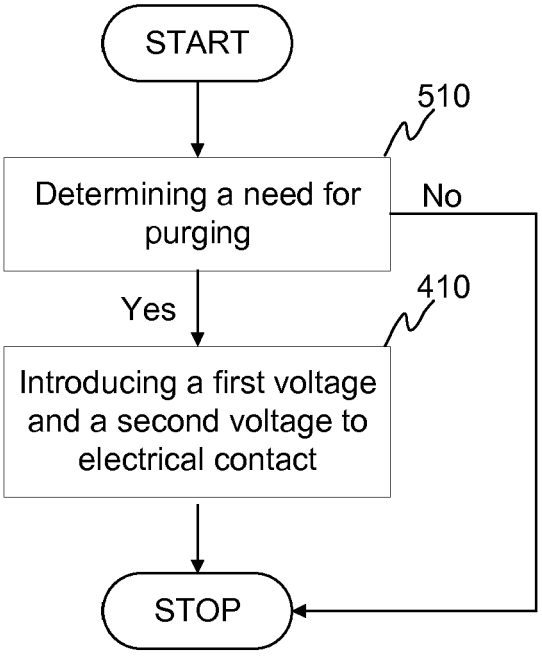

FIGURE 5

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EUROPEAN SEARCH REPORT

Application Number
EP 15 20 1617

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	DE 195 13 615 A1 (MORITA MFG [JP]) 12 October 1995 (1995-10-12) * column 1, lines 3-11 * * column 2, lines 24-45 * * column 5, line 30 - column 6, line 29 * * figure 4 *	1,5	TECHNICAL FIELDS SEARCHED (IPC) H01H B66B
Y	US 2005/231876 A1 (KOMATSU KAZUHIRO [JP] ET AL) 20 October 2005 (2005-10-20) * paragraph [0002] * * paragraph [0010] - paragraph [0012] * * paragraph [0035] * * paragraph [0040] *	1-8	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 May 2016	Hristov, Stefan

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 20 1617

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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