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(54) **LED BULB**

(57) The present invention relates to the field of lighting, and particularly to a retrofit LED bulb (10). The LED bulb (10) comprises a burner (11), an elastic component (12), and a center ring (13). The burner (11) comprises a first pin (1131). The center ring (13) comprises a central opening (130), a first flat rim (1311), and a first notch (1321). The burner (11) is inserted through the central opening (130) on assembly of the LED bulb (10). The first flat rim (1311) extends along a first part of an outer edge of the central opening (130). The first notch (1321) is cut-out beyond the central opening (130) at an end of the first flat rim (1311), and allows the first pin (1131) of the burner (11) to pass through on insertion of the burner (11). The elastic component (12) is configured to press the first flat rim (1311) of the center ring (13) against the first pin (1131) of the burner (11) after assembly of the LED bulb (10), so that an unintentional rotation between the burner (11) and the center ring (13) is inhibited.

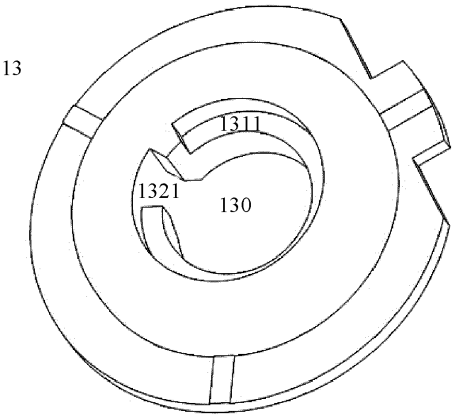

Fig. 3

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to the field of lighting, and particularly to a retrofit LED bulb.

BACKGROUND OF THE INVENTION

[0002] Bulbs, including halogen bulbs and LED bulbs, are widely used in various lighting scenarios, for example in automotive lighting and in indoor lighting. Due to an omni-directional light emission of halogen, the halogen bulbs can be installed in any direction within the whole lighting module or system, for example within an automotive headlight, and all help to output the same beam pattern.

[0003] However, things will be changed if the halogen bulbs are replaced by the LED bulbs, because typically light emitting elements, *i.e.,* LEDs, of the LED bulbs are only emitting light across half of the 3D space, for example merely side-emitting. In this case, at least two LEDs are usually required in a conventional LED bulb, located respectively at two opposite sides of the LED bulb's body, helping to get a similar output of light emission as that of the halogen bulbs. In a case that two LEDs are comprised in a conventional LED bulb, stepped rims comprising discrete steps are often required on the center ring of the LED bulb to obtain an excellent omni-directional beam output as that of the halogen bulbs, wherein pins on the burner of the LED bulb are configured to rest into valleys between adjacent steps for the assembly of the LED bulb. In this case, only a limited number of angle positions can be reached if the burner is rotated with respect to the center ring of the LED bulb, rendering it to be extremely inconvenient for an end user to install the LED bulb in an optimal rotational position.

[0004] Thus, there is a need in the art to provide a retrofit LED bulb, so as to ensure that the end user can adjust the installing angle of the LED bulb according to the specific requirements of applications or just based on what the end user desires, while still having a perfect light beam output as that of the halogen bulbs and also a nice mechanical resistance for field applications.

SUMMARY OF THE INVENTION

[0005] The present invention provides a retrofit LED bulb, so as to eliminate or at least alleviate one or more of the above mentioned disadvantages.

[0006] According to an embodiment of the present invention, a retrofit LED bulb is proposed, for use for example in an automotive vehicle. The LED bulb comprises a burner, an elastic component, and a center ring. The burner comprises a first pin. The center ring comprises a central opening, a first flat rim, and a first notch. In particular, in the above proposed LED bulb, the burner is inserted through the central opening on assembly of the LED bulb, and the first flat rim of the center ring extends along a first part of an outer edge of the central opening. Besides, the first notch of the center ring is cut-out beyond the central opening at an end of the first flat rim, and allows the first pin of the burner to pass through on insertion of the burner. The elastic component, preferably an O-ring or springs made for example by elastic materials, is configured to press the first flat rim of the center ring against the first pin of the burner after assembly of the LED bulb, such that an unintentional rotation between the burner and the center ring is inhibited.

[0007] In the LED bulb provided by the present invention, the center ring is provided with a flat rim which has a notch at an end thereof. This flat rim replaces the stepped rim of the center ring in a conventional LED bulb. Thus, in the LED bulb according to the present invention, there will be no need to provide the pin of the burner (which is about to be pressed against the flat rim of the center ring) with any special curves that were otherwise matched with the valleys between adjacent steps of the stepped rim of the center ring in the conventional LED bulb. This is beneficial for the easy and cost-effective manufacture of the pin and also of the burner in the LED bulb. Further, after introducing a flat rim in the center ring of the above proposed LED bulb, a continuous angle rotation can be achieved between the burner and the center ring, wherein the burner and the center ring are able to be kept at any of continuous angle positions relative to each other. This is easy to operate by an end user as what he desires. By contrast, by using a conventional LED bulb with a stepped rim of the center ring, comprising for example three valleys between adjacent steps, only a limited number of, especially three, discrete angle positions can be reached for the burner with respect to the center ring. Therefore, according to the present invention, a great flexibility can be provided for the end user in installing the LED bulb on a specific automotive vehicle according to the practical requirements, because the relative angle position between the burner and the center ring of the LED bulb is no longer restricted only to those limited ones determined by the valleys between adjacent steps of the center ring's stepped rim in the conventional LED bulb.

[0008] According to an optional embodiment of the present invention, in the above proposed LED bulb, the first pin comprises a first flat surface, which is configured to be in contact with the first flat rim on assembly of the LED bulb. In this case, once the LED bulb gets assembled, the contact interface between the first pin and the first flat rim is flat, thus being advantageous to the durable use of the pin (thus of the burner) and also of the flat rim (thus of the center ring). Besides, a perfect fitting with a higher accuracy or a nearly zero tolerance is much easier to be obtained between the first flat surface of the first pin and the first flat rim, as compared to that between two curved surfaces. This, on one hand, renders installation and rotation of the burner and the center ring in the LED bulb to be more accurate, and on the other hand,

helps to increase the vibration resistance of the burner and the center ring in the LED bulb. Further, due to the flat contact interface between the first pin and the first flat rim as well, the pressure applied by the elastic component on the first flat rim of the center ring against the first pin of the burner is ensured to be large enough, such that the center ring is fixed firmly against the burner, thus providing the LED bulb with a high mechanical stability. Preferably, according to an optional embodiment of the present invention, the first pin of the burner in the above proposed LED bulb is shaped into a cuboid, which is easy and cost-effective to manufacture.

