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(54) **Light apparatus**

(57) A light apparatus (2) comprising one or a plurality of light-emitting unit(s) (4) and a transparent section (6) through which light (5) emitted by said unit(s) (4) is intended to pass, which light apparatus (2) further comprises a heating system (8) intended to conduct heat generated by the light-emitting unit(s) (4) by means of a heat-transferring medium (12) to the transparent portion (6) in order to heat same. The heating system (8) comprises a conducting arrangement (10) arranged in direct connection to said transparent portion (6) and containing said heat-transferring medium (12), wherein the heating system (8) is a closed system in which vaporization and condensation of the heat-transferring medium (12) occur, and wherein the heat that is generated in connection with condensation it utilized to heat said transparent portion (6) directly.

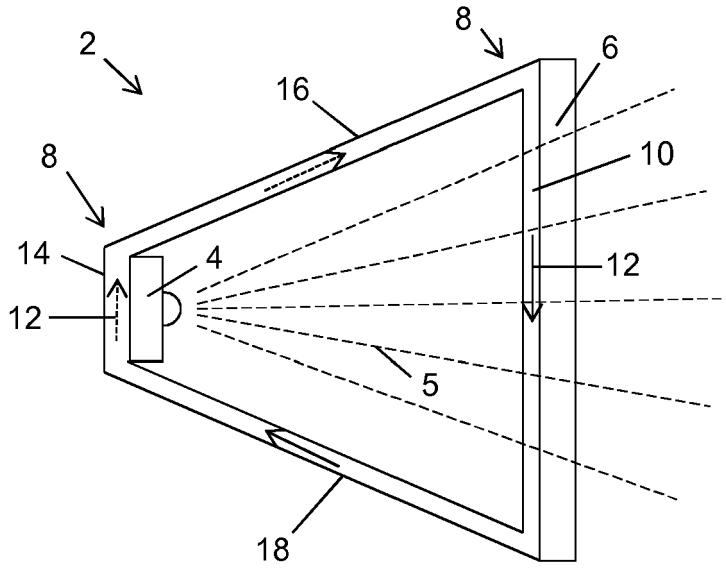

FIG. 1

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Description

Technical field of the invention

[0001] The present invention concerns a lighting apparatus according to the preamble to the independent claim, and in particular a light apparatus comprising a heating system arranged so as to heat a transparent portion of the lighting apparatus.

Background of the invention

[0002] Vehicle lights traditionally have a lamp housing with a light-emitting source in the form of incandescent bulbs or xenon bulbs. One advantage of this type of light is that, in wintertime, the radiant heat from these light sources is used to heat the lens so that the formation of mist and ice is counteracted.

[0003] In connection with the introduction of LED bulbs for vehicle lighting, for example for headlights (high beam and low beam), it has been shown that, in certain weather situations, mist and ice will form on the lens when LED bulbs are used. The reason for this is that the heat radiated by the LED bulbs is insufficient suffice to heat the lens. The heat from the LED bulbs heats the bulb socket but not the lens.

[0004] The heating of a lens for a vehicle light is known from, for instance, US-2010/0296308, which concerns a headlight for a vehicle in which a so-called heat-pipe system is used to heat the lens. The heat is conducted from the bulb to the lens by means of a heat pipe and then transferred to a heat-generating element disposed in the lamp housing. There the heat from the heat-generating element causes a hot airflow that heats the lens in order to, for example, melt snow on the outside.

[0005] A so-called heat-pipe system, as is used in US2010/0296308, is generally a closed pipe with a medium within. The pressure in the pipe is such that the medium is vaporized at a suitable temperature (for example just above room temperature) and the pipe can thus be used to conduct heat efficiently, for example from electronics in computers, by moving heating from one end of the pipe to the other, where the possibilities for efficient cooling in a normal way are greater. A heat-pipe system is also used to transport heat from vacuum tube solar collectors to water-borne heat-conducting systems. In a heat-pipe system the heat can only be transported in one direction from below, whereupon the fluid is vaporized upwards where the gas condenses in order to run down along the inside the pipe and be vaporized again.

