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(54) **STAGE LIGHTING FIXTURE**

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F21V 9/04 (2006.01)
F21W 131/406 (2006.01)

(52) **U.S. Cl.**
CPC ***F21V 29/025*** (2013.01); ***F21V 9/04*** (2013.01); *F21W 2131/406* (2013.01); ***F21V 29/02*** (2013.01)
USPC **362/294**; 362/373

(58) **Field of Classification Search**
CPC . F21V 29/02; F21V 29/025; F21W 2131/406
USPC 362/294, 373
See application file for complete search history.

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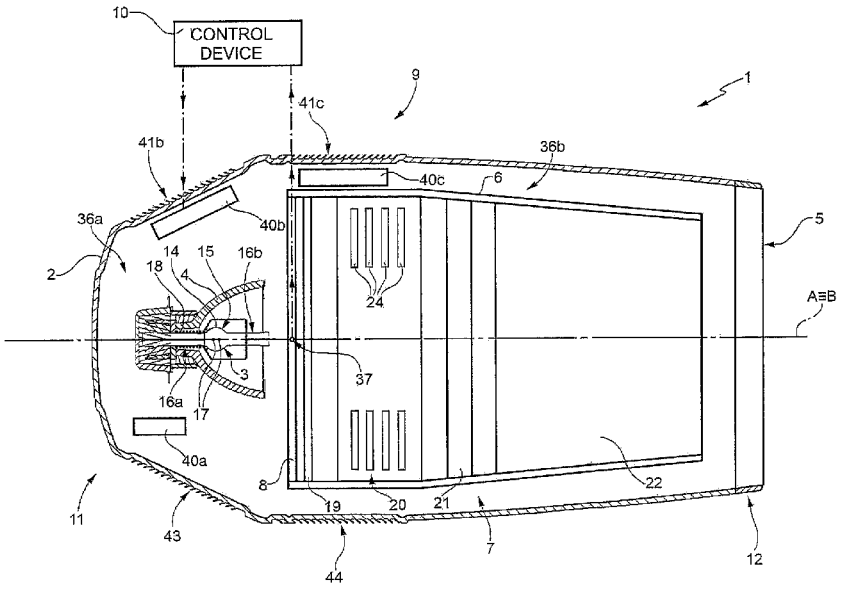
(57) **ABSTRACT**

A stage lighting fixture includes a casing; a light source, which is housed inside the casing and is adapted-to emit a light beam along an optical axis; a reflector coupled to the light source; light beam processing means housed inside the casing and adapted to selectively intercept the light beam; at least one heat-shield assembly located inside the casing, between the light source and the light beam processing means, to substantially divide the casing into a first area comprising the light source and the reflector, and a second area comprising the light beam processing means; the heat-shield assembly comprising a heat-shield filter, and a detector for detecting a parameter indicative of the temperature of the heat-shield filter; a cooling assembly for cooling the inside of the casing; a control device configured for regulating the cooling assembly on the basis of the parameter detected by the detector.

