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(54) **COOLING ASSEMBLY FOR COOLING AT LEAST ONE LIGHT SOURCE OF A LIGHT FIXTURE AND LIGHT FIXTURE COMPRISING SAID COOLING ASSEMBLY**

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F21V 29/503	(2015.01)
F21V 29/67	(2015.01)
F21W 131/406	(2006.01)

(52) **U.S. Cl.**

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(58) **Field of Classification Search**

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See application file for complete search history.

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(57) **ABSTRACT**

A cooling assembly for cooling at least one light source of a light fixture is provided with at least a cooling fan configured to generate a cooling air flow; and at least with a flow-guiding element configured to convey the cooling air flow of the cooling fan and divide it into a primary flow adapted to mainly cool a first zone of the light source and at least a secondary flow adapted to mainly cool a second zone of the light source, at least partially distinct from the first zone.

13 Claims, 4 Drawing Sheets

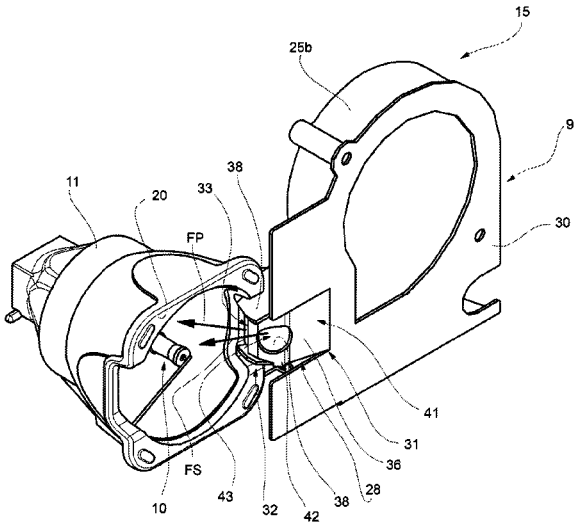


FIG. 1

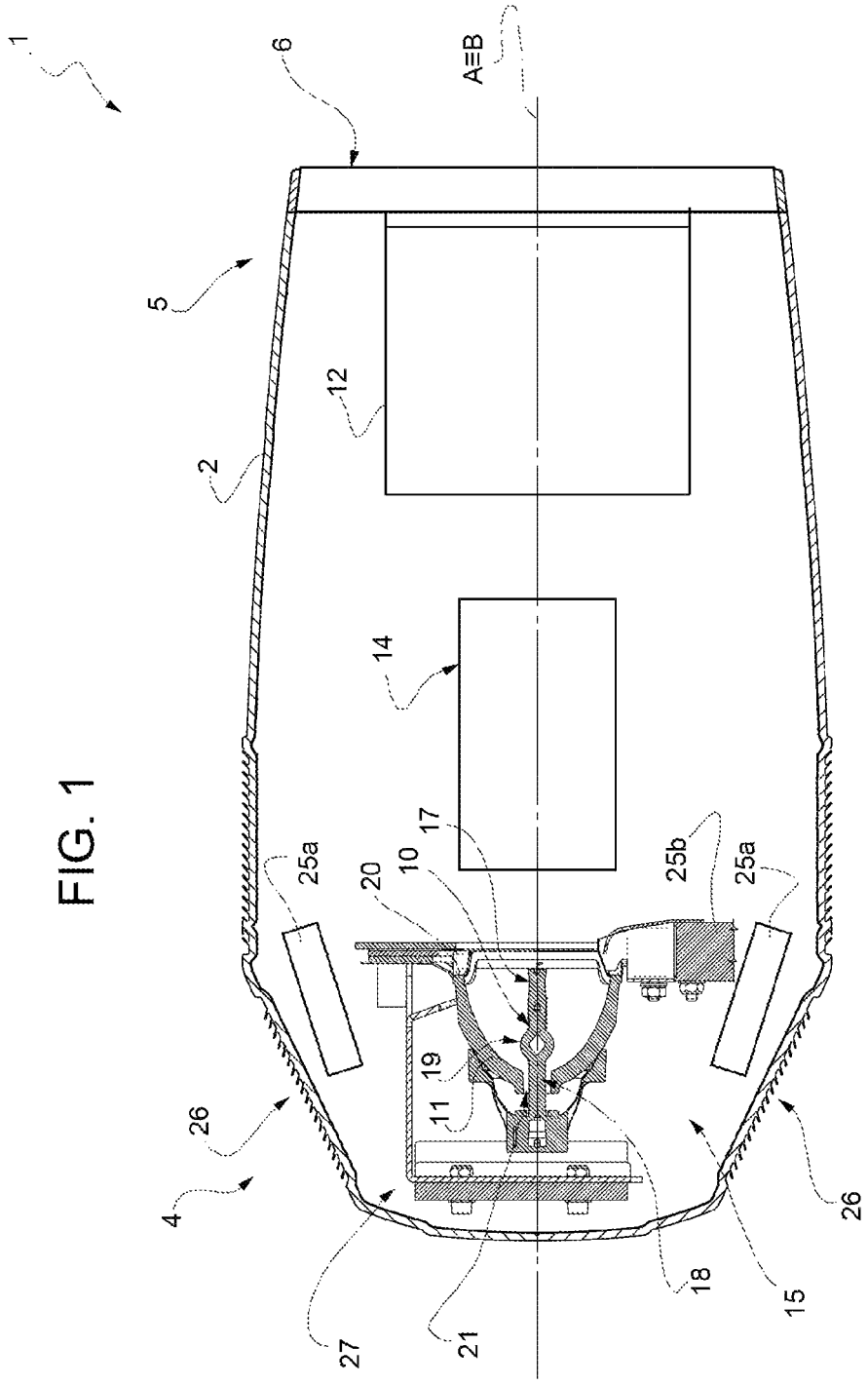
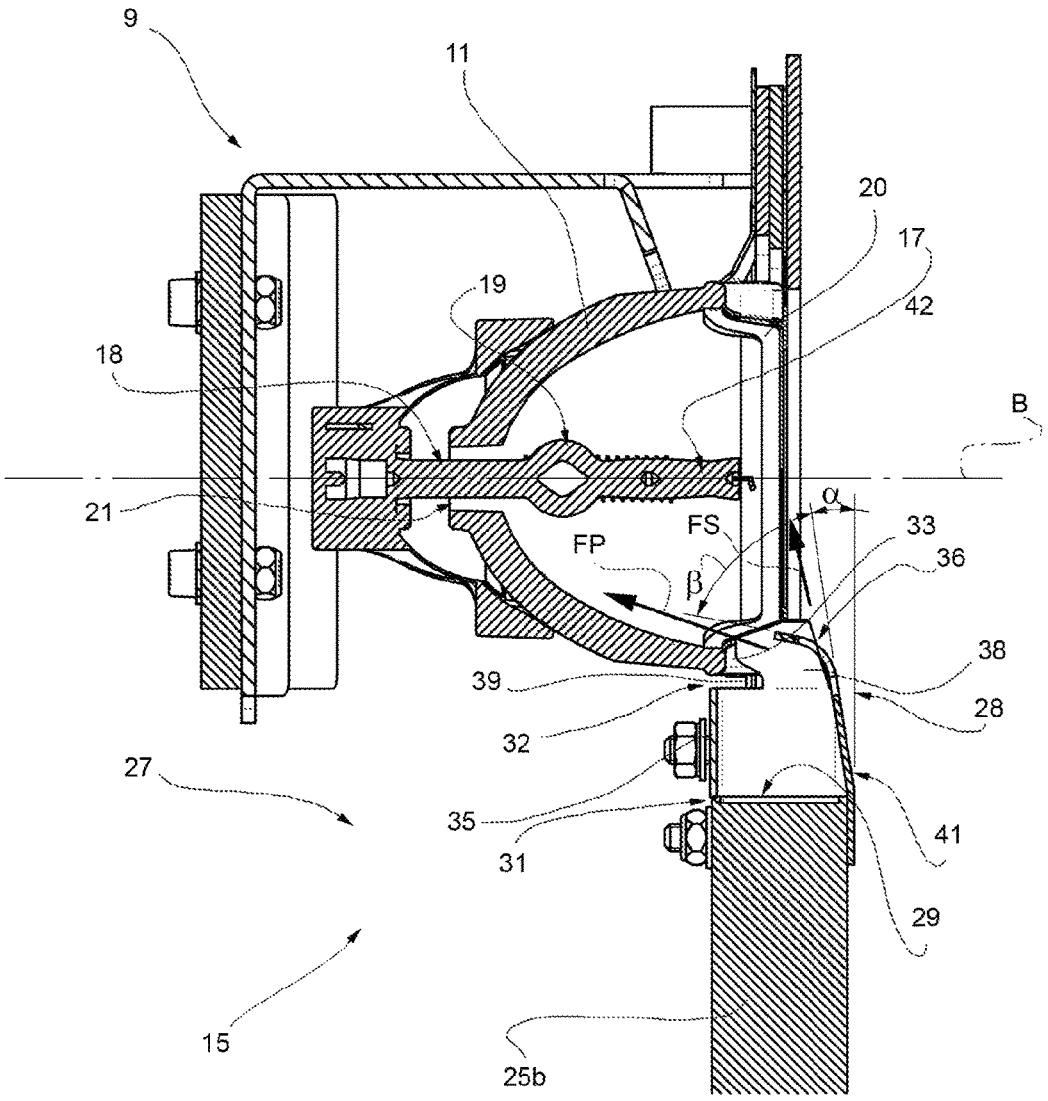


