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(54) APPARATUS TO SWITCH A LED

(57) An apparatus (1, 1a, 1b) to switch a light emitting diode (LED) or another load, comprising a mechanical switch (2), which comprises a moving electrode (3), wherein the moving electrode (3) is a contact, which electrically gets in connection with a further contact or electrode (4) to enable a current flow while a closing phase, characterized in that the apparatus (1, 1a, 1b) comprises a body (5, 5a, 5b) which absorbs or dissipates the kinetic energy of the moving electrode (3), achieves the object to prevent bounces or arcs of electrodes, especially to prevent bounces or arcs of a moving electrode of a mechanical switch.

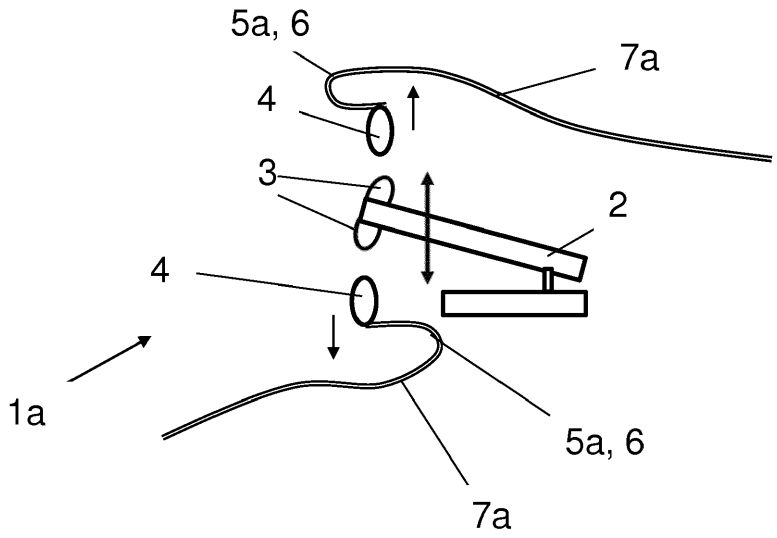

Fig. 3

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Description

[0001] The invention is related to an apparatus to switch a light emitting diode (LED) or another load, comprising a mechanical switch, which comprises a moving electrode, wherein the moving electrode is a contact, which electrically gets in connection with a further contact or electrode to enable a current flow while a closing phase.

[0002] Nowadays LED lamps are replacing the traditional light bulbs for the sake of their more efficient conversion of electricity into light. This change is even enforced by regulation in most of the countries worldwide.

[0003] However, when switching on a LED lamp, a high inrush current occurs during the first milliseconds due to the sudden charge of capacitors located in the LED driver (AC/DC converter), as illustrated in Fig. 1. Typical inrush peak currents are ranging about 10 times higher than the rated current, and have to be in accordance with the international standards (for instance, IEC 60669-1 for "Switches for household and similar fixed electrical installations - Part 1. General requirements").

[0004] One of the issues of mechanical switches is that there is a certain bouncing of the moving electrode during the closing phase. The kinetic energy of the moving electrode can not be dissipated efficiently, which generates a bouncing.

[0005] The main problem occurs, when mechanical switches are used to switch on LEDs, for instance. Since the bounces occur while the current flows, then an arc forms between the two contacts. Due to the very high inrush current, that can be reached in switching on LEDs; this can lead to an accelerating contact ageing, or even to a welding of the two contacts.

[0006] The object of the invention therefore is to prevent bounces or **arcing on** electrodes, especially to prevent bounces or arcing on a moving electrode of a mechanical switch.

[0007] The object of the invention is achieved by means of the features of claim 1.

[0008] According to this claim, the apparatus comprises a body, which absorbs or dissipates the kinetic energy of the moving electrode.

