(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 722 654 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
14.10.2020 Bulletin 2020/42

(21) Application number: **20168386.9**

(22) Date of filing: **07.04.2020**

(51) Int Cl.:
F21K 9/233 *(2016.01)* ***F21V 5/04*** *(2006.01)*
F21V 23/00 *(2015.01)* *F21K 9/238* *(2016.01)*
F21K 9/69 *(2016.01)* *F21V 5/00* *(2018.01)*
F21V 7/00 *(2006.01)* *F21V 23/04* *(2006.01)*
F21V 29/70 *(2015.01)* *F21Y 105/12* *(2016.01)*
F21Y 107/50 *(2016.01)* *F21Y 113/10* *(2016.01)*
F21Y 113/13 *(2016.01)* *F21Y 115/10* *(2016.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **12.04.2019 CN 201920492279 U**

(71) Applicant: **LEEDARSON LIGHTING CO., LTD.**
Changtai, Zhangzhou
Fujian 363999 (CN)

(72) Inventors:
- **CHEN, Xueqiong**
  Zhangzhou, Fujian CN-363999 (CN)
- **JIANG, Hongkui**
  Zhangzhou, Fujian CN-363999 (CN)
- **YAN, Fengyu**
  Zhangzhou, Fujian CN-363999 (CN)

(74) Representative: **Leihkauf, Steffen Falk et al**
Jacobacci & Partners S.p.A.
Via Senato, 8
20121 Milano (IT)

(54) SPOT LIGHT APPARATUS

(57) A spot light apparatus (10) includes a light source plate (895), a driver (894), a control module (888) and a lens module (880). A color module (892) and a white light module (893) are mounted in a central area of the light source plate (895). The lens module (880) has an inner central lens (898), a surrounding lens (896), an outer central lens (881), and a main light output side (897). The inner central lens (898) refracts the mixed light to the main light output side (897). The surrounding lens (896) reflects the mixed light to the main output side (897). The outer central lens (881) mixes sub-lights from the color module (892) and the white light module (893). The inner central lens (898) is aligned with the central part of the light source plate (895) and disposed above the color module (892) and the white light module (893).

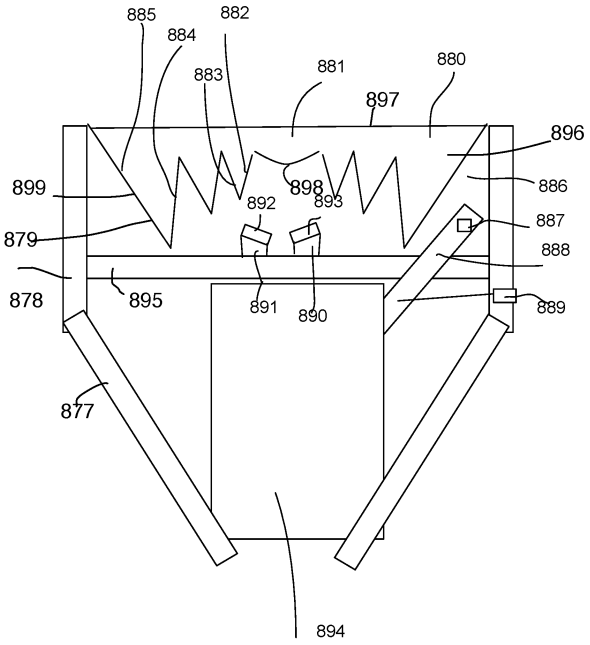

Fig. 10

EP 3 722 654 A1

Description

FIELD

[0001] The present invention is related to the technical field of illumination and more particularly related to a spot light apparatus.

BACKGROUND

[0002] Lighting or illumination is the deliberate use of light to achieve a practical or aesthetic effect. Lighting includes the use of both artificial light sources like lamps and light fixtures, as well as natural illumination by capturing daylight. Daylighting (using windows, skylights, or light shelves) is sometimes used as the main source of light during daytime in buildings. This can save energy in place of using artificial lighting, which represents a major component of energy consumption in buildings. Proper lighting can enhance task performance, improve the appearance of an area, or have positive psychological effects on occupants.

[0003] Indoor lighting is usually accomplished using light fixtures, and is a key part of interior design. Lighting can also be an intrinsic component of landscape projects.

[0004] A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. This effect is called electroluminescence. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.

[0005] Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared light. Infrared LEDs are used in remote-control circuits, such as those used with a wide variety of consumer electronics. The first visible-light LEDs were of low intensity and limited to red. Modern LEDs are available across the visible, ultraviolet, and infrared wavelengths, with high light output.

[0006] Early LEDs were often used as indicator lamps, replacing small incandescent bulbs, and in seven-segment displays. Recent developments have produced white-light LEDs suitable for room lighting. LEDs have led to new displays and sensors, while their high switching rates are useful in advanced communications technology.

[0007] LEDs have many advantages over incandescent light sources, including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. Light-emitting diodes are used in applications as diverse as aviation lighting, automotive headlamps, advertising, general lighting, traffic signals, camera flashes, lighted wallpaper and medical devices.

[0008] Unlike a laser, the color of light emitted from an LED is neither coherent nor monochromatic, but the spectrum is narrow with respect to human vision, and functionally monochromatic.

[0009] The energy efficiency of electric lighting has increased radically since the first demonstration of arc lamps and the incandescent light bulb of the 19th century. Modern electric light sources come in a profusion of types and sizes adapted to many applications. Most modern electric lighting is powered by centrally generated electric power, but lighting may also be powered by mobile or standby electric generators or battery systems. Battery-powered light is often reserved for when and where stationary lights fail, often in the form of flashlights, electric lanterns, and in vehicles.

[0010] Spot light devices provide light beams projected on desired object. It is important and useful to study the needs and characteristics of spot light devices to develop a better solution with lower cost, easy to assemble and good heat dissipation.

[0011] Although lighting devices are widely used, there are still lots of opportunity and benefit to improve the lighting devices to provide more convenient, low cost, reliable and beautiful lighting devices for enhancing human life.

SUMMARY

[0012] In some embodiments, a spot light apparatus includes a light source plate, a driver, a control module and a lens module.

[0013] The light source plate is mounted with a color module and a white light module in a central area of the light source plate.

[0014] The color module has LED chips of multiple colors integrated in a package. The driver is used for converting an external power source to an internal power source. The control module is electrically connected to the driver for controlling the color module and the white light module to emit a mixed light.

