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(56) Related Art
US 7458706 (Liu et al.)
US 4987522 (MIYANO)
US2004/0252520 (MARTINEAU)
US 7396146 (Wang)
US 6402112 (THOMAS et al.)
US 6264354 (MOTILAL)

STRUCTURE FOR SUPPORTING LAMP APPARATUS FOR VEHICLE

Abstract

5 A structure for supporting a lamp apparatus (206) for a vehicle (2) is disclosed, capable of increasing an illumination angle range by forming position controlling slits (236) at lateral sides of a bracket (226), more securely fixing a main case (208) of the lamp apparatus (206) as position-controlled by supporting the main case (208) at 4 points using hinges (222) and the position controlling slits (236), and securely fixing the main case
10 (208) to the bracket (226) by connecting a connection screw (260) fixing a hinge bolt (242), restricting undesired rotation of the hinge bolt (242). Since a position controlling rib (234) having a position controlling slit (236) is extended rearward from side supporters (230), the illumination angle can be controlled within a greater range. The main case (208) can be supported at 4 points through the plurality of position controlling
15 slits (236). Furthermore, by fitting the connection screw (260) with an outer circumferential recess of a hinge bolt fastening lever (240), rotational separation of the hinge bolt (242) and change of the illumination angle of the main case (208) can be prevented.

This exploded perspective view illustrates the assembly of a multi-well plate. The components are labeled as follows: 206 (top plate), 210 (top plate with wells), 220 (middle plate), 218 (conical inserts), 214 (conical inserts), 216 (bottom plate), 212 (bottom plate with wells), 208 (bottom plate with wells), 222 (bottom plate with wells), 248 (bottom plate with wells), 242 (bottom plate with wells), 240 (bottom plate with wells), 246 (bottom plate with wells), 244 (bottom plate with wells), 260 (bottom plate with wells), 250 (bottom plate with wells), 250a (bottom plate with wells), 240a (bottom plate with wells), 224 (bottom plate with wells), 238a (bottom plate with wells), 238b (bottom plate with wells), 230 (bottom plate with wells), 232 (bottom plate with wells), 236 (bottom plate with wells), 234 (bottom plate with wells), 230a (bottom plate with wells), 228 (bottom plate with wells), 226 (bottom plate with wells), 225 (bottom plate with wells).

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COMPLETE SPECIFICATION

FOR A STANDARD PATENT

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Address for Service:	Spruson & Ferguson St Martins Tower Level 35 31 Market Street Sydney NSW 2000 (CCN 3710000177)
Invention Title:	Structure for supporting lamp apparatus for vehicle

The following statement is a full description of this invention, including the best method of performing it known to me/us:

STRUCTURE FOR SUPPORTING LAMP APPARATUS FOR VEHICLE

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a structure for supporting a lamp apparatus for a vehicle, and more particularly to a supporting structure for a lamp apparatus for a vehicle, capable of increasing an illumination angle range by forming position controlling slits at lateral sides of a bracket, more securely fixing a main case of the lamp apparatus as position-controlled by supporting the main case through 4 points using a plurality of hinges and a plurality of the position controlling slits, and also securely fixing the main case to the bracket by connecting a connection screw that fixes a hinge bolt, restricting undesired rotation of the hinge bolt.

Description of the Related Art

As generally known, vehicles are provided with a headlamp assembly to secure a driver's front field of vision while driving at night or in a dark place such as a tunnel. The headlamp assembly comprises a lamp chamber constituted by a main housing and a transparent cover, a sub housing constituted by a lens and a reflecting mirror and mounted in the lamp chamber, and a headlamp unit mounted in the sub housing.

The headlamp unit comprises a bulb as a light source, and a bulb adaptor that supports the bulb. For the bulb, a halogen bulb adopting a temperature radiation system and a gas discharge bulb adopting a luminescence system are generally used.

The halogen bulb is relatively darker than the gas discharge bulb since having a low luminous flux, but is cheaper and therefore generally applied to mid and low-end cars. On the other hand, although being expensive, the gas discharge bulb is even brighter than the halogen bulb since having a high luminous flux, and therefore is generally applied to high price cars.

Recently, researches for headlamp assemblies using an LED lamp as the light source have been actively performed.

Especially, the LED lamp is advantageous in terms of general aspects including a processing rate, power consumption and the lifespan owing to its properties as a semiconductor, and therefore has been widely used as an electronic indication part in various electronic appliances. Furthermore, as high-brightness LEDs are introduced recently, the LED lamp has been spotlighted as a high-tech future light source. The LED lamp is not only power-saving in comparison with other conventional bulbs, but also achieves excellent color rendering in comparison with conventional color lighting using glasswork, coating, a filter and so on, since having elements of a variety

of colors. In addition, the LED lamp has a great durability. Therefore, the maintenance cost and the replacement cost for the vehicle headlamp assembly can be reduced.

FIG. 1 is a perspective view showing a lamp apparatus fixed to a heavy-equipment vehicle, according to a conventional art.

Referring to FIG. 1, since having a high brightness and an excellent durability as described above, the LED lamp is generally applied to a heavy equipment vehicle 2 used in a construction site, that is a poor environment, or an off-road vehicle (not shown) such as a jeep.

FIG. 1 shows the heavy equipment vehicle 2 mounted with a lamp apparatus 6 at an upper surface of a roof panel 4 thereof. The appearance of the lamp apparatus 6 is constituted by a hexahedral case 8. In the center of a lower surface of the case 8, a fixed rod 10 is fixed to the roof panel 4, being equipped with a connection bolt 12 at a lower end thereof.