FIG. 2



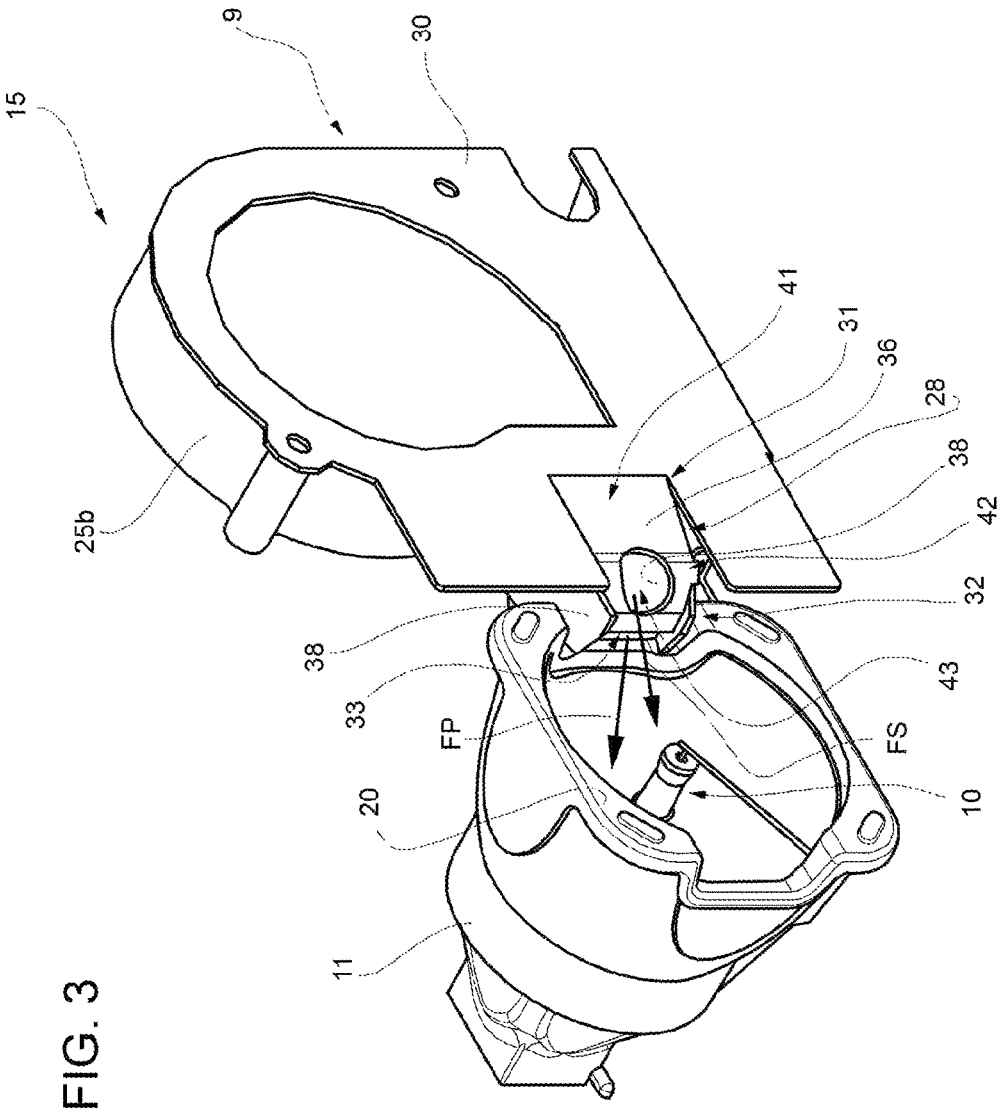
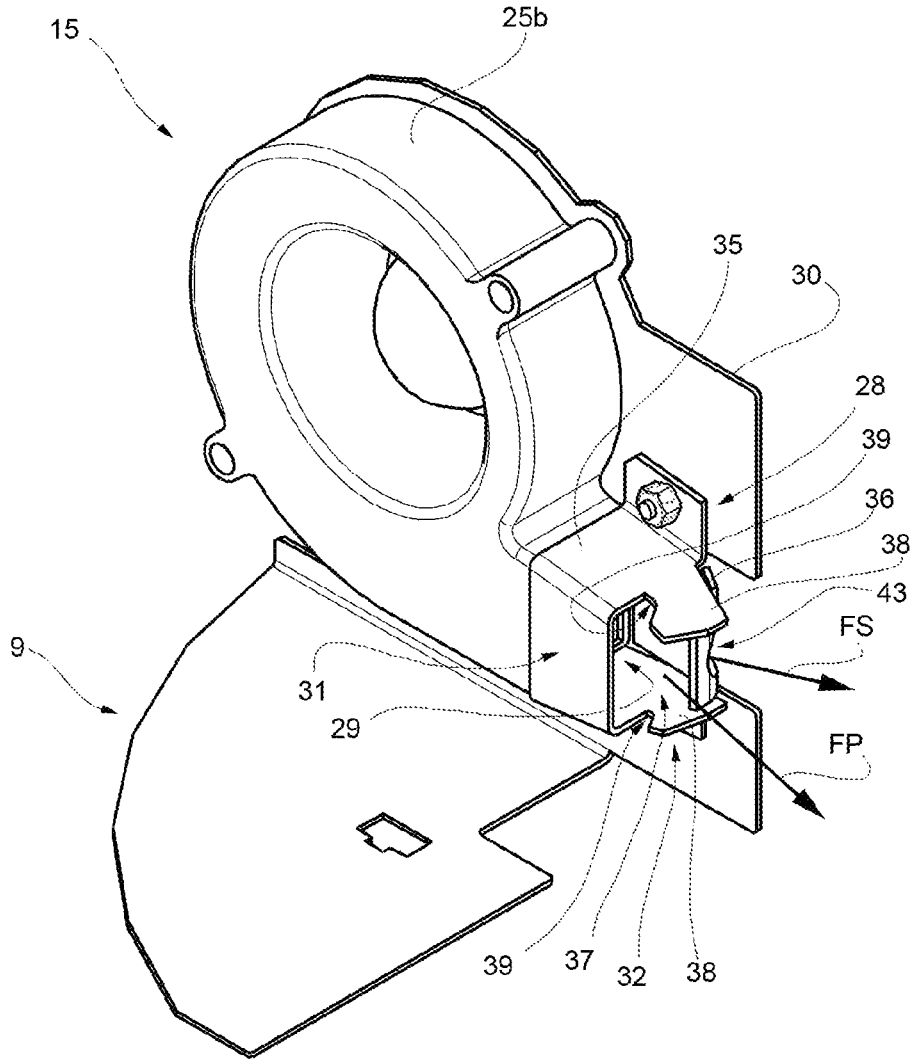


FIG. 3

FIG. 4



COOLING ASSEMBLY FOR COOLING AT LEAST ONE LIGHT SOURCE OF A LIGHT FIXTURE AND LIGHT FIXTURE COMPRISING SAID COOLING ASSEMBLY

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

The present application claims the benefit of priority under 35 U.S.C. § 119 of Italian patent application serial No. MI2015A000554, filed Apr. 16, 2015, which is hereby incorporated by reference in its entirety.

