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(54) Title: LED DRYING DEVICE FOR INDUSTRIAL USE

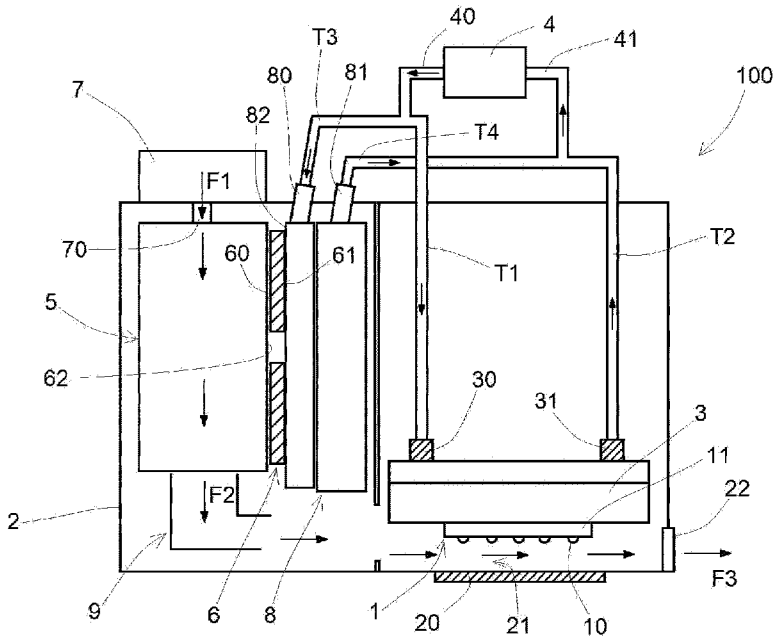

FIG. 1

(57) Abstract: A drying device (100) comprises a COB LED (1) comprising LEDs (10) mounted on a PCB (11), a box (2) provided with a protection window (20) made of a transparent material, disposed in front of said LEDs (10) in such a way to have an empty space (21) between the LEDs (10) and the protection window (20), a first heat exchanger (3) disposed in contact with said PCB (11) in order to cool it down, and a second heat exchanger (5) coupled with a fan (7) in such a way to convey a flow of cold air (F2) towards said empty space (21) between the LEDs (10) and the protection window (20) in order to cool down said LEDs (10).

[Continued on next page]

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— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

Description

LED DRYING DEVICE FOR INDUSTRIAL USE

The present invention relates to a LED drying device for industrial use, in particular for the drying of varnishes, adhesives and resins.

Varnishes, adhesives and resins are currently used in the graphic industry of wood, glass, ceramic and marble working. Ultraviolet (UV) emitter devices are used for the drying of said varnishes, adhesives and resins. Such devices generally comprise high-power mercury discharge lamps.

However, the use of mercury is affected by contamination problems. For this reason, the use of LEDs as a replacement of mercury lamps has progressively increased.

The LEDs are used in arrays of single LED crystals that are commonly known as “chip on board “ (COB), i.e. an array of LED crystals suitable for forming a single light source or emitter of visible light, ultraviolet or infrared radiation.

Such COB LEDs are produced with increasingly high power in order to meet the demand from the market. However, the high-power COB LEDs reach very high temperatures.

Therefore, one of the major problems for the technician is related with the cooling system of said LED devices. In fact, the cooling system must dissipate high powers of approximately 40-50 watt per square centimeter, and of 8 kwatt in the case of lamps with over 1 meter length.

The cooling systems of the prior art generally use a coolant, such as air or water. The most typical cooling system is a heat exchanger, which is generally made of aluminum, which is internally provided with a serpentine with a passage of refrigerated water in order to cool the entire device that contains the array of LEDs.

However, in this way, the cooling is barely sufficient to dissipate the heat produced by the COB LED.

In fact, it must be considered that the COB LED has two sides:

- an internal side represented by the PCB where the LEDs are mounted; and

- an external side that emits the light and is protected by a glass, both for protection and for separation from the product to be dried.