The conventional lamp apparatus 6 is immovably fixed to the upper surface of the roof panel 4. However, it is disadvantageous to fix the lamp apparatus 6 to the roof panel 4 in an angle-uncontrollable state because the lamp apparatus 6 would illuminate different positions according to the working positions by the heavy equipment vehicle 2.

For example, more specifically, in case of excavating the ground or a wall, the lamp apparatus 6 needs to have totally

different illumination angles to adequately function. That is, when the lamp apparatus 6 is immovably fixed to the upper surface of the roof panel 4, the working areas can not be properly illuminated.

Accordingly, a structure for supporting a lamp apparatus has recently been developed as shown in FIGs. 2 and 3.

FIG. 2 is an exploded perspective view of the lamp apparatus supporting structure for a vehicle according to another conventional art. FIG. 3 is a side view of the lamp apparatus supporting structure of FIG. 2, showing an illumination angle range.

Referring to the drawings, in the another conventional lamp apparatus supporting structure, a lamp apparatus 106 comprises a main case 108 equipped with a plurality of LED lamps (not shown) mounted therein. The main case 108 includes a connection hole 112 on both sides, and a front cover 110 at the front. In addition, a connection protrusion 114 is formed on a lower rear surface of the main case 108.

The main case 108 is fixed to the roof panel 4 of the heavy equipment vehicle 2, and a fixing unit 120 for controlling the illumination angle is additionally provided. The fixing unit 120 comprises a center supporter 122 fixed to the roof panel 4 apart from a lower part of the main case 108, and side supporters 124 vertically extended upward from both ends of the center supporter 122 and brought into close contact

with lateral sides of the main case 108. A hinge hole 126 is formed at each side supporter 124, corresponding to the connection hole 112.

The center supporter 122 has a penetration hole 218 substantially in the middle. In addition, a position determining rib 130 is extended from a rear side of the center supporter 122 as seen from the front to the rear of the vehicle. More specifically, the position determining rib 130 is bent in a regular arc form upward from the center supporter 122, and includes a position determining slit 142 formed in a length direction thereof.

A washer 136, a nut 134 and a fixing bolt 132 are sequentially connected through the penetration hole 128 of the center supporter 122, thereby connecting the center supporter 122 to the upper surface of the roof panel 4 (FIG. 1).

In a state where the connection holes 112 formed on the main case 108 and the hinge holes 126 formed on the side supporter 124 are correspondingly connected to each other, a washer 140 and a hinge bolt 138 are sequentially connected to the connection holes 112 through the hinge holes 126. Therefore, the main case 108 is rotatably hinged on the fixing unit 120.

Next, when the connection protrusion 114 of the main case 108 is engaged with the position determining slit 142 of the position determining rib 130 formed at the fixing unit 120 and

a position fixing lever 141 is connected to the connection protrusion 114, the main case 108 can be rotated with respect to the fixing unit 120 fixed to the roof panel 4 of the vehicle. Accordingly, the illumination angle of the LED lamps (not shown) provided in the main case 108 can become controllable as shown in FIG. 3.

According to the above-described conventional lamp apparatus supporting structure for a vehicle, however, since a displacement range of the illumination angle of the main case 108 is restricted within the length of the position determining slit 132, the actual illumination angle is approximately 10-12 degrees as shown in FIG. 3.

Moreover, since the conventional lamp apparatus supporting structure is supported by 3 points, that is, both sides of the main case 108 and the connection protrusion 114 formed at the rear middle part of the main case 108, it is difficult to securely fix the main case 108 with respect to the fixing unit 120. More specifically, while the heavy equipment vehicle 2 is moving to work in such a poor work environment, the position fixing lever 141 fixed merely by one position may be unfastened, thereby hindering the normal performance of the lamp apparatus.

Meanwhile, considering that the conventional lamp apparatus supporting structure is mainly applied to the heavy equipment vehicle which works at a poor environment such as a

construction site generating much vibration with an uncompleted underground construction, the hinge bolt 138 would be transmitted with the vibration of the vehicle and easily separated from the connection hole 112 of the main case 108. As a result, unwanted change of the illumination angle of the lamp apparatus 6 may be caused.

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Object of the Invention

It is the object of the present invention to substantially overcome or ameliorate one or more of the disadvantages of the prior art.

Summary of the Invention

The present invention provides a structure for supporting a lamp apparatus including a plurality of LED lamps mounted in a main case, a lamp PCB mounted with parts and sockets for operating the LED lamps, a collimate lens connected to a front side of the LED lamps to reflect light by a predetermined angle, a protection board formed at the front side of the collimate lens to protect the LED lamps from contaminants, a cover covering the protection board, the cover being connected to the front of the main case, and a packing material interposed between the cover and the main case, the structure comprising:

the main case for mounting parts required for the lamp apparatus therein, the main case including a hinge hole formed on a central part of both sides thereof, and a fixing recess formed on the both sides thereof, thereby achieving a 4-point supporting system;

a fixing unit fixing the main case to a roof panel of a heavy equipment vehicle, the fixing unit including a penetration hole and a position controlling slit corresponding to the hinge hole and the fixing recess of the main case respectively;

a hinge bolt fastening lever including a hinge bolt formed on the front side thereof to connect the main case to the fixing unit in a hinged manner;

a fixing bolt fixing the main case to the fixing unit through the position controlling slit of the fixing unit to provide a predetermined illumination angle, and

a connection screw brought into close contact with an outer circumferential recess of the hinge bolt fastening lever and connected with a connection hole of the fixing unit, thereby preventing rotation and separation of the hinge bolt fastening lever.

