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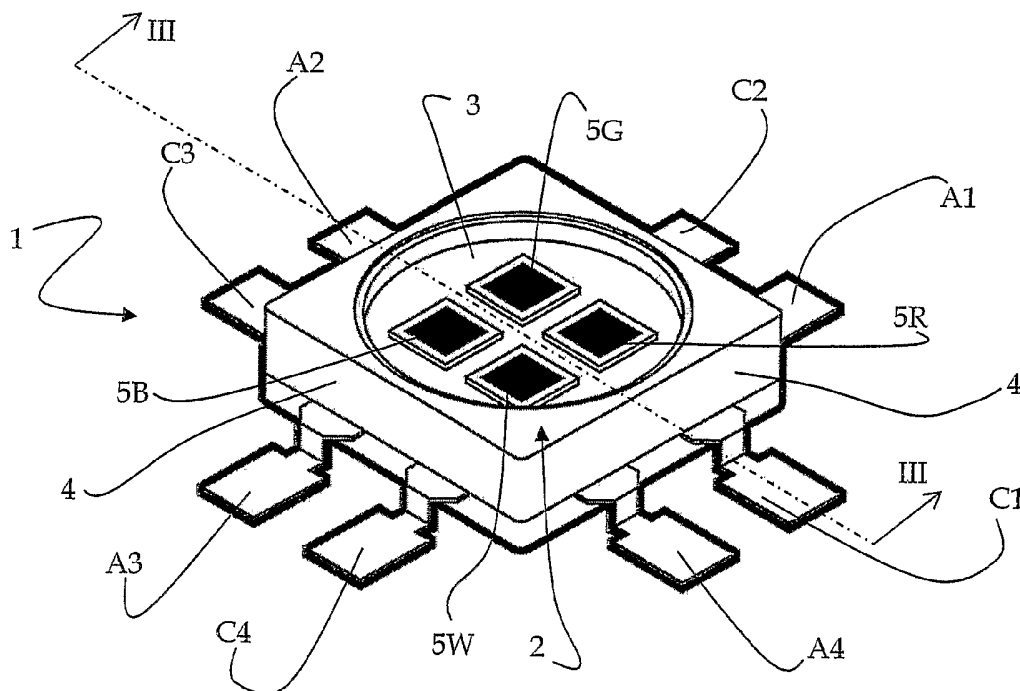
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(54) Title: LED DEVICE COMPRISING A PLURALITY OF LED DIODES



(57) Abstract: A LED (Light Emitting Diode) device is described, being of a type comprising: a structure (2) having abase (3, 3') and side walls (4); a light source comprising a plurality of LED diodes (5R, 5G, 5B, 5W). The invention is characterized in that said plurality of LED diodes (5R, 5G, 5B, 5W) comprises four LED diodes (5R, 5G, 5B, 5W) positioned on said base (3, 3') according to a matrix pattern.

LED DEVICE COMPRISING A PLURALITY OF LED DIODES

DESCRIPTION

The present invention relates to a LED device according to the preamble of claim 1.

Various LED (Light Emitting Diode) devices are known in the art which comprise a light source consisting of a single LED diode which allows to generate a white or coloured light beam; said LED devices are fitted with a rather simple optical system, usually consisting of a hemispherical lens, which allows to modify the light beam emission angle.

Light projectors are also known which generally utilize a plurality of LED devices, each having a single LED diode; in order to match the light beam generated by said plurality of LED devices, it is necessary to use a second optical system which allows to obtain a homogeneous light beam. Besides, the use of a plurality of LED devices each having a single LED diode requires that the mixing of the light beams emitted by said devices, which may also have different colours, takes place outside the LED device; since the structure of every LED device compels to position each LED diode at a great distance from the LED diode of another LED device, the mixing of the different light beams turns out to be complex and poorly effective.

Light projectors are also known which employ LED devices comprising a plurality of LED diodes having different colours; furthermore, the techniques known in the art also include the possibility of combining the three primary colours most commonly used, i.e. red, blue and green, so as to provide a plurality of colours depending on the mixing of said primary colours. The US Patent Application No. US 2003/0076034 describes a LED device comprising a plurality of LED diodes, in particular red, green and blue LED diodes, which emit a red, green and blue light beam, respectively; the light beams emitted by the red, green and blue LED diodes are combined in various manners in order to generate a wide range of colours which can be perceptible by the human eye. According to the above-mentioned Patent Application, the LED diodes are positioned on the base of the LED device in such a way as to be aligned horizontally.