The present invention relates to a cooling assembly for cooling at least a light source of a light fixture and a light fixture comprising said cooling assembly.

Preferably, the cooling assembly is configured to cool at least a light source of a stage light fixture.

BACKGROUND OF THE INVENTION

The stage light fixtures of known type, in fact, comprise at least one light source configured to generate a light beam and a plurality of light beam processing elements configured to selectively process the light beam according to the stage requirements. The light source and the light beam processing elements are generally housed in a casing and generate heat inside the casing.

The heat accumulated inside the casing can excessively heat the light source and the remaining components of the light fixture, with the risk of permanent damage. For these reasons, the majority of stage light fixtures includes a cooling system capable of removing the heat generated inside the casing. However, the normally used cooling systems cannot always correctly cool the casing interior. Sometimes, in fact, an insufficient cooling or an excessive cooling has irreparable consequences, which mostly determine a reduction of the duration of the light source or even the breakage of the light source.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a cooling assembly which is free from the aforesaid drawbacks of the prior art. In particular, it is an object of the present invention to provide a cooling assembly for cooling at least a light source of a light fixture which can suitably cool the light source during use, so as to ensure an adequate durability and reliability.

According to these objects, the present invention relates to a cooling assembly for cooling at least a light source of a light fixture comprising:

- at least one cooling fan configured to produce a cooling air flow;
- at least one flow-guiding element configured to guide the cooling air flow of the cooling fan and divide it into a primary air flow, able to mainly cool a first zone of the light source, and at least a secondary air flow, able to mainly cool a second zone of the light source, at least in part distinct from the first zone.

It is also an object of the present invention to provide a reliable and long-lasting light fixture.

According to these objects, the present invention relates to a light fixture comprising a casing, a light source arranged inside the casing and able to produce a light beam, and a cooling assembly for cooling at least a light source of a light fixture; the cooling assembly comprising:

- at least one cooling fan configured to produce a cooling air flow;
- at least one flow-guiding element configured to guide the cooling air flow of the cooling fan and divide it into a primary air flow, able to mainly cool a first zone of the light source, and at least a secondary air flow, able to mainly cool a second zone of the light source, at least in part distinct from the first zone.

BRIEF DESCRIPTION OF THE DRAWINGS

Further characteristics and advantages of the present invention will become clear from the following description of a non-limiting embodiment, with reference to the figures of the accompanying drawings, in which:

FIG. **1** is a first schematic side view with parts in section and parts removed for clarity's sake, of a light fixture according to the present invention;

FIG. **2** is a second schematic side view, with parts in section and parts removed for clarity's sake, of a first detail of the light fixture of FIG. **1**;

FIG. **3** is a schematic perspective view, with parts removed for clarity's sake, of a second detail of the stage light fixture of FIG. **1**;

FIG. **4** is a schematic perspective view, with parts removed for clarity's sake, of a third detail of the stage light fixture of FIG. **1**.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. **1**, the reference number **1** indicates a stage light fixture comprising a casing **2** and support means (not shown in the accompanying figures) configured to support the casing **2**. Preferably, the support means are configured to move the casing **2** and to allow its rotation about two orthogonal axes, commonly said PAN and TILT. The operation of the support means is regulated by a motion control device (not visible in the accompanying figures). The motion control device can also be used remotely, preferably through communications with a DMX protocol.

According to a variant, the support means may be configured only to support the casing **2**, without allowing its movement.

The casing **2** extends along a longitudinal axis A and is provided with a first closed end **4** and with a second end **5**, opposite to the first closed end **4** along the axis A, and provided with a projection mouth **6**. In the non-limiting example here described and shown, the projection mouth **6** has a substantially circular section.

The light fixture **1** further comprises a frame **9** coupled to the casing **2** (not shown for simplicity's sake in FIG. **1** and partially visible in FIGS. **2** and **3**), a light source **10**, a reflector **11**, an optical assembly **12** (schematically shown in FIG. **2**), beam processing means **14** (schematically shown in FIG. **2**) and a cooling assembly **15**.