[0009] According to the invention, it has been found that the reason for the bounces especially in light switches is due to a collision between two bodies, i.e. the two electrodes when they close. Physically, two bodies entering into an elastic collision are unable to collide without a bounce. The reason is due to the fact, that the momentum and energy equations cannot be fulfilled simultaneously. In order to have two bodies colliding without bouncing, the collision must be either very inelastic, i.e. energy absorbed by the system, or there must be a third body involved in the collision. Insofar it is necessary to use means to absorb the kinetic energy at the impact of two electrodes. Different materials and/or geometries can fulfill the task of absorbing the kinetic energy.

[0010] Advantageously the further respectively second contact or electrode is fixed and the body is arranged at least partially behind the further contact or electrode on a side, which is averted to that side of the further contact or electrode where the moving electrode impacts on the further contact or electrode. Through this, it is possible to add a body behind a fixed electrode, so that it takes the kinetic energy and dissipates it, so that it prevents the electrodes from bouncing. The body behind the fixed electrodes fulfils the task of absorbing and dissipating the kinetic energy. The body is a dampening element behind the fixed electrode.

[0011] Further advantageously at least one electrode is connected to the body, wherein the body forms a part of a flexible section of a current carrier or wherein the body is a flexible current carrier. In order to absorb the kinetic energy a holder of the fixed electrode is designed as a loop, an arch or a bent design of the current carrier directly behind the contact or electrode. By correct dimensioning of the flexible section, this acts as a dampened spring and can absorb and dissipate the energy of the impact of the moving electrode.

[0012] Advantageously the body comprises a polymer or is a polymer. Polymeric materials can provide an efficient damping of a moving electrode. This depends on the damping factor and/ or a spring constant of an element to be placed behind a fixed electrode. A spring constant may depend on its turns, of the module of elasticity of the material and/ or the geometry of the element.

[0013] Advantageously the body comprises an elastomer or is an elastomer. Elastomeric materials, which can be used to develop the body, are e.g. natural rubber, synthetic rubber or thermoplastic elastomers. It is possible to use a rubber band, as absorbing body, placed behind a top fixed electrode.

[0014] Further advantageously the body comprises a foam or is developed as a foam. Foam or foam-like materials can be used to develop the body. In particular, a metallic foam, a ceramic foam, a composite foam or a polymer foam could be used. Foams can be brought in every shape in an easy way.

[0015] Advantageously the body comprises a solid gel material or is developed as a solid gel material. Such materials may have viscosities, which create very good dampening properties.

[0016] Advantageously the body comprises a spring or is developed as a spring. A spring may exert a restoring force or a reset force on the impacting moving electrode. Springs with high dampening ratio may be used, especially metallic and polymer-based springs, may be used.

[0017] Further advantageously the body is wavy, and/ or shows a repetition of minima and maxima along an extension of the body and/ or comprises a corrugation or is corrugated. A wave, undulation or corrugation can dissipate excessive energy. Preferably the current carrier is developed wavy, shows an undulation or is modified with a corrugation, so that the kinetic energy of a collision traveling through the current carrier is effectively damped before behind restored to the contact.

[0018] The field of the invention relates to mechanical switches, in particular to mechanical switches at low voltages, namely smaller than 1 kV, such as rocker light switches. The invention relates to applications of light switches with LED lamps, or any other type of loads with high inrush currents occurring during the making of the current.

[0019] Advantageously the rated voltage level, which is applied to the mechanical switch is smaller than 1000 V, especially smaller than 600 V, and/ or the rated current which flows through the mechanical switch is smaller than 20 A and/ or the inrush current when the mechanical switch is closed is smaller than 250 A. Such a switch at least complies with the requests of international standards. The peak inrush current, as well as the energy during the making operation, are given in these standards. Such a switch complies with the standard "Switches for household and similar fixed electrical installations", which is the IEC 60669-1 Edition 4.0, 2017-02.

[0020] By a method and apparatus described above is used to avoid any bouncing and/ or arcs in the mechanical switch.

