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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, 2a, 2b), 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 and/ or the momentum which is exerted from the moving electrode (3) on the further contact or electrode (4), achieves the object to prevent bounces of electrodes, especially to prevent bounces of a moving electrode of a mechanical switch.

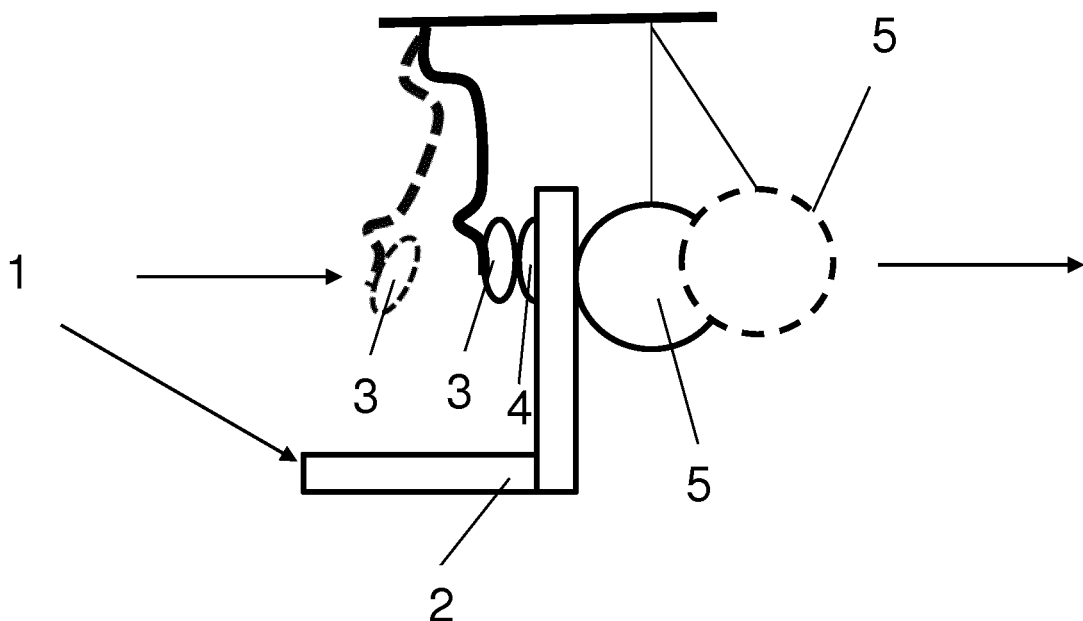


Fig. 3

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 then rated current.

[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 of electrodes, especially to prevent bounces of 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 and/ or the momentum which is exerted from the moving electrode on the further contact or 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. 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. In the latter case, the equations of momentum and energy can be fulfilled.

[0010] Advantageously the further 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 a momentum or pulse can be directed

and transmitted or transferred to the body. Through this it is possible to add a third body behind a fixed electrode, so that it takes the kinetic energy and dissipates it, so that it prevents the electrodes from bouncing.

[0011] Further advantageously the body is a movable body. A movable body can move in such a way that the two contacts or electrodes remain on their place without bouncing when the mechanical switch is closed and the contacts are electrically connected.

[0012] Advantageously the body is separated from the moving electrode and the further electrode. Through this the body can move independently from the electrically connected electrodes. The body can be lead in a rail or can hang on a wire to be movable in a defined manner.

[0013] Further advantageously the body is also a contact or an electrode, through which current can flow. Through this current can be lead into a combined element having a bigger cross section through which current can flow.

[0014] Further advantageously the body is part of a contact or an electrode. Through this an electrode can be integrated into the body.

[0015] Advantageously the body is made of a polymer or comprises a polymer. A polymer is insulating and has a low density. Polymers are used to create cases or housings of standard mechanical switches.

[0016] Further advantageously the body is a part of a case of the mechanical switch. Alternatively the case itself is the body. Through this, it is possible to use the polymer case that is part of a traditional switch. It is possible to transform a polymer part behind the normally fixed electrode, so that it has an appropriate mass and shape in order to move and to take the momentum and/ or kinetic energy of the collisions, while leaving two metallic electrodes without motion.

[0017] The polymer parts behind fixed contacts, which are parts of the switch case, advantageously are used and reshaped in order to play the role of a third body, i. e. transforming the already existing physical switch geometry rather than adding a new part.

[0018] The geometry of a third body advantageously is such that the kinetic energy is efficiently dissipated into a moving arm holding the third body. Like this, the new part is not coming back and retransferring its velocity to the two electrodes, like it would be for example in a Newton's cradle game.