The frame **9** is integral with the casing **2** and comprises a plurality of elements coupled to each other and configured to define a support structure for the components arranged within the casing **2**, such as the light source **10**, the reflector **11**, the optical assembly **12**, the beam processing means **14** and the cooling assembly **15**. FIG. **2** and FIG. **3** partially show some of the elements of the frame **9** configured to support the light source **10**, the reflector **11** and, as shown in more detail below, the cooling assembly **15**.

With reference to FIG. **1** and to FIG. **2**, the light source **10** is arranged inside the casing **2** at the closed end **4** of the

casing **2**, is supported by the frame **9**, and is adapted to emit a light beam substantially along an optical axis B.

In the non-limiting example here described and shown, the optical axis B coincides with the longitudinal axis A of the casing **2**.

The light source **10** is preferably a discharge lamp made of glass or quartz and containing mercury and halides.

The discharge lamp is preferably a short arc lamp extending along the optical axis B and comprising a front tubular portion **17**, a rear tubular portion **18** axially opposite to the front tubular portion **17**, and a central bulb **19** arranged between the front tubular portion **17** and the rear tubular portion **18**.

Two electrodes connected to a power supply circuit (not visible in the accompanying figures) are arranged inside the bulb **19**, at a determined distance. The distance between the electrodes is less than approximately 2 mm. In the non-limiting example here described and shown, this distance is about 1.3 mm.

In the non-limiting example here described and shown, the short arc lamp **10** has a power greater than about 400 watts.

The reflector **11** is a reflector, preferably elliptical, coupled to the light source **10** and having an outer edge **20**.

Preferably, the reflector **11** is provided with a central hole **21** housing the rear tubular portion **18** of the light source **10**.

With reference to FIG. **1**, the optical assembly **12** is arranged in correspondence with the open end **5** of the casing **2**, is centred on the optical axis B, is the last assembly able to process the intercepted light beam and, preferably, closes the casing **2**.

The optical assembly **12** includes one or more lenses (not shown in the attached figures). Preferably, the optical assembly **12** is movable along the optical axis B to adjust the focus of the projected image.

Preferably, the optical assembly **12** includes a support frame coupled to a carriage movable along the optical axis B (not shown for simplicity's sake), whose movement is regulated by an auto focus device (known and not shown).

The light beam processing means **14** comprise a plurality of light beam processing elements **9** supported by the frame and configured to process the light beam generated by the light source **10** so as to obtain particular effects. In particular, the beam processing elements are supported and/or configured to selectively intercept the light beam and to change it only if necessary. In other words, the beam processing elements can intercept the beam to change its properties only if necessary.

The location of each of the beam processing elements is regulated by a control device of the beam processing means (not visible in the accompanying figures). The control device of the beam processing elements can also be managed remotely, preferably through communications with a DMX protocol.

The light beam processing means **14** may include one or more processing elements selected from the group comprising a dimmer, a colour group, a gobo wheel, a rainbow device, an effects wheel, a frost group and a prismatic element. It is clear that the light beam processing means **14** can include further beam processing elements not listed here.

The cooling assembly **15** comprises a plurality of cooling fans **25** (schematically represented in FIG. **1**), variously arranged inside the casing **2** and supported by the frame **9**.

Preferably, the cooling fans **25** are governed by a control device (not shown), which regulates the activation and, preferably, the rotation speed.

Preferably, the control device of the cooling assembly **15** is configured to adjust the activation and/or the speed of the cooling fans **25** on the basis of one or more parameters of the light fixture **1**, such as the detected position of the casing **2**, the detected temperature inside the casing **2**, the temperature outside the casing, the actual power of the light source **10**, etc.

In the non-limiting example here described and shown, the cooling fans **25** are three. The cooling assembly **15** comprises two cooling fans **25***a* arranged at a respective air vent **26** formed along the wall of the casing **2**, a cooling fan **25***b* beside the light source **10** and a flow-guiding element **28** configured to direct the air flow generated by the cooling fan **25***b* and visible only in FIGS. **2**, **3** and **4**.