The main case may include a plurality of heat sinks formed on an outer surface of the main case to increase a contacting area with the air.

The main case may be formed of a high-conductivity material such as aluminum.

The fixing unit may include a center supporter fixed to the roof panel of the vehicle, a side supporter vertically extended upward from both ends of the center supporter and brought into close contact with lateral sides of the main case, including a penetration hole corresponding to the hinge hole, and a position controlling rib extended

rearward from upper parts of the side supporters and each formed with the position controlling slit in the center thereof.

The position controlling slit may have an arc form cut out by 1/4 length of a circular circumference.

5 The main case may be rotated through the position controlling slit by an illumination angle of 90 degrees.

The fixing unit may have a U-shape to receive and fix the main case therein.

The heat sinks may be connected to a lower surface and a rear surface of the main case corresponding to a direction of the airflow.

10 The center supporter may include a connection rod formed

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with a male screw thread on an outer circumference thereof to be fixed to the roof panel, and a nut.

According to the lamp apparatus supporting structure for a vehicle as described above, the illumination angle of the lamp apparatus can be increased since the position controlling rib having the position controlling slit is extended to the rear side of the lateral sides of the side supporters and also provided at both sides of the fixing unit. Moreover, the main case is fixed to the fixing unit through a plurality of the position controlling slits, that is, supported by 4 points, thereby being more securely fixed. Also, by fitting the connection screw with any one circumferential recess of the hinge bolt fastening lever, undesired separation of the hinge bolt and undesired change of the illumination angle of the main case can be prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view showing a lamp apparatus fixed to a heavy-equipment vehicle, according to an embodiment of the present invention;

FIG. 2 is an exploded perspective view of the lamp

apparatus supporting structure for a vehicle according to another conventional art;

FIG. 3 is a side view of the lamp apparatus supporting structure of FIG. 2, showing an illumination angle range;

FIG. 4 is an exploded perspective view of a lamp apparatus supporting structure for a vehicle according to an embodiment of the present invention;

FIG. 5 is a perspective view of the lamp apparatus supporting structure for a vehicle, according to the embodiment of the present invention; and

FIG. 6 is a side view of the lamp apparatus supporting structure of FIG. 5.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

5 Hereinafter, an exemplary embodiment of the present invention will be described in detail with reference to the accompanying drawings.

FIG. 4 is an exploded perspective view of a lamp apparatus supporting structure for a vehicle according to an
20 embodiment of the present invention, and FIG. 5 is a perspective view of the lamp apparatus supporting structure for a vehicle, according to the embodiment of the present invention. FIG. 6 is a side view of the lamp apparatus supporting structure of FIG. 5.

25 Referring to the drawings, according to the embodiment

of the present invention, position controlling slits are formed on lateral sides of a bracket so that the illumination angle range of the lamp apparatus can be increased. A main case of the lamp apparatus is supported by 4 points through pluralities of hinges and the position controlling slits. In addition, a fixing screw for fixing a hinge bolt not to be rotated is provided so that the main case of the lamp apparatus supporting structure can be securely fixed to the bracket.

More specifically, a lamp apparatus 206 equipped with the lamp apparatus supporting structure comprises a main case 208 having a hexahedron form with an opened upper side. Additionally, the lamp apparatus comprises a plurality of LED lamps 216 mounted in the main case 208, a PCB 214 for the lamp apparatus, being equipped with parts and sockets for operating the LED lamps 216, a collimate lens 218 connected to a front side of the LED lamps 216 to reflect an illuminated light by a predetermined angle, and a protection board 220 formed at the front side of the collimate lens 218 to protect the LED lamps 216 from contaminants.

In addition, a cover 210 covering the front of the protection board 220 is connected to the front of the main case 208. A packing material 212 is interposed between the cover 210 and the main case 208.

The main case 208 is mounted with various parts of the

lamp apparatus therein. A hinge hole 222 is formed in the center of both sides of the main case 208 to be engaged with a hinge bolt 242 formed on a front end of a hinge bolt fastening lever 240. In addition, a fixing recess 224 for connection with a fixing bolt 250 is formed at a predetermined position on the both sides of the main case 20, being spaced from each hinge hole 222. Thus, a 4-point supporting system can be achieved.

Additionally, a fixing unit 226 is provided to fix the main case 208 to a roof panel 4 of a heavy equipment vehicle 2. The fixing unit 226 includes a penetration hole 232 and position controlling slits 236 respectively corresponding to the hinge hole 222 and the fixing recesses 224 of the main case 208.

A plurality of heat sinks 225 are formed on an outer surface of the main case 208 to thereby increase a contacting area with the air. The main case 208 is formed of a high-conductive material such as aluminum. The heat sinks 225 are connected to a lower surface and a rear surface of the main case 208 corresponding to a direction of the airflow.

The lamp apparatus supporting structure according to the embodiment of the present invention further includes the hinge bolt fastening lever 240 for connecting the main case 208 to the fixing unit 226 in a hinged manner, and the fixing bolts 250 for fixing the main case 208 to the fixing unit 226

through the position controlling slits 236 to have a predetermined illumination angle.

Here, the hinge bolt fastening lever 240 includes the hinge bolt 242 at the front end, and the hinge bolt 242 is formed with male screw threads on an outer circumference thereof.

The hinge hole 222 and the fixing recess 224 of the main case 208 are formed with female screw threads on an inner circumference thereof, respectively. On the other hand, the hinge bolt fastening lever 240 and the fixing bolt 250 are formed with male screw threads on an outer circumference, respectively.