[0019] 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.

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

[0021] In the drawings:

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 with the Newton's cradle "game", the kinetic energy of the left ball can be fully transmitted to the right one during a collision, while leaving the middle and left ball non-moving,

Fig. 3 shows an illustration of the principle of the object of this invention disclosure, a third ball, in this case a moving polymer, is placed behind the two contacts to take the momentum and kinetic energy of the collision of the two contacts or electrodes, which should leave the two electrodes motion-less,

Fig. 4 shows on the left side an illustration of a standard rocker light switch and on the right side a modified light switch case, that shows a third additional contact, and

Fig. 5 schematically shows the case of a mechanical switch, which shows the body as a part of the case.

[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 then rated current.

[0023] Fig. 2 shows an illustration of the principle of the invention with the Newton's cradle "game", the kinetic energy of the left ball can be fully transmitted to the right one during a collision, while leaving the middle and left ball nonmoving. The dashed lines show the moving balls. First the left ball moves and impacts in the direction of the arrow on the middle ball, then the right ball moves in the direction of the arrow and the left and middle ball remain motionless. The momentum of the left ball is transmitted or transferred to the right ball.

[0024] Fig. 3 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 of the mechanical switch 2.

[0025] The apparatus 1 further comprises a body 5, which absorbs or dissipates the kinetic energy and/ or the momentum, which is exerted from the moving electrode 3 on the further contact or electrode 4.

[0026] The principle is as follows:
First the moving electrode 3 moves and impacts in the

direction of the arrow on the further electrode 4, then the body 5, in this case a ball, moves in the direction of the arrow and the moving electrode 3 and the further electrode 4 remain motionless and are electrically connected.

5 The momentum of the moving electrode 3 is transmitted to the right ball. The dashed lines show the moving parts.

[0027] The further contact or electrode 4 is fixed and the body 5 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.

[0028] The body 5 is a movable body. The body 5 is separated from the moving electrode 3 and the further electrode 4. The body 5 is made of a polymer. The body 5 hangs on a wire and can swing out like a pendulum in the direction of the arrow. The ball may also be a polymeric part and connected or hung up in another manner, as described later.

20 **[0029]** Fig. 4 schematically shows on the left side an illustration of a standard rocker light switch, and on the right side a further apparatus 1a, comprising a modified light switch case, that shows a third additional contact.

[0030] On the right side of Fig. 4, it is schematically shown, that the movable body 5a is also a contact or an electrode, through which current can flow. This body 5a is also movable in the direction of the arrow as shown on the right side of Fig. 4, when the mechanical switch 2a is closed.

30 **[0031]** Fig. 5 schematically shows a modified standard rocker light switch, having a base 6, that comprises a third additional body 5b, which is formed into the polymer of the case 7. The third additional body 5b lies just below the bottom electrode 4 of the mechanical switch 2b. Fig. 5 insofar shows a further apparatus 1b, wherein the body 5b is a part of a case 7 of the mechanical switch 2b.

[0032] If the third body 5b is not completely made of a polymer it can have the function of a third electrode or contact additionally to its dissipating function.

40 **[0033]** In Fig. 5 it is shown to use the polymer case 7, that is part of a traditional switch, and to transform the polymer part behind the normally fixed electrode 4. The polymer part has an appropriate mass and shape in order to move and to take the momentum and kinetic energy of the collisions, while leaving the two metallic electrodes 3, 4 without motion.

[0034] The polymer parts behind fixed contacts, namely parts of a switch case 7, advantageously are used and reshaped in order to play the role of a third body 5b, i.e. transforming the already existing physical switch geometry rather than adding a new part.

[0035] The geometry of a third body 5b is such that the kinetic energy is efficiently dissipated into a moving arm 8 holding the third body 5b. Like this, the new part is not coming back and retransferring its velocity to the two electrodes 3, 4, like it would be for example in a Newton's cradle game.

[0036] The apparatuses 1, 1a, 1b shown here may also

be encapsulated as a whole or in part in a case 7.

Reference numbers

1, 1a, 1b	Apparatus
2, 2a, 2b	Mechanical switch
3	Moving electrode
4	Further electrode
5, 5a, 5b	Body
6	Base of 7
7	Case
8	Holding arm of 5b

characterized in that the body (5, 5a, 5b) is made of a polymer or comprises a polymer.