11 Claims, 2 Drawing Sheets



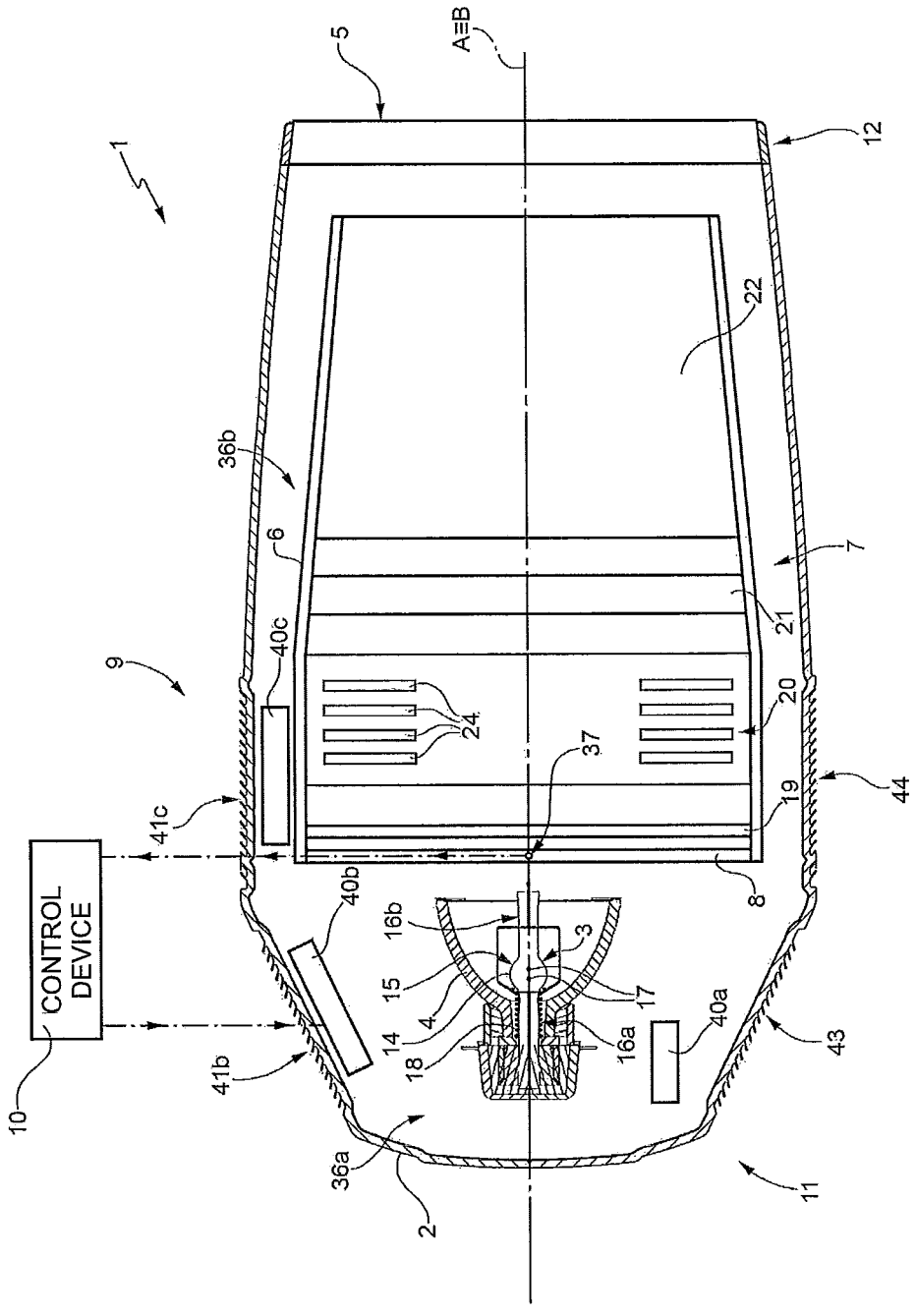

A≡B
5
12
1
22
36b
6
7
21
40c
9
24
20
37
44
41c
19
CONTROL DEVICE
40b
16b
3
8
15
17
4
14
16a
40a
43
18
41b
10
36a
2
11