Such a LED device has several drawbacks in that, in order to allow for the mixing of the light beams emitted by the LED diodes, it is necessary to use a collimator, in particular being rectangular in shape, which concentrates the light emitted by every single LED diode into a single light beam.

Another problem of the LED device according to the above-mentioned US Patent Application

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lies in the fact that, the LED diodes being aligned, such a positioning of the LED diodes does not allow to obtain a uniform distribution of the light beams emitted by the LED diodes, so that the user perceives the various light sources, consisting of every single LED diode, instead of a homogeneous light beam.

A further problem of such a LED device lies in the fact that the colour variations, or colour corrections, allowed by the red, green and blue LED diodes are not continuous, so that it is not possible to obtain small modifications with said corrections.

In this frame, the main object of the present invention is to provide a LED device comprising a plurality of LED diodes, constructed in such a way as to provide a homogeneous light beam. A further object of the present invention is to provide a LED device comprising a plurality of LED diodes wherein the different punctiform sources represented by the plurality of LED diodes, adapted to generate the light beam, are not perceptible by a user.

A further object of the present invention is to provide a LED device comprising a plurality of LED diodes which gives the possibility of obtaining a light beam having different simultaneous colours being continuously adjustable.

In order to achieve these objects, the present invention provides a LED device incorporating the features of the annexed claims, which form an integral part of the present description.

Further objects, features and advantages of the present invention will become apparent from the following detailed description and annexed drawings, which are supplied by way of non-limiting example, wherein:

Fig. 1 shows a perspective view of a LED device incorporating the features of the present invention;

Fig. 2 shows a top view of a LED device incorporating the features of the present invention;

Figs. 3a and 3b show two sectional side views, according to the line III - III of Fig. 1, of a first and a second embodiments of a LED device incorporating the features of the present invention.

As to the description of the drawings, Fig. 1 shows a LED device 1 incorporating the features of the present invention and comprising a structure 2 having a base 3, side walls 4 and a light source comprising a plurality of LED diodes 5R, 5G, 5B, 5W.

According to a preferred embodiment of the present invention, said plurality of LED diodes consists of high-power LED diodes 5R, 5G, 5B, 5W, in particular having a power of at least

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1W.

In accordance with the present invention, said plurality of LED diodes comprises four LED diodes 5R, 5G, 5B, 5W positioned on said base 3 according to a matrix pattern.

As shown in Fig. 2, too, which represents a top view of a LED device incorporating the features of the present invention, said four LED diodes 5R, 5G, 5B, 5W are positioned on the base 3 in such a way as to cover an area being substantially square.

Moreover, each of said LED diodes 5R, 5G, 5B, 5W is positioned at a close distance D from the remaining LED diodes of said plurality; in particular, the distance D which separates each of the four LED diodes from the adjoining LED diodes (e.g. the LED diode 5R from the LED diodes 5G and 5W) is in a range between 0.1 and 1 mm.

Such a matrix arrangement of the LED diodes 5R, 5G, 5B, 5W allows to provide for the light beam emitted by each of said LED diodes 5R, 5G, 5B, 5W, to match in an optimum way thereby allowing the LED device 1 to emit a homogeneous light beam.

In accordance with the present invention, the four LED diodes 5R, 5G, 5B, 5W have each a different basic colour; in particular, the four LED diodes 5R, 5G, 5B, 5W comprise a LED diode 5R emitting a Red light beam, a LED diode 5G emitting a Green light beam, a LED diode 5B emitting a Blue light beam, and a LED diode 5W emitting a light beam having a different basic colour. In particular, the LED diode 5W emitting a light beam having a different basic colour is a LED diode which emits a White or Amber light beam.

Each of said LED diodes 5R, 5G, 5B, 5W is respectively connected to an anode A1, A2, A3, A4 and to a cathode C1, C2, C3, C4, which get in contact with respective tracks of a printed circuit (not shown in the drawings since being of a known type) whereon the LED device 1 is positioned.

In particular, the LED diode 5R is connected to the anode A1 and the cathode C1; the LED diode 5G is connected to the anode A2 and the cathode C2; the LED diode 5B is connected to the anode A3 and the cathode C3, and finally the LED diode 5W is connected to the anode A4 and the cathode C4.