8. Apparatus according to one of the preceding claims, **characterized in that** the body (5b) is a part of a case (7) of the mechanical switch (2b) or that the case (7) itself is the body.
9. Method of use of an apparatus (1, 1a, 1b) according to one of the preceding claims to avoid any bouncing or arcs in the mechanical switch (2, 2a, 2b).

Claims

- Apparatus (1, 1a, 1b) to switch a light emitting diode (LED) or another load, comprising a mechanical switch (2, 2a, 2b), 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 and/ or the momentum which is exerted from the moving electrode (3) on the further contact or electrode (4).
- 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).
- Apparatus according to claim 1 or 2, **characterized in that** the body (5, 5a, 5b) is a movable body.
- Apparatus according to one of the preceding claims, **characterized in that** the body (5, 5a, 5b) is separated from the moving electrode (3) and the further electrode (4).
- Apparatus according to one of the preceding claims, **characterized in that** the body (5a, 5b) is also a contact or an electrode, through which current can flow.
- Apparatus according to one of the claims 1 to 4, **characterized in that** the body (5b) is a part of a contact or an electrode (4).
- Apparatus according to one of the preceding claims,

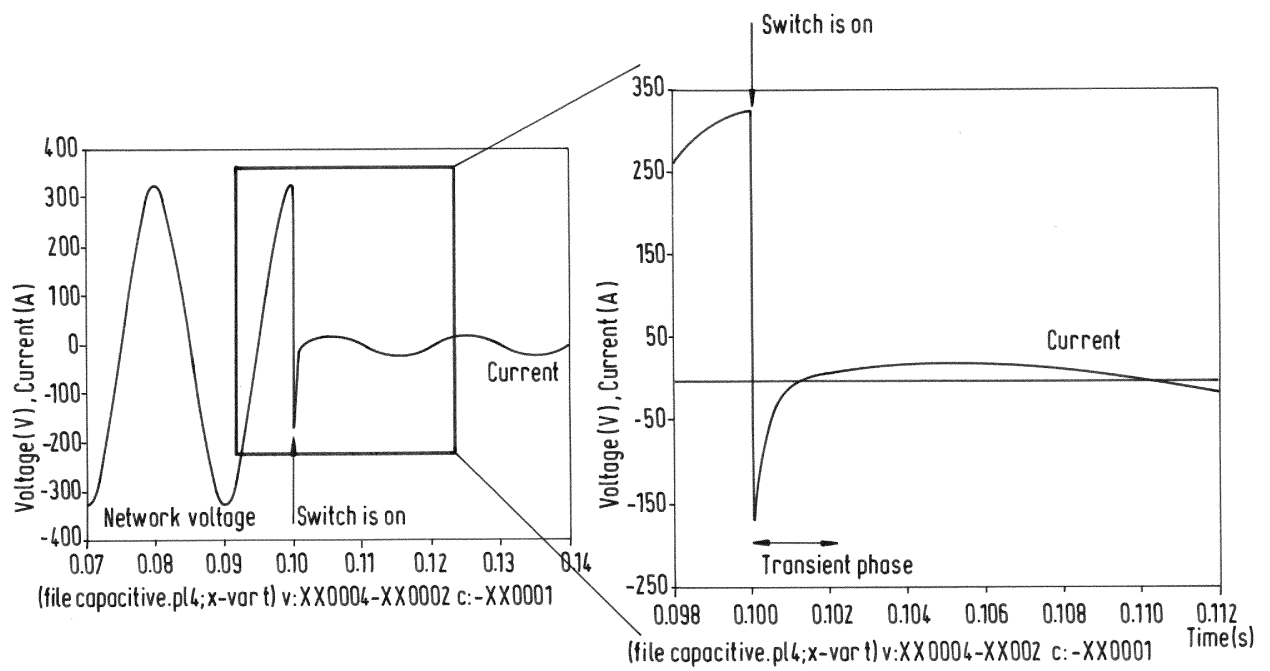


Fig.1

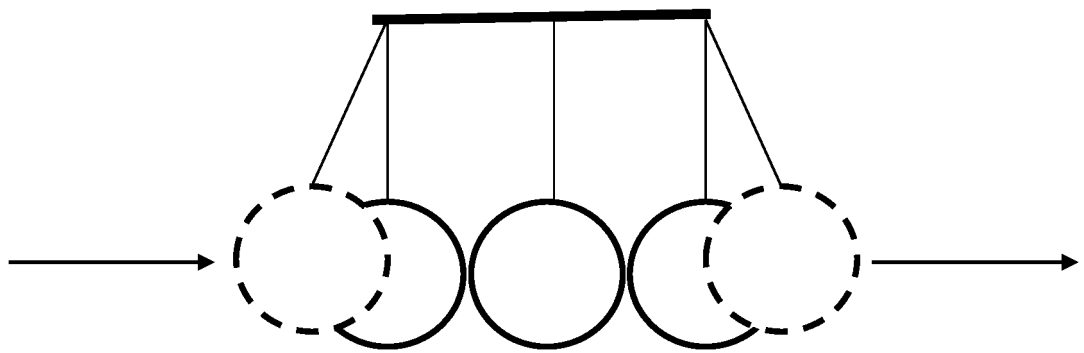


Fig. 2

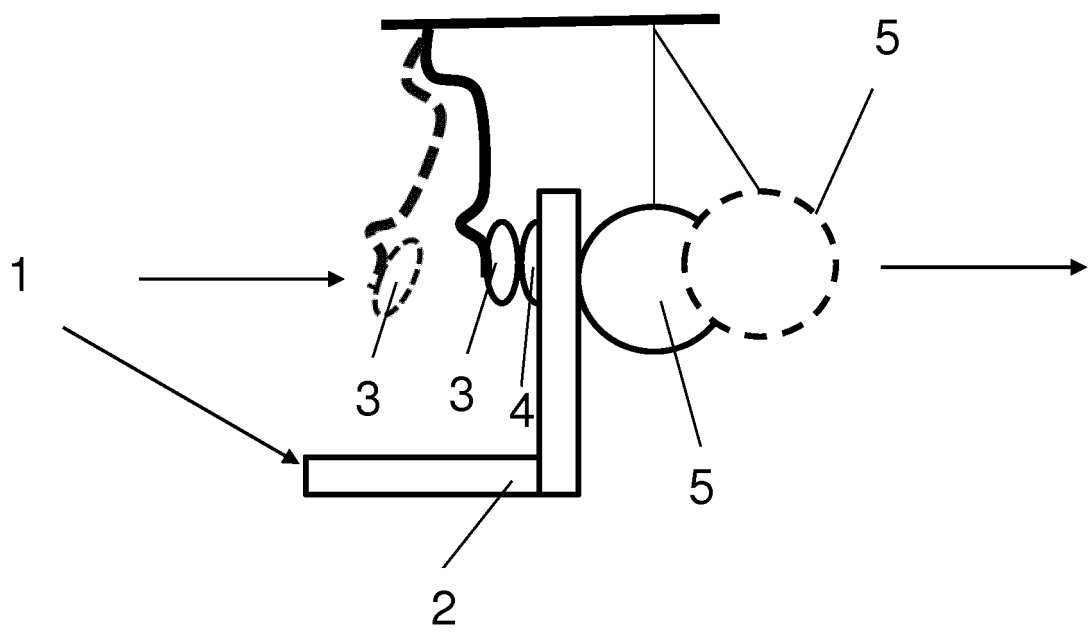