In the drawings:

[0021]

Fig. 1 shows an inrush current which occurs when the switch closes with a LED load, it is shown that a fast transient phase occurs, which is smaller than 2ms, with a peak inrush current reaching up to about ten times the rated current,

Fig. 2 shows an illustration of the principle of the invention, a body to absorb and dissipate energy is arranged behind each fixed electrode, which gets in electrical contact with a moving electrode,

Fig. 3 shows a modified holding system for the fixed electrodes, wherein the arrangement is made so that the electrodes can move a bit, and that the design absorbs the kinetic energy, and

Fig. 4 shows a wavy corrugated current carrier made to dissipate the excess of energy at the impact of the moving electrode on a fixed electrode.

[0022] Fig. 1 illustrates, that a high inrush current occurs during the first milliseconds due to the sudden charge of capacitors located in a LED driver (AC/DC converter), when switching on a LED lamp. Typical inrush peak currents are ranging about 10 times higher than the rated current. Exact conditions are described in the standard. For instance, IEC 60699-1 Edition 4.0 2017-02 for the International Electrotechnical Commission.

[0023] Fig. 2 shows an apparatus 1 to switch a light emitting diode (LED) or another load, comprising a mechanical switch 2, which comprises a moving electrode 3, wherein the moving electrode 3 is a contact, which electrically gets in connection with a further contact or electrode 4 to enable a current flow while a closing phase.

[0024] The apparatus 1 comprises a body 5 which absorbs or dissipates the kinetic energy of the moving electrode 3. In this case two fixed electrodes 4 are given which each can get in electrical contact with a different moving electrode 3 of a tumbler or rocker switch 2.

[0025] Each further contact or electrode 4 is fixed and each body 5 is arranged behind the further contact or electrode 4 on a side which is averted to that side of the further contact or electrode 4, where the respective moving electrode 3 impacts on the respective further contact or electrode 4.

[0026] The body 5, which is schematically shown in Fig. 2, may comprise a polymer or may be a polymer, especially an elastomer. The body 5 may comprise a foam or may be developed as a foam. The body 5 may comprise a solid gel material or may be developed as a solid gel material.

[0027] Fig. 3 shows a further apparatus 1a to switch a light emitting diode (LED) or another load, comprising a mechanical switch 2, which comprises a moving electrode 3, wherein the moving electrode 3 is a contact, which electrically gets in connection with a further contact or electrode 4 to enable a current flow while a closing phase.

[0028] The apparatus 1a comprises a body 5a which absorbs or dissipates the kinetic energy of the moving electrode 3. In this case two fixed electrodes 4 are given which each can get in electrical contact with a different moving electrode 3 of a tumbler or rocker switch 2.

[0029] Each further contact or electrode 4 is fixed and each body 5a is arranged behind the further contact or electrode 4 on a side, which is averted to that side of the further contact or electrode 4, where the respective moving electrode 3 impacts on the respective further contact or electrode 4.

[0030] Each electrode 4 is connected to the respective body 5a, wherein the body 5a forms a part of a flexible section 6 of a current carrier 7a. The flexible section 6 is designed as a loop or is bent in such a manner that kinetic energy may be absorbed.

[0031] It becomes clear from Fig. 3 that the body 5a may also be a flexible current carrier 7a. The body 5a acts as a spring or is developed as a spring. The current carrier 7a may be a cable or wire.

[0032] Fig. 4 shows a further apparatus 1b to switch a light emitting diode (LED) or another load, comprising a mechanical switch 2, which comprises a moving electrode 3, wherein the moving electrode 3 is a contact, which electrically gets in connection with a further contact or electrode 4 to enable a current flow while a closing phase.

[0033] The apparatus 1b comprises a body 5b which absorbs or dissipates the kinetic energy of the moving electrode 3. In this case two fixed electrodes 4 are given

which each can get in electrical contact with a different moving electrode 3 of a tumbler or rocker switch 2.