5 The fixing unit 226 comprises a center supporter 228 fixed to the roof panel 4 of the vehicle, side supporters 230 extended upward in a vertical direction from both ends of the center supporter 228 and brought into close contact with lateral sides of the main case 208, and position controlling ribs 234 extended rearward from upper parts of the side supporters 230 (refer to FIG. 5) and each formed with the position controlling slit 236 in the center thereof.

20 The position controlling slit 236 is formed at the main case 208 in an arc form to cope with displacement of the main case 208 pivoting with respect to the fixing recesses 224 engaged with the fixing bolts 250. Here, the illumination angle
25 according to a rotational range of the main case 208 through

the position controlling slit 236 is ± 90 degrees.

More specifically, the position controlling slit 236 is cut out in the arc form around the hinge bolt fastening lever 240, by $1/4$ length of a circular circumference such that the angle of the main case 208 can be controlled between the front side and the vertical lower side. Therefore, when the fixing bolt 250 is connected at the uppermost position of the position controlling slit 236, the main case 208 illuminates the front side. When the fixing bolt 250 is connected at the lowermost position of the position controlling slit 236, the main case 208 illuminates the vertical lower side.

Especially, considering that the present invention is explaining the lamp apparatus supporting structure for the heavy equipment vehicle, the working position of the lamp apparatus supporting structure may be a front bottom surface or a front wall of the vehicle. Therefore, as the illumination angle range of the main case 208 is increased, convenience of the work is improved.

In addition, the center supporter 228 further includes a connection rod 238 formed at a lower central position, having a male screw thread 238a on an outer circumference thereof to be fixed to the roof panel 4, and a nut 238b.

According to the conventional lamp apparatus supporting structure for such a heavy equipment vehicle, the hinge bolt fastening lever 240 may be loosened and separated while the

vehicle is running on a rough ground of the poor working environment. To this end, according to this embodiment, a connection screw 260 is provided to the side supporter 230 to prevent separation of the hinge bolt fastening lever 240 by being fitted with any one outer circumferential recess 240A of the hinge bolt fastening lever 240.

After the main case 208 is connected using the hinge bolt fastening lever 240 in a hinged manner, the connection screw 260 is fitted with the any one outer circumferential recess 240a of the hinge bolt fastening lever 240 and then connected with the connection hole 230a formed at the side supporter 230. In this state, the hinge bolt fastening lever 240 can be prevented from being separated.

Hereinafter, the function and operation of the lamp apparatus supporting structure according to the embodiment of the present invention will be described in detail with reference to the accompanying drawings.

First, to fix the lamp apparatus 206 to the roof panel 4 of the heavy equipment vehicle, the penetration hole 232 of the side supporter 230 of the fixing unit 226 is corresponded to the hinge hole 222 formed on both sides of the main case 208 and then hinge-connected using the hinge bolt fastening lever 240. Accordingly, the main case 208 is hinged on the fixing unit 226 by the hinge bolt 242 formed at the front end of the hinge bolt fastening lever 240, thereby enabling the

main case 208 to rotate about the hinge bolt 242 of the fixing unit 226.

The hinge bolt 242 formed at the front end of the hinge bolt fastening lever 240 has male screw threads along the outer circumference thereof. In addition, the hinge bolt fastening lever 240 may further include a wrench hole 246 in the center thereof so as to be rotated by a wrench.

In this state, the fixing unit 226 is connected to the upper surface of the roof panel 4 using the nut 238b and the connection rod 238 formed in the lower central surface of the fixing unit 226.

Therefore, the lamp apparatus 206 for the vehicle can be fixed to the roof panel 4.

In order to more securely fix the hinge bolt fastening lever 240 and prevent separation of the hinge bolt fastening lever 240, the connection screw 260 is fitted with the any one outer circumferential recess 240a of the hinge bolt fastening lever 240 and the connection screw 260 is connected with the connection hole 230a of the side supporter 230.

The illumination angle range of the lamp apparatus 206 can be controlled by the operator. More specifically, the operator may hold an angle controlling bar 262 and rotate the main case 208 by a predetermined angle relative to the fixing unit 226, while unfastening the fixing bolt 250 connected to the fixing recess 224 through the position controlling slit

236 while maintaining a rotatable state of the main case 208 with respect to the fixing unit 226.

Next, by fastening the fixing bolt 250 to the fixing recess 224, the fixing bolt 250 can be securely fastened to the fixing recess 224, passing through the position controlling slit 236, thereby fixing the main case 208 by the predetermined angle with respect to the fixing unit 226.

In this state, since the position controlling slit 236 is in the arc form having $1/4$ length of a circular circumference, the main case 208 can be rotated by 90 degrees with respect to the fixing unit 226. Accordingly, the LED lamps 216 can be freely moved within the controllable angle range, that is, between the front side and the vertical lower side. Especially in the working environment for the heavy equipment vehicle, it is more advantageous when the LED lamps 216 have a great illumination angle. In this regard, the position controlling slit 236 of this embodiment is desirable since having such a relatively long length.

Therefore, when the LED lamps 216 are turned on, the LED lamps 216 can light up the front side of the heavy equipment vehicle 2 by the predetermined illumination angle. Here, according to the above-structured lamp apparatus 206, since the position controlling rib 234 including the position controlling slit 236 is extended rearward from the side supporter 230 and provided on both sides of the fixing unit

226, the position controlling slit 236 can be formed long enough to increase the illumination angle.

Moreover, the main case 208 fixed to the fixing unit 226 through the plurality of position controlling slits 236 can be more securely fixed by the 4-point supporting system.

Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

The claims defining the invention are as follows:

1. A structure for supporting a lamp apparatus including a plurality of LED lamps mounted in a main case, a lamp PCB mounted with parts and sockets for operating the LED lamps, a collimate lens connected to a front side of the LED lamps to reflect light by a predetermined angle, a protection board formed at the front side of the collimate lens to protect the LED lamps from contaminants, a cover covering the protection board, the cover being connected to the front of the main case, and a packing material interposed between the cover and the main case, the structure comprising:
 - the main case for mounting parts required for the lamp apparatus therein, the main case including a hinge hole formed on a central part of both sides thereof, and a fixing recess formed on the both sides thereof, thereby achieving a 4-point supporting system;
 - a fixing unit fixing the main case to a roof panel of a heavy equipment vehicle, the fixing unit including a penetration hole and a position controlling slit corresponding to the hinge hole and the fixing recess of the main case respectively;
 - a hinge bolt fastening lever including a hinge bolt formed on the front side thereof to connect the main case to the fixing unit in a hinged manner;
 - a fixing bolt fixing the main case to the fixing unit through the position controlling slit of the fixing unit to provide a predetermined illumination angle, and
 - a connection screw brought into close contact with an outer circumferential recess of the hinge bolt fastening lever and connected with a connection hole of the fixing unit, thereby preventing rotation and separation of the hinge bolt fastening lever.
2. The structure according to claim 1, wherein the main case comprises a plurality of heat sinks formed on an outer surface of the main case to increase a contacting area with the air.
3. The structure according to claim 1, wherein the main case is formed of a high-conductivity material.
4. The structure according to claim 3, wherein said material is aluminium.
5. The structure according to claim 1, wherein the fixing unit comprises:
 - a center supporter fixed to the roof panel of the vehicle;
 - a side supporter vertically extended upward from an end of the center supporter and brought into close contact with a lateral side of the main case, the side supporter including the penetration hole corresponding to the hinge hole; and

a position controlling rib extended rearward from an upper part of the side supporter and formed with the position controlling slit in the center thereof.

6. The structure according to claim 1, wherein the position controlling slit has an arc form cut out by 1/4 length of a circular circumference.

7. The structure according to claim 1, wherein the main case can be rotated through the position controlling slit by an illumination angle of 90 degrees.

8. The structure according to claim 1, wherein the fixing unit has a U-shape to receive and fix the main case therein.

9. The structure according to claim 2, wherein the heat sinks are connected to a lower surface and a rear surface of the main case corresponding to a direction of the airflow.

10. A structure for supporting a lamp apparatus substantially as hereinbefore described with reference to Figures 4 to 6 of the accompanying drawings.

Dated 26 July, 2011

Wookang Tech Co., Ltd.