[0009] According to an optional embodiment of the present invention, in the above proposed LED bulb, the burner comprises a second pin, and accordingly the center ring comprises a second flat rim and a second notch. To be specific, the second flat rim extends along a second part of the outer edge of the central opening, while the second notch is cut-out beyond the central opening at an end of the second flat rim and allows the second pin of the burner to pass through on insertion of the burner. In this case, the elastic component is further configured to press the second flat rim of the center ring against the second pin of the burner after assembly of the LED bulb, so that the unintentional rotation between the burner and the center ring is further inhibited.

[0010] As similar to the first pin on the burner and the first flat rim on the center ring, in the LED bulb according to the above mentioned embodiment of the present invention, a second pair of components being pressed against each other, *i.e.,* the second pin and the second flat rim, is introduced, such that the center ring and the burner are pressed against each other strong enough so as to inhibit further the unintentional rotation therebetween. Apparently, the pressing force can be for example doubled by incorporating the additional, second pin and second flat rim, rendering the LED bulb obtained thereby to be stable in mechanics and also in electrics.

[0011] In a similar way as the first pin above, according to an embodiment of the proposed LED bulb, the second pin of the burner can be provided with a second flat surface as well, which second flat surface is in contact with the second flat rim of the center ring on assembly of the LED bulb. Preferably, the second pin is also designed in the shape of a cuboid, for an easy and cost-effective manufacture.

[0012] According to an optional embodiment of the present invention, in the above proposed LED bulb, the burner comprises a first portion for example in shape of a plate and a second portion for example in shape of a cylinder. To be specific, the first portion of the burner comprises a first side and a second side opposite to the first side, wherein each of the first side and the second side is provided with at least one LED. For example, the first side is be provided with at least one first LED, while the second side is provided with at least one second LED. In this case, as an optional instance, the first pin and the second pin can be located on the second portion of the burner, more preferably right opposite to each other. As described above, the second notch of the center ring is configured to allow the second pin of the burner to pass therethrough, and the first notch is in a similar configuration. Thus, if the two pins, *i.e.,* the first pin and the second pin, are positioned right opposite to each other on the second portion of the burner, the two notches, *i.e.,* the first notch and the second notch, will be necessarily located opposite to each other on the center ring. This results in that both of the first flat rim and the second flat rim extend between the first notch and the second notch on the center ring, but along two different parts of the outer edge of the center opening. For example, the outer edge of the center opening comprises two half parts, both extending between the first notch and the second notch, wherein the first flat rim extends along one half part and the second flat rim extends along the other half part.

[0013] According to an optional embodiment of the present invention, in the above proposed LED bulb, the burner comprises a third pin, and accordingly the center ring comprises a third flat rim and a third notch. To be specific, the third flat rim extends along a third part of the outer edge of the central opening, while the third notch is cut-out beyond the central opening at an end of the third flat rim and allows the third pin of the burner to pass through on insertion of the burner. In this way, the elastic component is configured further to press the third flat rim of the center ring against the third pin of the burner after assembly of the LED bulb, so that the unintentional rotation between the burner and the center ring is further inhibited.

[0014] Similar to the above description with regard to the first and second pins of the burner and the first and second flat rims of the center ring, engagement between the burner and the center ring can be enhanced furthermore by introducing a third pair of components being pressed against each other, *i.e.,* the third pin of the burner and the third flat rim of the center ring, which helps to obtain a LED bulb with an even higher stability in mechanics and also electrics.

[0015] In a similar way, according to an embodiment of the proposed LED bulb, the third pin of the burner can be provided with a third flat surface as well, which third flat surface is in contact with the third flat rim of the center ring on assembly of the LED bulb. Preferably, the third pin is also designed in the shape of a cuboid, thus being beneficial for easy manufacture too.

[0016] According to an optional embodiment of the present invention, in the above proposed LED bulb, the first pin, the second pin, and the third pin are uniformly spaced on the second portion of the burner. As described above, the third notch of the center ring is configured to allow the third pin of the burner to pass through, and the first and second notches are in similar configurations as well. Thus, if the three pins, *i.e.,* the first pin, the second pin, and the third pins, are positioned with an equal distance on the second portion of the burner, the three notches, *i.e.,* the first notch, the second notch, and the

third notch, will be located at three uniformly spaced positions respectively along the outer edge of the center opening of the center ring. For example, in the center ring of the LED bulb, the outer edge of the center opening is divided into three equal parts, *i.e.,* the first part, the second part, and the third part, by the three notches, *i.e.,* the first notch, the second notch and the third notch, wherein the first flat rim extends along the first part between the first notch and the second notch, the second flat rim extends along the second part between the second notch and the third notch, while the third flat rim extends along the third part between the third notch and the first notch.

[0017] According to an optional embodiment of the present invention, in the above proposed LED bulb, the center ring is manufactured by injection molding using one of the following materials: Polyphenylene Sulfide (PPS), Polyvinyl Toluene (PVT), Polyamide 6, 6 (PA66), Polyamide 4, 6 (PA46), Liquid Crystal Polymer (LCP), Polyether Ether Ketone (PEEK), and Polyphthalamide (PPA). Apparently, these materials and the processing method as listed above are merely provided to illustrate, rather than limit the present invention, and those skilled in the art shall easily obtain other equivalents after having benefited from the teaching of the present invention.