The cooling device cools only the internal side of the COB LED. However, an air space is formed between the external side of the COB LED and the protection glass, where the temperature can reach 60-70°C, generating a hazard situation both for the life of the COB LED and for the drying device.

WO03096387 discloses a solid state light source with a sufficient electromagnetic radiation density to perform several functions in various commercial applications.

The purpose of the present invention is to eliminate the drawbacks of the prior art by disclosing a LED drying device that is effective, efficacious, reliable, safe and long-lasting.

Another purpose of the present invention is to provide such a LED drying device that is not bulky and easy to make and use.

These purposes are achieved according to the invention with the characteristics of the independent claim 1.

Advantageous embodiments of the invention appear from the dependent claims.

The LED drying device of the invention is defined by the independent claim 1.

Additional features of the invention will appear evident from the following detailed description, which refers to a merely illustrative, not limiting embodiment, as illustrated in the appended figure, wherein:

Fig.1 is a block diagram that diagrammatically illustrates the LED drying device of the invention.

With reference to Fig.1, the drying device according to the invention is disclosed, which is generally indicated with reference numeral (100).

The drying device (100) comprises a COB LED (1) comprising an array of LEDs (10) mounted on a PCB (11). The PCB (11) is configured in such a way that the LEDs (10) emit light in the ultraviolet range (UV). The COB LED (1) has a power of approximately 40-50 watt per square centimeter.

The COB LED (1) is mounted in a box (2) provided with a protection window (20) made of glass or of a transparent material, disposed in front of the LEDs (10) in such a way as to permit the passage of the light emitted by the LEDs.

An air space (21) is provided between the LEDs (10) and the protection window (20).

A first heat exchanger (3) is disposed in contact with the PCB (11) of the COB LED (1) in such a way to cool the PCB (11). The first heat exchanger (3) is a serpentine heat exchanger with a circulation of a coolant, such as water, which is cooled by a cooling system (4).

The first heat exchanger (3) has an inlet duct (30) and an outlet duct (31) connected to an outlet duct (40) and to an inlet duct (41) of the cooling system (4) by means of corresponding pipes (T1, T2), in such a way to form a hydraulic circuit.

The cooling system (4) is of known type and therefore its detailed description is omitted. The cooling system (4) is provided with pumps for the delivery and the extraction of the coolant that circulates in the hydraulic circuit.

The cooling system (4) is disposed outside the box (2), whereas the first heat exchanger (3) is disposed inside the box (2).

The drying device (100) comprises a second heat exchanger (5) disposed inside the box (2). The second heat exchanger (5) is of finned type, comprising a plurality of fins made of a heat-dissipating material, such as copper or aluminum, which forms a plurality of empty spaces.

The second heat exchanger (5) is cooled by at least one Peltier cell (6).

As it is known, when it is electrically powered, the Peltier cell (6) has a cold side (60) and a hot side (61).The cold side (60) of the Peltier cell is in contact with the second heat exchanger (5) for cooling purposes.

A fan (70) has an outlet duct (70) that delivers an air flow (F1) on the second heat exchanger (5). The air flow (F1) passes through the empty spaces between the fins of the second heat exchanger (5) and is cooled down.

Therefore, a flow of cold air (F2) is emitted by the second heat exchanger (5) and is conveyed inside the box (2) towards the empty space (21) between the LEDs (10) and the protection window (20).

Conveyor means (9) suitable for conveying the flow of cold air (F2) emitted by the second heat exchanger (5) towards the empty space (21) may be provided. The conveyor means (9) may be a suitably configured conduit.

The flow of cold air (F2) grazes the LEDs (10), which are cooled down. In view of the above, the temperature in the empty space (21) is maintained at a sufficiently low value, for instance at a value lower than 50°C, in such a way to avoid any hazardous situation.

A slot (22) is disposed in the box (2) in proximal position to the empty space (21) in such a way to let the cooling air (F3) out of the box (2).