Patent Attorneys for the Applicant/Nominated Person

SPRUSON & FERGUSON

Fig. 1

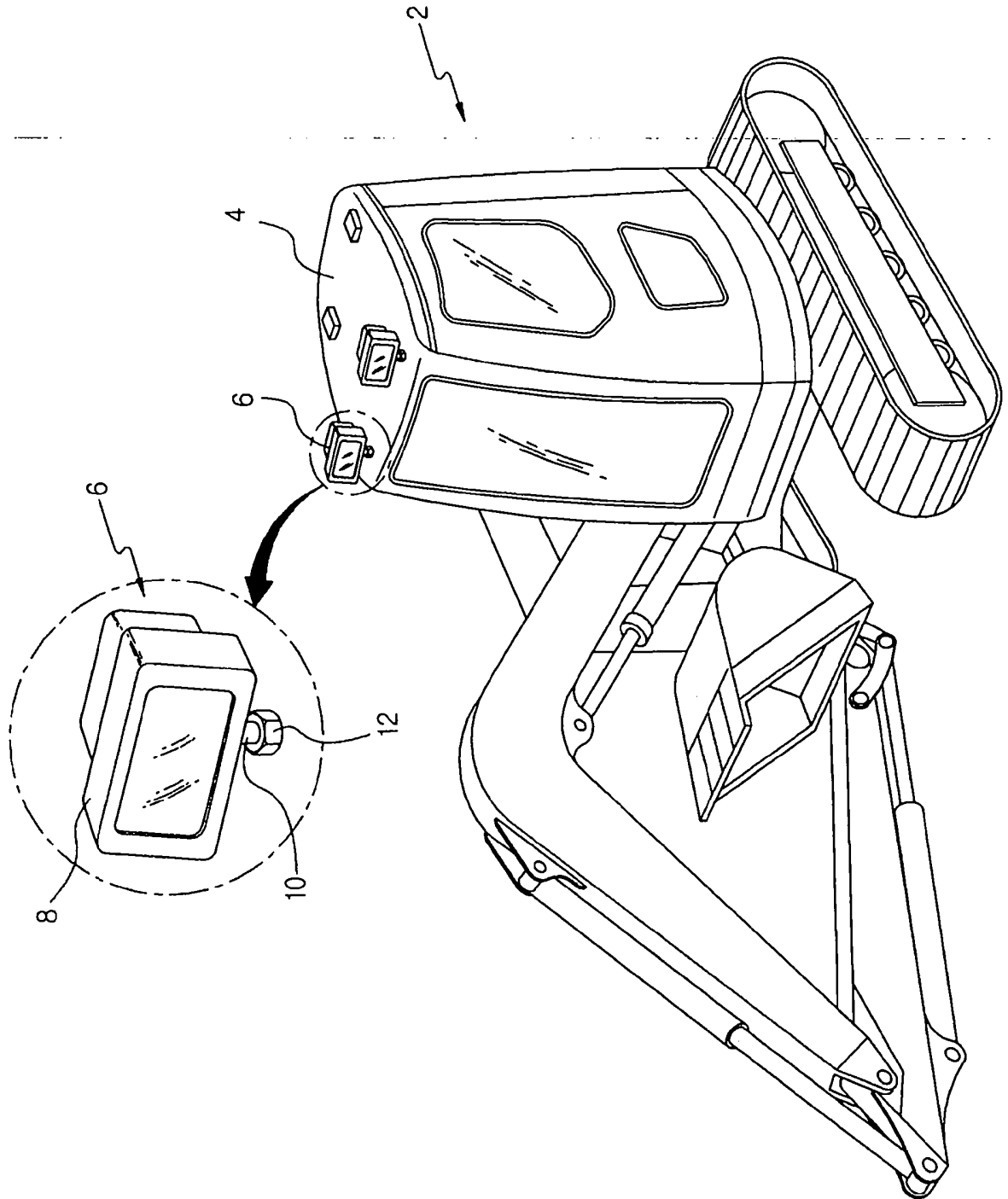