[0018] According to an optional embodiment of the present invention, in the above proposed LED bulb, the first flat surface of the first pin, and a surface of the first flat rim contacting the first flat surface of the first pin on assembly of the LED bulb, are made of a first material with a first frictional resistance high enough to resist an unintentional sliding along each other. Similarly, according to another optional embodiment of the LED bulb proposed by the present invention, the second flat surface of the second pin, and a surface of the second flat rim contacting the second flat surface of the second pin on assembly of the LED bulb, are made of a second material with a second frictional resistance high enough to resist an unintentional sliding along each other. Still, as yet another optional embodiment, in the above proposed LED bulb of the present invention, the third flat surface of the third pin, and a surface of the third flat rim contacting the third flat surface of the third pin on assembly of the LED bulb, are made of a third material with a third frictional resistance high enough to resist an unintentional sliding along each other. Preferably, at least one of the first material, the second material, and the third material is Polyphenylene Sulfide (PPS). In this way, any unintentional sliding of the three pins along the respective flat rims can be inhibited by the high frictional resistance therebetween.

[0019] It will be appreciated by those skilled in the art that two or more of the above disclosed embodiments, implementations and/or aspects of the present invention may be combined in any way deemed useful. Different modifications and variations of the front-lighting system for a vehicle can be carried out by a person skilled in the art based on the disclosure of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] These and other aspects of the present invention will be described in the following in more details, with reference to the appended drawings showing embodiments and forming a part of the present invention. In the drawings:

Fig. 1 schematically illustrates an LED bulb, after assembly, according to an embodiment of the present invention;

Fig. 2 schematically illustrates a burner and an elastic O-ring of an LED bulb according to an embodiment of the present invention, where the burner is shaped to have a first portion in shape of a plate and a second portion in shape of a cylinder, where a first pin is provided on the second portion of the burner;

Fig. 3 schematically illustrates a center ring to be used together with the burner and the elastic O-ring in Fig. 2 for assembly of an LED bulb according to an embodiment of the present invention, where a first flat rim with a first notch at an end is provided on the center ring;

Fig. 4 schematically illustrates a burner and an elastic O-ring of a conventional LED bulb, for the purpose of comparison with that shown in Fig. 2;

Fig. 5 schematically illustrates a center ring to be used together with the burner and the elastic O-ring in Fig. 4 for assembly of a conventional LED bulb, for the purpose of comparison with that shown in Fig. 3;

Fig. 6 schematically illustrates a burner and an elastic O-ring of an LED bulb according to another embodiment of the present invention, where two pins are provided oppositely on the second portion of the burner;

Fig. 7 schematically illustrates a center ring to be used together with the burner and the elastic O-ring in Fig. 6 for assembly of an LED bulb according to another embodiment of the present invention, where two flat rims separated by two notches are provided on the center ring;

Fig. 8 schematically illustrates a burner and an elastic O-ring of an LED bulb according to another embodiment of the present invention, where three pins are provided with an equal distance on the second portion of the burner; and

Fig. 9 schematically illustrates a center ring to be used together with the burner and the elastic O-ring in Fig. 8 for assembly of an LED bulb according to another embodiment of the present invention, where three flat rims separated by three notches are provided on the center ring.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0021] While the present invention is susceptible of embodiments in many different forms, there is shown in

the drawings and will be described in detail herein only one or more specific embodiments, with the understanding that the present description is only considered as exemplary of the basic principle of the present invention but not intended to limit the present invention merely to the specific embodiments shown and described herein.

[0022] It should be noted that various components in different figures are not drawn to scale. Besides, relative positions between individual elements shown in the figures are only used to illustrate the basic principle of the present invention and should not be considered to limit the scope of the present invention.

[0023] With reference to Fig. 1, a LED bulb is proposed for use for example in an automotive vehicle, wherein the LED bulb 10 comprises a burner 11, an elastic component 12 (for example, an O-ring 120, see the following Fig. 2), and a center ring 13. As shown by Fig. 1, in the assembled LED bulb 10, the elastic component 12 and the center ring 13 are both inserted through by the burner 11. To be specific, when assembling the LED bulb 10, a user may insert the left part of the burner 11 firstly through the elastic component 12 and then through the center ring 13, thus giving the assembled LED bulb 10 like that in Fig. 1. Besides, the burner 11 of the LED bulb 10 comprises two portions, a first portion 111 and a second portion 112. For example, as shown in Fig. 1, in the LED bulb 10, the first portion 111 of the burner 11 can be shaped in a plate, and the second portion 112 of the burner 11 can be shaped in a cylinder, wherein the first portion 111 and the second portion 112 are contiguous to each other at for example a right side of the first portion 111 and a left side of the second portion 112. Furthermore, in the LED bulb 10 of Fig. 1, the first portion 111 of the burner 11 comprises a first side 1111 and a second side 1112, especially the upper and lower sides in Fig. 1, on which first side 1111 at least one first LED 11110 can be provided and on which second side 1112 at least one second LED 11120 can be provided. Apparently, the number of first LEDs 11110 and/or second LEDs 11120 is shown to be two in Fig. 1 just for the sake of clarity. A skilled person in the art shall easily understand that any suitable number of first LEDs 11110 and/or second LEDs 11120 can be provided on the first side 1111 and/or second side 1112 of the burner 10, and the present invention shall get all these alternatives encompassed within the protection scope thereof.

[0024] For a better understanding of different constituent parts of the LED bulb, the following Fig. 2 and Fig. 3 are both referred to, wherein Fig. 2 shows the burner and the elastic O-ring of the LED bulb in Fig. 1, *i.e.,* a half-assembled LED bulb, while Fig. 3 shows the corresponding center ring of the LED bulb in Fig. 1.

[0025] As similar to the above description about Fig. 1, in the LED bulb 10 of Fig. 2 (which is half-assembled and comprises only the burner 11 and the O-ring 120), the burner 11 has been inserted through the elastic O-ring 120. Besides, as seen in Fig. 2 as well, the burner 11 comprises a first portion 111 in shape of a plate and a second portion 112 in shape of a cylinder, wherein the first portion 111 comprises a first side 1111 (specifically, the lower side in the drawing) provided with two first LEDs 11110 and a second side 1112 (specifically, the upper side in the drawing) provided with two second LEDs 11120. Preferably, as shown in Fig. 2, the first pin 1131 of the burner 11 can be shaped into a cuboid, *i.e.,* comprising at least flat side faces.

