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(54) FOCUSING MECHANISM FOR LED SPOTLIGHT

(57) A focusing mechanism for an LED spotlight comprises a lens assembly (1 to 3), a light source assembly (4, 5), lever connectors (6, 9) and a motor drive device (11, 13, 14) axially disposed in succession along a motor shaft. The motor drive device is connected to the lever connectors. The lever connectors have at least three connection parts (c) connected to one side of a light source casing and at least three fitting parts (b) connected to the lens assembly. The connection parts of the lever connectors are located in the same plane perpendicular to the axial direction and evenly disposed in the same plane, and the fitting parts are located in another plane perpendicular to the axial direction and evenly disposed in the other plane. By application of the lever principle, the focusing mechanism for the LED spotlight achieves fine and stable focusing of a high power LED spotlight and ensures the evenness of the light spot illuminated by the high power LED spotlight with low focusing error, great luminous efficacy and high brightness.

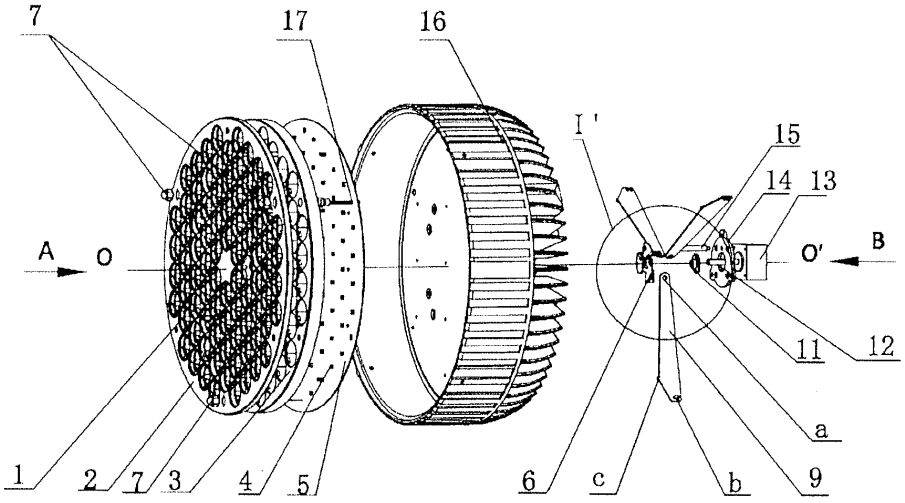

FIG. 1

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Description

Technical Field

[0001] The present invention relates to a focusing mechanism for a Light Emitting Diode (LED) spotlight, and more particularly to a focusing mechanism for an LED spotlight capable of realizing stable focusing, which belongs to the field of an illumination lamp for a stage or a film and television.

Related Art

[0002] Most of conventional stage spotlights are halogen tungsten lamps of a point light source type. A focusing mechanism for a common halogen tungsten lamp is formed by a lens, a light source and a reflective bowl, and is mostly of the following structure: the light source is mounted on a lamp holder, the reflective bowl is mounted at the rear of the lamp holder, the light source is located on a central axis of the reflective bowl; the lens and a bottom case are fixed with respect to each other; the lamp holder is mounted on the bottom case, in which the lamp holder moves backward or forward with the light source and the reflective bowl by adjusting a lead screw, so as to change a distance between the light source and reflective bowl and the lens to adjust a focal length of the spotlight; the light from the light source is reflected by the reflective bowl and refracted by the lens, and then is cast on the stage, and performance requirements are met by adjusting a diameter of a cast light spot.

[0003] However, since a large gap exists between a penetration hole of the lamp holder and a focusing screw and a slide bar during movement of the light source and the lamp holder, during focusing, a slide base plate suffers uneven stress and has a great idle motion in a moving process due to the rotation of the focusing screw, so that a light source assembly inclines and vibrates in the focusing process and a center of a bulb in the light source assembly is not precisely positioned, thereby affecting accuracy of the focusing. Therefore, the method is merely applicable to the focusing of the spotlight of a point light source type.

[0004] An LED is a semiconductor capable of converting electric energy into visible light, and has advantages such as a long service life, high luminous efficacy, no radiation and low power consumption, so an illumination lamp with the LED as a light source gradually becomes a future direction. Therefore, a spotlight with the LED as a light source will necessarily become an important lamp in stage lighting. Since a single LED has low power, merely 1 W-5 W, it is generally required to integrate multiple LEDs to manufacture the lamp, so as to improve the power and increase the brightness. Since a surface light source formed by multiple LEDs integrated on one surface has a large light source area, a light source assembly and a lens assembly must be stably moved during the focusing to maintain the focusing consistency of the luminous points and a small error, so that a focusing effect of the spotlight is not affected, thereby meeting operating requirements.

[0005] In Chinese patent No. ZL 200820233726.X of the applicant , disclosed is a zooming LED spotlight for a film and television or a stage with a focusing mechanism. A light source of the spotlight is an LED array module and is mounted on a fixed base, the fixed base is mounted on a light source support, and movement of the light source on a lead screw is adjusted by a slide base, the lead screw and an adjusting knob to implement the focusing. In the utility model, an aspheric lens and a Fresnel lens are used at the same time. Scattered light from the surface light source is focused by mounting the aspheric lens at a front side of the LED array module, and then is cast on the Fresnel lens in the front. A beam angle is changed by adjusting a relative distance between the light source assembly and the Fresnel lens, so as to implement light focusing and light scattering. In such a focusing mechanism, two lenses are used to implement the focusing consistency, so that the structure of the spotlight is complicated. In another aspect, the utility model is limited to a spotlight with the LED module as the light source and the power being below 200 W, and stable focusing still cannot be implemented for an LED spotlight with high power, so the focusing consistency of the LEDs cannot be achieved.