Fig. 2

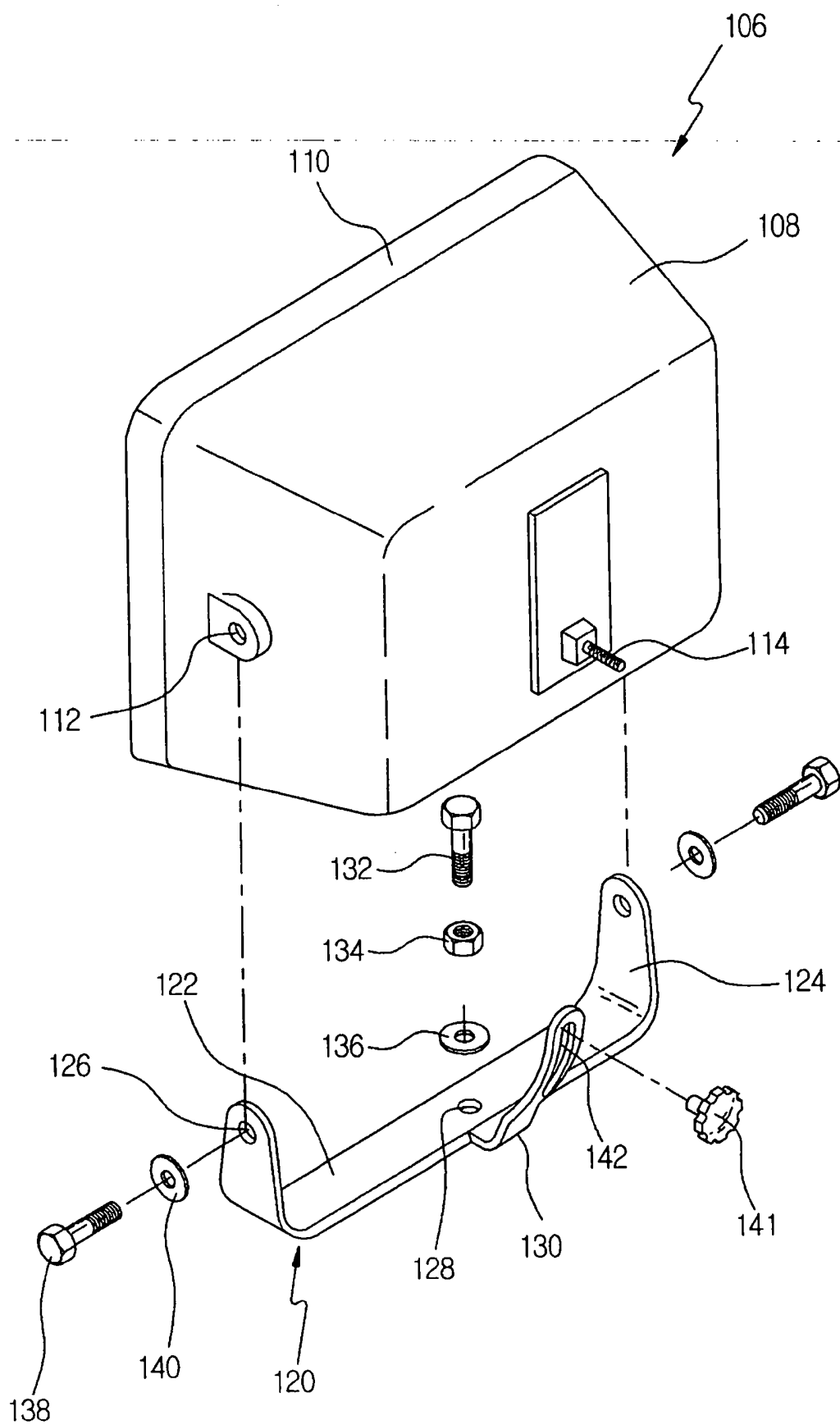


Fig. 3

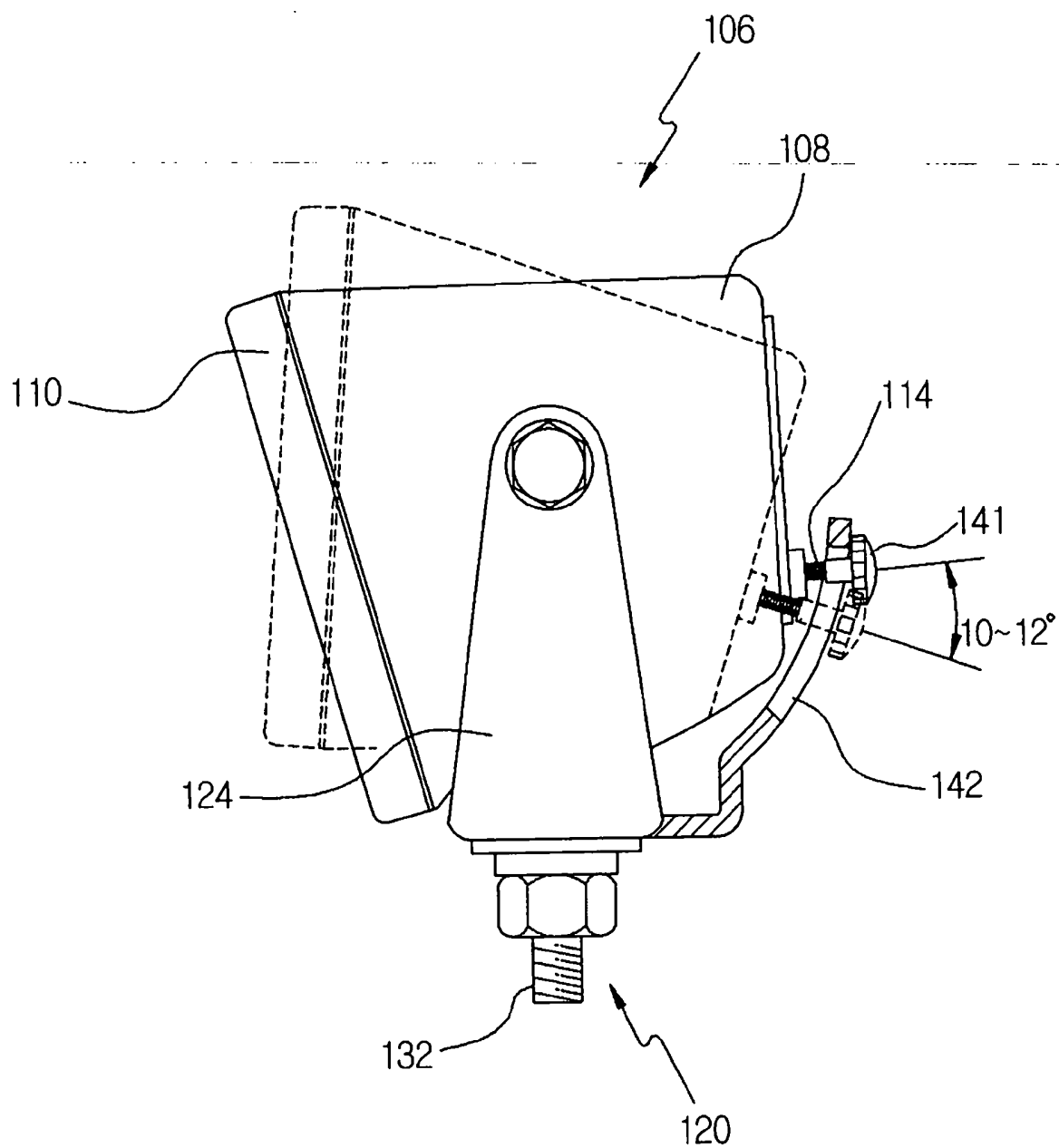