FIG. 1

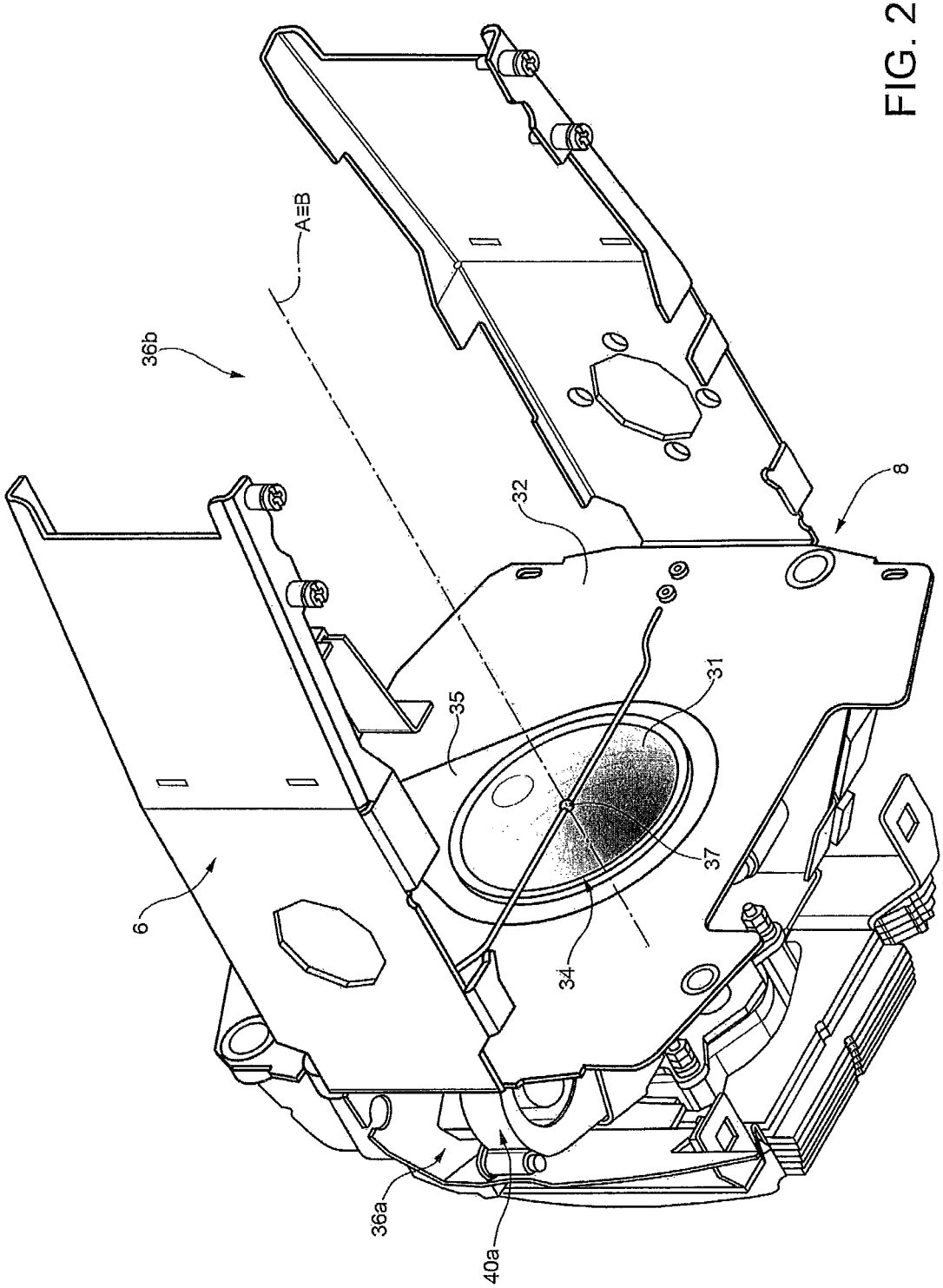


FIG. 2

STAGE LIGHTING FIXTURE

The present invention relates to a stage lighting fixture.

BACKGROUND OF THE INVENTION

Stage lighting fixtures are known which are provided with a casing, a light source adapted to emit a light beam, a reflector coupled to the light source and at least one beam processing element (such as a dichroic filter, a gobo disc, a dimmer), adapted to selectively intercept the light beam for processing it.

A heat-shield filter is arranged between the light source and the beam processing elements, which divides the casing substantially into a first area comprising the light source and into a second area comprising the light beam processing elements.

A lighting fixture of this type is described for example in documents U.S. Pat. No. 4,890,208 and U.S. Pat. No. 5,515,254.