[0015] The lens module has an inner central lens, a surrounding lens, an outer central lens, and a main light output side. The inner central lens refracts the mixed light to the main light output side. The surrounding lens reflects the mixed light to the main output side. The outer central lens further mixes sub-lights from the color module and the white light module. The inner central lens is aligned with the central part of the light source plate and disposed above the color module and the white light module.

[0016] In some embodiments, the surrounding lens has multiple lens rings. Each lens ring has a tilt reflection surface for reflecting a sub-light of the mixed light to the light output side. The tilt reflection surface has a tilt angle less than 90 degrees with respect to the light source plate.

[0017] In some embodiments, each lens ring has a vertical wall for receiving the sub-light of the mixed light. The vertical wall is substantially perpendicular to the light source plate.

[0018] In some embodiments, the vertical wall of an external ring lens of the multiple lens rings engages the

light source plate.

[0019] In some embodiments, there are three lens rings arranged in parallel surrounding the central part of the light source plate.

[0020] In some embodiments, an external ring lens of the multiple lens rings has a larger length than an internal ring lens of the multiple lens rings.

[0021] In some embodiments, there is a reflection layer on the tilt reflection surface.

[0022] In some embodiments, there is a heat dissipation layer on the tilt reflection surface.

[0023] In some embodiments, the spot light apparatus also includes a light housing with a bowl potion and a neck portion. The lens module is installed to the bowl portion and defining a peripheral space. A portion of the control module is kept in the peripheral space.

[0024] In some embodiments, the control module comprises a wireless circuit disposed in the peripheral space.

[0025] In some embodiments, the control module is plugged to the driver and extended with a tilt angle toward the peripheral space.

[0026] In some embodiments, over 70% of the light housing is made of a metal material.

[0027] In some embodiments, there is an antenna area electrically connected to the control module and disposed on an exterior surface of the light housing.

[0028] In some embodiments, at least one of the color module and the white light module are disposed on the light source plate with a tilt angle so as to increase overlapping lights of the color module and the white light module.

[0029] In some embodiments, the outer central lens comprises more than 25 micro lens.

[0030] In some embodiments, there is a peripheral diffusion ring surrounding the outer central lens.

[0031] In some embodiments, the outer central lens and the peripheral diffusion ring are substantially located in the same plane.

BRIEF DESCRIPTION OF DRAWINGS

[0032]

Fig. 1 shows a spot light apparatus.

Fig. 2 shows a lens module of a spot light apparatus.

Fig. 3 shows a cross section view of a spot light apparatus.

Fig. 4 shows an exploded diagram of the embodiment in Fig. 1.

Fig. 5 shows a light source plate example.

Fig. 6 shows a lens module.

Fig. 7 shows another view of the lens module in Fig. 6.

Fig. 8 shows light paths of a spot light apparatus.

Fig. 9 shows a heat sink cup example.

Fig. 10 shows a spot light example.

DETAILED DESCRIPTION

[0033] In Fig. 10, a spot light apparatus includes a light source plate 895, a driver 894, a control module 888 and a lens module 880.

[0034] The light source plate 895 is mounted with a color module 892 and a white light module 893 in a central area of the light source plate 895.

[0035] The color module 892 has LED chips of multiple colors integrated in a package. The driver 894 is used for converting an external power source to an internal power source. The control module 888 is electrically connected to the driver 894 for controlling the color module 892 and the white light module 893 to emit a mixed light.

[0036] The lens module 880 has an inner central lens 898, a surrounding lens 896, an outer central lens 881, and a main light output side 897. The inner central lens 898 refracts the mixed light to the main light output side. The surrounding lens reflects the mixed light to the main output side 897. The outer central lens 881 further mixes sub-lights from the color module 892 and the white light module 893. The inner central lens 898 is aligned with the central part of the light source plate 895 and disposed above the color module 892 and the white light module 893.

[0037] In some embodiments, the surrounding lens has multiple lens rings. Each lens ring has a tilt reflection surface for reflecting a sub-light of the mixed light to the light output side. The tilt reflection surface has a tilt angle less than 90 degrees with respect to the light source plate.

[0038] In Fig. 10, each lens ring has a vertical wall 884 for receiving the sub-light of the mixed light. The vertical wall 884, 882 are substantially perpendicular to the light source plate 895.

[0039] In Fig. 10, the vertical wall of an external ring lens of the multiple lens rings engages the light source plate.

[0040] In some embodiments, there are three lens rings arranged in parallel surrounding the central part of the light source plate.

[0041] In some embodiments, an external ring lens of the multiple lens rings has a larger length than an internal ring lens 883 of the multiple lens rings.

[0042] In Fig. 10, there is a reflection layer 899 on the tilt reflection surface 885. For example, a material is coated or pained on surface of the lens module.

[0043] In Fig. 10, there is a heat dissipation layer 879 on the tilt reflection surface 885. For example, a metal layer is attached to the surface of the lens module.

[0044] In Fig. 10, the spot light apparatus also includes a light housing with a bowl potion 878 and a neck portion 877. The lens module is installed to the bowl portion 878 and defining a peripheral space 886. A portion of the control module 888 is kept in the peripheral space 886.

[0045] In Fig. 10, the control module 888 comprises a wireless circuit 887 disposed in the peripheral space.

[0046] In some embodiments, the control module is plugged to the driver and extended with a tilt angle toward

the peripheral space.

[0047] In some embodiments, over 70% of the light housing is made of a metal material.

[0048] In Fig. 10, there is an antenna area 889 electrically connected to the control module and disposed on an exterior surface of the light housing.

[0049] In Fig. 10, at least one of the color module and the white light module are disposed on the light source plate with a tilt angle, e.g. on tilt platforms 891, 890 so as to increase overlapping lights of the color module and the white light module.

[0050] In some embodiments, the outer central lens comprises more than 25 micro lens.

[0051] In some embodiments, there is a peripheral diffusion ring surrounding the outer central lens.

[0052] In some embodiments, the outer central lens and the peripheral diffusion ring are substantially located in the same plane.

[0053] Please refer to Fig. 1. The spot light apparatus 10 has a lens module 50. The lens module 50 has an outer central lens 51. A peripheral diffusion ring 511 surrounds the outer central lens 51.

[0054] Please refer to Fig. 2 and Fig. 6. The peripheral diffusion ring 511 surrounds the outer central lens 51.

[0055] Please refer to Fig. 7, which shows another view of the example in Fig. 6. In Fig. 7, the lens module 50 has a central inner lens 52. There are three peripheral lens 53.

[0056] Please refer to Fig. 3, which shows a spot light apparatus 10. The lens module 50 has an outer central lens 51. There is also an inner central lens 52. There are three surrounding lens 53 surrounding the inner central lens 52. There is a light source plate 20. There is a control module 40. The light source plate 20 is placed in a heat dissipation cup 60. There is a driver 30.