[0006] A typical heat-pipe system consists of a closed pipe made of a material with high thermal conductivity, such as copper or aluminum. The pipe is evacuated and partly filled with a suitable heat-transferring medium. The medium has been chosen based on the area of application for the system. Examples of media are water, ethanol, acetone and mercury. According to this type of heat-pipe system, the pipes have been provided on the inside with a material that exhibits a capillary pressure for the medium that has been chosen. The medium can consist of, for instance, sintered metal powder or furrows along the length of the pipe. Regardless of the design, the object is to utilize the capillary force to return the condensed medium to the heated end. In some cases gravity may instead be used to return the condensed medium, and it can also be returned via a separate tube instead of the tube that is transferring the vaporized medium. A heat-pipe system contains no moving parts, and typically requires no maintenance.

[0007] As noted above, the materials chosen as heat-transferring media depend on the working temperatures that are relevant for a specific application. For example, methanol exhibits a working temperature range of 283-403 K, ethanol a temperature range of 273-403 K. Various so-called freons can also be suitable for use.

[0008] The object of the present invention is to provide an improved and simplified light apparatus in terms of reducing mist formation and ice formation on its transparent, translucent portion.

Summary of the invention

[0009] The aforementioned object is achieved by means of the invention defined in the independent claim.

[0010] Preferred embodiments are defined by the dependent claims.

[0011] According to the invention, the heat is conducted from the socket of the light-emitting unit, e.g. the LED bulb, using the so-called heat-pipe principle, to the transparent portion (the lens) of the light apparatus. This is achieved by having a suitable heat-conducting medium (liquid/gas) be vaporized around the hot socket and conducted in a first pipe over the upper edge of the transparent portion. There the steam is conducted downward via essentially vertical channels while it condenses and thus emits heat. The liquid is then conducted back to the hot socket, preferably by means of a capillary material in a second pipe, where it is vaporized again. Heat is thereby conducted from the hot socket to the lens, which is then heated, and prevents misting and snow and ice formation on the lens. According to one embodiment, this circulation is maintained by means of gravity and the capillary force. Thus, no active regulation in the form of a pump or fan is necessary to circulate the heat-transferring medium.

Brief description of the drawing

[0012]

Figure 1 is a schematic side view of a light apparatus according to the present invention.

Figure 2 is a schematic side view of a light apparatus according to the present invention that depicts various embodiments.

Figure 3 is a frontal view of a light apparatus according to one embodiment of the present invention.

Figure 4 shows a cross-section of the transparent portion according to one embodiment of the present invention.

Figure 5 shows a cross-section of the transparent portion according to another embodiment of the present invention.

Figure 6 is a schematic side view of yet another embodiment of the present invention.

Figure 7 is a schematic side view of a light apparatus according to yet another embodiment of the present invention.

Detailed description of preferred embodiments of the invention

[0013] The invention will now be described in detail with reference to the accompanying figures. The same reference designations have been used in the figures to designate details with the same or similar functions.

[0014] Figure 1 is a schematic side view of a light apparatus 2 comprising one or a plurality of light-emitting units 4, preferably arranged in a housing (not shown), and a transparent portion 6 through which light 5 generated by said units is intended to pass. The light-emitting units are, for example, LED lights and the light apparatus is preferably a vehicle light.

[0015] The light apparatus 2 further comprises a heating system 8 intended to conduct heat generated by the light-emitting unit(s) 4 by means of a heat-transferring medium 12 to the transparent portion 6 in order to heat same.