The cooling fans **25***a* are symmetrical with respect to the longitudinal axis A of the casing **2** and are respectively configured, the one to convey the air drawn from the respective air vent **26** in a zone **27** of the casing **2** comprised between the end **4** of the casing **2** and the outer portion of the reflector **11**, and the other to ease the air escape through the respective air vent **26**, thus favouring the cooling air exchange and optimizing the cooling effect.

With reference to FIGS. **2**, **3** and **4**, the cooling fan **25***b* is substantially coupled to the outer edge **20** of the reflector **11** and is configured to generate a cooling air flow drawn from the zone **27** between the end **4** of the casing **2** and the outer portion of the reflector **11** and to convey it through an outlet **29**.

The flow-guiding element **28** is arranged between the outlet **29** of the cooling fan **25***b* and the outer edge **20** of the reflector **11**.

The cooling fan **25***b* and the flow-guiding element **28** are supported by a supporting plate **30** of the frame **9** (visible in FIG. **3** and in FIG. **4**).

In particular, the flow-guiding element **28** is provided with a first end **31** coupled to the outlet **29** and with a second end **32** coupled to a recess **33** formed along the edge **20** of the reflector **11**.

With reference to FIGS. **2-4**, the flow-guiding element **28** is formed so as to generate a primary flow FP and at least a secondary flow FS (schematically represented by the arrows of FIG. **2**). The primary flow PF is adapted to mainly cool a first zone of the light source **10**, whereas the secondary flow FS is adapted to mainly cool a second zone of the light source, at least partially distinct from the first zone.

In particular, the flow-guiding element **28** is formed so as to generate a primary flow FP which is directed so as to cool the bulb **19** and the rear tubular portion **18** of the light source **10** and a secondary flow FS which is directed so as to cool the front tubular portion **17** of the light source **10**. The flow guiding element **28** comprises a channel **37** which receives the cooling air from the cooling fan **25***b* and a main fin **36**, which is arranged inside the channel **37** and shaped so as to generate the primary flow FP and the secondary flow FS.

In the non-limiting example here described and shown, the flow-guiding element **28** comprises a plate **35**, substantially C-folded, and a main fin **36**, arranged to form the channel **37**, together with the folded plate **35**.

With particular reference to FIGS. **3** and **4**, the flow-guiding element **28** comprises two further lateral fins **38**, coupled to opposite sides of the folded plate **35** and shaped so as to be coupled to the recess **30** of the edge **20** of the reflector **11**. In particular, each lateral fin **38** is formed so as to define, together with the plate **35**, a seat **39** adapted to be engaged by the edge **20** of the reflector **11**.

With particular reference to FIGS. **2** and **3**, the main fin **36** comprises a first portion **41** and a second portion **42**.

The first portion **41** is inclined with respect to the supporting plate **30** at a first angle α, whereas the second portion **42** is inclined with respect to the first portion at a second angle β.

The first angle α is comprised between 6° and 12° and is preferably equal to 9°±0.5°.

The second angle β is comprised between 60° and 85° and is preferably equal to 70°±0.5°.

The second portion **42** preferably includes a curved portion proximal to the first portion **41** and having a radius of curvature preferably comprised between 5 mm and 7 mm, preferably 6 mm.

The second portion **42** is further provided with a through hole **43**.

The size of the hole **43** mainly depends on the type of used light source **10**.

A variant not shown provides that the second portion is provided with a plurality of suitably arranged and sized holes.

A variant not shown provides that the flow-guiding element **28** is configured so that the deflection of the first portion **41** and/or of the second portion **42** and, in case, even the hole section **43** can be manually or automatically adjusted, according to the cooling requirements of the used light source **10**.

In use, the so configured flow-guiding element **28** determines a division of the air flow produced by the cooling fan **25***b* in the primary flow FP conveyed by the plate **35** and by the main fin **36** and the secondary flow FS passing through the hole **43**.

A variant not shown provides that the flow-guiding element **28** can divide the air flow produced by the cooling fan **25***b* in a primary flow FP and in a secondary flow FS thanks to the presence of at least one fin provided with a forked portion in which each fork has a respective appropriate deflection. According to this variant, the flow-guiding element **28** may be preferably configured so that the deflection of each fork can be manually or automatically adjusted, according to the cooling requirements of the used light source **10**.