[0057] Please refer to Fig. 4, which shows an exploded diagram of the example in Fig. 3. Therefore, reference numerals with the same values refer to the same components and are not repeated for brevity.

[0058] In Fig. 4, there are two screws 70 for fixing the light source plate 21 mounted with a color module 23 and a white light module 22.

[0059] In Fig. 5, the light source plate 21 has a color module 23. The color module 23 has a red LED chip 232, a blue LED chip 233, a green LED chip 234 integrated in a package 231. There are more than one white light modules 22 surrounding the color module 23. There is a positioning structure 211.

[0060] Fig. 8 shows light paths in an example. In Fig. 8, most light are refracted by the inner central lens 52 to emit light from an external central lens 51. There are micro lens on the external central lens 51 for further mixing lights from the color module and the white light module. Some lights enter the peripheral lens 53 and are reflected to the desired output directions.

[0061] In Fig. 9, the heat sink cup 60 has a positioning block 61 with a cone structure 62 for guiding connection of the heat sink cup 60 and the light source plate.

[0062] The foregoing description, for purpose of explanation, has been described with reference to specific embodiments. However, the illustrative discussions above are not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations are possible in view of the above teachings.

[0063] The embodiments were chosen and described in order to best explain the principles of the techniques and their practical applications. Others skilled in the art are thereby enabled to best utilize the techniques and various embodiments with various modifications as are suited to the particular use contemplated.

[0064] Although the disclosure and examples have been fully described with reference to the accompanying drawings, it is to be noted that various changes and modifications will become apparent to those skilled in the art. Such changes and modifications are to be understood as being included within the scope of the disclosure and examples as defined by the claims.

Claims

1. A spot light apparatus, **characterized by** comprising:

   a light source plate (895) mounted with a color module (892) and a white light module (893) in a central area of the light source plate (895), the color module (892) having LED chips of multiple colors integrated in a package;
   a driver (894) configured for converting an external power source to an internal power source;
   a control module (888), electrically connected to the driver (894) and configured for controlling the color module (892) and the white light module (893) to emit a mixed light; and
   a lens module (880) having an inner central lens (898), a surrounding lens (896), an outer central lens (881), and a main light output side (897), the inner central lens (898) refracting the mixed light to the main light output side (897), the surrounding lens (896) reflecting the mixed light to the main light output side (897), the outer central lens (881) further mixing sub-lights from the color module (892) and the white light module (893), the inner central lens (898) being aligned with the central part of the light source plate (895) and being disposed above the color module (892) and the white light module (893).

2. The spot light apparatus of claim 1, wherein the surrounding lens (896) has multiple lens rings, each lens ring has a tilt reflection surface for reflecting a sub-light of the mixed light to the light output side, and the tilt reflection surface has a tilt angle less than 90 degrees with respect to the light source plate (895).

3. The spot light apparatus of claim 2, wherein each lens ring has a vertical wall (884) for receiving the sub-light of the mixed light, wherein the vertical wall (884) is substantially perpendicular to the light source plate (895).

4. The spot light apparatus of claim 3, wherein the vertical wall of an external ring lens of the multiple lens rings engages the light source plate (895).

5. The spot light apparatus of any one of claims 2 to 4, wherein there are three lens rings arranged in parallel surrounding the central part of the light source plate (895).

6. The spot light apparatus of any one of claims 2 to 5, wherein an external ring lens of the multiple lens rings has a larger length than an internal ring lens (883) of the multiple lens rings.

7. The spot light apparatus of any one of claims 2 to 6, wherein there is a reflection layer (899) on the tilt reflection surface.

8. The spot light apparatus of claim 6, wherein there is a heat dissipation layer (879) on the tilt reflection surface (885).

9. The spot light apparatus of any one of claims 1 to 8, further comprising a light housing with a bowl potion (878) and a neck portion (877), the lens module (880) being installed to the bowl portion (878) and defining a peripheral space (886), a portion of the control module (888) being kept in the peripheral space (886).

10. The spot light apparatus of claim 9, wherein the control module (888) comprises a wireless circuit (887) disposed in the peripheral space (886).

11. The spot light apparatus of any one of claims 9 to 10, wherein the control module (888) is plugged to the driver (894) and extended with a tilt angle toward the peripheral space (886).

12. The spot light apparatus of any one of claims 9 to 11, wherein over 70% of the light housing is made of a metal material.

13. The spot light apparatus of claim 12, wherein there is an antenna area (889) electrically connected to the control module (888) and disposed on an exterior surface of the light housing.

14. The spot light apparatus of any one of claims 1 to 13, wherein at least one of the color module (892) and the white light module (893) are disposed on the light source plate with a tilt angle so as to increase overlapping lights of the color module and the white light module.

15. The spot light apparatus of any one of claims 1 to 14, wherein there is a peripheral diffusion ring (511) surrounding the outer central lens, the outer central lens and the peripheral diffusion ring are substantially located in the same plane.