[0016] The heating system 8 comprises a conducting arrangement 10 arranged in direct connection to the transparent portion 6 and containing said heat-transferring medium 12, whereupon the heating system 8 is a closed system in which vaporization and condensation of the heat-transferring medium 12 occur. In the figures, medium in the vapor phase has been designated using broken arrows, medium in the liquid phase with solid arrows. The heat that is generated in connection with condensation is utilized to heat said transparent portion 6 directly. In other words, the heating system 8 functions according to the so-called heat-pipe principle. As noted, the figures are schematic, and have been simplified in order to illustrate the invention as clearly as possibly; for example, naturally there is also often some type of housing (lamp housing) that supports the components involved.

[0017] The conducting arrangement has thus been adapted so that the heat-transferring medium heats the transparent portion directly.

[0018] The conducting arrangement 10 comprises, for example, conducting channels 11 that can, for example, consist of one or a plurality of separate pipes.

[0019] According to one embodiment, the conducting arrangement 10 is arranged on the inside of the transparent portion 6. This is illustrated schematically in Figure 1.

[0020] According to another embodiment, the conducting arrangement 10 is arranged on the outside of the transparent portion 6. This is illustrated schematically in Figure 5.

[0021] According to yet another embodiment, the conducting arrangement 10 is arranged so that it is integrated into the transparent portion 6. This is illustrated schematically in Figure 4. In this case, where the conducting channels are designed in the transparent portion, no separate pipes are needed, but rather the conducting channels can be formed in connection with the fabrication of the transparent portion, for example in that the transparent portion is fabricated by joining two layers that are laminated together in such a way that the channels are formed by means of grooves in each respective layer that match up so that they form channels when joined. It is also possible to have the conducting channels consist of pipes that are cast in the transparent portion.

[0022] Another alternative is to have the transparent portion consist of a double-wall structure, i.e. two transparent walls with a gap between them through which the heat-transferring medium passes.

[0023] In the case of both other variants, i.e. wherein the conducting arrangement is arranged on the outside or inside of the transparent portion, the conducting channels consist of one or a plurality of separate pipes.

[0024] Regardless of the placement of the conducting arrangement, the conducting channels can be likened to a network that is arranged so as to be uniformly distributed across the transparent portion in order to thereby distribute the heat uniformly.

[0025] The conducting channel can have, for example, a circular cross-section. However, other cross-sections have proven to be more advantageous, wherein the surface that faces the part of the transparent portion that is to be heated the most, i.e. the outside, is larger. This can be achieved, for example, by designing the channel with a cross-section that is an isosceles or equilateral triangle, wherein the apex of the triangle is pointed toward the outside. Another alternative is to have the cross-section be a semicircle, wherein the arc is pointed toward the outside.

[0026] The conducting channels in the transparent portion must be designed in such a way that the beam pattern is affected as little as possible. This means, for example, that the conducting channels have a maximum outer diameter that is relatively small, on the order of several millimeters.

[0027] The heating system 8 comprises a heat-absorbing part 14 arranged in connection with said light-emitting units 4 and containing said heat-transferring medium 12. The purpose of the heat-absorbing part is to surround parts of the light-emitting unit 4, for example a socket for same, so that the heat-transferring medium can absorb as much heat as possible from the light-emitting unit 4. The heat-absorbing part 14 is a closed container that is

connected only to at least one first line 16 adapted so as to conduct said heat-transferring medium 12 from the heat-absorbing part 14 to the conducting arrangement 10, and to at least one second line 18 adapted so as to conduct said heat-transferring medium 12 from the conducting arrangement 10 back to the heat-absorbing part 14.

[0028] The first line 16 is preferably made of a material with low thermal conductivity, since as much of the heat as possible must be emitted to the transparent portion and not lost en route. The heat emitted from the first line is further reduced by wholly or partly insulating all or parts of the outside of the first line 16 with an insulating layer 20; see the embodiment shown in Figure 2.

[0029] As the heat-transferring medium condenses, heat is emitted to the transparent portion. The conducting arrangement is arranged in such a way that the condensed medium is carried down along the transparent portion by gravity. Figure 3 shows a front view of the light apparatus in which the vertical extent of the conducting channels has been marked.