SUMMARY OF THE INVENTION

[0006] To solve the above technical problems, the present invention provides a focusing mechanism for an LED spotlight, which has a simple structure and can implement stable focusing of an LED spotlight with high power, so that desirable focusing consistency of luminous points and high brightness are achieved.

[0007] To achieve the above objectives of the invention, the present invention adopts the following technical solutions.

[0008] A focusing mechanism for an LED spotlight includes a light source casing, a light source assembly and a lens assembly that are located inside the light source casing, and a motor drive device located outside the light source casing and having a motor shaft.

[0009] The focusing mechanism for an LED spotlight further includes a lever connector located outside the light source casing.

[0010] The lens assembly, the light source assembly, the lever connector and the motor drive device are successively distributed in an axial direction of the motor shaft in the motor drive device. The motor drive device is connected to the lever connector. The lever connector has at least three connection portions connected to one side of the light source casing, and at least three fitting portions connected to the lens assembly. The connection portions of the lever connector are located on the same plane perpendicular to the axial direction and are evenly distributed on the plane. The fitting portions are located

on another plane perpendicular to the axial direction and are evenly distributed on the plane.

[0011] Preferably, the lever connector includes a lever connection plate and at least three levers in the same shape. The levers, with an axis as a center, are evenly distributed on and connected to the lever connection plate. The lever includes a first endpoint, a second endpoint and a fulcrum, where the first endpoint is connected to the lever connection plate, the second endpoint serves as the fitting portion and is connected to the lens assembly through a connection bar, and the fulcrum serves as the connection portion and is contacted with a surface of the light source casing.

[0012] In the focusing mechanism for an LED spotlight provided by the present invention, a guide post is used to limit rotation of a motor connection disk spirally connected to the motor shaft, so that the lever connection plate fixedly connected to the motor connection disk is driven to axially move during the focusing. The focal length of the lens is finely adjusted according to the two different distances on the lever, one distance from a stressed point to a fulcrum and the other distance from a stressing point to the same fulcrum. In the focusing mechanism for an LED spotlight, multiple levers are used to drive the lens assembly to axially move at the same time, so that the lens assembly moves more stably, thereby ensuring focusing consistency of a surface light source in the LED spotlight.

[0013] The present invention is applicable to a spotlight with multiple LEDs with low power integrated on the same plane, especially, a spotlight for a film and television or a stage with a large diameter of the surface light source and high power. The present invention has a simple structure and a low cost, solves the technical problem of inaccurate focusing for the LED spotlight with high power, implements stable focusing for the spotlight with LEDs integrated on the same plane, and ensures evenness of light spots cast by the LEDs, a low focusing error, desirable luminous efficacy and high brightness.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The present invention is described in further detail in the following with reference to the accompanying drawings and the specific embodiments.

[0015] FIG. 1 is a schematic exploded view of a focusing mechanism for an LED spotlight;

[0016] FIG. 2 is a view in an A direction of the focusing mechanism shown in FIG. 1;

[0017] FIG. 3 is an A-A cutaway view of the focusing mechanism shown in FIG. 1;

[0018] FIG. 4 is a partial enlarged view of the A-A cutaway view shown in FIG. 3;

[0019] FIG. 5 is a view in a B direction of the focusing mechanism shown in FIG. 1;

[0020] FIG. 6 is a partial enlarged view of I' shown in FIG. 1; and

[0021] FIG. 7 is a schematic enlarged view of a lever connection plate.

DETAILED DESCRIPTION OF THE INVENTION

[0022] As shown in FIG. 1, this embodiment provides a focusing mechanism for an LED spotlight, which includes a light source casing 16, a light source assembly and a lens assembly that are located inside the light source casing 16, and a motor drive device and a lever connector that are located outside the light source casing 16. The lens assembly, the light source assembly, the lever connector and the motor drive device are successively distributed in an axial direction of a motor shaft 12 in the motor drive device, that is, are successively arranged from left to right in an O-O' direction shown in FIG. 1. The motor drive device drives, through the lever connector relatively rotatablely connected to the motor drive device, the lens assembly to axially move with respect to the light source assembly.

[0023] As shown in FIG. 1 and FIG. 3, the light source assembly includes multiple LEDs 4 and an aluminum-base circuit board 5 welded with the multiple LEDs 4. The aluminum-base circuit board 5 is fastened in the light source casing 16. Three evenly distributed through holes are opened on the light source casing 16. It can be understood that, the present invention is not limited to the aluminum-base circuit board, and can adopt other circuit boards according to the use environment and the function requirements. The number in the embodiment is merely for exemplification, multiple through holes may be selected according to actual conditions, and the number is not limited to three.

[0024] Three connection posts 17 are fixedly disposed on the aluminum-base circuit board 5, and are evenly distributed on the circular aluminum-base circuit board 5 at the same radian (120 degrees). One end (a left end in FIG. 1) of the connection post 17 extends from a surface of the aluminum-base circuit board 5 towards a lens support 3, and the other end (a right end in FIG. 1) extends from the other surface of the aluminum-base circuit board 5 towards a lever 9. One end of the connection post 17 has a thread fit with a lock nut 7, and the other end has a hook portion for hooking the lever 9.