The area comprising the light source is characterized by high temperatures and is generally cooled by means of a cooling assembly comprising at least one fan arranged in the proximity of an air outlet for aiding the circulation of cold air coming from outside the casing.

The heat-shield filter is substantially configured so as to produce a heat barrier between the area in which the light source is housed and the area in which the beam processing means are housed. In detail, the heat-shield filter is configured so as to filter the hot radiations (radiations which cause an increase in the temperature of the body on which they impinge) in the field of non visible radiations. This prevents the hot radiations in the field of non visible radiations from impinging on the light beam processing means (dichroic filters, gobo assemblies, dimmers), thereby heating them.

However, in the lighting fixtures of this type it often happens that the heat-shield filter becomes excessively overheated. In fact, the hot radiations produced by the light source and the hot radiations in the field of visible radiations reflected by the light beam processing means (for example, by the dichroic filters, by the dimmer) impinge on the heat-shield filter.

The overheating of the heat-shield filter contributes to increasing the temperature of the area comprising the light source and in particular, of the light source bulb portion proximal to the heat-shield filter. Such phenomenon causes an uncontrolled overheating of the light source which, most of the times, causes irreversible damage to the light source.

This implies the unreliability of the lighting fixture and obvious inconveniences for the end user.

SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to provide a stage lighting fixture free from the above-described drawbacks of the prior art. In particular, it is an object of the present invention to provide a reliable lighting fixture capable of ensuring a suitable duration of the light source.

According to such objects, the present invention relates to a stage lighting fixture according to claim **1**.

BRIEF DESCRIPTION OF THE DRAWINGS

Further features and advantages of the present invention will appear clearly from the following description of a non-limiting embodiment example thereof, made with reference to the figures in the accompanying drawings, in which:

FIG. **1** shows a schematic view of a stage lighting fixture according to the present invention;

FIG. **2** shows a perspective view of a detail of the lighting fixture of FIG. **1**.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. **1**, reference numeral **1** indicates a stage lighting fixture comprising a casing **2**, a light source **3**, a reflector **4**, a lens **5**, a framework **6** coupled to casing **2**, beam processing means **7** (schematically shown in FIG. **1**), a heat-shield assembly **8** (schematically shown in FIG. **1**), a cooling assembly **9** and a control device **10**.

Casing **2** extends along a longitudinal axis A and has a closed end **11** and an open end **12** opposite to the closed end **11** along axis A. Preferably, casing **2** is supported by supporting means (not shown for simplicity in the accompanying figures). In particular, the supporting means and casing **2** are configured for allowing casing **2** to rotate around two orthogonal axes, commonly referred to as PAN and TILT.

Framework **6** consists of elements coupled to each other and configured for defining a supporting structure for the elements housed inside casing **2** such as the light source **3**, reflector **4**, the light beam processing means **7**, the heat-shield assembly **8** and the cooling assembly **9**.

The light source **3** is housed inside casing **2** at the closed end **11** of casing **2**, is supported by framework **6** and is adapted to emit a light beam substantially along an optical axis B.

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

The light source **3** preferably is a discharge lamp comprising a bulb **14**, generally made of glass or quartz, containing halides.

Bulb **14** comprises a center portion **15**, substantially spherical, and two side portions **16***a* and **16***b*, which are substantially tubular, preferably but not necessarily with rectangular or circular section. The side portions **16***a* and **16***b* are substantially identical and the dimensions of the section of the side portions **16***a* and **16***b* substantially depend on the power of the lamp. Two electrodes **17** connected to a power circuit **18** (partially shown in the accompanying figures) are housed in the center portion **15**.

The light beam is emitted substantially at the center portion **15** of bulb **14**, while the side portions **16***a* and **16***b* do not emit light and are arranged in the shadow cone of the light source **3**.

In the non-limiting example described and illustrated herein, the light source **3** is a metal iodide lamp.

Reflector **4** preferably is an elliptical reflector and is coupled to the light source **3**.