A third heat exchanger (8) is arranged in such a way to cool down the hot side (61) of the Peltier cell (6).

The third heat exchanger (8) is disposed in contact with the hot side (61) of the Peltier cell (6) in such a way to cool down the Peltier cell (6). The third heat exchanger (8) is a serpentine heat exchanger with a circulation of a coolant, such as water, which is cooled by the cooling system (4).

The third heat exchanger (8) has an inlet duct (80) and an outlet duct (81) connected to the outlet duct (40) and to the inlet duct (41) of the cooling system (4) by means of corresponding pipes (T3, T4), in such a way to form a hydraulic circuit.

Numerous equivalent variations and modifications can be made to the present embodiment of the invention, which are within the reach of an expert of the field and fall in any case within the scope of the invention as disclosed by the appended claims.

Claims

1. Drying device (100) comprising:

- a COB LED (1) comprising LEDs (10) mounted on a PCB (11),

- a box (2) provided with a protection window (20) made of a transparent material, disposed in front of said LEDs (10) in such a way to have an empty space (21) between the LEDs (10) and the protection window (20), and

- a first heat exchanger (3) disposed in contact with said PCB (11) for cooling purposes,

characterized in that

said drying device (100) also comprises a second heat exchanger (5) coupled with a fan (7) in such a way to convey a flow of cold air (F2) towards said empty space (21) between the LEDs (10) and the protection window (20) in order to cool down said LEDs (10).

2. The drying device (100) of claim 1, also comprising at least one Peltier cell (6) with a cold side (60) connected to said second heat exchanger (5).

3. The drying device (100) of claim 2, also comprising a third heat exchanger (8) disposed in contact with a hot side (61) of said Peltier cell (6) in order to cool down said Peltier cell.

4. The drying device (100) of claim 3, wherein said third heat exchanger (8) is of serpentine type and said drying device (100) also comprises a cooling system (4) that feeds a coolant into said third heat exchanger (8).

5.The drying device (100) of any one of the preceding claims, wherein said second heat exchanger (5) is of finned type, having a plurality of fins that form empty spaces wherein the air fed by the fan (7) flows.

6. The drying device (100) of claim 5, wherein said fins of the second heat exchanger (5) are made of copper or aluminum.