[0025] As shown in FIG. 1 to FIG. 3, the lens assembly includes lenses 1 corresponding to the multiple LEDs 4 in a one-to-one manner, a lens pressing plate 2 and a lens support 3. The lens support 3 has multiple grooves corresponding to the LEDs 4 and the lenses 1 in a one-to-one manner, and is opened with a via hole for the connection post 17 to pass through. Hole positions on the lens pressing plate 2 correspond to hole positions on the lens support, and correspond to the LEDs welded on the aluminum-base circuit board 5 in a one-to-one manner. The lenses 1 are fixed in the grooves of the lens support 3 with the lens pressing plate 2. The lens pressing plate 2 is fastened onto the lens support 3 with the lock nut 7, so that the lenses 1, the lens pressing plate 2 and the lens support 3 are integrated, so as to ensure that

each LED 4 corresponds to one lens 1. In this way, a light ray emitted by the LED 4 can be cast on a center of the lens 1 in a forward direction. In addition to the above lens assembly including three parts, the lens assembly may also be a lens module including two parts, which are a lens holder (equivalent to the lens pressing plate 2 and the lens support 3) and multiple lenses 1 distributed on the lens holder. The positions of the lenses 1 in the lens module correspond to the multiple LEDs 4 in the light source assembly in a one-to-one manner.

[0026] Referring to FIG. 1, FIG. 6 and FIG. 7, the lever connector includes a lever connection plate 6 and three levers 9 in the same shape similar to a triangle. The lever connection plate 6 has a base sheet with three blades evenly distributed on the same plane, and bending portions perpendicularly connected to the blades. The base sheet is perpendicular to the motor shaft when being mounted on the motor shaft, and the three bending portions are all parallel to the axial direction of the motor shaft. Each bending portion is opened with a lever connection hole 18, where the lever connection hole 18 is a via hole and used for connecting the lever 9. Since the blades of the base sheet are evenly distributed, the levers 9 mounted on the bending portions are also evenly distributed, so that the three levers 9 suffer the same stress and have the same deformation. One blade of the base sheet of the lever connection plate 6 is further opened with a guide post connection hole 19 for being fit with a guide post 15.

[0027] The lever 9 is in a shape of a triangle plate, and includes three endpoints at three angles of the triangle plate. The first endpoint (point a) is opened with a hole for being connected to the lever connection hole 18 of the lever connection plate 6 in a screw connection manner, so that the lever 9 can be relatively rotatablely connected to the lever connection plate 6. The second endpoint (point b) is hooked to the lens assembly and the light source casing 16 through the connection post 17. The fulcrum (point c) is a fulcrum protruding outward from an edge of the triangle plate, serves as a connection portion, and is held against one side of the light source casing 16 far away from the lens assembly, and can relatively slide. The second endpoint (point b) of each lever 9, that is, an end far away from a motor rotation shaft in a radial direction of the motor rotation shaft, is opened with a connection hole. A distance from the fulcrum to the light source casing 16 is less than distances from the first and the second endpoints to the light source casing 16. It can be understood that, the lever 9 may be connected to the lever connection plate 6 with a single screw (a rotation shaft), or the first endpoint a of the lever 9 is disposed with an outward protrusion fit with the lever connection hole 18, so that the first endpoint a of the lever 9 can rotate in the lever connection hole 18.

[0028] In this embodiment, the three fulcrums serve as the connection portions and are connected to one side of the light source assembly, and are all located on the same plane. The three second endpoints serve as the fitting portions and are connected to the lens assembly through the connection post 17, and are all located on another plane.

[0029] Specifically, the fulcrums c serve as the connection portions and are held against one side (a right side in FIG. 1) of the light source casing 16, and the connection portions always maintain on the same plane in an axial moving process, so as to ensure stability of the light source assembly and the lens assembly in a moving process, that is, the light source assembly and the lens assembly move axially with respect to the motor shaft without deflection. In this way, it can be ensured that the distances from all the LEDs 4 to the lenses 1 equally change, and evenness of the emitted light rays is not affected by the moving of the light source assembly or the lens assembly.

[0030] As described above, the first endpoint of the lever 9 is relatively rotatablely connected to the lever connection plate 6, and the relative rotation direction is in a plane including the motor shaft. In the case that the lever 9 at the bottom of FIG. 1 is taken as an example, a rotation direction of the first endpoint a of the lever 9 with respect to the lever connection plate 6 is in the plane including the motor shaft. In addition, the end a of the lever 9 can be relatively rotatablely connected to the lever connection plate 6 in a manner of screw connection, movable rivet connection, sleeve connection or rotation shaft connection.

[0031] As shown in FIG. 4, the second endpoint b of the lever 9 is flexibly connected to the lens support 3 and the lens pressing plate 2 through the connection post 17 fixed on the aluminum-base circuit board 5. The connection post 17 passes through the via hole on the lens support 3 and a penetration hole on the lens pressing plate 2, and extends out of one side of the lens pressing plate 2 far away from the lens support 3. By being fit with the lock nut 7, the connection post 17 connects the lens support 3 with the lens pressing plate 2. Moreover, a positioning post 10 is axially disposed at a portion between the aluminum-base circuit board 5 and the lens support 3, and a periphery of the positioning post 10 is disposed with a spring 8. The positioning post 10 passes through the lens support 3 and the lens pressing plate 2, so as to be fit with the lock nut 7. The spring 8 is clamped between the aluminum-base circuit board 5 and the lens support 3 with a certain pre-pressure, so as to apply a pressure to the aluminum-base circuit board 5 and the lens support 3.