Lens **5** is arranged at the open end **12** of casing **2**. A variant not shown of the present invention envisions that lens **5** is a Fresnel lens (the case of a "wash" lighting fixture).

The light beam processing means **7** are supported by framework **6** and are configured for processing the light beam produced by the light source **3** so as to obtain particular effects.

In particular, the light beam processing means **7** comprise, preferably in a sequence, at least one dimmer **19**, a color assembly **20**, a gobo assembly **21** and a zoom device **22**. It is understood that the light beam processing means **7** may comprise further beam processing means not described herein.

In particular, the color assembly **20** comprises a plurality of pairs of dichroic filters **24** (schematically shown in FIG. **1**) adapted to selectively intercept the light beam for coloring it.

The dichroic filters **24** are arranged in a sequence along the optical axis B of the light beam and are configured for transmitting light radiations having predetermined wavelengths and for reflecting light radiations having different wavelengths.

The beam projected by the lighting fixture **1** will thus have a predetermined color, depending on the wavelengths of the light radiations that are not reflected by the dichroic filter **24** that intercepts the beam.

In detail, the dichroic filters **24** comprise a glass substrate on which a sequence of layers of dielectric material is deposited. Hence, each dichroic filter **24** differs from the adjacent dichroic filter **24** by the number and thickness of the layers of dielectric material deposited on the glass substrate.

In the non-limiting example described and illustrated herein, the color assembly **20** comprises four pairs of dichroic filters **24** (cyan, magenta, yellow, orange).

With reference to FIG. **2**, the heat-shield assembly **8** comprises a heat-shield filter **31** and a frame **32** provided with a center hole **34** for the passage of the light beam. Frame **32** is coupled to framework **6** and is configured for supporting the heat-shield filter **31** so that the heat-shield filter **31** is arranged at the center hole **34**.

Preferably, the heat-shield filter **31** is provided with a frame **35**, which is coupled to the edge of the heat-shield filter **31** and to frame **32**.

The heat-shield assembly **8** is substantially configured so as to produce a heat barrier between area **36***a* in which the light source **3** is housed and area **36***b* in which the beam processing means **7** are housed.

The heat-shield filter **31** is configured for filtering the hot radiations (radiations that cause an increase in the temperature of the body on which they impinge) in the field of non visible radiations which come from the area in which the light source **3** is provided. In this way, the hot radiations in the field of non visible radiations produced by the light source **3** and by reflector **4** are prevented from impinging on the light beam processing means **7**.

The heat-shield filter **31** is provided with a sensor **37** configured for detecting a parameter indicative of the temperature of the heat-shield filter **31**. The indicative parameter detected by sensor **37** is fed to the control device **10** which, as will be seen in detail hereinafter, regulates the cooling assembly **9** on the basis of the parameter detected by sensor **37**.

In particular, sensor **37** is configured for detecting the temperature of the heat-shield filter **31**.

Sensor **37** is preferably arranged so that the temperature detection point is arranged in the proximity of the center of the heat-shield filter **31**.

In fact, the center area of the heat-shield filter **31** is arranged in the proximity of portion **16***b* of bulb **14** and therefore, the overheating of the center area of the heat-shield filter **31** may cause a dangerous increase in the temperature of portion **16***b* of bulb **14** of the light source **3**.

Sensor **37** preferably is a thermocouple consisting of a pair of electrical conductors of different material (preferably chromium/aluminum) connected to each other at a junction point, generally referred to as hot point and corresponding to the temperature measurement point. Preferably, the junction point is arranged at the center of the heat-shield filter **31**. The opposite end of each conductor is conventionally referred to as cold joint and is connected to a control board (not shown in the accompanying figures), which feeds the detected temperature data to the control device **10**.

With reference to FIG. **1**, the cooling assembly **9** comprises a plurality of cooling fans **40** (schematically shown in FIG. **1**) variously arranged inside casing **2**.

In detail, each cooling fan **40** is arranged in the proximity of a respective air outlet **41** (not all of them are visible in the accompanying figures) obtained in casing **2**.