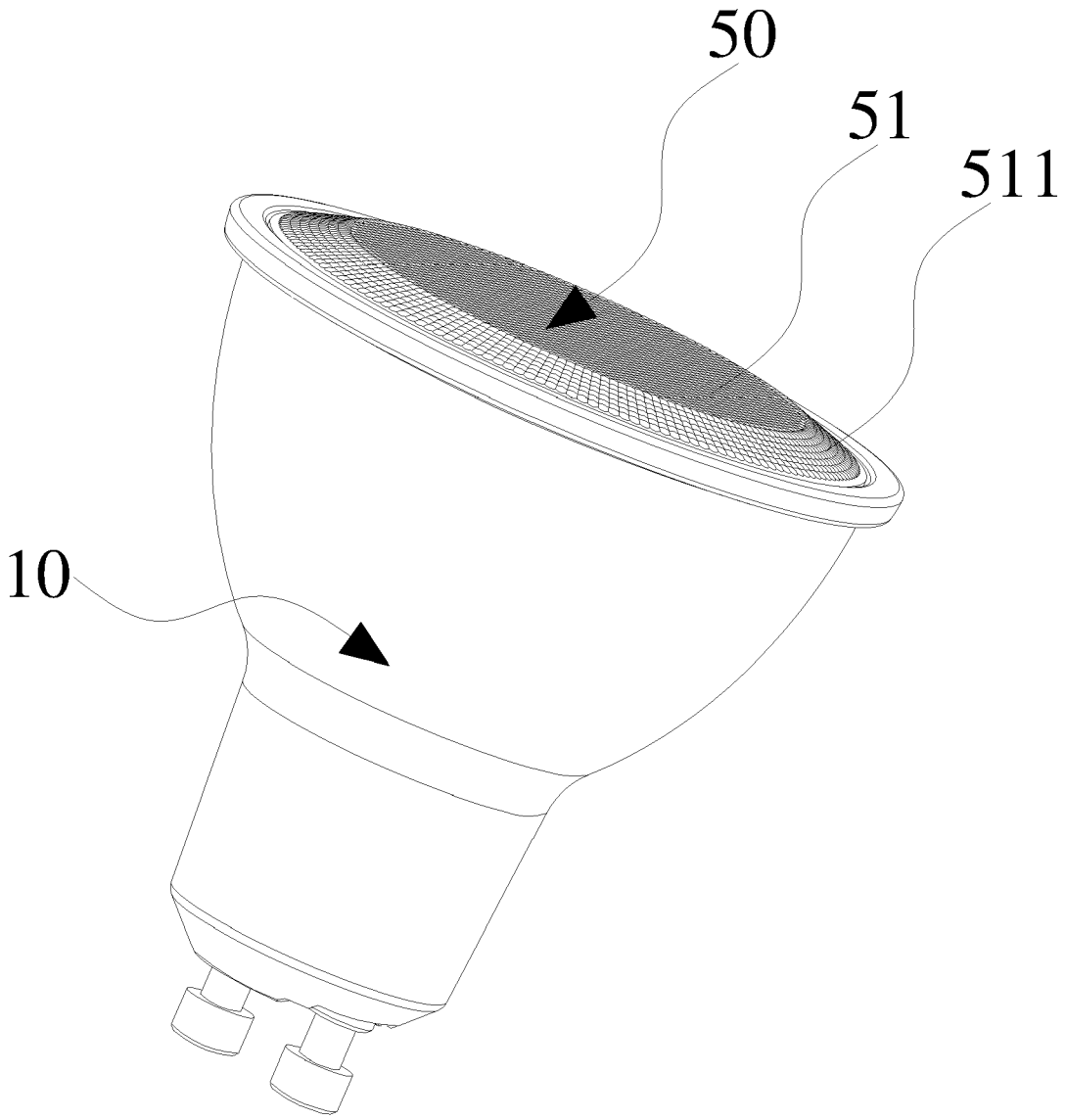

Fig.1

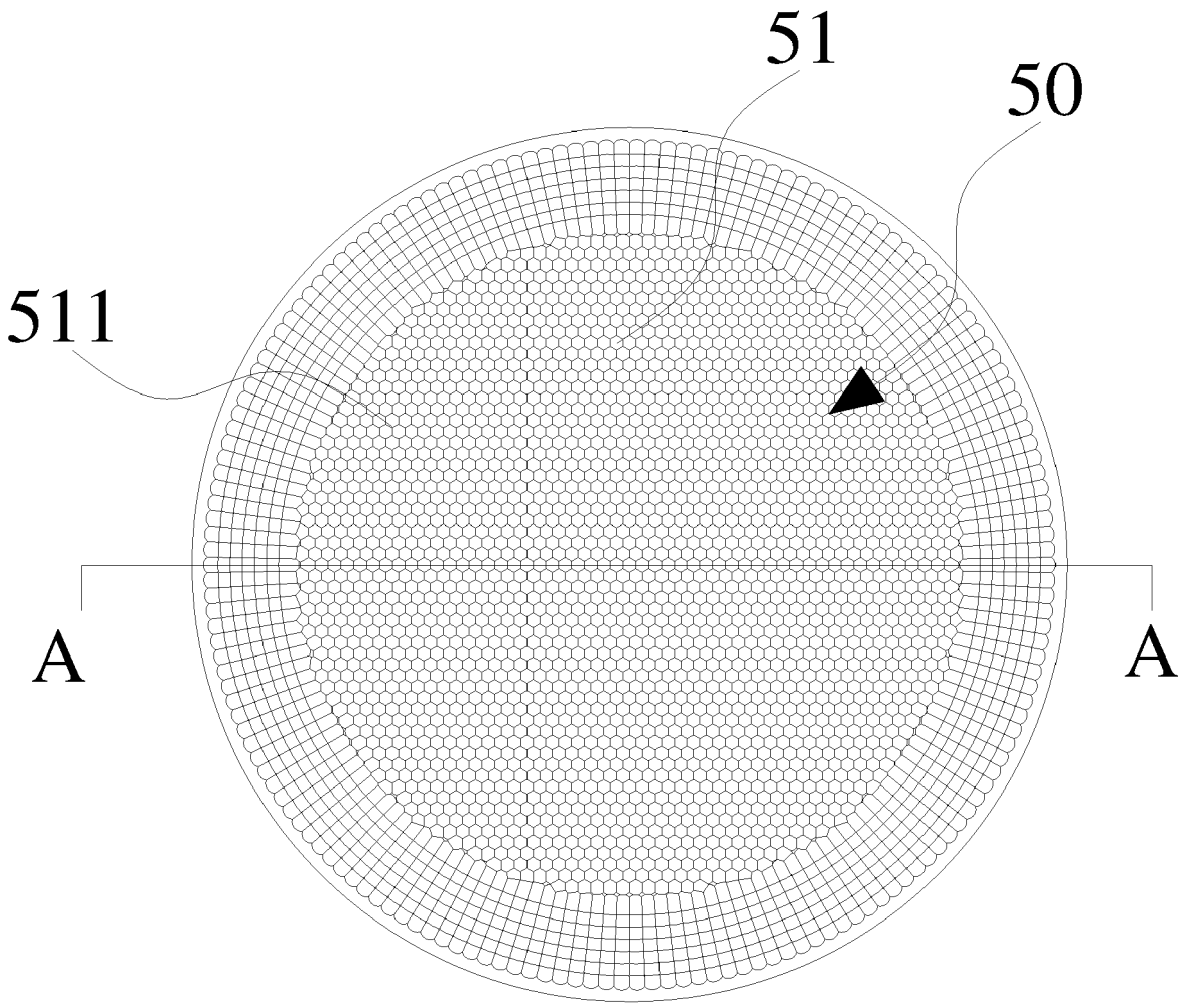

Fig. 2

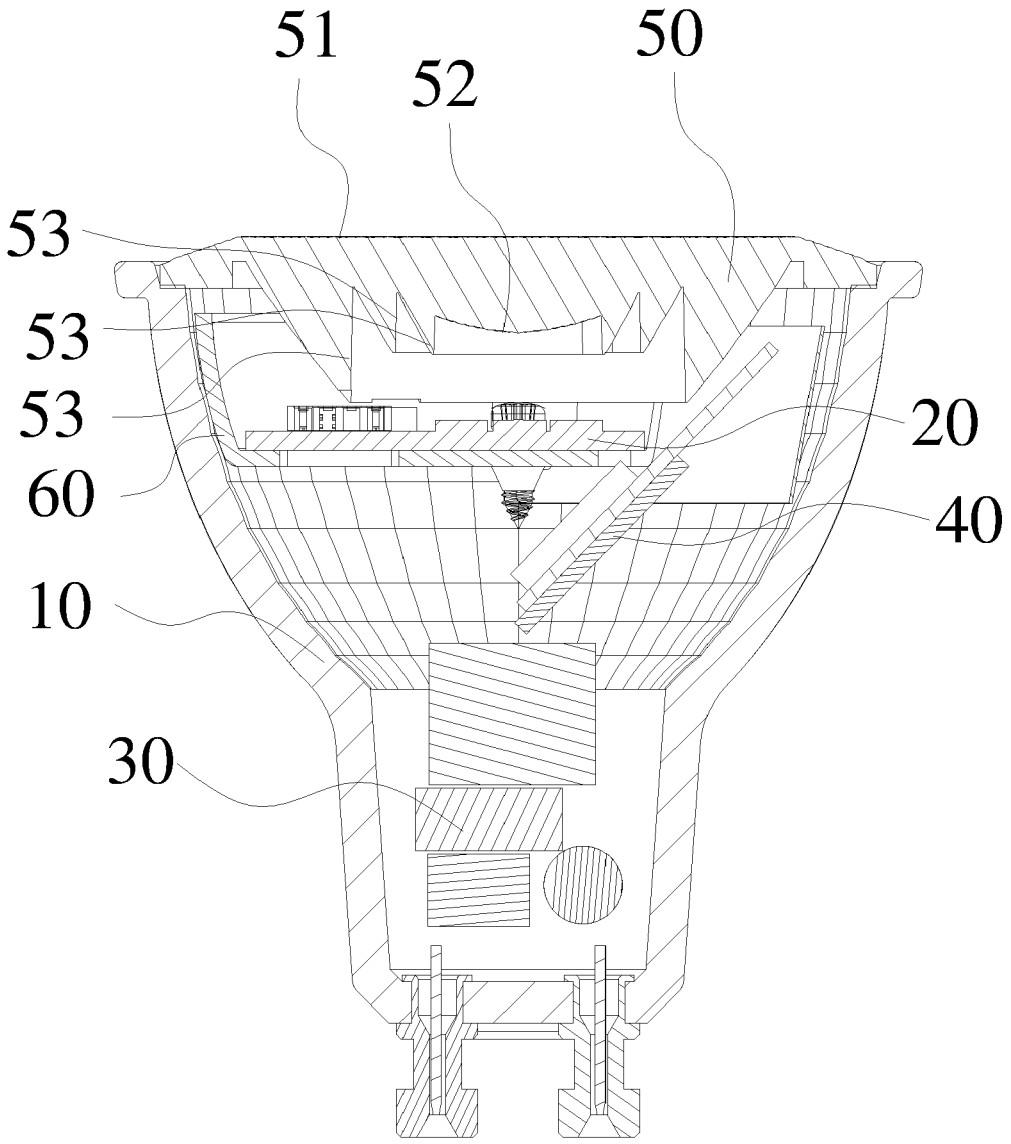

Fig. 3

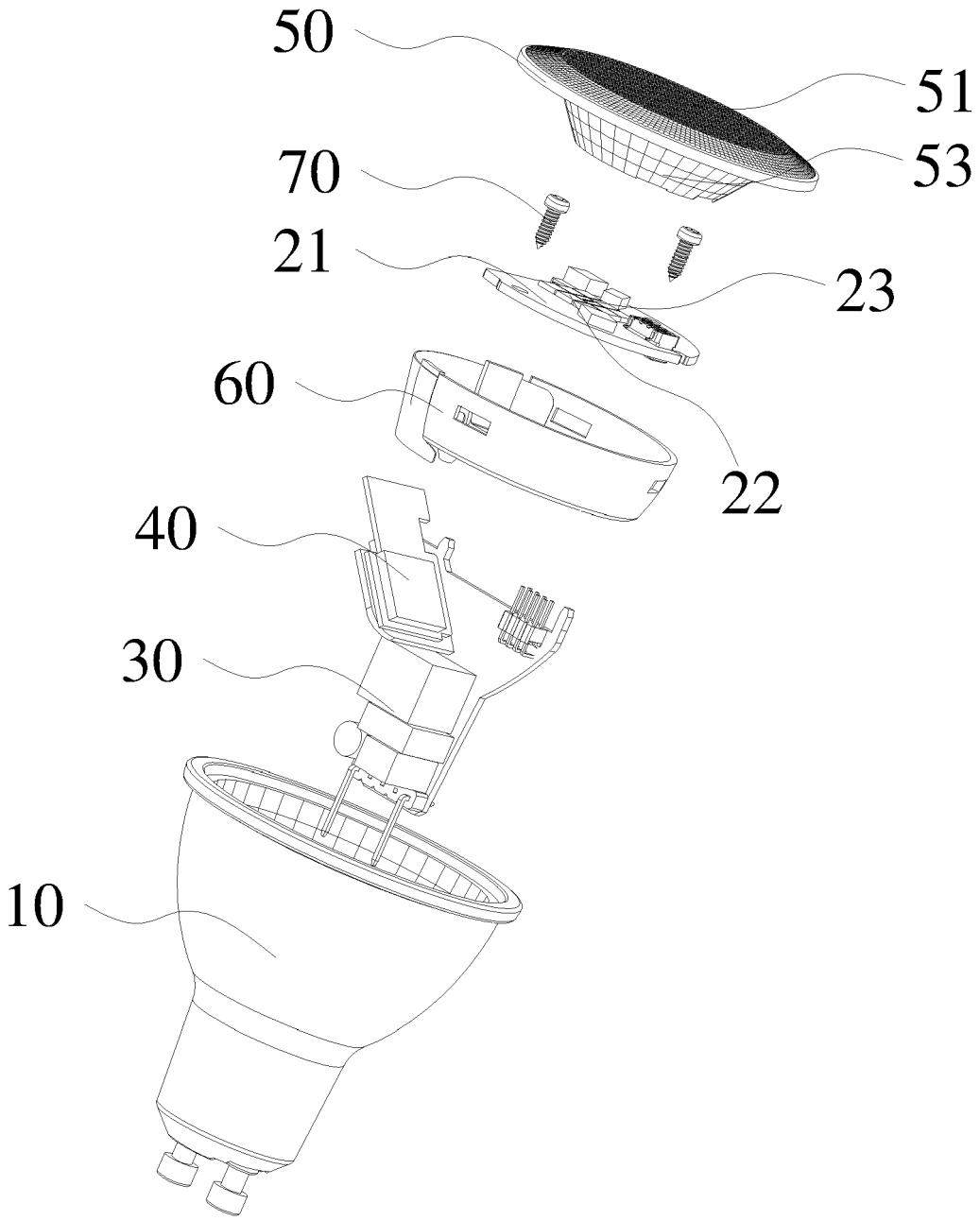

Fig. 4

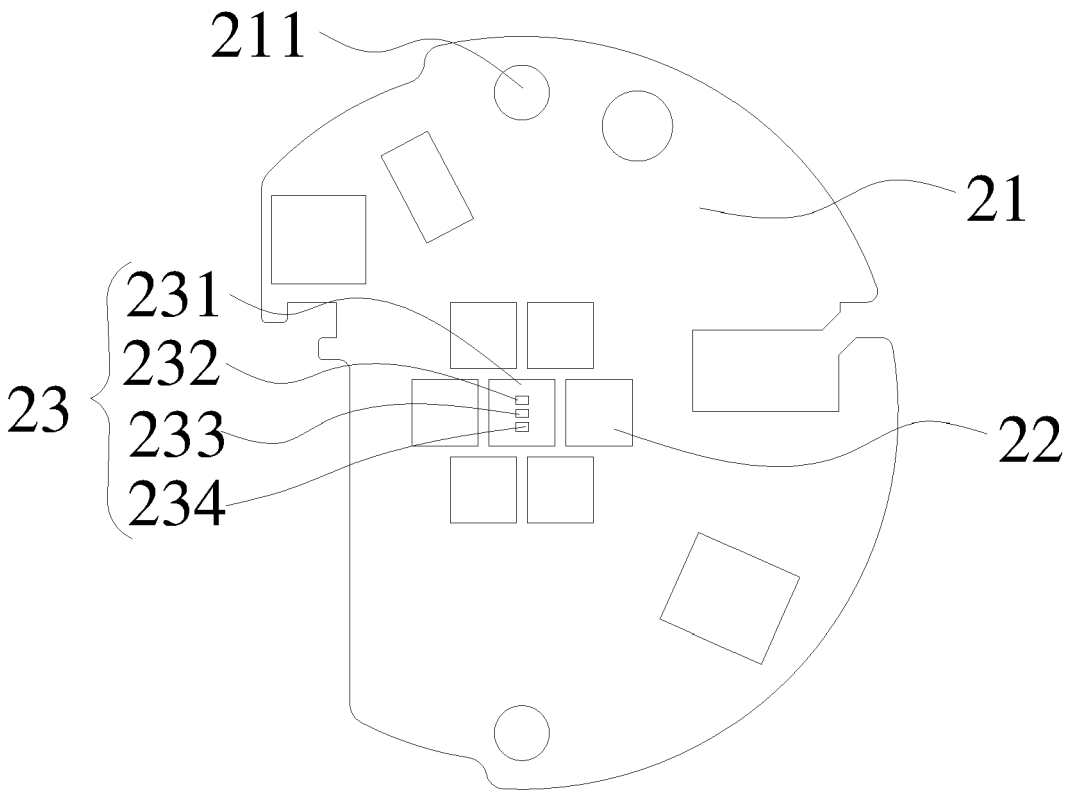

Fig. 5

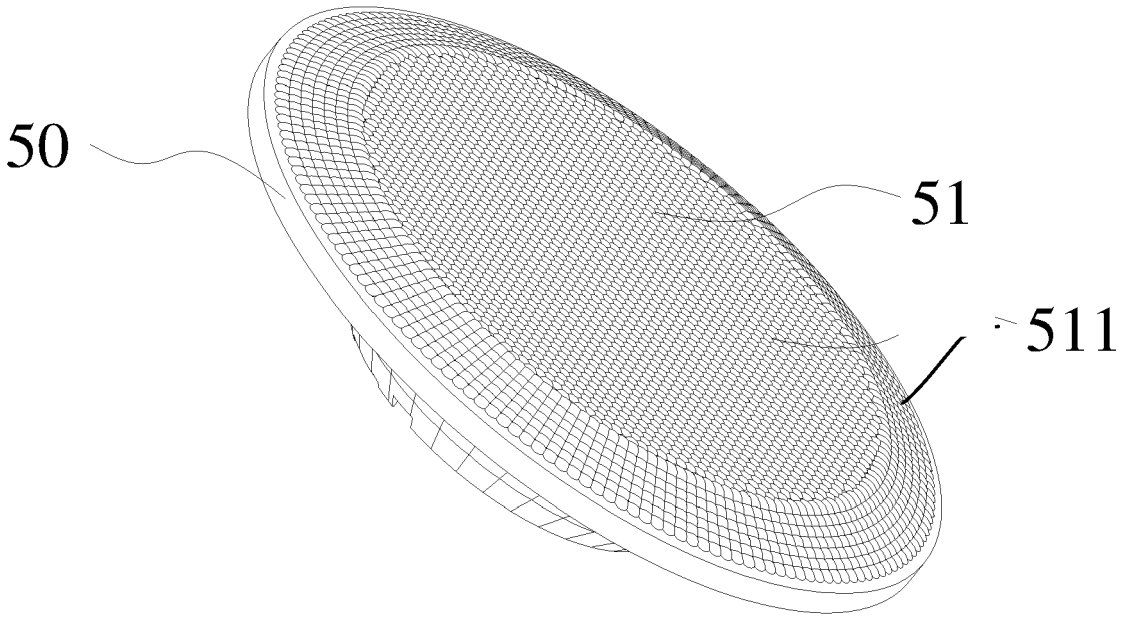

Fig. 6

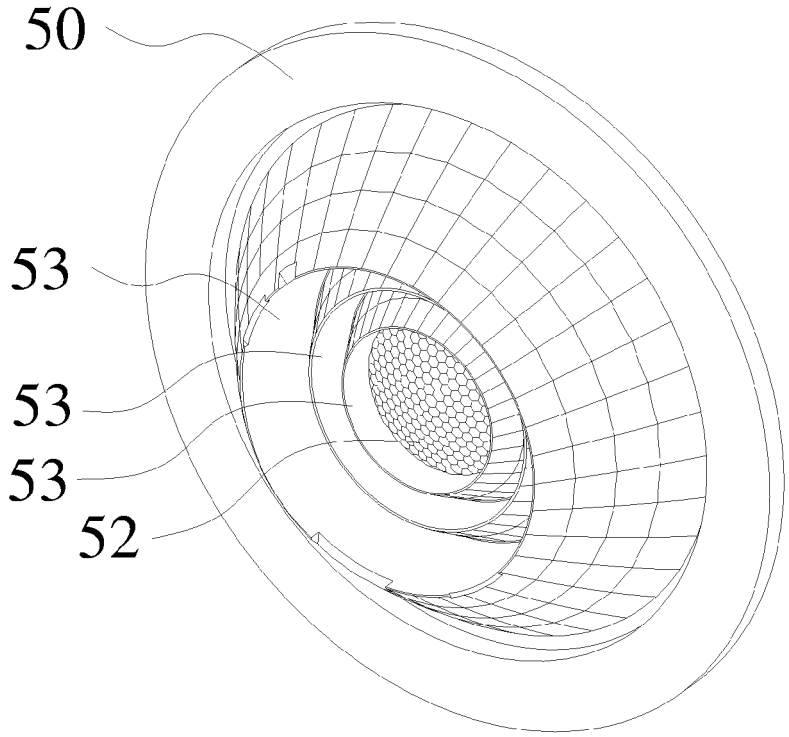

Fig. 7

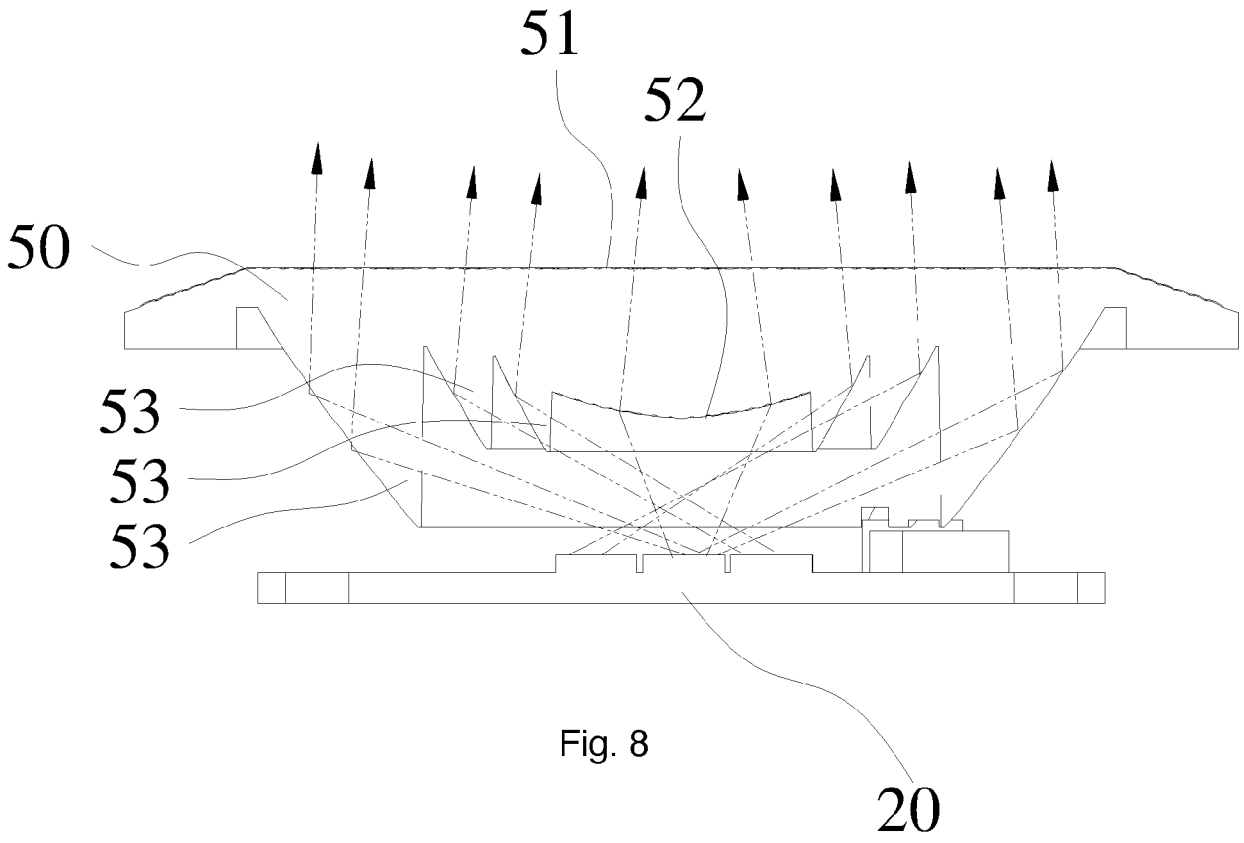

Fig. 8