[0032] One end of the connection post 17 extends to a hollow area in a middle of the positioning post 10 in the light source casing 16 (as shown in FIG. 4), passes through the positioning post 10 and is connected to the lock nut 7. The other end, a hook portion, of the connection post 17 passes through the through hole disposed on the light source casing 16 and is hooked into the connection hole at the second endpoint b of the lever 9. In the hooking manner, when the lens assembly axially moves along the motor shaft, the lever 9 may rotate with

respect to the connection post 17 in a plane including an axial direction of the motor shaft. The second endpoint b of the lever 9 may relatively rotatablely connected to the connection post 17, and the relative rotation direction is in the plane including the motor shaft. In the case that the lever 9 at the bottom of FIG. 1 is taken as an example, a rotation direction of the second endpoint b of the lever 9 with respect to the connection post 17 is in the plane including the motor shaft. It can be understood that, the hooking manner may be replaced by a manner such as movable rivet connection, as long as the lever connection plate 6 can apply a force to the connection post 17, through the rotatable connection to the connection post 17, so that the connection post 17 goes forward or backward in the axial direction of the motor shaft.

[0033] The fulcrum c of the lever 9 can be contacted with a bottom surface of the light source casing 16 in a slidable manner. The point c should protrude from the end a and the end b to an extent large enough, so that in the whole process of the lever 9 rotating in the plane including the axial direction of the motor shaft, the fulcrum c is contacted with the bottom surface of the light source casing 16, and is always closer to the bottom surface of the light source casing 16 than other portions of the lever 9.

[0034] In addition, a distance from the end a to the fulcrum c is greater than a distance from the end b to the fulcrum c. As shown in FIG. 1, on the lever 9, a distance from the end a to the fulcrum c is 6-7 times greater than a distance from the end b to the fulcrum c. When the end a of the lever 9 moves by a large distance, the end b moves by a small distance which is merely 1/6 of the moving distance of the end a, so as to finely adjust the moving of the lens assembly.

[0035] As shown in FIG. 1 and FIG. 6, the motor drive device includes a motor 13, a motor support 14 and a motor connection disk 11. The motor 13 is fixedly connected to the light source casing 16 through the motor support 14. In the motor 13, the motor shaft 12 with an outer thread is spirally connected to the motor connection disk 11 with an inner thread, so as to convert the rotation of the motor rotation shaft of the motor 13 into axial moving of the motor connection disk 11.

[0036] FIG. 6 and FIG. 7 show a structure of the lever connection plate 6 and a connection relationship between the lever connection plate 6 and the motor drive device. A protrusion on the motor connection disk 11 passes through the positioning hole 20 of the lever connection plate 6, and then is fastened to a thread hole 21 of the motor connection disk with a screw, so as to fixedly connect the motor connection disk 11 with the lever connection plate 6. When the motor 13 rotates, the motor connection disk 11 is driven by the motor rotation shaft to move forward and backward in an axial direction of the motor rotation shaft (axially move), and then push or pull the lever connection plate 6 fixed to the motor connection disk 11 to move in the same direction.

[0037] Meanwhile, the cylindrical guide post 15 is axially disposed. One end of the guide post 15 is fixed on the motor support 14, and the other end passes through the guide post connection hole 19 on the lever connection plate 6 to be fixed. When the lever connection plate 6 is driven by the motor connection disk 11 to axially move, the guide post 15 may limit rotation moving of the lever connection plate 6 along the motor rotation shaft, so as to ensure that the lever connection plate 6 reliably axially moves along the motor rotation shaft instead of rotation moving. In addition, since the motor connection disk 11 is fixedly connected to the lever connection plate 6, the guide post 15 may further limit the motor connection disk 11 to merely axially move when the motor shaft 12 rotates.

[0038] With the rotation of the motor 13, the motor shaft 12 also rotates, so that the motor connection disk 11 spirally connected to the motor shaft 12 axially moves. Correspondingly, the lever connection plate 6 fixedly connected to the motor connection disk 11 axially moves in the same way. At the same time when the first endpoint (the end a) of the lever 9 spirally connected to the lever connection plate 6 axially moves with the lever connection plate 6, the fulcrum (the end c) of the lever 9 slides in the radial direction of the motor rotation shaft along one side of the light source casing 16. The lever 9 moves with the fulcrum (the end c) as a fulcrum, and the first and the second endpoints move in opposite directions. Specifically, when the motor connection disk 11, the lever connection plate 6 and the first endpoint (the end a) of the lever 9 move forward to a left side of FIG. 1, the second endpoint (the end b) of the lever 9 moves in an opposite direction, that is, to a right side of FIG. 1. When the second endpoint (the end b) of the lever 9 moves to the right side of FIG. 1, the connection post 17 hooked to the second endpoint and connected to the lens assembly applies a pull force towards the right side of FIG. 1 to the lens assembly. At this time, the lens assembly applies a pressure on the spring 8, and the spring 8 is compressed. The lens assembly moves in a direction opposite a moving direction of the motor connection disk 11 and the lever connection plate 6.

[0039] In another aspect, when the motor connection disk 11, the lever connection plate 6 and the first endpoint (the end a) of the lever 9 move forward to the right side of FIG. 1, the second endpoint (the end b) of the lever 9 moves to the left side of FIG. 1. The connection post 17 does not apply a pressure on the lens assembly. The spring releases the lens assembly, and under the elastic force of the spring 8, a force towards the left side of FIG. 1 is applied on the lens assembly. In this way, the lens assembly can move in left and right directions, so that a distance from the lens assembly to the light source 4 changes, so as to implement the focusing function.

[0040] In the process of the motor connection disk 11 and the lever connection plate 6 axially moving, the guide post 15 prevents the motor connection disk 11 from rotating but converts the rotation to axial moving.

[0041] The connection portions (the three fulcrums)

connected to the light source assembly on the lever 9 are located on the same plane, and are evenly distributed on the plane. The fitting portions (the three second endpoints) connected to the lens assembly on the lever 9 are located on another plane, and are evenly distributed on the plane. Based on the above structural characteristics, when the lever connection plate 6 axially moves, the three endpoints of the connection portions may move in the same way all the time, so as to ensure that the light source assembly is always located on the plane perpendicular to the axial direction of the motor rotation shaft, without deflection with respect to the axial direction. Similarly, when the lever connection plate 6 axially moves, the three endpoints of the fitting portions may also move in the same way all the time, so as to ensure that the lens assembly is always located on the plane perpendicular to the axial direction of the motor rotation shaft, without deflection with respect to the axial direction.