In the non-limiting example described and illustrated herein, the cooling assembly **9** comprises a fan **40***a*, a fan **40***b* and a fan **40***c*.

Fan **40***a* is arranged on the side of the light source **3** so as to convey the air drawn from the respective air outlet (not shown in the accompanying figures as it is arranged on a portion of the casing which is not shown) and direct it into the area of casing **2** comprised between end **11** of casing **2** and the outer portion of reflector **4**. In this way, fan **40***a* aids cooling of the light source **3** and of reflector **4**.

Fan **40***b* is arranged above the light source **3** at a respective air outlet **41***b*. Fan **40***b* is arranged so as to convey the air drawn from the air outlet **41***b* into the area comprised between the light source **3** and the heat-shield assembly **8** so as to cool the heat-shield assembly **8**. Preferably, casing **2** is provided with a further air outlet **43**, arranged on the opposite side of the air outlet **41***b* with respect to axis A. Such air outlet **43** aids the escape of the airflow produced by fan **40***b* and thereby, it aids the cooling air change optimizing the cooling effect thereof.

Fan **40***c* is arranged substantially above at least a part of the light beam processing means **7**, at an air outlet **41***c*.

In particular, in the non-limiting example described and illustrated herein, fan **40***c* is arranged above dimmer **19** and above the color assembly **20** for cooling them. Preferably, casing **2** is provided with an air outlet **44** arranged on the opposite side of the air outlet **41***c* with respect to axis A for aiding the circulation of the cooling flow and optimizing the cooling effect thereof.

In the non-limiting example described and illustrated herein, fan **40***a* and fan **40***c* are operated at a fixed rotation speed while fan **40***b* is operated at a variable speed under the control of the control device **10**.

A variant not shown of the present invention provides for the control device to regulate also the supply of fans **40***a* and **40***c* of the cooling assembly **9** on the basis of the temperature detected by sensor **37**.

The control device **10** is configured for changing the rotation speed of fan **40***b* on the basis of the parameter detected by sensor **37** of the heat-shield assembly **8**.

In particular, the control device **10** is configured so as to increase the rotation speed of fan **40***b* if the parameter detected by sensor **37** exceeds a predetermined threshold value.

In the non-limiting example described and illustrated herein, the threshold value corresponds to a temperature value increased by 20/30% with respect to an acceptable value. The acceptable value varies according to the type of light source **3** used. For a light source **3** of 800 W, the temperature acceptance value is around about 200° C. and the threshold value corresponds to about 250° C.

Preferably, the control device **10** is configured to stepwise increase the rotation speed of fan **40***b* from a base value to a predetermined nominal value.

In the non-limiting example described and illustrated herein, when the parameter detected by sensor **37** exceeds the threshold value, the speed of fan **40***b* changes from a value of about 2500 revolutions per minute to a value of about 2800 revolutions per minute.

Preferably, the increase in the rotation speed of fan **40***b* is obtained by changing the supply voltage of fan **40***b*. In the non-limiting example described and illustrated herein, when the parameter value detected by sensor **37** exceeds the thresh-

old value, the control device **10** changes the supply voltage of fan **40***b* from about 21 V to about 24 V.

Accordingly, the control system **10** causes an increase or a decrease in the rotation speed of fan **40***b* by regulating the supply voltage of fan **40***b*. The supply voltage is regulated on the basis of the parameter detected by sensor **37**.

Advantageously, the lighting fixture **1** according to the present invention is configured so as to prevent an excessive overheating of the light source **3**.

In fact, increasing the speed of fan **40***b* compensates the increase in the temperature of the heat-shield filter **31** and minimizes the risk of overheating of bulb **14** of the light source **3**.

In fact, according to the present invention, when the temperature of the heat-shield filter **31** exceeds a critical value that may cause overheating of bulb **14** of the light source **3**, the control device **10** operates by regulating the cooling assembly **9** so as to aid cooling of the light source **3** and of the heat-shield filter **31**.