Fig. 4

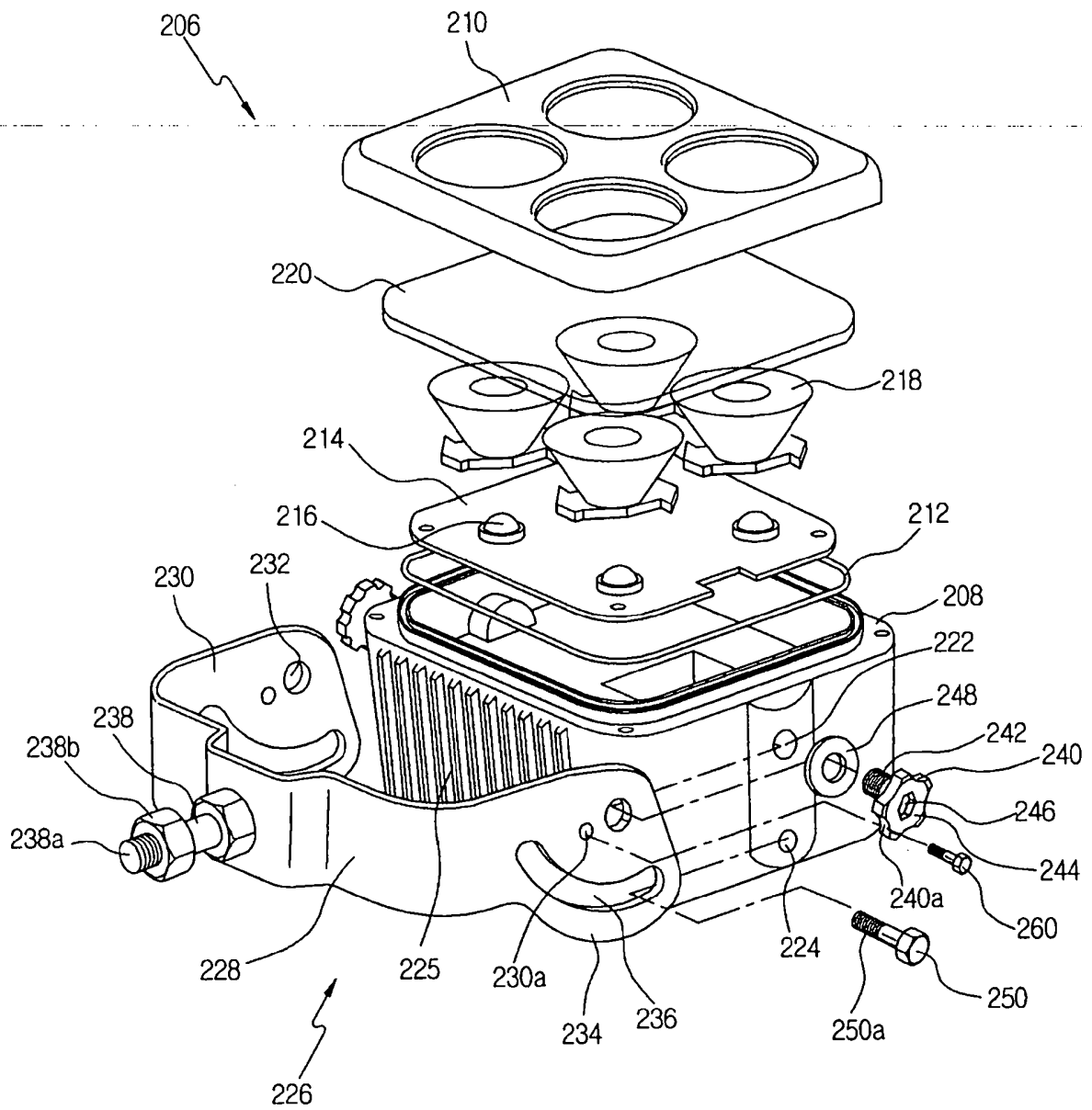


Fig. 5

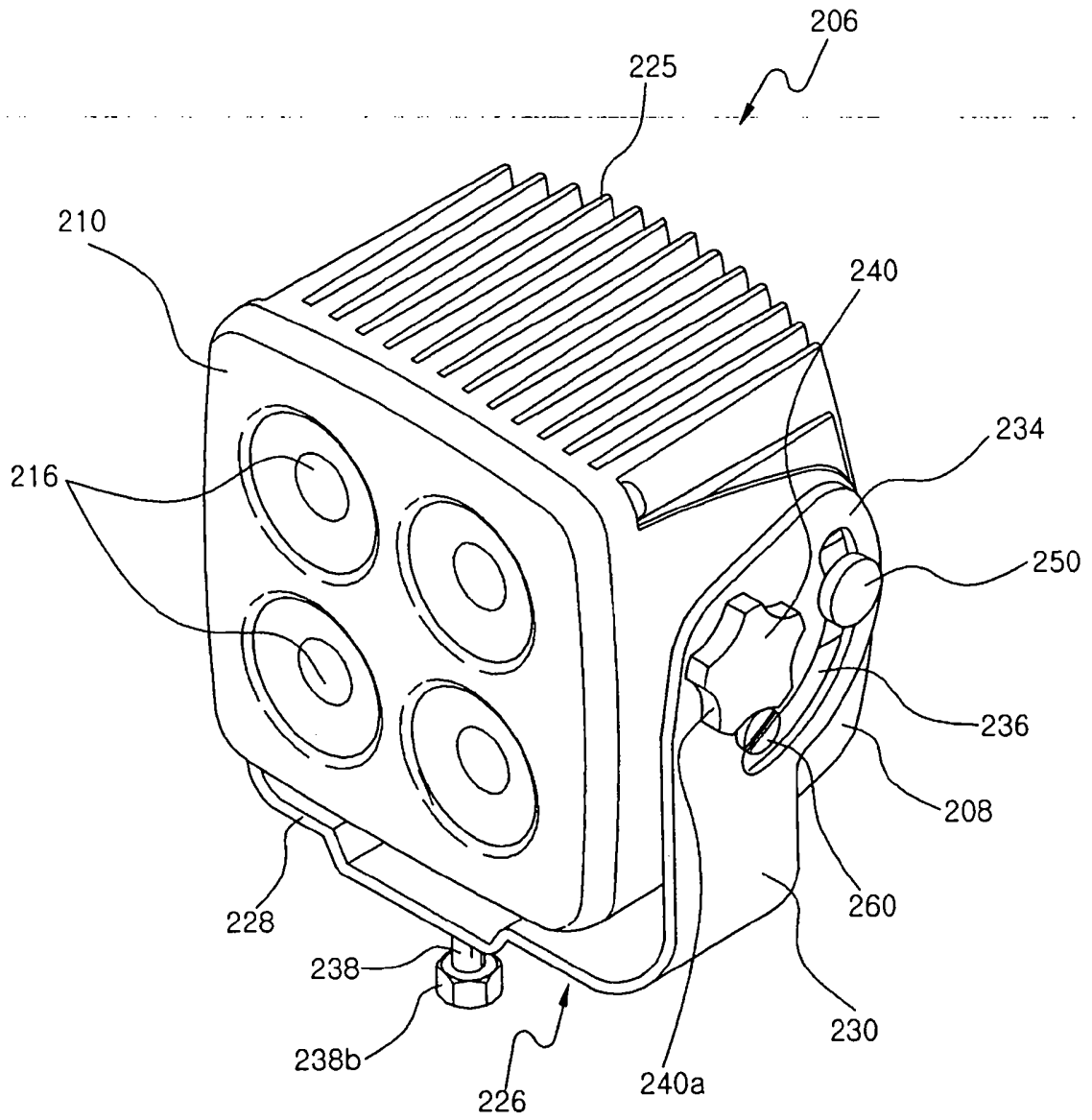


Fig. 6