[0026] In the following description, insertion of the burner through the center ring, especially the center opening of the center ring, will be explained in detail with reference to Fig. 3, where the center ring is shown structurally in a perspective view. As shown in Fig. 3, the center ring 13 comprises a center opening 130 and a first notch 1321, which first notch 1321 is cut-out beyond the center opening 130 at a certain point along an outer edge of the center opening 130. Besides, in the center ring 13 of the LED bulb, as shown by Fig. 3, there is also a first flat rim 1311, which is extending partly along the outer edge of the center opening 130, specifically along a first part of the outer edge (for example, along most of the outer edge in the drawing), and the first notch 1321 is located at one end of the first flat rim 1311 (for example, the starting end in the drawing). In this case, if the half-assembled LED bulb like that in Fig. 2, comprising already the burner 11 and the elastic O-ring 120, is assembled further with the center ring 13 in Fig. 3, the first pin 1131 on the second portion 112 of the burner 11 will pass through the first notch 1321 of the center ring 13 first, and then get pressed against the first flat rim 1311 (especially, the upper face thereof) by the elastic O-ring 120 after for example a slight rotation of the center ring 13 with respect to the burner 11.

[0027] As described above, the first pin 1131 can be shaped into a cuboid, and comprises preferably a flat side face. Thus, the contacting interface between the first pin 1131 and the first flat rim 1311, which are pressed against each other by the O-ring 120 after assembly of the LED bulb 10, will be flat as well, rendering the further rotation of the first pin 1131 (thus of the burner 11) along the first flat rim 1311 (thus along the center ring 13) to be continuous and stable. This helps to obtain not only a continuous relative rotation between the burner 11 and the center ring 13, but also a reliable mechanical performance of the LED bulb 10 as assembled, thus being well distinguished from a conventional LED bulb, for example the one comprising a conventional burner 41 and O-ring 42 of Fig. 4, and a conventional center ring 53 of Fig. 5.

[0028] For comparison with the retrofit LED bulb 10 proposed by the present invention, the conventional burner 41 and O-ring 42 of a conventional LED bulb is shown in Fig. 4, while the corresponding center ring 53 is shown in Fig. 5. As can be seen in Fig. 5, the conventional center ring 53 comprises a stepped rim 531 instead of a flat one, where several distinct steps 5310 (such as three) are separated by the respective one of the valleys therebetween. In this case, the corresponding pin 413 on the conventional burner 41 shall be shaped to have

at least a curved or round side face, which is going to be pressed against the respective valley between adjacent steps 5310 of the stepped rim 531 in the conventional center ring 53, so that the burner 41 and the center ring 53 are fixed firmly by means of the O-ring 42.

[0029] As seen obviously in Fig. 4 and Fig. 5, the conventional round pin 413 can be only pressed against the respective valley between adjacent steps 5310 of the stepped rim 531 in the conventional center ring 53. In this case, if the user rotates the burner 41 with respect to the center ring 53 to change the installing angle of the conventional LED bulb, only three positions can be reached, each corresponding to a valley with the round pin 413 rest thereon. Thus, only a limited number of distinct orientations can be obtained, *i.e.,* there is no way to rotate the conventional burner 41 continuously with respect to the conventional center ring 53 having a stepped rim 531, which brings about a lot of inconvenience for practical applications. Besides, as shown in Fig. 4 and Fig. 5 as well, a side face of the conventional round pin 413 is curved or round, so as to fit and get contact with the respective recessed valley between adjacent steps 5310 of the stepped rim 531 after assembly of the conventional LED bulb. This not only goes against the easy and cost-effective manufacture of the pin 413 and thus of the burner 41, but also results in a severe wear of the pin 413 and the respective stepped rim 531. Furthermore, the curved or round interface between the pin 413 and the stepped rim 531 in the conventional LED bulb also tends to show a poor vibration resistance, because a clearance appears easily between two curved or round surfaces touching each other, leading to an easy loose after vibration. All these disadvantages can be eliminated perfectly or at least alleviated by the retrofit LED bulb proposed by the present invention, wherein a flat rim is introduced on the center ring to replace the conventional stepped one, and furthermore, a pin having a flat side face to be in contact with the flat rim of the center ring is used on the burner.

[0030] With reference to Fig. 6 and Fig. 7, the LED bulb according to another embodiment of the present invention is described, wherein Fig. 6 shows the burner and the O-ring of the LED bulb, while Fig. 7 shows the corresponding center ring. As shown in Fig. 6, the burner 11 has inserted through the elastic O-ring 120 to obtain a half-assembled LED bulb. Like the burner 11 of Fig. 2, the burner 11 of Fig. 6 comprises also a first portion 111 with a first side 1111 and a second side 1112, and a second portion 112 provided with a first pin 1131, wherein the first side 1111 of the first portion 111 is provided with two first LEDs 11110 and the second side 1112 of the first portion 111 is provided with two second LEDs 11120. The difference is that now in Fig. 6, there is another second pin 1132 opposite to the first pin 1131 on the second portion 112 of the burner 11. In this case, the respective center ring 13 of the LED bulb may comprise a center opening 130, a first flat rim 1311, a second flat rim 1312 opposite to the first flat rim 1311, a first notch 1321, and a second notch 1322 opposite to the first notch 1321. When the half-assembled LED comprising the burner 11 and the O-ring 120 of Fig. 6 is inserted through the center opening 130 of the center ring 13 shown in Fig. 7, the first pin 1131 and the second pin 1132 are passing through the first notch 1321 and the second notch 1322 respectively, and after a slight rotation of the burner 11 with relative to the center ring 13 for example, the two pins 1131, 1132 will rest on the respective first and second flat rims 1311, 1312. In this case, under the pressure of elastic O-ring 120, the first pin 1131 and the second pin 1132, preferably both shaped into a cuboid having a flat side face, will be kept firmly against the respective first and second flat rims 1311, 1312, rendering the final assembled LED bulb to be compact and stable.