In this way, the entirety and the protection of bulb **14** and the reliability of the lighting fixture **1** are ensured.

Advantageously, sensor **37** is configured for detecting a parameter correlated to the temperature of the heat-shield filter **31** portion proximal to the side portion **16***b* where the electrical contacts for powering electrodes **17** are housed.

The controlled operation of fan **40***b* on the basis of the temperature of the heat-shield filter **31** allows the overheating of the contacts and the breakage of the light source **3** to be prevented.

Moreover, the provision of sensor **37** has no effect on the quality of the beam projected by the lighting fixture **1**. In fact, sensor **37** is arranged in a grey area of the light source **3** and is sized so as not to cause any loss in the radiations useful for projecting the beam (conductors having a diameter of about 0.5 mm).

Finally, it is clear that changes and variations may be made to the lighting fixture described herein without departing from the scope of the appended claims.

The invention claimed is:

1. A stage lighting fixture comprising:

a casing (**2**);

a light source (**3**) which is housed inside the casing (**2**) at a first end (**11**) of the casing (**2**) and is adapted to emit a light beam along an optical axis (B);

a reflector (**4**) coupled to the light source (**3**);

light beam processing means (**7**) housed inside the casing (**2**) and adapted to selectively intercept the light beam;

at least one heat-shield assembly (**8**) located inside the casing (**2**), between the light source (**3**) and the light beam processing means (**7**), to substantially divide the casing (**2**) into a first area (**36***a*) comprising the light source (**3**) and the reflector (**4**), and a second area (**36***b*) comprising the light beam processing means (**7**); the heat-shield assembly (**8**) comprising a heat-shield filter (**31**), and a detector (**37**) for detecting a parameter indicative of the temperature of the heat-shield filter (**31**);

a cooling assembly (**9**) for cooling the inside of the casing (**2**);

a control device (**10**) configured for regulating the cooling assembly (**9**) on the basis of the parameter detected by the detector (**37**).

2. A lighting fixture according to claim **1**, wherein the detector (**37**) is configured for detecting a parameter indicative of the temperature of a center portion of the heat-shield filter (**31**).

3. A lighting fixture according to claim **1**, wherein the detector (**37**) is a temperature sensor thermally coupled to the heat-shield filter (**31**).

4. A lighting fixture according to claim **3**, wherein the detector (**37**) comprises a thermocouple.

5. A lighting fixture according to claim **1**, wherein the detector (**37**) is located substantially at the center of the heat-shield filter (**31**).

6. A lighting fixture according to claim **1**, wherein the cooling assembly (**9**) comprises at least a first fan (**40***a*, **40***b*, **40***c*); the control device (**10**) being configured for regulating the rotation speed of at least the first fan (**40***a*, **40***b*, **40***c*) of the cooling assembly (**9**) on the basis of the parameter detected by the detector (**37**).

7. A lighting fixture according to claim **6**, wherein the control device (**10**) is configured for increasing the rotation speed of at least the first fan (**40***a*, **40***b*, **40***c*) when the parameter indicative of the temperature of the heat-shield filter (**31**) exceeds a threshold value.

8. A lighting fixture according to claim **7**, wherein the threshold value corresponds to a temperature value increased by 20/30% with respect to an acceptable value.

9. A lighting fixture according to claim **7**, wherein the control device (**10**) is configured to stepwise increase the rotation speed of the first fan (**40***a*, **40***b*, **40***c*) from a base value to a predetermined nominal value.

10. A lighting fixture according to claim **6**, wherein the control device (**10**) is configured for regulating the power to the first fan (**40***a*, **40***b*, **40***c*) so as to cause a change in the rotation speed of the first fan (**40***a*, **40***b*, **40***c*).

11. A lighting fixture according to claim **6**, wherein the first fan (**40***b*, **40***c*) is so located as to produce an airflow adapted to aid cooling of the heat-shield filter (**31**).

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