A further variation not shown of the flow-guiding element **28** provides the use of two or more separate fins, having different deflections and arranged along the flow escaping from the outlet **29** of the cooling fan **25***b*. According to this variant, the flow-guiding element **28** may be preferably configured so that the deflection of each separate fin can be manually or automatically adjusted, according to the cooling requirements of the used light source **10**.

A variant not shown provides that the flow-guiding element **28** is at least partially made of a transparent material. In this way, the flow-guiding element may also be arranged at the light source **10** and may possibly intercept the light beam without affecting its optical properties.

A further variant not shown provides that the flow-guiding element **28** is at least partially made of an optically active material. In this way, the flow-guiding element may also be arranged at the light source **10** to intercept the light beam and change its optical properties.

A further variant not shown provides that the flow-guiding element **28** is at least partially made of a bimetallic material and/or of a shape memory metal.

A further variant not shown provides that the flow-guiding element **28** includes at least one noise-attenuating device configured to minimize the disorder-related noise.

Advantageously, the cooling assembly **15** according to the present invention can suitably cool the light source **10** by ensuring adequate durability and reliability of the light fixture **1**. Thanks to the presence of the flow-guiding element **28** arranged between the cooling fan **25***b* and the reflector **11**, in fact, the light source **10** is evenly cooled, thus avoiding the risk of localized overheating that may jeopardize the functioning of the light source **10**.

Finally, it is evident that the cooling assembly and the light fixture described here can be modified and varied without departing from the scope of the appended claims.

The invention claimed is:

1. Cooling assembly for cooling at least one light source of a light fixture comprising:

at least one cooling fan configured to produce a cooling air flow; and

at least one flow-guiding element configured to guide the cooling air flow of the cooling fan and divide it into a primary air flow, able to mainly cool a first zone of the light source, and at least a secondary air flow, able to mainly cool a second zone of the light source, at least in part distinct from the first zone;

wherein the cooling fan and the flow-guiding element are supported by a supporting plate of the light fixture;

wherein the flow-guiding element comprises at least one main fin provided with a first portion and a second portion arranged in succession along the cooling air flow direction;

wherein the second portion is provided with at least one through hole.

2. Cooling assembly according to claim **1**, wherein the second portion is inclined with respect to the first portion at an angle.

3. Cooling assembly according to claim **2**, wherein the angle is comprised between 60° and 85°.

4. Cooling assembly according to claim **3**, wherein the angle is equal to 70°.

5. Cooling assembly according to claim **1**, wherein the second portion comprises a curved section proximal to the first portion.

6. Cooling assembly according to claim **1**, wherein the flow-guiding element comprises a plate substantially C-folded and arranged so as to define a channel with the at least one main fin.

7. Cooling assembly according to claim **6**, wherein the flow-guiding element comprises two further lateral fins coupled to the opposite sides of the plate and shaped so as to be coupled to the light source.

8. Cooling assembly according to claim **1**, wherein the flow-guiding element comprises two or more distinct fins having different deflections and arranged along the cooling air flow of the cooling fan.

9. Cooling assembly according to claim **1**, comprising at least two further cooling fans arranged at opposite sides of the light source; one of the further cooling fans being configured to produce a further cooling air flow towards the light source; the other of the further cooling fans being configured to evacuate the further cooling air flow outside the light fixture.

10. Light fixture comprising a casing, the light source arranged inside the casing and able to produce a light beam, and a cooling assembly as claimed in claim **1**.

11. Cooling assembly for cooling at least one light source of a light fixture comprising:

at least one cooling fan configured to produce a cooling air flow; and

at least one flow-guiding element configured to guide the cooling air flow of the cooling fan and divide it into a primary air flow, able to mainly cool a first zone of the light source, and at least a secondary air flow, able to

mainly cool a second zone of the light source, at least in part distinct from the first zone;

wherein the cooling fan and the flow-guiding element are supported by a supporting plate of the light fixture;

wherein the flow-guiding element comprises at least one main fin provided with a first portion and a second portion arranged in succession along the cooling air flow direction;

wherein the first portion is inclined with respect to the supporting plate at a angle.

12. Cooling assembly according to claim **11**, wherein the angle is comprised between 6° and 12°.

13. Cooling assembly according to claim **12**, wherein the angle is equal to 9°.

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