[0031] In the above embodiment of the present invention, a second pair of components, *i.e.,* the second pin 1132 and the second flat rim 1312, is introduced further onto the LED bulb, which enables the elastic O-ring 120 to apply a larger (for example, a doubled) pressure of the burner 11 against the center ring 13, helping to provide the final assembled LED bulb with a more stable performance in mechanics and also electrics, in addition to the continuous angle rotation between the burner 11 and the center ring 13 described above. Besides, according to an example instance of the above embodiment, in the proposed LED bulb, the first and second sides 1111, 1112 of the plate-shaped first portion 111 of the burner 11 are both provided with LEDs, which renders an omnidirectional emission of light to be possible, thus being beneficial for practical applications.

[0032] With continued reference to Fig. 8 and Fig. 9, the LED bulb according to still another embodiment of the present invention is illustrated, wherein Fig. 8 shows the burner and the O-ring of the LED bulb, while Fig. 9 shows the respective center ring. As shown in Fig. 8, the burner 11 has inserted through the elastic O-ring 120 to obtain a half-assembled LED. Like the burner 11 of Fig. 6, the burner 11 in Fig. 8 comprises a first portion 111, and a second portion 112 having a first pin 1131 and a second pin 1132 provided thereon. Besides, as similar to Fig. 6, the first side 1111 and the second side 1112 of the burner 11 can be provided with LEDs as well, which is not illustrated herein for the sake of clarity. The difference is that now in Fig. 8, there is also a third pin 1133 of the burner 11. Preferably, the first pin 1131, the second pin 1132, and the third pin 1133 can be positioned at an equal distance on the second portion 112 of the burner 11. In this case, the respective center ring 13 may comprise a center opening 130, a first flat rim 1311, a second flat rim 1312, a third flat rim 1313, a first notch 1321, a second notch 1322, and a third notch 1323. When the half-assembled LED comprising the burner 11 and the O-ring 120 of Fig. 8 is inserted further through the center opening 130 of the center ring 13 shown in Fig. 9, the first pin 1131, the second pin 1132, and the third pin 1133 will pass through the first notch 1321, the second notch 1322, and the third notch 1323 respectively. Again, for

example, after a slight rotation of the burner 11 with relative to the center ring 13, the three pins 1131, 1132, 1133 will rest on the respective first, second and third flat rims 1311, 1312, 1313 of the center ring 13. In the end, under the pressure of O-ring 120, the first pin 1131, the second pin 1132, and the third pin 1133, preferably all shaped into a cuboid having a flat top face, are all kept firmly against the respective first, second and third flat rims 1311, 1312, 1313, helping to provide a firm fixation between the burner 11 and the center ring 13.

[0033] As explained above, in the above proposed LED bulb, a further third pair of components, *i.e.,* the third pin 1133 and the third flat rim 1313, is incorporated, which renders the elastic O-ring 120 to be capable of applying an even larger (for example, triple) pressure of the burner 11 against the center ring 13. Again, not only the continuous angle rotation between the burner 11 and the center ring 13 can be achieved like the description above but also the assembled LED bulb can be provided with a more stable performance in mechanics and electrics. Besides, as stated above, according to an example embodiment, in the proposed LED bulb, the first and second sides 1111, 1112 of the first portion 111 of the burner 11 are all provided with LEDs, helping to give an omni-directional emission of light output, thus being beneficial for practical applications. Preferably, LEDs can be disposed uniformly on the respective side of the first portion of the burner.

[0034] According to an example embodiment of the present invention, in the above proposed LED bulb, the center ring can be made by injection molding using one of the following materials: Polyphenylene Sulfide (PPS), Polyvinyl Toluene (PVT), Polyamide 6, 6 (PA66), Polyamide 4, 6 (PA46), Liquid Crystal Polymer (LCP), Polyether Ether Ketone (PEEK), and Polyphthalamide (PPA). Apparently, those skilled in the art shall easily understand that all the above materials are merely listed as possible candidates for manufacturing the center ring, but never going to be read as any restriction to the present invention, and other suitable materials, such as metal or plastic, can be used as well. A similar reasoning applies to the manufacture process, i.e., injection molding, as well, because a skilled person in the art shall appreciate that other suitable processes, such as die casting and stamping, can be also used according to the present invention.

[0035] According to another example embodiment of the present invention, in the above proposed LED bulb, the contacting interface between the first pin of the burner and the first flat rim of the center ring is made of a special material, preferably, Polyphenylene Sulfide (PPS), having such a high frictional resistance that an unintentional sliding along each other is well resisted. Things can be the same for the contacting interface between the second/third pin and the second/third flat rim. In this way, once assembled, the constitute components, such as the burner and the center ring, can be well fixed with respect to each other, helping to provide the final assembled LED bulb with a higher stability in mechanics and further electrics.

[0036] It should be noted that for the sake of clarity, all the above description about a LED bulb is merely focused on the mechanical components in structure, and little or nothing is ever talked about the electrical parts of the LED bulb. However, this shall be never read as any limitation to the present invention. As a matter of fact, having benefitted from the present invention, a skilled person in the art shall easily understand that apart from those mechanical parts as described above, the proposed LED bulb comprises all the necessary electrical components as well, such as PCB(s), electrical wires, driving circuits for LEDs, etc., and all these alternatives shall be covered within the protection scope of the present invention.

[0037] It should also be noted that the above-mentioned embodiments illustrate rather than limit the present invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope and spirit of the present invention. Although the present invention has been described in connection with some embodiments, it is not intended to be limited to the specific forms as set forth herein. Rather, the scope of the present invention is limited only by the accompanying claims. Additionally, although a feature may appear to be described in connection with particular embodiments, those skilled in the art would recognize that various features of the described embodiments may be combined in accordance with the present invention.