[0034] Each further contact or electrode 4 is fixed and the body 5b is arranged behind one further contact or electrode 4 on a side which is averted to that side of the further contact or electrode 4, where the respective moving electrode 3 impacts on the respective further contact or electrode 4.

[0035] Fig. 4 shows an apparatus 1b, wherein the body 5b is wavy or comprises a corrugation and is corrugated. The wave form or undulation or corrugation can dissipate the excessive energy. Preferably the current carrier 7b is wavy or is modified with a corrugation, so that the kinetic energy of a collision traveling through the current carrier 7b is effectively damped before behind restored to the contact. The current carrier 7b may be a cable or wire.

Reference numbers

[0036]

1, 1a, 1b	Apparatus
2	Mechanical switch
3	Moving electrode
4	Further electrode
5, 5a, 5b	Body
6	Section of 7a
7a, 7b	Current carrier

Claims

1. Apparatus (1, 1a, 1b) to switch a light emitting diode (LED) or another load, comprising a mechanical switch (2), which comprises a moving electrode (3), wherein the moving electrode (3) is a contact, which electrically gets in connection with a further contact or electrode (4) to enable a current flow while a closing phase,
characterized in that the apparatus (1, 1a, 1b) comprises a body (5, 5a, 5b) which absorbs or dissipates the kinetic energy of the moving electrode (3).

2. Apparatus according to claim 1, **characterized in that** the further contact or electrode (4) is fixed and the body (5, 5a, 5b) is arranged at least partially behind the further contact or electrode (4) on a side which is averted to that side of the further contact or electrode (4), where the moving electrode (3) impacts on the further contact or electrode (4).

3. Apparatus according to claim 1 or 2, **characterized in that** at least one electrode (4) is connected to the body (5a, 5b), wherein the body (5a, 5b) forms a part of a flexible section (6) of a current carrier (7a) or wherein the body is a flexible current carrier (7b).

4. Apparatus according to one of the preceding claims, **characterized in that** the body (5) comprises a polymer or is a polymer.

5. Apparatus according to one of the preceding claims, **characterized in that** the body (5) comprises a foam or is developed as a foam.

6. Apparatus according to one of the preceding claims, **characterized in that** the body (5) comprises a solid gel material or is developed as a solid gel material.

7. Apparatus according to one of the preceding claims, **characterized in that** the body (5a) comprises a spring or is developed as a spring.

8. Apparatus according to one of the preceding claims, **characterized in that** the body (5b) is wavy, and/ or that the body (5b) shows a repetition of minima and maxima along an extension of the body (5b) and/ or that the body (5b) comprises a corrugation or is corrugated.

9. Apparatus according to one of the preceding claims, **characterized in that** the rated voltage level, which is applied to the mechanical switch (2), is smaller than 1000 V, especially smaller than 600 V, and/ or the rated current, which flows through the mechanical switch (2), is smaller than 20 A and/ or the inrush current, when the mechanical switch (2) is closed, is smaller than 250 A.

10. Method of use of an apparatus (1, 1a, 1b) according to one of the preceding claims to avoid any bouncing or arcing in the mechanical switch (2).