The fact that each of said LED diodes 5R, 5G, 5B, 5W is provided with its own anode and cathode advantageously allows to control said LED diodes 5R, 5G, 5B, 5W individually.

Thanks to the fact that the LED device 1 comprises LED diodes being Red (5R), Green (5G) and Blue (5B) in colour with the addition of LED diodes (5W) being White or Amber in colour, and that said LED diodes 5R, 5G, 5B, 5W are controlled individually, the LED device

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1 is capable of emitting a light beam covering the entire range of colours which can be perceptible by the human eye, including pure white.

Furthermore, the White or Amber LED diode 5W allows to further vary (i.e. adjust) said range of colours emitted by the LED device 1 being the subject of the present invention.

A further possibility offered by the combination of the three above-mentioned primary colours, with the addition of the White or Amber LED diode 5W, consists in the availability of one or more colour temperature corrections, allowing to eliminate certain colour temperature gradations before the resulting light beam exits the LED device 1. This allows to obtain light beams having different colour temperatures and suitable for different applications: outdoor lighting, indoor lighting, and so on.

As detailed in Fig. 3a, which shows a sectional side view of the LED device 1 according to the line III – III of Fig. 1, the LED diodes 5R, 5G, 5B, 5W are positioned on the base 3, which preferably consists of a plate made of a metallic material, in particular copper or aluminium. The height of said base 3 is substantially equal to approximately half the height of the walls 4 of the structure 2; the base 3 may then be positioned directly in contact with the printed circuit on which the LED device 1 is located, or else it may be positioned on a heat sink (not shown in the illustrations) suitable for preventing the heat produced by the LED diodes 5R, 5G, 5B, 5W from increasing the temperature within the structure 2 to levels which may damage the LED device 1.

The light produced by the LED diodes 5R, 5G, 5B, 5W creates a light beam which exits the LED device 1 through a lens 6, which is located at an open end portion 7 of the structure 2.

The shape of the section of the light beam may be modified by using various types of lenses 6, e.g. flat lenses, convex lenses, the type of lenses known as “frost”, etc., so that the light beam may be adapted to any specific application of the LED device 1. The lens 6 may also be shaped in such a way as to provide the utmost concentration of the light emitted by every single LED diode 5R, 5G, 5B, 5W in order to obtain a substantially parallel light beam.

The advantages of the present invention are apparent from the above description.

In particular, the matrix arrangement of the LED diodes according to the present invention allows to match the light beams emitted by each of said LED diodes and to obtain a homogeneous light beam; furthermore, the fact that each LED diode is positioned at a very short distance from the adjoining LED diodes, arranged according to a matrix pattern, allows to obtain a LED device being so constructed as to prevent a user from perceiving the different

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punctiform sources represented by the LED diodes generating the light beam.

Another advantage of the present invention is the fact that the LED device may generate light beams having different colour shades, thanks to the differentiation of colours and to the lighting independence of the different LED diodes which make up the light source.

Moreover, the simultaneous use of LED diodes having a basic colour being different from that of the LED diodes of the three primary colours (Red, Blue and Green), in particular being White or Amber in colour, on the one hand makes the calibration of the desired final colour simpler, and on the other hand allows to obtain light beams having a colour temperature being different from that generated by said LED diodes of the three primary colours, thereby making the LED device adapted to many different applications, e.g. for both outdoor and indoor lighting.

It can be easily understood that the present invention is not limited to the LED device described above in all its various components, but may be subject to many modifications, improvements or replacements of equivalent parts and elements without departing from the inventive idea, as clearly specified in the following claims.

Among the many possible modifications, the LED device provided with a base 3' as shown in Fig. 3b; as clearly visible in this drawing, the height of the base 3' is substantially equal to the height of the side walls 4 of the structure 2 of the LED device 1. This allows to position the LED diodes 5R, 5G, 5B, 5W at such a height that the light they emit does not hit an inner surface 2I of the structure 2 and that the various light beams generated by the LED diodes 5R, 5G, 5B, 5W are not reflected by said inner surface 2I, thus avoiding any disturbance to the light beam generated by the LED device 1.

Finally, the present invention also relates to a light projector comprising at least one LED device 1 incorporating one or more of the above-described features.