[0038] Furthermore, although individual features may be included in different claims, these may possibly be advantageously combined, and the inclusion in different claims does not imply that a combination of features is not feasible and/or advantageous. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claims. Use of the verb "comprise" and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. The article "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. Also, references to first, second etc. are merely to be considered as labels and do not imply or describe any ordering, sequence, relation or properties of the features prefixed by these terms. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

LIST OF REFERENCE NUMERALS

[0039]

10	LED bulb
11	burner
111	first portion of burner
1111	first side of first portion
11110	first LED
1112	second side of first portion
11120	second LED

112	second portion of burner
1131	first pin
1132	second pin
1133	third pin
12	elastic component
120	O-ring
13	center ring
130	center opening
1311	first flat rim
1312	second flat rim
1313	third flat rim
1321	first notch
1322	second notch
1323	third notch
41	conventional burner
413	conventional pin
42	conventional O-ring
53	conventional center ring
531	conventional stepped rim
5310	step of conventional stepped rim

Claims

1. An LED bulb (10), comprising a burner (11), an elastic component (12), and a center ring (13), wherein
the burner (11) comprises a first pin (1131),
the center ring (13) comprises a central opening (130), a first flat rim (1311), and a first notch (1321), wherein the burner (11) is inserted through the central opening (130) on assembly of the LED bulb (10), the first flat rim (1311) extends along a first part of an outer edge of the central opening (130), and the first notch (1321) is cut-out beyond the central opening (130) at an end of the first flat rim (1311) and allows the first pin (1131) of the burner (11) to pass through on insertion of the burner (11), and
the elastic component (12) is configured to press the first flat rim (1311) of the center ring (13) against the first pin (1131) of the burner (11) after assembly of the LED bulb (10), such that an unintentional rotation between the burner (11) and the center ring (13) is inhibited.

2. The LED bulb (10) according to claim 1, wherein
the first pin (1131) comprises a first flat surface contacting the first flat rim (1311) on assembly of the LED bulb (10).

3. The LED bulb (10) according to claim 2, wherein
the burner (11) further comprises a second pin (1132),
the center ring (13) further comprises a second flat rim (1312) and a second notch (1322), wherein the second flat rim (1312) extends along a second part of the outer edge of the central opening (130), and the second notch (1322) is cut-out beyond the central opening (130) at an end of the second flat rim (1312) and allows the second pin (1132) of the burner (11) to pass through on insertion of the burner (11), and
the elastic component (12) is further configured to press the second flat rim (1312) of the center ring (13) against the second pin (1132) of the burner (11) after assembly of the LED bulb (10), such that the unintentional rotation between the burner (11) and the center ring (13) is further inhibited.

4. The LED bulb (10) according to claim 3, wherein
the second pin (1132) comprises a second flat surface contacting the second flat rim (1312) on assembly of the LED bulb (10).

5. The LED bulb (10) according to claim 4, wherein
the burner (11) comprises a first portion (111) in shape of a plate and a second portion (112) in shape of a cylinder, wherein
the first portion (111) comprises a first side (1111) provided with at least one first LED (11110), and a second side (1112) opposite to the first side (1111) and provided with at least one second LED (11120),
the first pin (1131) is positioned opposite to the second pin (1132) on the second portion (112) , and
the second notch (1322) is positioned opposite to the first notch (1321).

6. The LED bulb (10) according to claim 5, wherein
the burner (10) further comprises a third pin (1133),
the center ring (13) further comprises a third flat rim (1313) and a third notch (1323), wherein the third flat rim (1313) extends along a third part of the outer edge of the central opening (130), and the third notch (1323) is cut-out beyond the central opening (130) at an end of the third flat rim (1313) and allows the third pin (1133) of the burner (11) to pass through on insertion of the burner (11), and
the elastic component (12) is further configured to press the third flat rim (1313) of the center ring (13) against the third pin (1133) of the burner (11) after assembly of the LED bulb (10), such that the unintentional rotation between the burner (11) and the center ring (13) is further inhibited.

7. The LED bulb (10) according to claim 6, wherein
the third pin (1133) comprises a third flat surface contacting the third flat rim (1313) on assembly of the LED bulb (10).

8. The LED bulb (10) according to claim 7, wherein
the first pin (1131), the second pin (1132), and the third pin (1133) are uniformly spaced on the second portion (112) of the burner (11).

9. The LED bulb (10) according to claim 7, wherein
at least one of the first pin (1131), the second pin (1132), and the third pin (1133) is designed in shape of a cuboid.

10. The LED bulb (10) according to any one of claims 1-9, wherein
the center ring (13) is manufactured by injection molding using one of: Polyphenylene Sulfide (PPS), Polyvinyl Toluene (PVT), Polyamide 6, 6 (PA66), Polyamide 4, 6 (PA46), Liquid Crystal Polymer (LCP), Polyether Ether Ketone (PEEK), and Polyphthalamide (PPA).

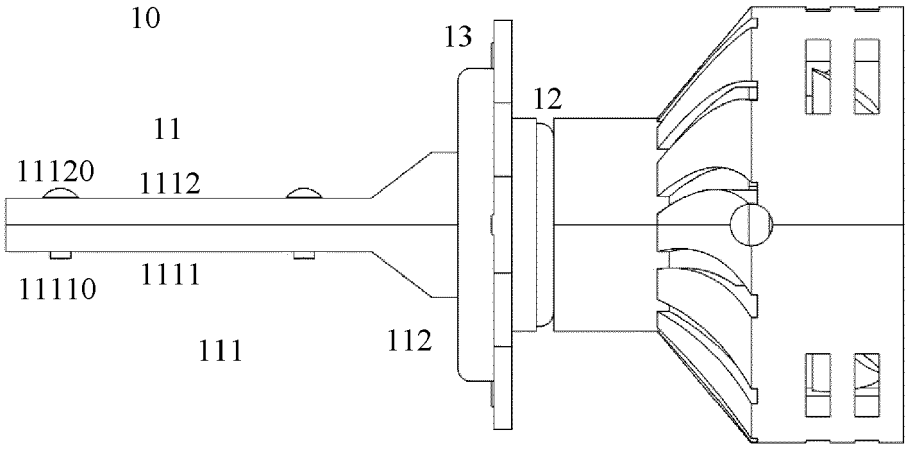
11. The LED bulb (10) according to any one of claims 7-9, wherein
the first flat surface of the first pin (1131), and a surface of the first flat rim (1311) contacting the first flat surface of the first pin (1131) on assembly of the LED bulb (10), are made of a first material with a first frictional resistance high enough to resist an unintentional sliding along each other.