[0030] In order to then return the medium to the heat-transferring part 14, the second line 18 contains a capillarily conductive material 22, as is depicted in the embodiment shown in Figure 2. The capillarily conductive material can, for example, consist of some form of metal wool or filter-like metal material. The reason why the capillarily conductive material is needed here is that the lower part of the transparent portion 6 is located below the heat-transferring part 14.

[0031] A capillarily conductive material can also be integrated into the conducting arrangement in the transparent portion, which offers the advantage that the conducting channels will then not need to be oriented vertically, but rather can be give an orientation suitable for achieving optimum effect. They can, for example, be arranged in suitable coils so as to thereby cover as large a part of the surface as possible.

[0032] Figure 6 shows a schematic side view of one embodiment in which no capillarily conductive material is needed, since the heat-transferring part 14 is located below the lowest part of the transparent portion, and the medium thus runs down to the heat-transferring part because of gravity. Such a light design requires, for example, a mirror arrangement (not shown) in order to output the light.

[0033] The background portion of the description identifies a number of media that can serve as heat-transferring media, depending on the application, in this case the temperatures that are present at the light-emitting unit. In the case of LED bulbs the working temperature is in the range of 60-90 degrees Celsius.

[0034] For example, the heat-transferring medium 12 can be butane or propane.

[0035] If the heat generated by the light-emitting unit does not suffice to prevent mist on the lens, additional heat can be supplied to the socket of the unit by means of, for example, electricity, hot cooling fluid, hot charge air or exhaust gases.

[0036] Finally, Figure 7 shows a schematic side view of a light apparatus according to yet another embodiment of the present invention.

According to this embodiment, a combined line 24, i.e. only one line, is used to carry the heat-transferring medium to and from the transparent portion 6. The combined line 24 has preferably been equipped with a capillarily conductive material 22 and with an insulating layer 20. In the embodiment shown in Figure 7, the conducting arrangement has been disposed on the inside of the transparent portion 6; it is naturally possible to have it be integrated into or arranged on the outside of the portion 6.

[0037] The foregoing description of other embodiments is naturally applicable, where technically feasible, to the embodiment shown in Figure 7 as well.

[0038] The present invention is not limited to the preferred embodiments described above. Various alternatives, modifications and equivalents can be used. The embodiments above are thus not to be viewed as limitative of the scope of the protective scope of the invention, which is defined in the accompanying claims.

Claims

1. A light apparatus (2) comprising one or a plurality of light-emitting units (4) and a transparent portion (6) through which light (5) emitted by said units is intended to pass, which light apparatus (2) further comprises a heating system (8) intended to conduct heat that is generated by the light-emitting unit(s) (4) by means of a heat-transferring medium (12) to the transparent portion (6) in order to heat same, **characterized in that** the heating system (8) comprises a conducting arrangement (10) arranged in direct connection to said transparent portion (6) and containing said heat-transferring medium (12), wherein the heating system (8) is a closed system in which vaporization and condensation of the heat-transferring medium (12) occur, and wherein the heat that is generated in connection with condensation is utilized to heat said transparent portion (6) directly.

2. The light apparatus according to claim 1, wherein said conducting arrangement (10) comprises conducting channels (11).

3. The light apparatus according to claim 1 or 2, wherein said conducting arrangement (10) is arranged on the inside of the transparent portion (6).

4. The light apparatus according to any of claims 1-2, wherein said conducting arrangement (10) is arranged on the outside of the transparent portion (6).

5. The light apparatus according to any of claims 1-4, wherein said conducting arrangement (10) is ar-

ranged integrated into the transparent portion (6).

6. The light apparatus according to any of claims 1-5, wherein the heating system (8) comprises a heat-absorbing part (14) arranged in connection to said light-emitting units (4) and containing said heat-transferring medium (12), at least one first line (16) arranged so as to conduct said heat-transferring medium (12) from said heat-absorbing part (14) to said conducting arrangement (10), and at least one second line (18) arranged so as to conduct said heat-transferring medium (12) from said conducting arrangement (10) back to said heat-absorbing part (14).