[0042] As shown in the above structure, when the focus is required, the motor 13 rotates forward or in reverse to drive the motor shaft 12 to rotate, so that the motor connection disk 11 axially moves with the lever connection plate 6 in the axial direction of the motor shaft 12. The lever connection plate 6 enables the end a of the lever 9 to move correspondingly. Due to the lever principle, the end b of the lever 9 moves in a direction opposite the moving direction of the end a, and the connection post 17 axially moves in a direction same as the moving direction of the end b, so that the lens assembly moves in the same direction. The fulcrum c of the lever 9 acts on the bottom surface of the light source casing 16, and when the end a of the lever 9 moves by a large distance, the end b outside the fulcrum c moves by a small distance which is merely about 1/6 of the moving distance of the end a, so as to finely adjust the displacement of the lens assembly.

[0043] In the focusing process, in a three-point positioning manner, the lens assembly is driven by the lever 9 and then axially moves with the three connection posts 17 together along the axial direction, without deflection or deformation, so as to achieve desirable focusing consistency and a stable focusing structure. In addition, the lever 9 drives, through the connection post 17, the lens assembly to axially move with respect to the light source assembly. A pair of forces in opposite directions is applied on the lens assembly by the connection post 17 and the spring 8, ensuring that the distances from the LEDs 4 in the light source assembly to the lenses 1 corresponding to the LEDs 4 in a one-to-one manner consistently change in the focusing process, that is, achieving focusing consistency.

[0044] It can be seen from the above that, in this embodiment, through a principle of three points supporting a plane and by using the three levers 9, the lens assembly and the light source assembly stably move without deflection with respect to the axial direction of the motor shaft. Moreover, a pair of forces in opposite directions is applied on the lens assembly by the spring 8 and the connection post 17, so that the lens assembly more stably axially moves with respect to the light source assembly.

[0045] The focusing mechanism implements stable and fine focusing for the LED spotlight with high power, ensures evenness, desirable luminous efficiency, and high brightness of the light spots cast by the LEDs 4, and is appropriate for manufacturing of an LED lamp for a film and television with high power.

[0046] The optimal implementation manner of the present invention is described in detail through the above embodiments, and the embodiments are not intended to limit the present invention. For example, the number and the shapes of the levers can be adjusted according to the diameter of the LED surface light source. Any obvious change made by persons of ordinary skill in the art without departing from the essence and the spirit of the present invention constitutes an infringement of the patent right of the present invention, and the corresponding legal responsibilities will be borne.

Claims

1. A focusing mechanism for a Light Emitting Diode (LED) spotlight, comprising a light source casing, a light source assembly and a lens assembly that are located inside the light source casing, a motor drive device located outside the light source casing and having a motor shaft, **characterized in that**
the focusing mechanism for an LED spotlight further comprises a lever connector located outside the light source casing, wherein the lens assembly, the light source assembly, the lever connector and the motor drive device are successively distributed in an axial direction of a motor shaft in the motor drive device; the motor drive device is connected to the lever connector; the lever connector has at least three connection portions connected to one side of the light source casing, and at least three fitting portions connected to the lens assembly; the connection portions of the lever connector are located on a plane perpendicular to the axial direction and are evenly distributed on the same plane; and the fitting portions are located on another plane perpendicular to the axial direction and are evenly distributed on the another plane;
the lever connector comprises a lever connection plate and at least three levers in the same shape, and the leversare evenly distributed with an axis as a center and connected to the lever connection plate;
the lever comprises a first endpoint, a second endpoint and a fulcrum, wherein the first endpoint is connected to the lever connection plate, the second endpoint serves as the fitting portion and is connected to the lens assembly, and the fulcrum serves as the connection portion and is contacted with a surface of the light source casing;
the first endpoint, the second endpoint and the ful-

crum are distributed in a triangle shape, a distance from the fulcrum to the light source casing is less than distances from the first and the second endpoints to the light source casing, and a distance from the first endpoint to the fulcrum is greater than a distance from the second endpoint to the fulcrum;
the fulcrum is connected to one side of the light source casing far away from the lens assembly in a relatively slidable manner; the first endpoint is relatively rotatablely connected to the lever connection plate, and a rotation direction of the first endpoint with respect to the lever connection plate is perpendicular to the motor shaft; the second endpoint is capable of rotating with respect to the lens assembly, and a rotation direction is perpendicular to the motor shaft;
the lever is a triangle plate, the first endpoint, the second endpoint and the fulcrum are respectively located at three angles of the triangle plate, the first endpoint is opened with a hole for rotatablely connecting the lever with the lever connection plate, the second endpoint is opened with a hole for connecting the lever with the lens assembly, and the fulcrum protrudes from the angel towards the light source casing; and
the lever connection plate has a base sheet with at least three blades evenly distributed on the same plane, and bending portions with the same number as that of the blades; each of the bending portions is perpendicularly connected to one corresponding blade and is parallel to the axial direction of the motor shaft; the bending portion is opened with a lever connection hole for connecting the first endpoint of the lever.