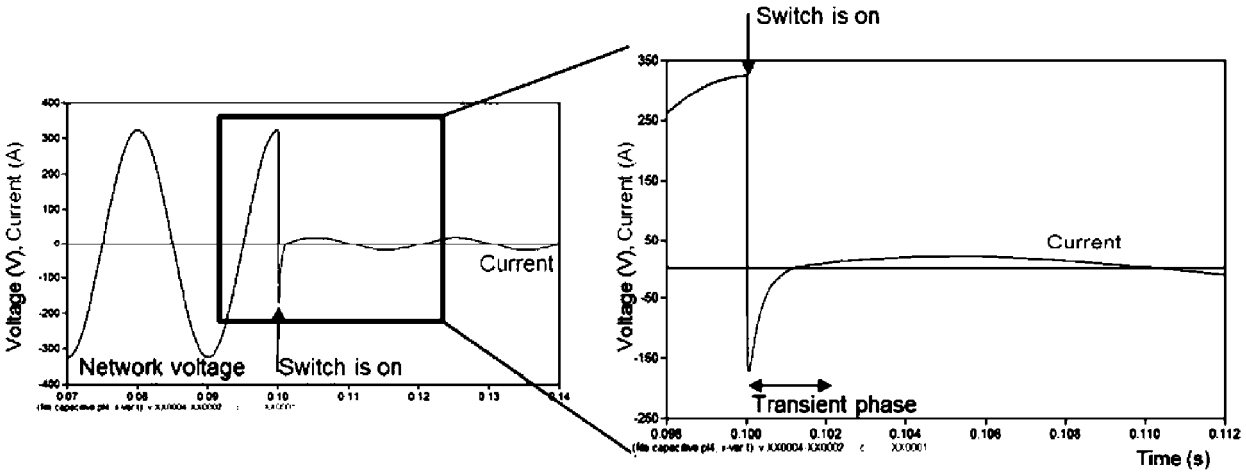
Switch is on
Voltage (V), Current (A)
Current
Network voltage
Switch is on
Transient phase
Time (s)