* * * * *

CLAIMS

1. LED (Light Emitting Diode) device, of a type comprising:
 - a structure (2) having a base (3, 3') and side walls (4);
 - a light source comprising a plurality of LED diodes (5R, 5G, 5B, 5W);characterized in that said plurality of LED diodes (5R, 5G, 5B, 5W) comprises four LED diodes (5R, 5G, 5B, 5W) positioned on said base (3, 3') according to a matrix pattern.
2. LED device (1) according to claim 1, characterized in that said four LED diodes (5R, 5G, 5B, 5W) are positioned on said base (3, 3') in such a way as to cover an area being substantially square.
3. LED device (1) according to one or more previous claims, characterized in that each of said four LED diodes (5R, 5G, 5B, 5W) is positioned at a predetermined distance (D) from the adjoining LED diodes (5R, 5G, 5B, 5W).
4. LED device (1) according to the previous claim, characterized in that said distance (D) is in the range between 0.1 and 1 mm.
5. LED device (1) according to claim 1, characterized in that each of said four LED diodes (5R, 5G, 5B, 5W) has a different basic colour.
6. LED device (1) according to the previous claim, characterized in that said four LED diodes (5R, 5G, 5B, 5W) comprise a LED diode (5R) emitting a Red light beam, a LED diode (5G) emitting a Green light beam, a LED diode (5B) emitting a Blue light beam, and a LED diode (5W) emitting a light beam having a basic colour being different from Red, Green or Blue.
7. LED device (1) according to the previous claim, characterized in that said LED diode (5W) emitting a light beam having a different basic colour is a LED diode (5W) emitting a White light beam.
8. LED device (1) according to claim 6, characterized in that said LED diode (5W) emitting a light beam having a different basic colour is a LED diode (5W) emitting an Amber light beam.
9. LED device (1) according to claim 1, characterized in that each of said four LED diodes (5R, 5G, 5B, 5W) is respectively connected to an anode (A1, A2, A3, A4) and to a cathode (C1, C2, C3, C4), which get in contact with respective tracks of a printed circuit whereon said LED (1) device is positioned.
10. LED device (1) according to claim 1, characterized in that said four LED diodes (5R, 5G, 5B, 5W) are high-power LED diodes, in particular having a power of at least 1 W.

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11. LED device (1) according to claim 1, characterized in that said base (3, 3') consists of a plate made of a metallic material, in particular copper or aluminium.
12. LED device (1) according to claim 1, characterized in that the height of said base (3) is substantially equal to half the height of the side walls (4) of the LED device (1).
13. LED device (1) according to claim 1, characterized in that the height of said base (3') is substantially equal to the height of the side walls (4) of said LED device (1).
14. LED device (1) according to one or more previous claims from 11 to 13, characterized in that said base (3) is positioned on a heat sink adapted to prevent the temperature within said structure (2) from increasing to levels which may damage said LED device (1).
15. LED device (1) according to claim 1, characterized in that at an open end portion (7) of said structure (2) a lens (6) is positioned being shaped in order to concentrate the light emitted by each LED diode (5R, 5G, 5B, 5W) in order to provide a substantially parallel light beam.
16. Light projector characterized in that it comprises at least one LED device (1) according to one or more previous claims.
17. LED device (1) and light projector comprising at least one LED device (1) according to the innovative teachings of the present description and of the annexed drawings, which represent a preferred embodiment of the claimed invention.