2. A focusing mechanism for a Light Emitting Diode (LED) spotlight, comprising a light source casing, a light source assembly and a lens assembly that are located inside the light source casing, and a motor drive device located outside the light source casing and having a motor shaft, **characterized in that**
the focusing mechanism for an LED spotlight further comprises a lever connector located outside the light source casing, wherein the lens assembly, the light source assembly, the lever connector and the motor drive device are successively distributed in an axial direction of the motor shaft; the motor drive device is connected to the lever connector; the lever connector has at least three connection portions connected to one side of the light source casing, and at least three fitting portions connected to the lens assembly; the connection portions of the lever connector are located on a plane perpendicular to the axial direction and are evenly distributed on the same plane; and the fitting portions are located on another plane perpendicular to the axial direction and are evenly distributed on the another plane.

3. The focusing mechanism for an LED spotlight according to claim 2, **characterized in that**
the lever connector comprises a lever connection plate and at least three levers in the same shape, and the leversare evenly distributed with an axis as a center and connected to the lever connection plate; and
the lever comprises a first endpoint, a second endpoint and a fulcrum, wherein the first endpoint is connected to the lever connection plate, the second endpoint serves as the fitting portion and is connected to the lens assembly, and the fulcrum serves as the connection portion and is contacted with a surface of the light source casing.

4. The focusing mechanism for an LED spotlight according to claim 3, **characterized in that**
the first endpoint, the second endpoint and the fulcrum are distributed in a triangle shape, a distance from the fulcrum to the light source casing is less than both distances from the first and the second endpoints to the light source casing.

5. The focusing mechanism for an LED spotlight according to claim 3, **characterized in that**
the fulcrum is connected to one side of the light source casing far away from the lens assembly in a relatively slidable manner.

6. The focusing mechanism for an LED spotlight according to claim 3, **characterized in that**
the first endpoint is relatively rotatablely connected to the lever connection plate, and a rotation direction of the first endpoint with respect to the lever connection plate is perpendicular to the motor shaft.

7. The focusing mechanism for an LED spotlight according to claim 6, **characterized in that**
the second endpoint rotates with respect to the lens assembly, and a rotation direction is perpendicular to the motor shaft.

8. The focusing mechanism for an LED spotlight according to claim 3, **characterized in that**
a distance from the first endpoint to the fulcrum is greater than a distance from the second endpoint to the fulcrum.

9. The focusing mechanism for an LED spotlight according to claim 3, **characterized in that**
the lever is a triangle plate, the first endpoint, the second endpoint and the fulcrum are respectively located at three angles of the triangle plate, the first endpoint is opened with a hole for rotatablely connecting the lever with the lever connection plate, the second endpoint is opened with a hole for connecting the lever with the lens assembly, and the fulcrum protrudes from the angel towards the light source

casing.

10. The focusing mechanism for an LED spotlight according to claim 3, **characterized in that** the lever connection plate has a base sheet with at least three blades evenly distributed on a plane, and bending portions with the same number as that of the blades; each of the bending portions is perpendicularly connected to one corresponding blade and is parallel to the axial direction of the motor shaft; the bending portion is opened with a lever connection hole for connecting the first endpoint of the lever.

11. The focusing mechanism for an LED spotlight according to claim 3, **characterized in that** the focusing mechanism for an LED spotlight further comprises a connection post, and the connection post is connected to the second endpoint of the lever and the lens assembly.

12. The focusing mechanism for an LED spotlight according to claim 11, **characterized in that** springs and positioning posts with the same number as that of the connection posts are further disposed between the light source assembly and the lens assembly; the spring is sleeved to a periphery of the positioning post, one end of the spring is held against the light source assembly, and the other end is held against the lens assembly.

13. The focusing mechanism for an LED spotlight according to claim 12, **characterized in that** the focusing mechanism for an LED spotlight further comprises a lock nut, and the connection post passes through the positioning post and the lens assembly and is connected to the lock nut.

14. The focusing mechanism for an LED spotlight according to claim 3, **characterized in that** the motor drive device comprises a motor, a motor support, and a motor connection disk, the motor is fixedly connected to the light source casing through the motor support; the motor shaft of the motor is spirally connected to the motor connection disk, the motor connection disk is fixedly connected to the lever connection plate, and the motor connection disk and the lever connection plate are both sleeved on the motor shaft.

15. The focusing mechanism for an LED spotlight according to claim 14, **characterized in that** the focusing mechanism for an LED spotlight further comprises a guide post disposed in the axial direction of the motor shaft, one end of the guide post is fixed on the motor support, and the other end is fixed on the lever connection plate.

16. A Light Emitting Diode (LED) spotlight, **characterized in that** the LED spotlight comprises the focusing mechanism for an LED spotlight according to any one of claims 1 to 15.