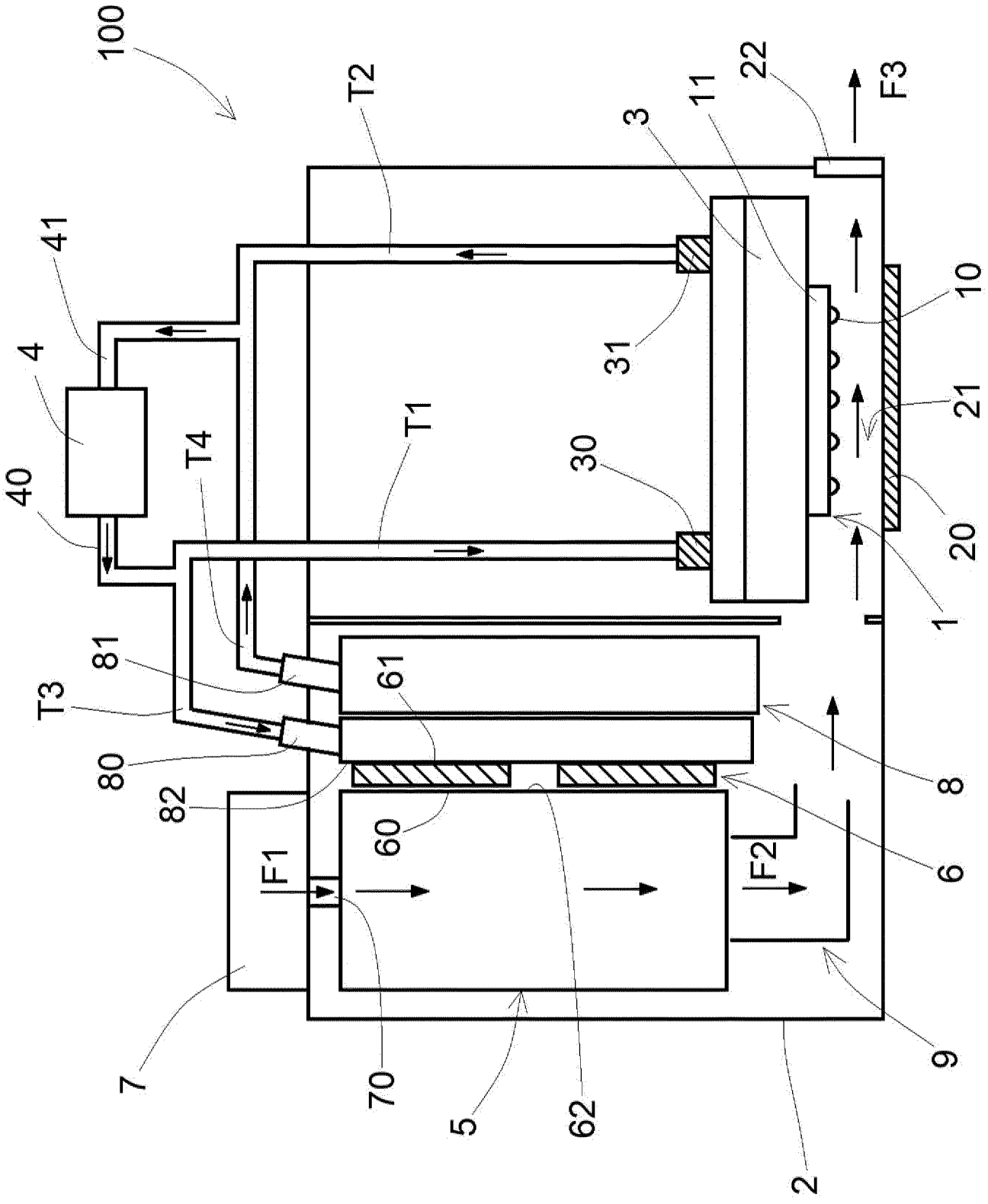
7. The drying device (100) of any one of the preceding claims, also comprising conveyor means (9) suitable for conveying the flow of cold air

(F2) emitted by the second heat exchanger (5) towards the empty space (21).

8. The drying device (100) of any one of the preceding claims, wherein said box (2) has a slot (22) disposed in proximal position to said empty space (21) between the LEDs (10) and the protection window (20) in order to let out the air that circulates in said empty space (21).

9. The drying device (100) of any one of the preceding claims, wherein said first heat exchanger (3) is of serpentine type and said drying device (100) also comprises a cooling system (4) that feeds a coolant into said first heat exchanger (3).

FIG. 1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T2
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F3
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T4
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80
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F1
F2
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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/071177

A. CLASSIFICATION OF SUBJECT MATTER
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ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F26B

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 03/096387 A2 (PHOSEON TECHNOLOGY INC [US]; OWEN MARK D [US]; MCNEIL TOM [US]; VLACH) 20 November 2003 (2003-11-20) figures 5, 6 page 3, line 20 - line 22	1-9
A	US 2008/315132 A1 (PLATSCH HANS G [DE]) 25 December 2008 (2008-12-25) figure 2	1-9
A	US 2005/042390 A1 (SIEGEL STEPHEN B [US]) 24 February 2005 (2005-02-24) abstract; figures	1-9
A	US 2010/242299 A1 (SIEGEL STEPHEN B [US]) 30 September 2010 (2010-09-30) abstract; figures	1-9

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 September 2019	12/09/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Fernandez Ambres, A

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/071177

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2014/031095 A1 (FUSION UV SYS INC [US]; DAHM JONATHAN S [US]) 27 February 2014 (2014-02-27) abstract; figures -----	1-9

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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