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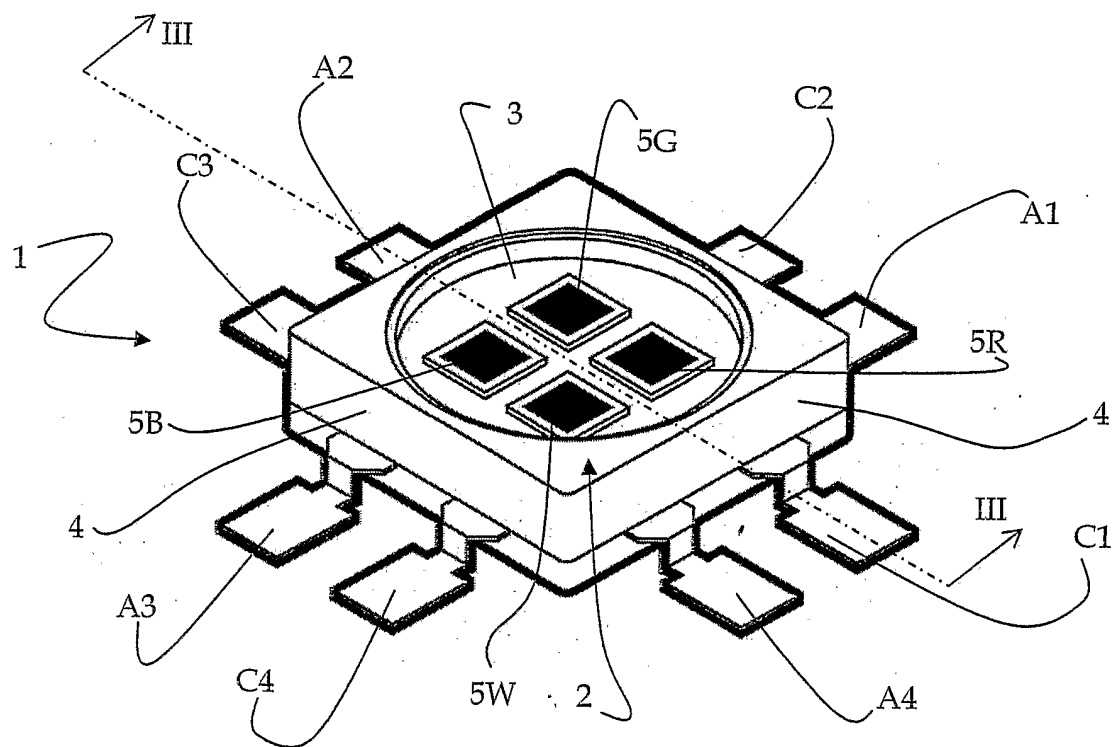