7. The light apparatus according to claim 6, wherein said first line (16) is made of a material with thermal conductivity.

8. The light apparatus according to claim 6 or 7, wherein said first line (16) is wholly or partly insulated by means of an insulating layer (20).

9. The light apparatus according to any of claims 6-8, wherein said second line (18) comprises a capillarily conductive material (22).

10. The light apparatus according to any of claims 1-5, wherein the heating system (8) comprises a heat-absorbing part (14) arranged in connection to said light-emitting units (4) and containing said heat-transferring medium (12), and a combined line (24) adapted so as to conduct said heat-transferring medium (12) between said heat-absorbing part (14) and said conducting arrangement (10).

11. The light apparatus according to claim 10, wherein said combined line (24) is wholly or partly insulated by means of an insulating layer (20).

12. The light apparatus according to claim 10 or 11, wherein said combined line (24) comprises a capillarily conductive material (22).

13. The light apparatus according to any of claims 1-12, wherein the heating system (8) functions according to the heat-pipe principle.

14. The light apparatus according to any of claims 1-13, wherein the heat-transferring medium (12) is butane or propane.

15. The light apparatus according to any of claims 1-14, wherein said one or a plurality of light-emitting units (4) is an LED bulb.

16. The light apparatus according to any of claims 1-15, wherein said light apparatus is a vehicle light.

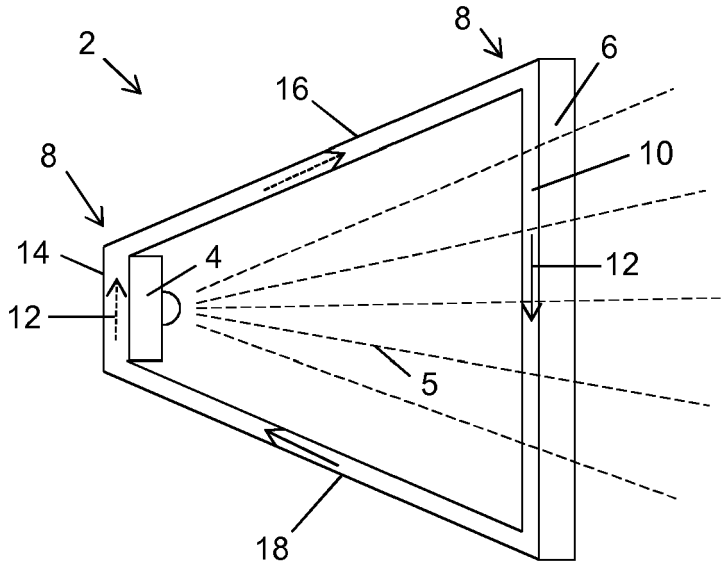

FIG. 1

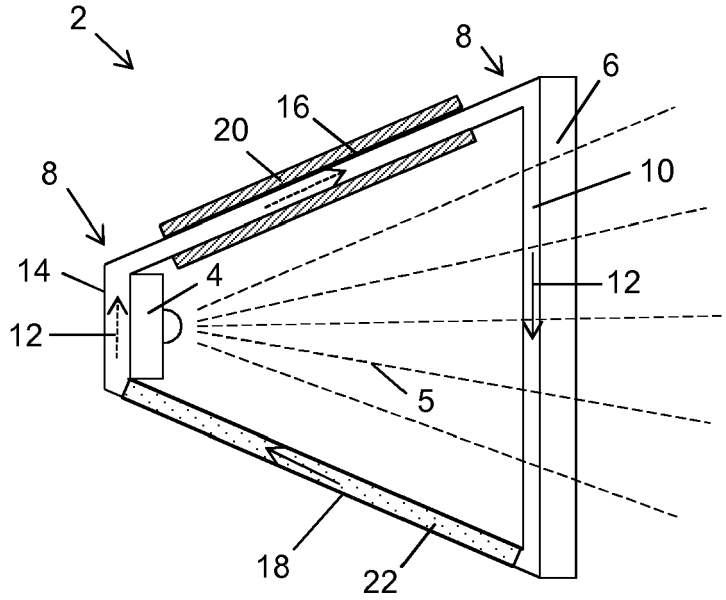

FIG. 2

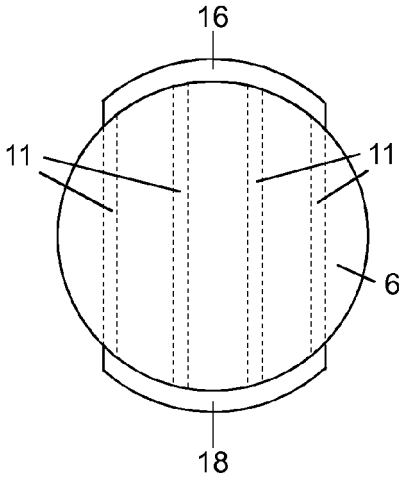

FIG. 3

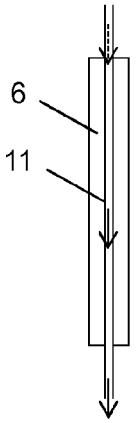

FIG. 4

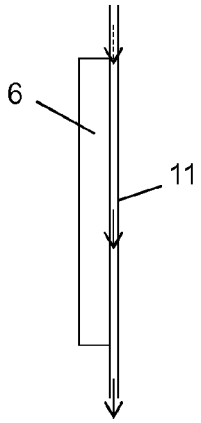

FIG. 5

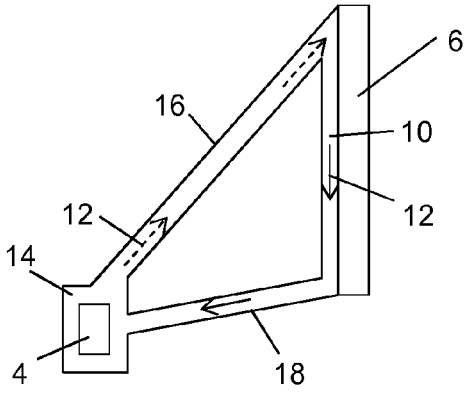

FIG. 6

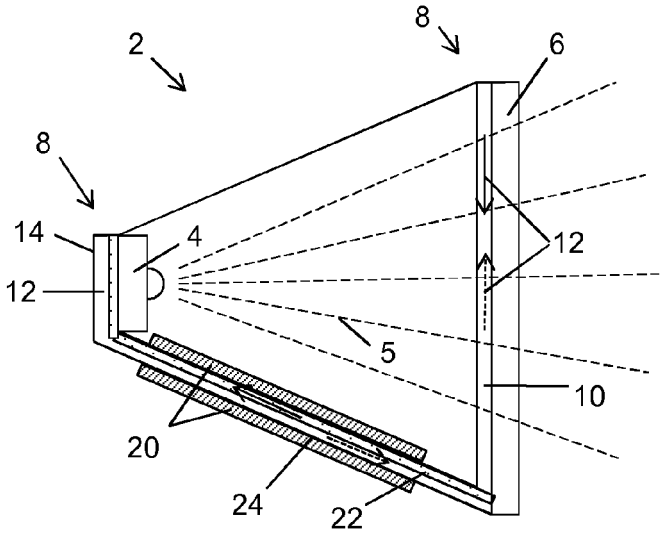

FIG. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 13 18 5134

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TECHNICAL FIELDS SEARCHED (IPC)

F21V
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	27 November 2013	Menn, Patrick

CATEGORY OF CITED DOCUMENTS

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