Fig. 3

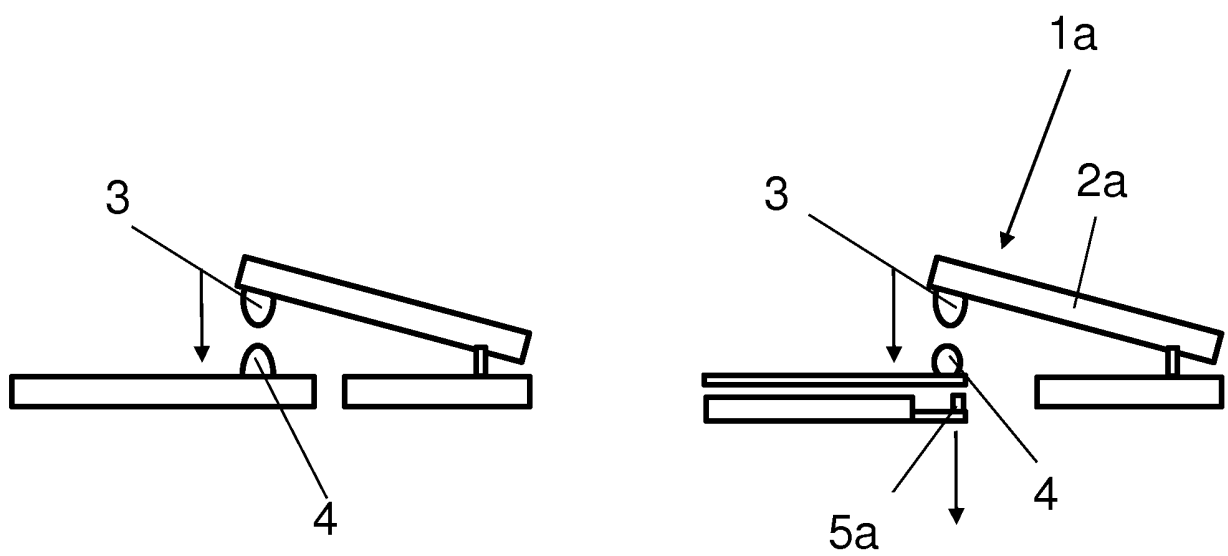


Fig. 4

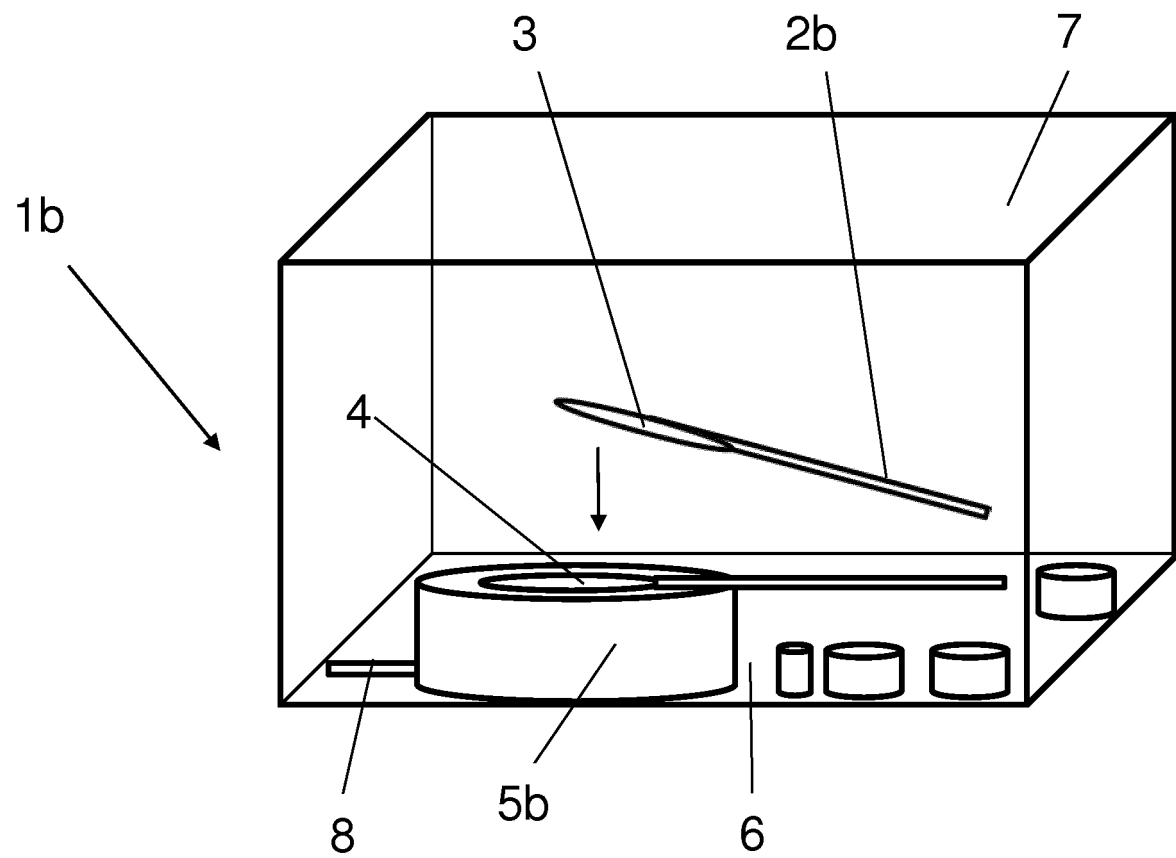


Fig. 5

Application Number
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X	US 2 743 330 A (LOUIS LUDWIG) 24 April 1956 (1956-04-24)	1-4,7-9	INV. H01H1/22 H01H3/60
Y	* column 2, line 16 - column 3, line 8; figures *	5,6	
X	----- EP 0 560 696 A1 (MERLIN GERIN [FR]) 15 September 1993 (1993-09-15)	1,2,9	
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The present search report has been drawn up for all claims			
Place of search	Date of completion of the search		Examiner
Munich	4 December 2018		Findeli, Luc
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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