Fig.1

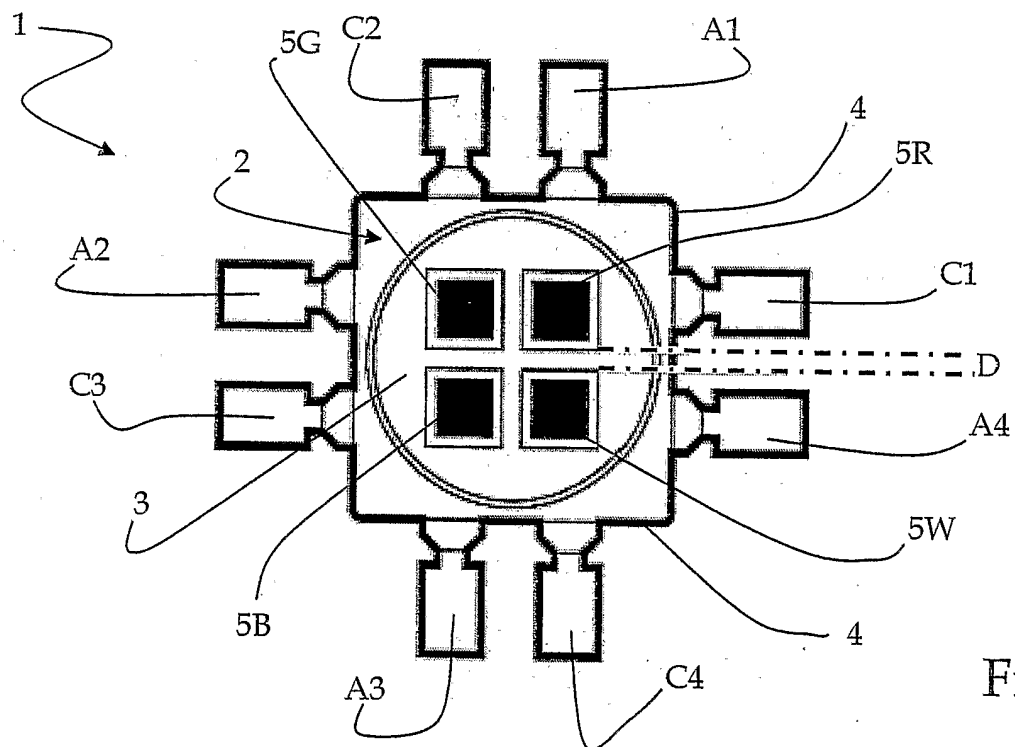


Fig.2

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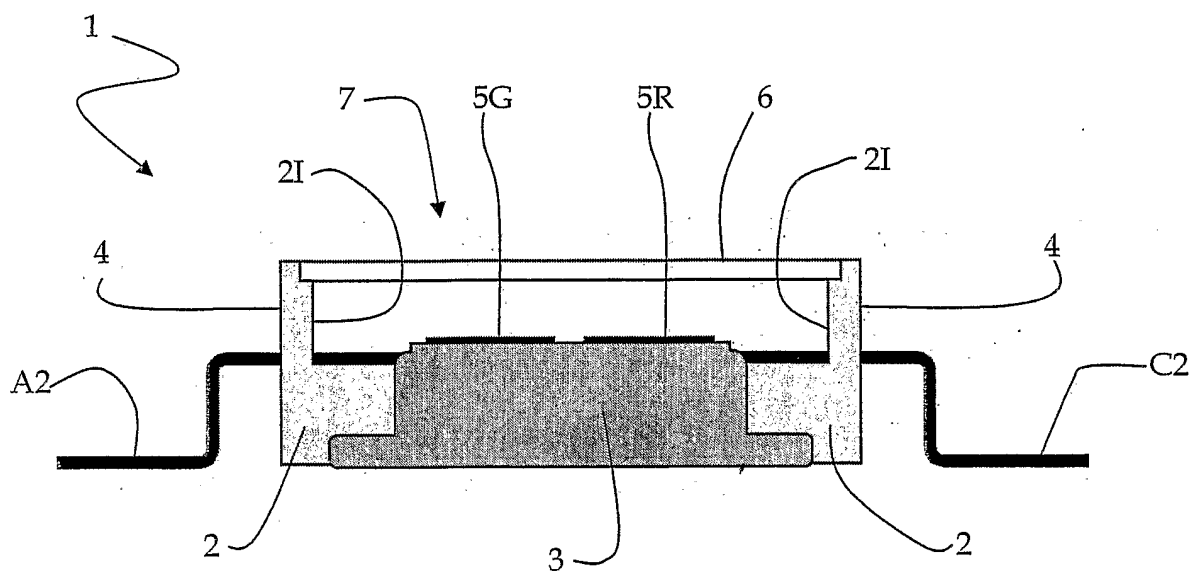


Fig.3a

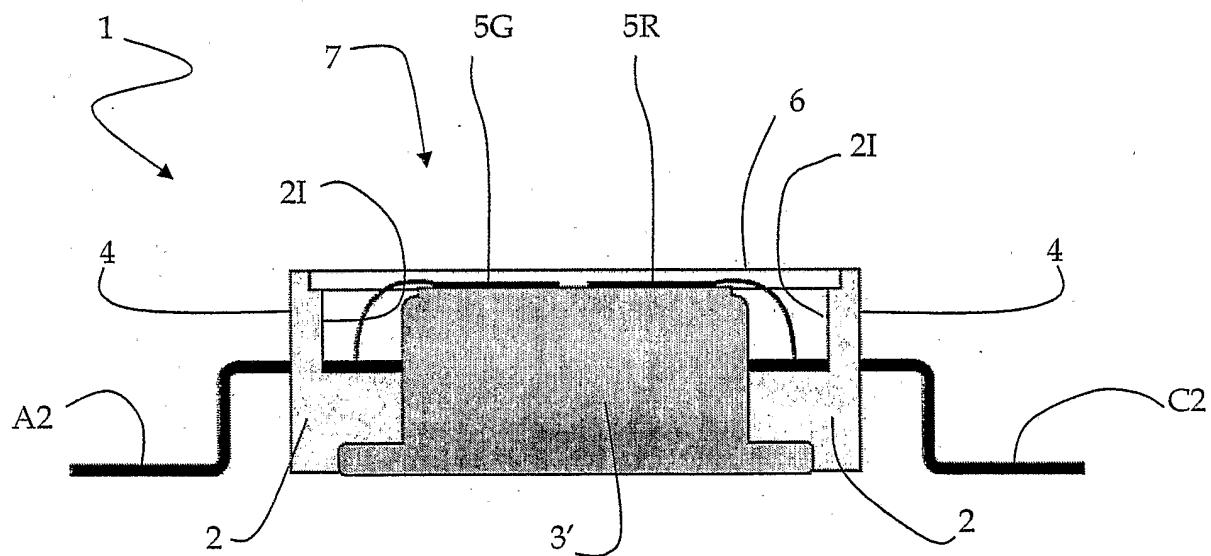


Fig.3b