Fig. 1

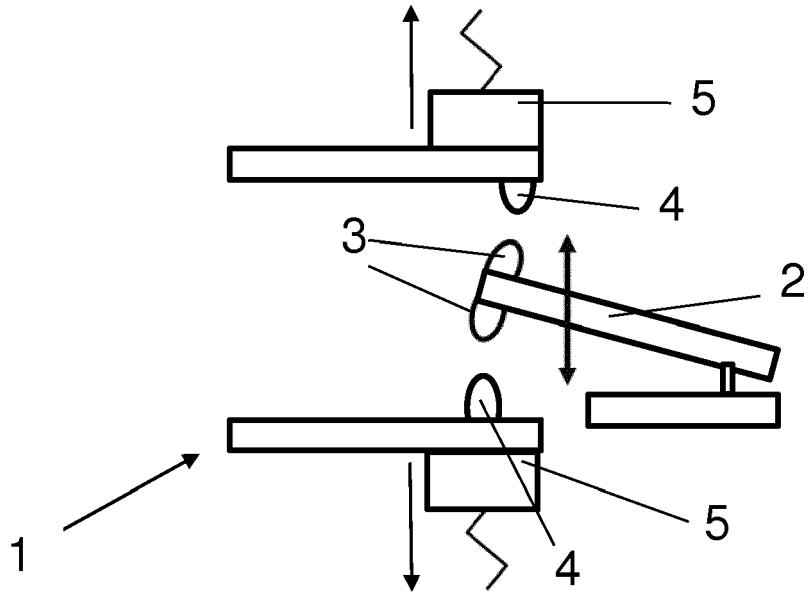

Fig. 2

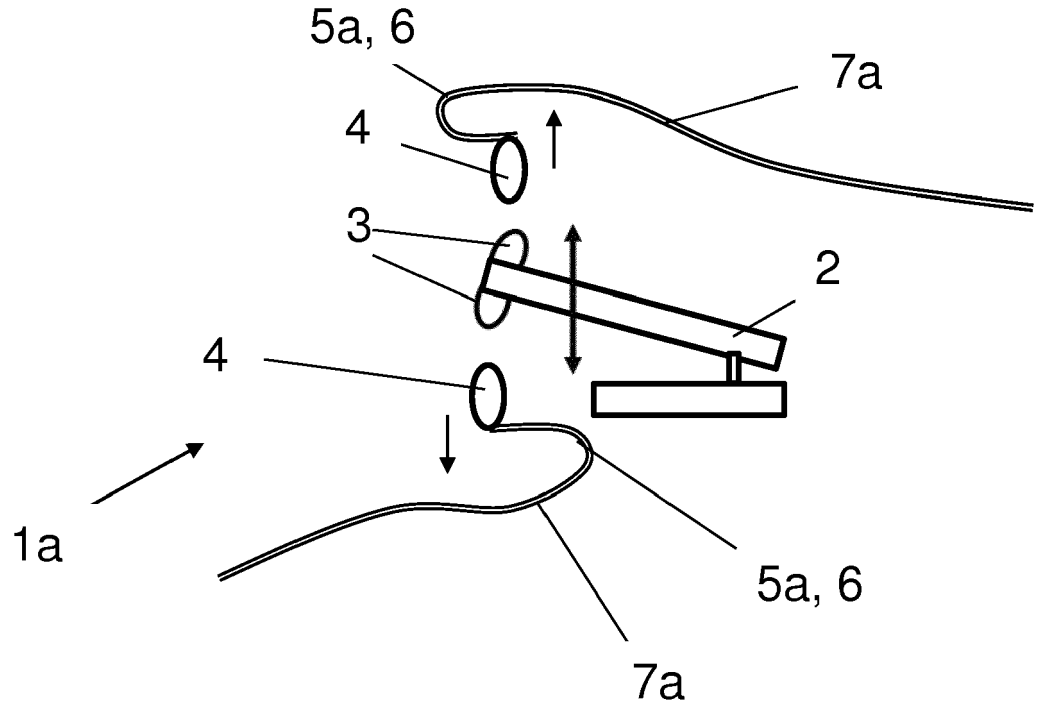

Fig. 3

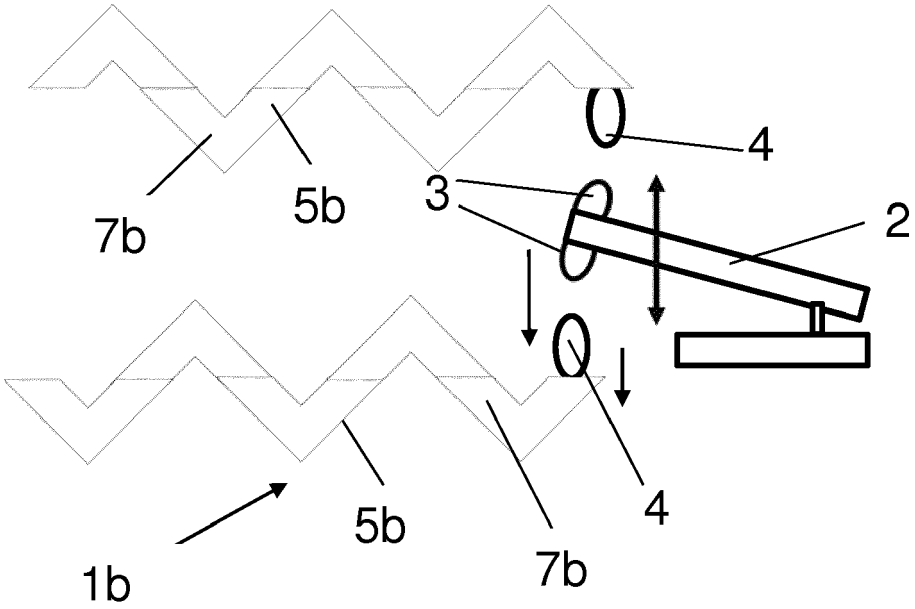

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 18 18 2429

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2 743 330 A (LOUIS LUDWIG) 24 April 1956 (1956-04-24) * column 2, line 16 - column 3, line 8; figures *	1-10	INV. H01H1/22 H01H3/60
X	GB 629 300 A (FREDERICK LEONARD COOK) 16 September 1949 (1949-09-16) * page 3, lines 47-58; figures *	1,10	
X	EP 0 560 696 A1 (MERLIN GERIN [FR]) 15 September 1993 (1993-09-15) * column 3, line 41 - column 4, line 20; figures *	1,10	
			TECHNICAL FIELDS SEARCHED (IPC)
			H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 December 2018	Findeli, Luc

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 18 2429

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03-12-2018

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