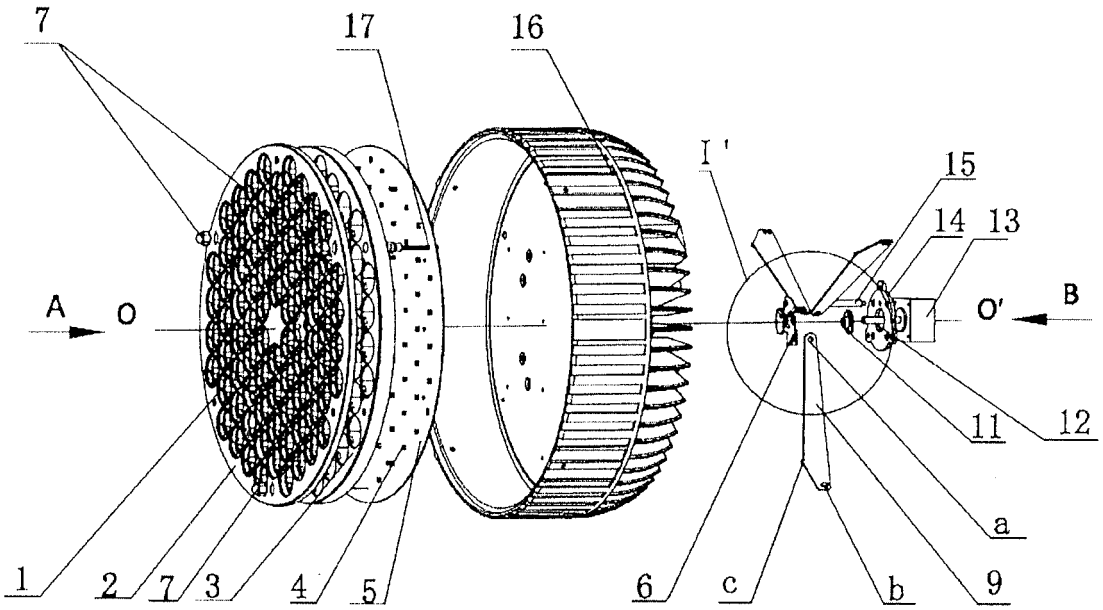

FIG. 1

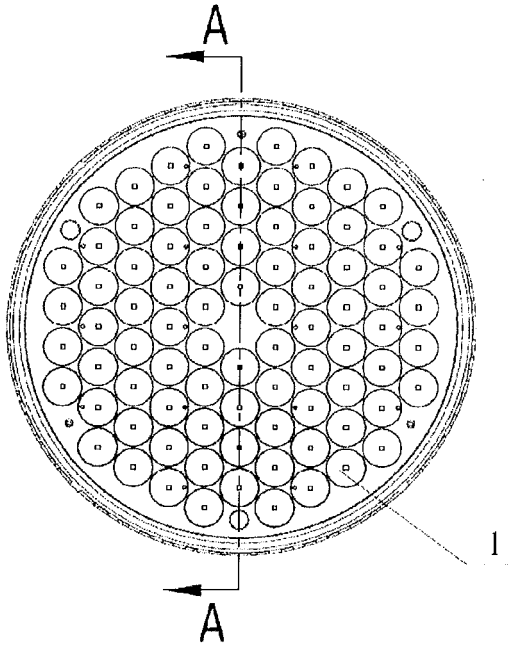

FIG. 2

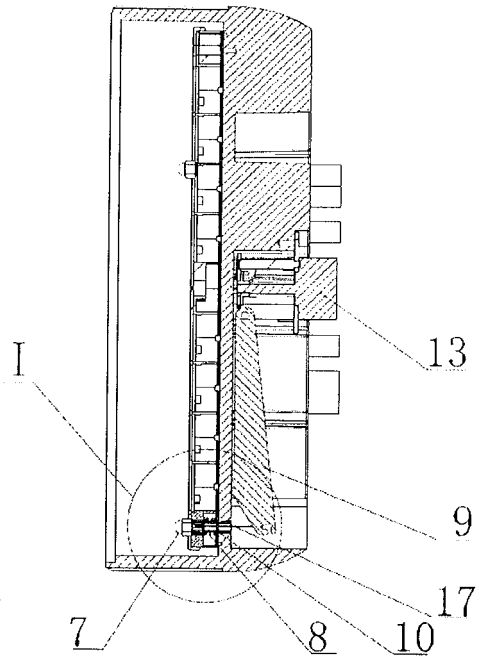

FIG. 3

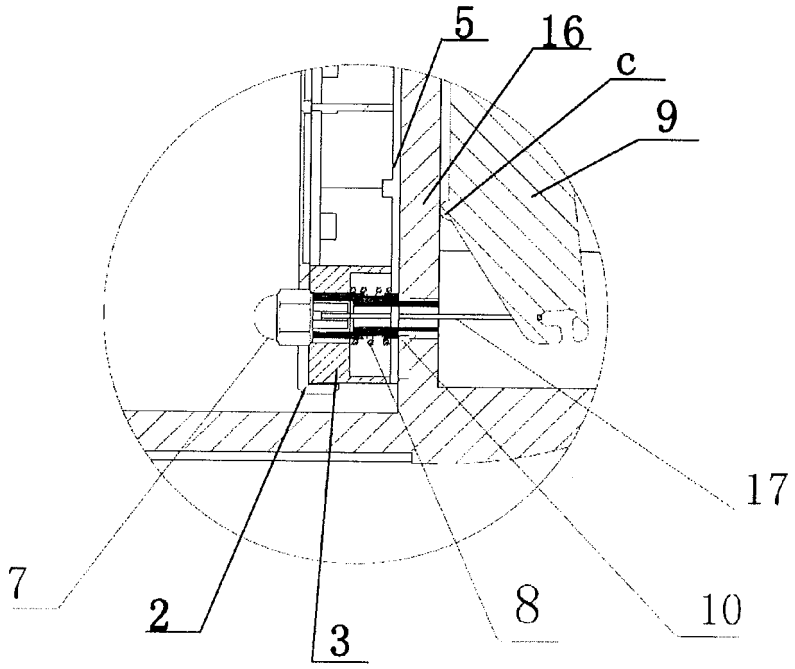

FIG. 4

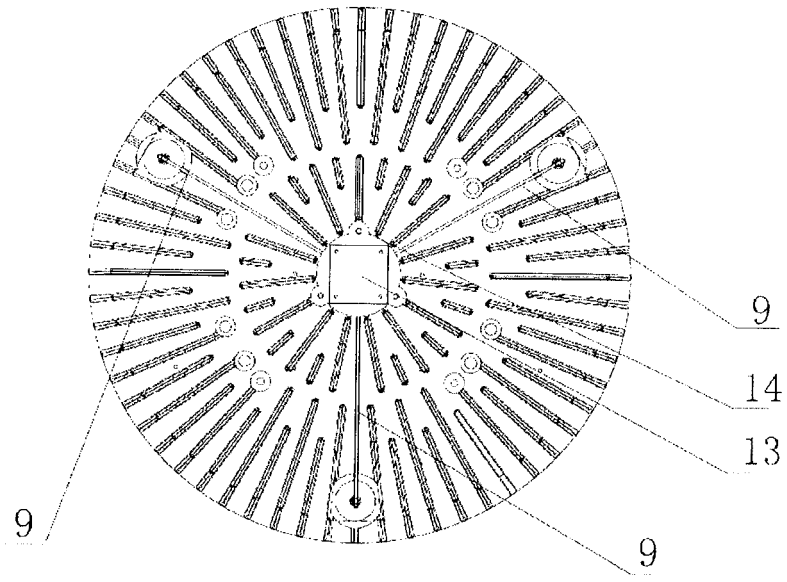

FIG. 5

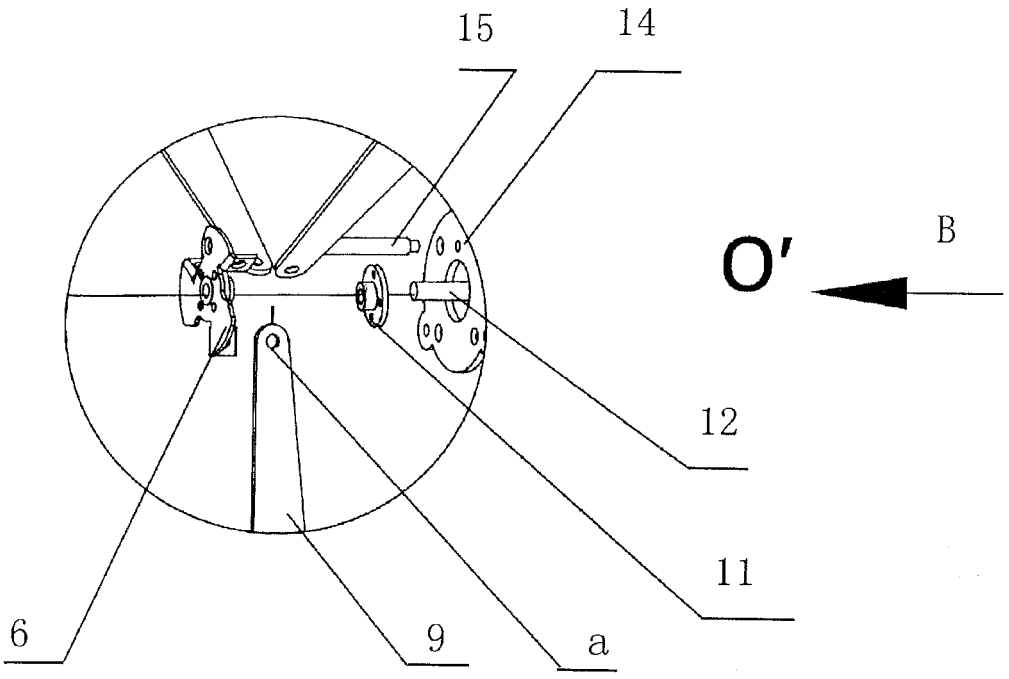

FIG. 6

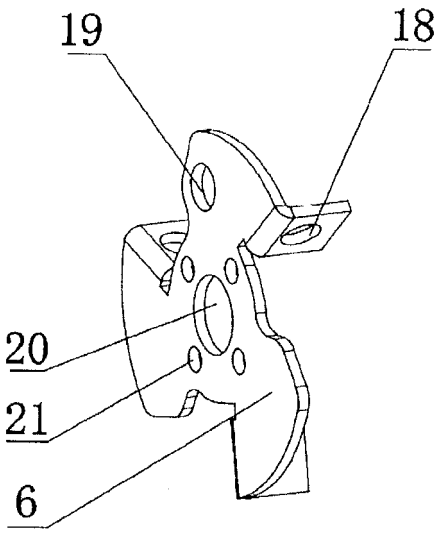

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/079077

A. CLASSIFICATION OF SUBJECT MATTER

See the extra sheet
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F21

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

VEN,CNABS,CPRSABS,CNTXT, lens??, focus+, focal+, lever+,support+,bar?,

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN201748343U(BEIJING XINGGUANG FILM&TV EQUIP TECHNO) 16 Feb.2011(16.02.2011) pages 1-2 in description, figures.1-5	1-16
A	CN201416845Y(GUANGZHOU HAOYANG ELECTRONICS CO LTD) 03 Mar.2010(03.03.2010) the whole document	1-16
A	CN201265823Y(GUANGZHOU YAJIAN PHOTOELECTRIC DEVICE CO LTD) 01 Jul.2009(01.07.2009) the whole document	1-16
A	WO2006/060905A1(DC AVENIR INC) 15 Jun.2006（15.06.2006）the whole document	1-16
A	WO01/98707A1(MARUMO ELECTRIC CO LTD) 27 Dec.2001(27.12.2001) the whole document	1-16

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 Nov.2011(24.11.2011)	08 Dec.2011(08.12.2011)
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. (86-10)62019451	Authorized officer HAN, Limin Telephone No. (86-10)62085768

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2011/079077

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN201748343U	16.02.2011	none	
CN201416845Y	03.03.2010	none	
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		EP1293722AB	19.03.2003
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		US6837596B	04.01.2005
		EP1462713AB	29.09.2004

Form PCT/ISA /210 (patent family annex) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/079077

A. CLASSIFICATION OF SUBJECT MATTER

F21V 14/06 (2006.01) i
F21Y 101/02 (2006.01) n

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN ZL200820233726X **[0005]**