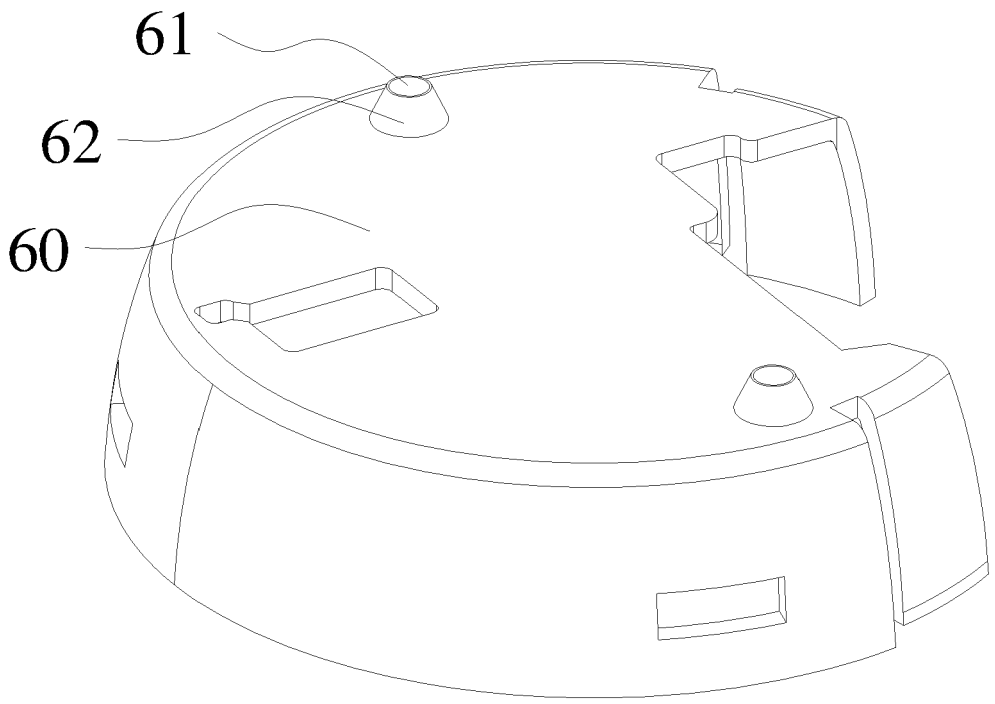

Fig. 9

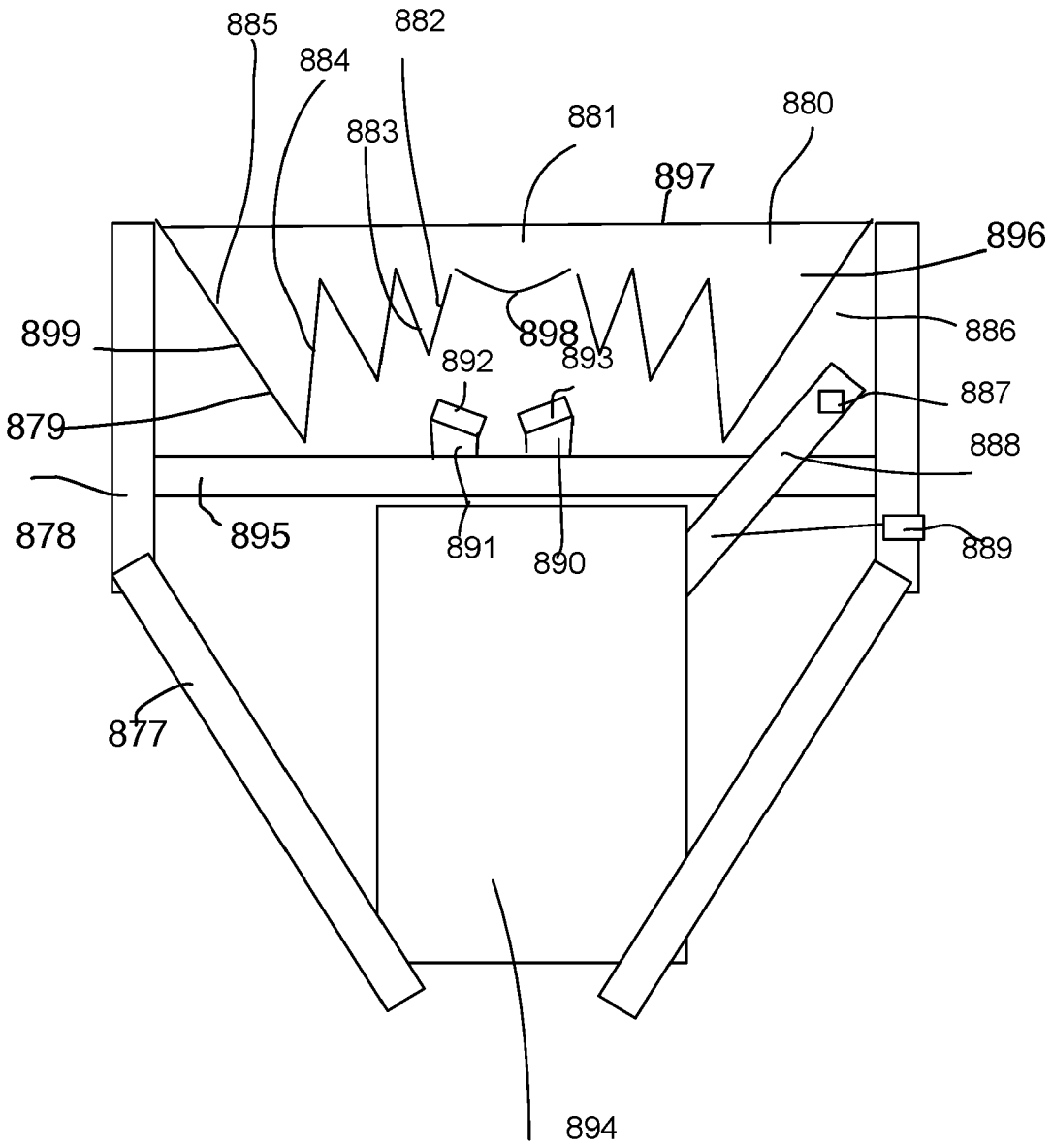
885
882
884
883
881
880
897
896
899
898
886
892
893
887
879
888
878
895
891
890
889
877
894

Fig. 10

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 20 16 8386

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y A	US 2017/254525 A1 (KLAFTA THOMAS [DE] ET AL) 7 September 2017 (2017-09-07) * paragraphs [0012], [0045] - [0062]; figures 1-9 * -----	1-10, 12-15 1,13,14 11	INV. F21K9/233 F21V5/04 F21V23/00
Y	US 2012/274208 A1 (CHEN BINGZHOU [CN] ET AL) 1 November 2012 (2012-11-01) * paragraphs [0035] - [0038]; figures 1,2 * -----	1,13	ADD. F21K9/238 F21K9/69 F21V5/00 F21V7/00
Y	WO 2012/159744 A2 (NASERI MORTEZA MOBALEGH [DE]; GUEZEL GALIP [DE]; HOBLER HARTWIN [DE]) 29 November 2012 (2012-11-29) * figure 1c * -----	14	F21V23/04 F21V29/70 F21Y105/12 F21Y107/50 F21Y113/10 F21Y113/13 F21Y115/10

TECHNICAL FIELDS SEARCHED (IPC)
F21K F21V F21Y

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	30 July 2020	Menn, Patrick

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 16 8386

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

30-07-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2017254525 A1	07-09-2017	CN 107152609 A	12-09-2017
		DE 102016203400 A1	07-09-2017
		US 2017254525 A1	07-09-2017
US 2012274208 A1	01-11-2012	BR PI1010173 A2	29-03-2016
		CN 102804493 A	28-11-2012
		EP 2438647 A1	11-04-2012
		JP 2012529143 A	15-11-2012
		KR 20120036937 A	18-04-2012
		US 2012274208 A1	01-11-2012
		WO 2010140136 A1	09-12-2010
WO 2012159744 A2	29-11-2012	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82