12. The LED bulb (10) according to claim 11, wherein
the second flat surface of the second pin (1132), and a surface of the second flat rim (1312) contacting the second flat surface of the second pin (1132) on assembly of the LED bulb (10), are made of a second material with a second frictional resistance high enough to resist an unintentional sliding along each other.

13. The LED bulb (10) according to claim 12, wherein
the third flat surface of the third pin (1133), and a surface of the third flat rim (1313) contacting the third flat surface of the third pin (1133) on assembly of the LED bulb (10), are made of a third material with a third frictional resistance high enough to resist an unintentional sliding along each other.

14. The LED bulb (10) according to claim 13, wherein
at least one of the first material, the second material, and the third material is Polyphenylene Sulfide (PPS).

15. The LED (10) bulb according to any one of claims 1-9, wherein
the elastic component (12) comprises an O-ring (120) or a spring.


10
13
12
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11120
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112

Fig. 1

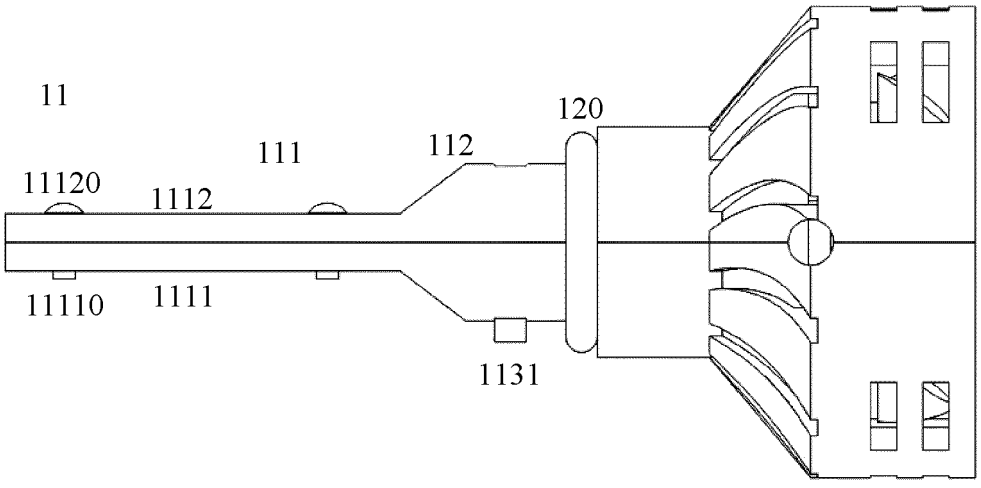
11
120
111
112
11120
1112
11110
1111
1131

Fig. 2

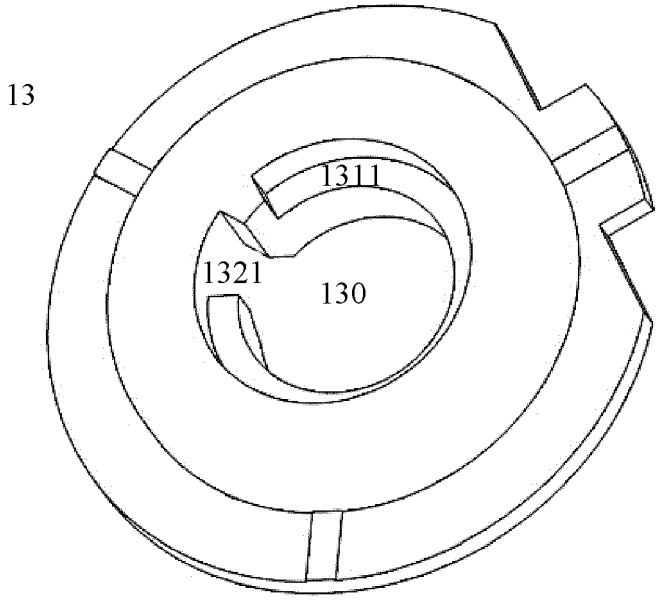

Fig. 3

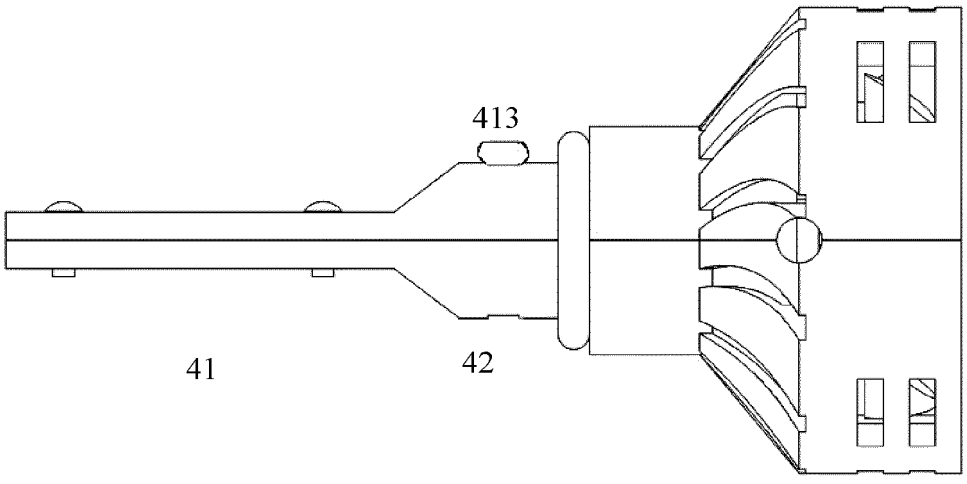

Fig. 4

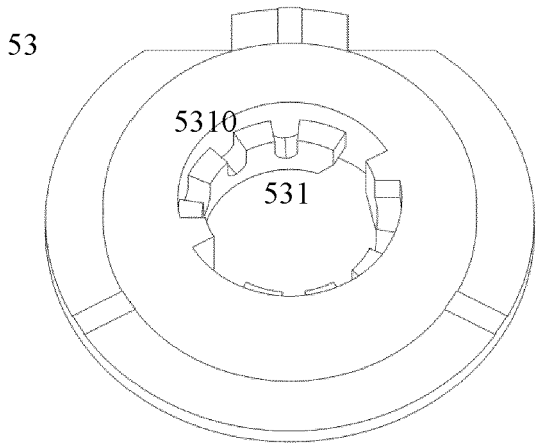

Fig. 5

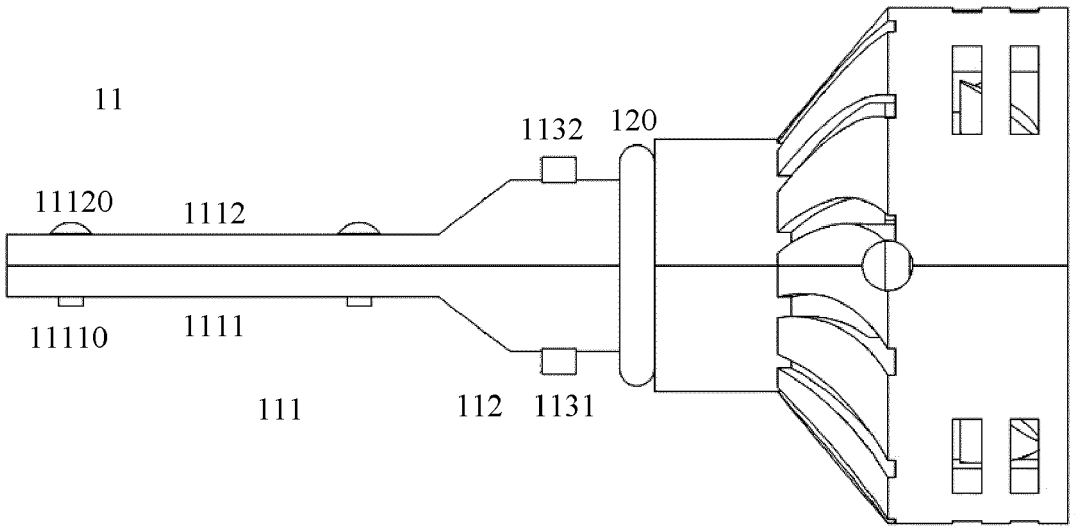

Fig. 6

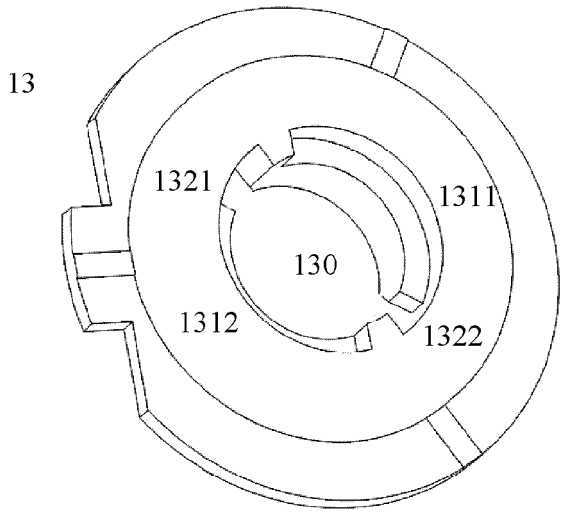

Fig. 7

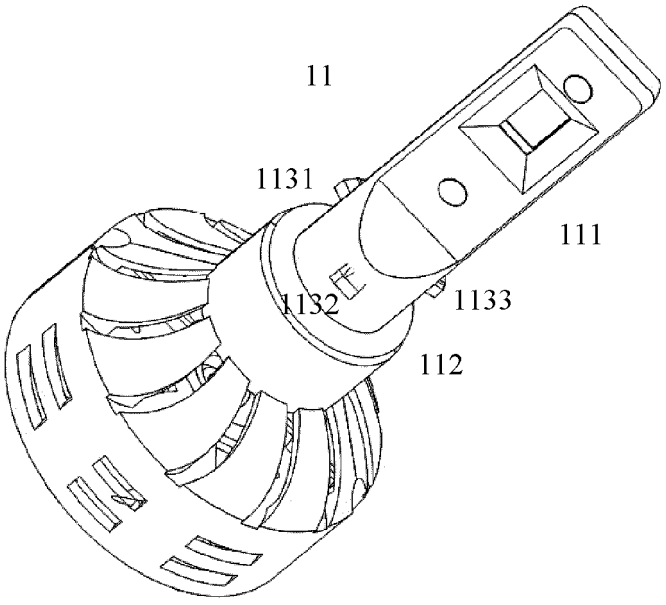

Fig. 8

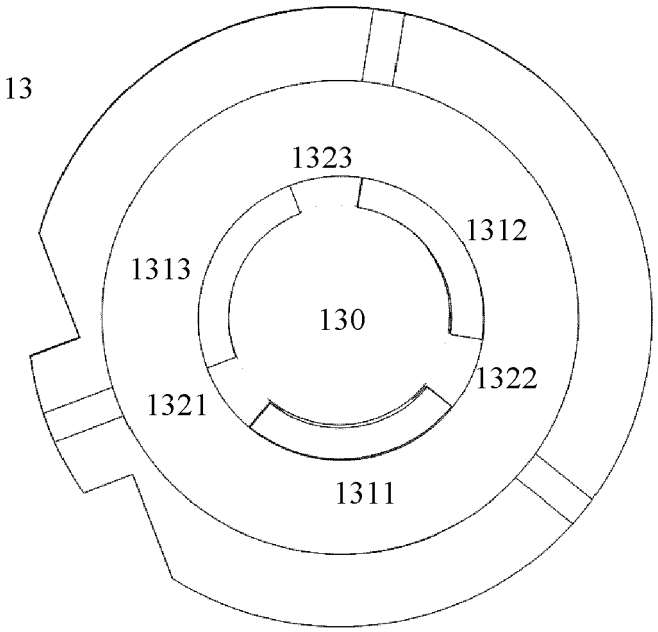

Fig. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 20 18 9843

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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	6 November 2020	Goltes, Matjaz

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EUROPEAN SEARCH REPORT

Application Number
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Place of search	Date of completion of the search	Examiner
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